ADF2 Impact Evaluation

Partnership Impact Brief:

DigiCow

March 2026

IDinsight

Summary

DigiCow demonstrates strong farmer engagement with livestock advisory and training services across Kenya. This brief presents findings from the ADF2 evaluation, combining breadth metrics (usage patterns) with impact evaluation results (farmer outcomes).

01 Service uptake

Share of surveyed farmers

LIVESTOCK ADVISORY

Deep reach, growing adoption

74% — Accessed livestock advice

33% — Actively using it

17% — Changed farming practices

CATTLE HEALTH PRACTICES

Significantly higher adoption vs. comparison

+15.3pp — Health monitoring · p<0.01

+7.1pp — Heat detection · p<0.01

+5.8pp — Vaccination · p<0.10

02 Farmer experience

Satisfaction & equity

45%

Would strongly recommend DigiCow

Nearly half of farmers reported **meaningful improvements** in their livestock farming experience.

NPS 9–10 · promoters

Gender equity

COMPARABLE ENGAGEMENT

Male and female farmers showed **comparable engagement patterns** across DigiCow services. Differences were **not statistically significant**.

Equal reach
advisory access & use

No sig. gap
male vs. female engagement

03 Impact evaluation

Treatment vs. control

DigiCow farmers produce more milk — and earn more from cattle

Treatment vs. comparison group · per cow, per year

ANNUAL MILK PRODUCTIVITY

▲+6.7%

+49 L/cow/yr · comparison mean 679 L

NOT STAT. SIGNIFICANT

NET INCOME FROM CATTLE

▲+KES 1,641

per year · comparison mean KES 16,344

NOT STAT. SIGNIFICANT

Productivity gains are complemented by significant adoption of clean milk production practices, reinforcing food safety and quality standards

PRACTICE ADOPTION

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1. About This Assessment

1.1 Evaluation Framework

IDinsight was assigned to evaluate the impact of the portfolio of partners under Mercy Corps' Agrifin Digital Farmers II (ADF2) program, funded by the Gates Foundation. As part of this evaluation, IDinsight collected data from DigiCow across three pillars of impact, which we used to model ADF2's effects on partner organizations and their member farmers. Given the resource and operational constraints involved in measuring the impact of multiple distinct partner engagements, IDinsight implemented an impact modeling approach. Impact Modeling is a mixed-methods approach that assesses program effectiveness across multiple dimensions within the ADF2 portfolio.

These dimensions are:

1. **Contribution** - The extent to which MercyCorps' support to DigiCow affected their depth or breadth of impact
2. **Breadth** - Usage and adoption of supported DigiCow services by farmers
3. **Depth** - The effect of DigCow's services on farmer outcomes

In this report, we present results assessing DigCow's services using two complementary approaches:

- **Breadth Assessment:** The breadth metrics measure the number of farmers who have engaged with a partner's product or service, across varying degrees. We used phone surveys with **~502 randomly sampled farmers** to measure usage partners across DigiCow's service portfolio.
- **Impact Evaluation:** IDinsight explored the possible causal impact of select AgriFin-supported partners on smallholder farmers using a matched-comparison design. We compared DigiCow users with similar livestock farmers from the KALRO database. We note that the comparison farmers have access to KALRO's extension services, including content available through the SPROUT platform, and therefore do not constitute a "pure" comparison group. However, because KALRO enrollment is widespread, mainstream, and non-exclusive across Kenya's smallholder population, we consider this to represent the prevailing status quo level of extension access. The impact evaluation thus measures the additional effect of DigiCow's services above this baseline.

HOW TO READ THIS REPORT:

- Numbers are presented as **percentages or whole numbers**, with units indicated where relevant.
- We use **error bars (95% confidence intervals)**to indicate the range within which the true value likely falls. Smaller confidence intervals indicate more precise estimates, while larger intervals suggest greater uncertainty—often due to smaller sample sizes or high variability in responses. .
- In the bar graphs, if the "error bars" for two groups overlap substantially, the difference between them may be due to chance. If they do not overlap or overlap slightly, the difference is more likely to be real.
- Where relevant, we note whether differences are ***statistically significant***. A statistically significant result ($p < 0.05$) means the observed difference is unlikely to be due to chance or sampling variation. We can be reasonably confident it reflects a true difference between groups.

1.2 DigiCow Profile

DigiCow provides digital livestock advisory and training services to smallholder farmers across Kenya. Their offerings include:

- **Livestock training on dairy and poultry management, including clean milk production practices, fodder establishment, and conservation**
- **Financial literacy training for livestock farmers, including record-keeping and management**
- **Methane and biogas production advisory services**
- **Livestock insurance awareness and access facilitation through an insurance provider**
- **SMS-based and social media advisory messages for ongoing farmer support**

1.3 Partnership Context

This section highlights the type of support MercyCorps AgriFin provided to DigiCow. For a more comprehensive discussion of the extent to which MC support enabled partner platforms to expand their reach (breadth), or improve farmer outcomes (depth), please refer to the Contribution section of the overall report.

Through multiple engagements since 2022, the ADF2 program has provided technical assistance and partnership support to DigiCow in several strategic areas:

- **Technical advisory and extension content:** Providing weekly advisory support and content development, including access to the SPROUT platform (an open-source content and knowledge platform provided by Mercy Corps)
- **Partnership facilitation:** Facilitating linkages with financial partners, biogas companies, and insurance partners
- **Platform accessibility:** Supporting USSD integration to enhance farmer access
- **Monitoring and evaluation support:** Helping DigiCow scale up monitoring activities
- **Gender mainstreaming:** Providing advisory support on business models to better engage women farmers

This evaluation assesses farmer engagement and agricultural outcomes during this period of partnership and innovation. The findings reflect the combined result of DigiCow's service delivery and the enhancements enabled through ADF2 support.

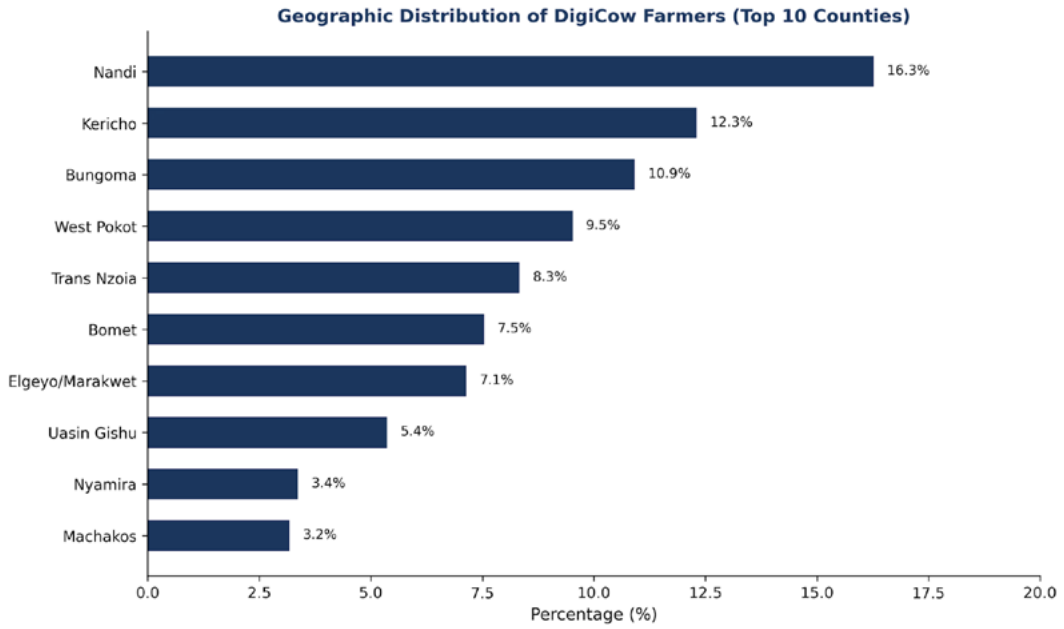
2. Farmer Reach & Engagement

2.1 Farmer Profile

Gender Distribution: The total survey respondents (N=502) were 54% female (N=270) and 46% male (N=232). The sample reflects the stratified sampling approach, where we oversampled female farmers, following a 60/40 gender split.

Geographic Distribution: The sample mirrors the distribution of DigiCow's beneficiaries across Kenya, with the highest concentrations in Nandi (16.3%), Kericho (12.3%), and Bungoma (10.9%).

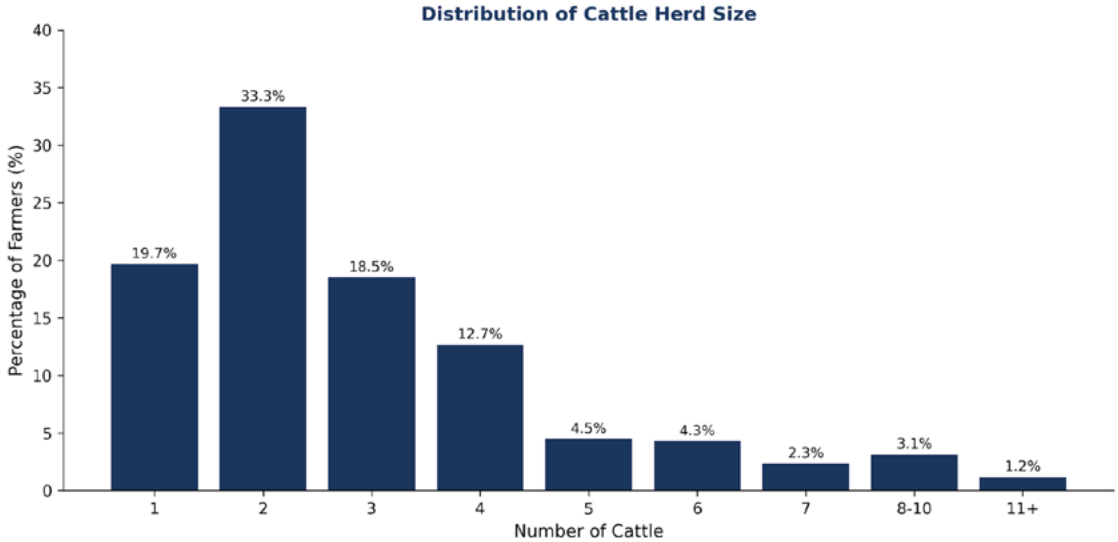
Figure 1: Geographic Distribution (Top 10 Counties)



Livestock Portfolio: All surveyed farmers keep cattle. In addition, 69.3% keep chickens, 33.7% keep sheep, and 30.7% keep goats, while other livestock (pigs, bees, camels, donkeys, and rabbits) are kept by fewer than 5% of respondents.

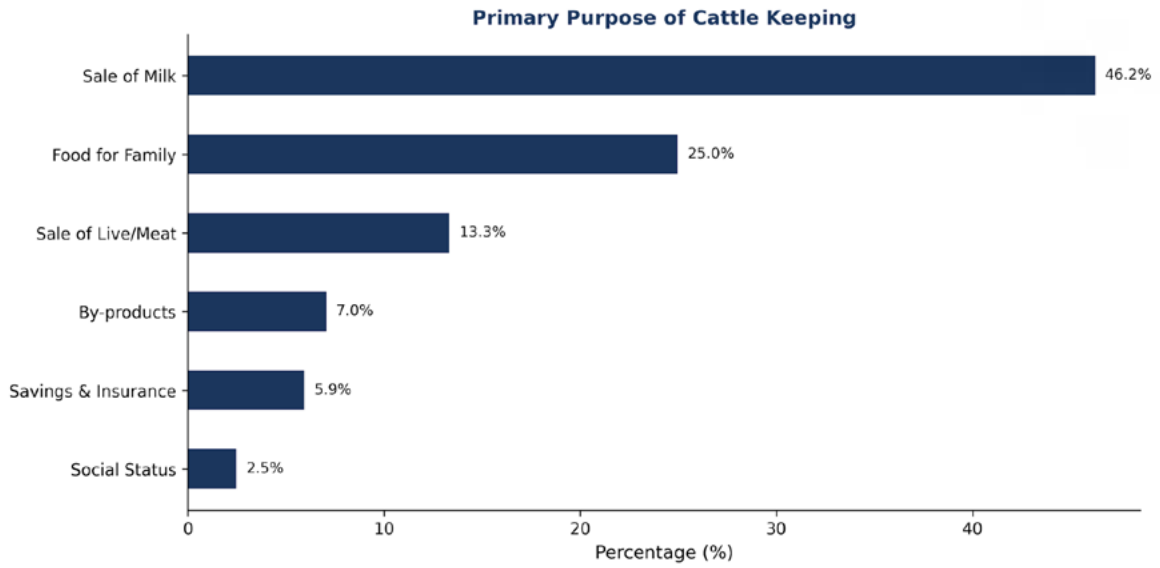
Cattle Herd Size: Farmers keep an average of 3 cattle (mean = 3.1), with a median of 2, indicating that most households manage small herds.

Figure 2: Distribution of Cattle Herd Size



Primary Purpose of Cattle Keeping: Sale of milk is the dominant purpose (46%), followed by milk/meat for the family (25%) and sale of live animals/meat (13%).

Figure 3: Primary Purpose of Cattle Keeping



2.2 Service Portfolio Overview

DigiCow farmers engage with various types of services, with livestock advisory showing the strongest reach.

We represent farmers' reach across services using a "usage funnel", which captures their progression from awareness and registration to increasingly intensive levels of product use.

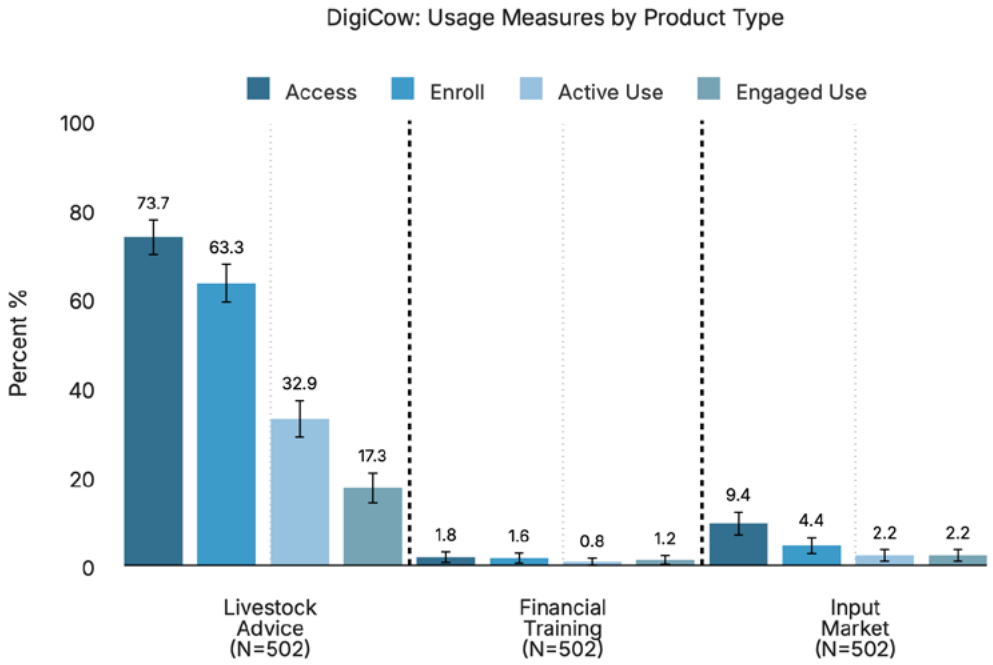
Table 1: Measures of Usage

Access	Enrolment	Active Use	Engaged Use
Number of farmers who report being able to access the partner intervention (product or service)	Number of farmers who are registered on a platform	Number of registered farmers who have actively used the partner's platform/agent to avail services within the past 90 days	Number of farmers who self-report a change in farming practices, financial usage, or market access as a result of engaging with the product or service

As expected, the proportion of farmers achieving a level of use declines at each successive stage of the funnel, moving from Access (least restrictive, highest numbers) to Enrolment, Active Use, and finally Engaged Use (most restrictive, lowest numbers).

Across all products and services, differences between male and female farmers in reach and meaningful use were not statistically significant ($p > 0.05$).

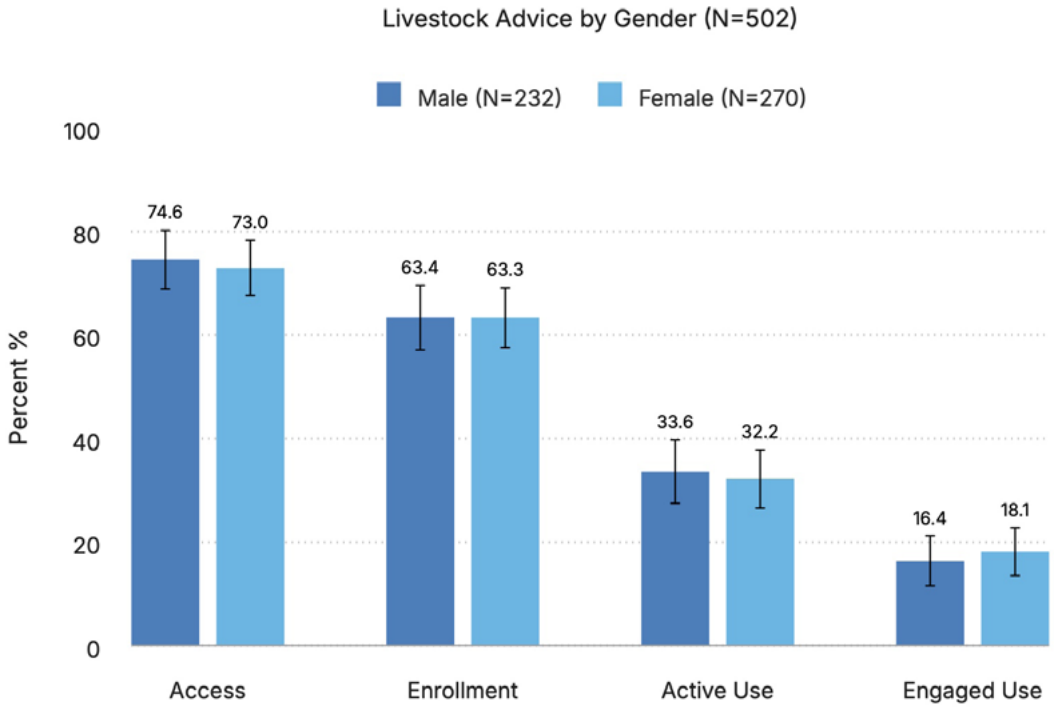
Figure 4: Farmer Reach Across Service Categories



2.3 Livestock Advisory Engagement

Livestock advisory represents DigiCow's core offering, with strong farmer engagement across the full usage funnel:

Figure 5: Livestock Advisory Service Engagement Funnel by Gender



The 45% conversion rate from access to active use (33% active users / 74% with access) and 23% conversion rate from access to engaged use show value perception among farmers. The drop-off from active use (33%) to engaged use (17%) indicates that some farmers face barriers to translating recommendations into sustained practice changes.

Patterns of Engagement

Farmers who reported receiving livestock advice from DigiCow were asked about the delivery mechanism, the frequency of receiving the advisory, and how often they viewed or attended the advisory messages or sessions.

Of the 310 farmers who received livestock advice, 30% reported that they received livestock advice more than once a month, 28% monthly, and 21% once per season. 60% reported reading, watching, or listening to advice within the last month or last three months, indicating rapid uptake following delivery. Notably, 24% of the farmers mentioned they had not read/listened to/watched the livestock advice and information shared with them. Commonly used platforms were extension officers (81% or 258 farmers) and SMS (37% or 120 farmers), followed by mobile applications (5%).

Practice Change

17.3% of farmers report that they **changed their farming practices based on advice received from DigiCow.** The practices most prevalently adopted by these farmers are listed in Table 3.

Table 2: Practice Change - Livestock Advice

Adopted Practice	Percentage
Adhered to recommended animal feeds and nutrition	65.5%
Regularly deworming and parasite control	42.2%
Vaccinated animal	40.2%
Changed how animal feeds are stored	39.1%
Improved housing for reared livestock,	36.8%
Practiced animal breeding/artificial insemination.	21.8%
Installed biogas	2.3%

2.4 Meaningful Use and Farmer Satisfaction

Beyond measuring usage levels, the evaluation assessed whether farmers derived tangible value from DigiCow's services.

Meaningful Use is a measure defined by 60 Decibels that we adopt for continuity and comparability. Further details on the meaningful use measure can be found in the linked report. It is a composite of:

- Impact of the ADF2 product/service on the overall farming season
- The extent to which the ADF2 product/service meets farmers' needs
- A farmer's likelihood of recommending an ADF2 product/service to their peers

For DigiCow:

- 44.6% of farmers reported meaningful improvements in their livestock farming experience through DigiCow's services
- 50.2% indicated DigiCow's solutions meet most or all of their needs
- 36.7% would strongly recommend DigiCow (NPS 9-10)

A meaningful user meets the threshold for all three indicators: reported meaningful improvements, solutions that meet most or all of their needs, and a strong recommendation for DigiCow (NPS 9-10).

Comparing our findings against 60 Decibels' benchmarks on meaningful use for digital information services, the sector average typically reflects a 51% improvement in farmer experience, 84% of needs met, and 48% NPS 9-10. DigiCow's results for changes in farmer experience (44.6%) and NPS (36.7%) align closely with these standards, while the needs-met measure (50.2%) falls below.

The two studies use different sampling approaches. The 60 Decibels study samples recent, active users of a specific product. IDinsight's sample was drawn from the full farmer listing provided by DigiCow, which includes all farmers with any level of exposure to DigiCow's services over time, regardless of how recently or intensively they engaged. Because IDinsight's sample includes farmers with minimal or lapsed engagement, we would expect lower satisfaction scores relative to a sample restricted to active users.

Figure 6: Measures of Meaningful Use

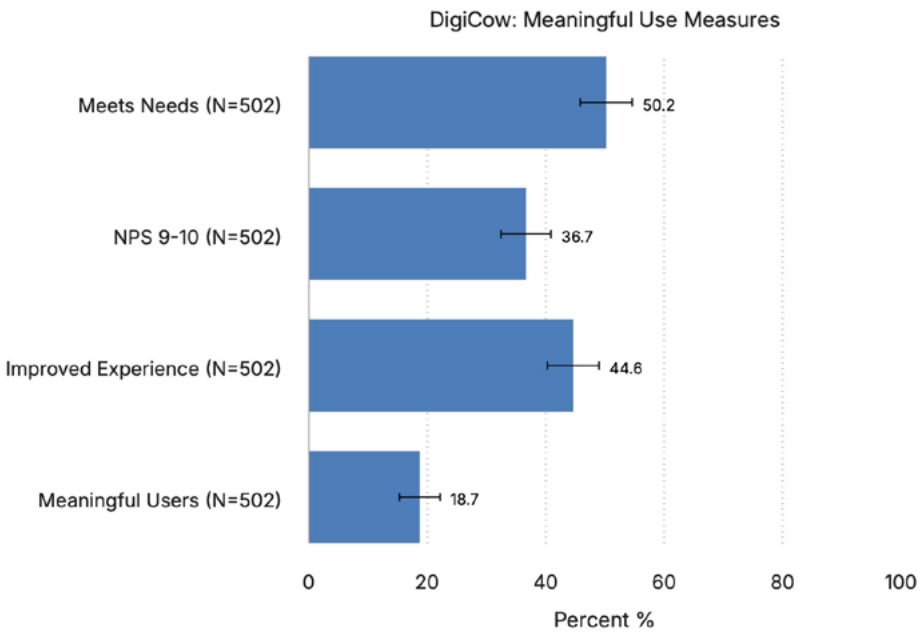
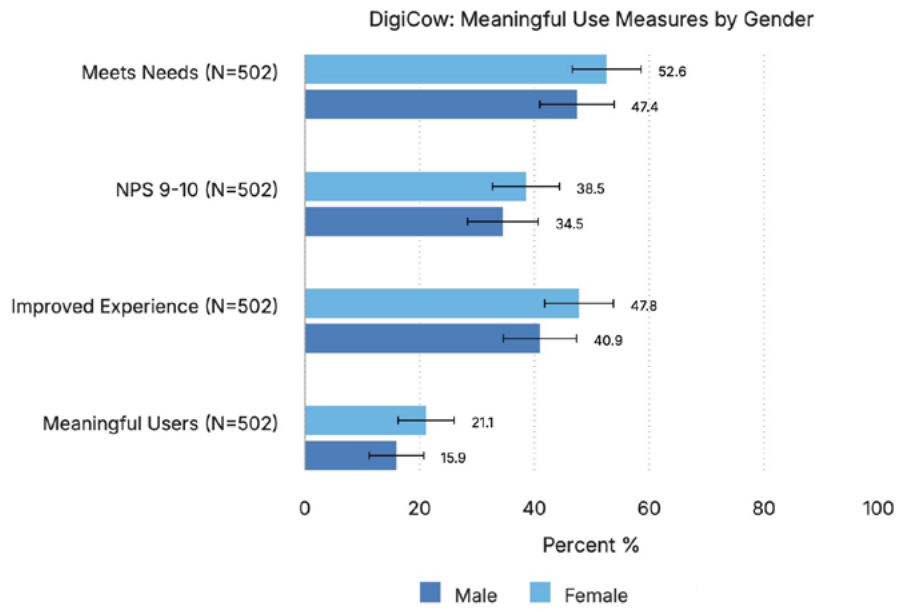


Figure 7: Measures of Meaningful Use by Gender



These consistent figures by nearly half of farmers indicate a solid foundation of satisfied users who perceive real value in DigiCow's services.

3. Impact Evaluation

All questions on farmer outcomes were asked with respect to cattle keeping. These outcomes were collected via phone surveys, with farmers recalling sales and their own consumption values for milk/ meat from the last year. Responses varied considerably as reflected in the wider confidence intervals for net Income and revenue. Given the reliance on recall and the inherent limitations of data collection by phone, these livestock outcomes may be subject to respondent bias and should be interpreted with caution. All outcomes are coded for a sample of respondent farmers who report that their primary purpose for keeping cattle was the sale of milk, meat, or live cattle, where applicable.

3.1 Evaluation Design

IDinsight conducted a matched comparison evaluation to assess the potential impact of DigiCow's services on farmer-level outcomes in Kenya.

The matched comparison evaluation compares DigiCow farmers to a group of similar non-DigiCow farmers at a single point in time. Both groups were surveyed during the same period and asked the same questions about their current outcomes. We use propensity score matching to pair DigiCow farmers with comparison farmers who look similar on observable characteristics, and estimate the effect as the difference in outcomes between the two matched groups.

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OUTCOMES AND INDICATORS

DigiCow provides dairy farmers with a livestock management platform that delivers advisory content on cattle health, breeding, and productivity. The platform covers disease prevention, veterinary care, input quality (dewormers, mineral salts), biogas use, aflatoxin awareness, and financial literacy.

Our primary outcomes capture three dimensions of livestock farming:

- Cattle health practice adoption,
- Milk productivity, and
- Profitability.

Additionally, we examined outcomes related to DigiCow's livestock training on clean milk production, fodder conservation, and biogas use.

Table 3: Outcomes for DigiCow Livestock Impact Evaluation

Outcome Measured	Outcome Definition
Cattle Health Practices	The cattle health index is a simple additive score (0-6) across six practices corresponding directly to DigiCow's training content: vaccination, deworming, tick control, curative treatment, health monitoring, and heat detection. Each practice is a binary indicator with a 12-month recall period. The index serves as an adoption-based measure of compliance with DigiCow's advisory recommendations.
Annual Milk Production Per Cow	Annual milk per cow is calculated as daily production times days milked per week times weeks milked per year, with missing milking frequency values imputed from county-level and cattle-herd-size modes. We derive this indicator from farmers' self-reported daily milk production.[1]
Net Income from Cattle	Gross income from all cattle sources minus total rearing costs. Gross income is the sum of: revenue from live cattle sales, slaughter meat revenue, annual milk sales revenue, imputed value of milk consumed at market prices, and animal by-product revenue (draft power, manure). The value of consumed milk is computed as annual litres consumed multiplied by the market price, with consumption quantity imputed at the county-household-size level (225 cases) and then at the household-size level for residual missings.
Clean Milk Index	Score 0-2, summing two binary food safety practices. (a) Antibiotic compliance: coded 1 if the farmer did not use antibiotics, or used antibiotics and reported observing a withdrawal period before milking for human consumption; coded 0 if antibiotics were used without a withdrawal period. (b) Aflatoxin prevention: coded 1 if the farmer takes active steps to prevent aflatoxin contamination in feed; coded 0 if not aware of aflatoxins or aware but taking no preventive action.
Biogas Production	Binary indicator for current household biogas system installation

STUDY DESIGN

We conduct a matched impact evaluation comparing Treatment and Comparison units to assess the impact of DigiCow's intervention on selected livestock outcomes.

Treatment Group Definition

Treatment is defined as any intended beneficiary of DigiCow's services. We drew a simple random sample of 502 farmers from a list of farmers who can access the DigiCow platform. The sample was drawn using a stratified sampling approach, oversampling female farmers to achieve a 60/40 gender split.

Comparison Group Construction

In the absence of a prospectively defined comparison group, we retrospectively constructed a comparison group using KALRO's (Kenya Agricultural and Livestock Research Organization) livestock farmer registry. We identified farmers who did not receive DigiCow's Mercy Corps-supported intervention and randomly sampled 775 farmers, deliberately oversampling to create a larger pool for matching with treatment units.

We drew the comparison sample from the same counties as the treatment group, maintaining proportional representation across counties. This approach reduces potential confounding from geographic factors, including climate conditions, livestock practices, and local market dynamics.

1 Daily milk per cow is total household milk production on a typical day divided by the number of cows milked, restricted to farmers who were milking at endline. Daily milk yields for cows in intensive smallholder systems in Kenya are usually within 9-18 litres (Lukuyu et al.,2012). Accordingly, all values greater than a maximum of 20 litres are treated as missing.

Matching Design

Since we cannot observe the counterfactual (what would have happened to treated farmers without the program), we employ propensity score matching (PSM) to approximate a comparison group. This method estimates each farmer's probability of receiving treatment based on observable pre-intervention characteristics, then matches treated farmers to untreated farmers with similar propensity scores.

PSM relies on a critical assumption: conditional on the covariates used in matching, treatment and control farmers are statistically indistinguishable from each other, identical with respect to all other factors influencing outcomes. When this assumption holds, comparing outcomes between matched groups provides an estimate of the program's causal effect.

This assumption may not fully hold in this context. DigiCow farmers chose to register with the platform, and this self-selection may reflect unobserved characteristics that independently affect the outcomes we measure. Additionally, the KALRO comparison farmers were drawn from a government research registry, and the selection process for that registry likely differs from DigiCow's beneficiary recruitment process. For these reasons, the matched estimates should be interpreted as suggestive rather than definitive.

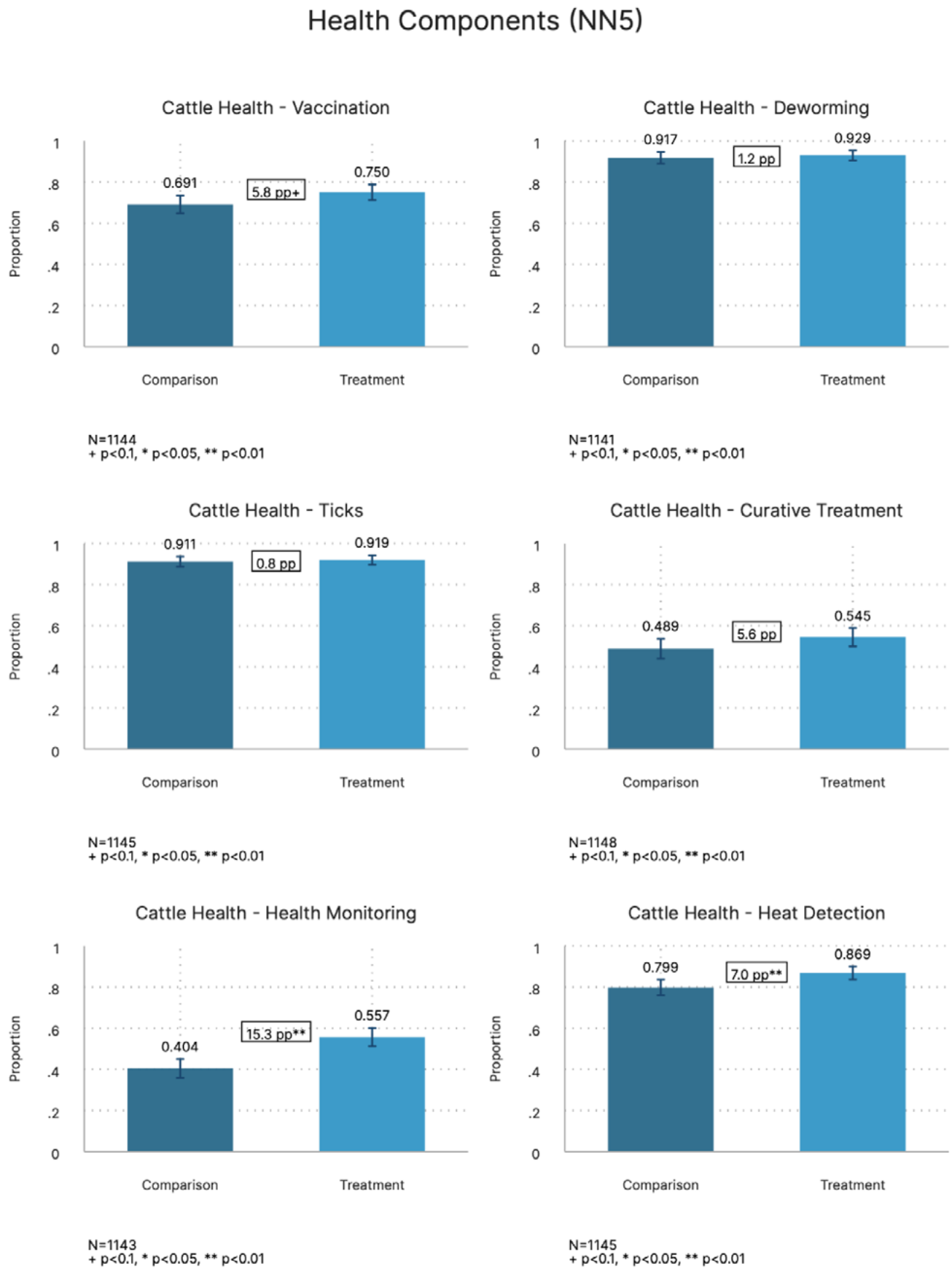
The matched evaluation estimates intent-to-treat (ITT) effects. This means we compare all DigiCow farmers in the matched sample to their matched comparisons, regardless of whether individual farmers actively used DigiCow's services. The ITT reflects the average effect of being offered access to DigiCow, not the effect of using it. Where actual engagement is low, the ITT will understate the effect among farmers who meaningfully used the services.

For more details on the Impact Evaluation Methodology, please refer to the Methodology Appendix (Section 5.3).

3.2 Results - Market Price

Treatment farmers scored 0.38 points higher on the cattle health index than comparison farmers, a statistically significant difference ($p < 0.01$). The comparison group mean was 4.19 on a 0-6 scale, making this an 8.9% improvement.

Figure 8: Cattle Health Practices

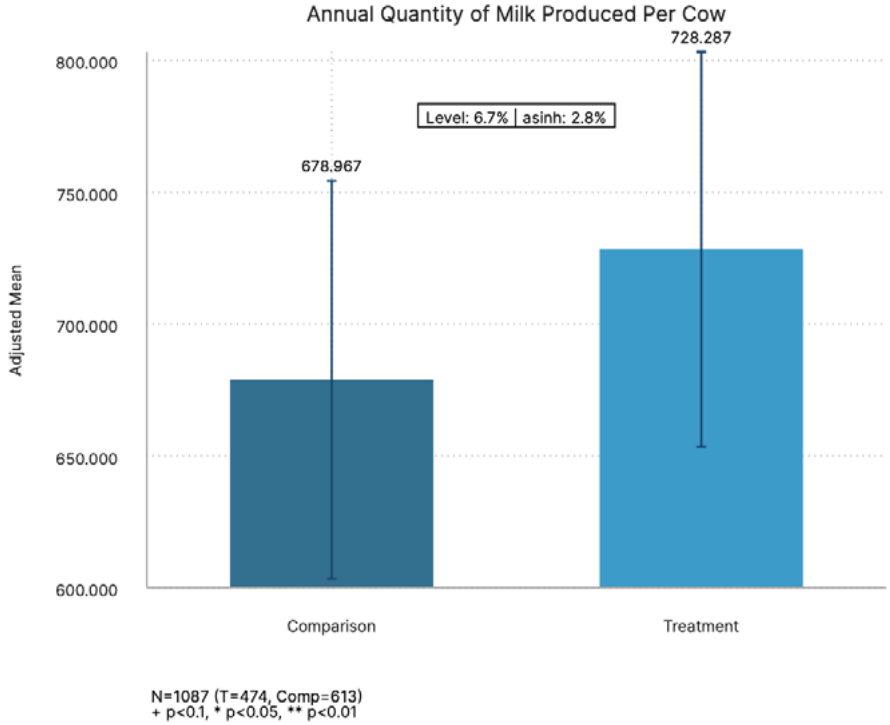


The component-level results show that health monitoring (+15.3 percentage points, $p < 0.01$) and heat detection (+7.1pp, $p < 0.01$) are the primary drivers, with vaccination marginally significant (+5.8pp, $p < 0.10$). There are no statistically significant differences in tick management, deworming, or curative treatment. This suggests that farmers who access DigiCow's products and services are more likely to adopt recommended cattle health practices and have healthier herds than control farmers.

3.3 Milk Production Results

Treatment farmers demonstrated higher dairy productivity (approximately 49 more litres of milk per cow per year than comparison farmers), though the differences were not statistically significant at the untransformed levels or after transformation using the inverse hyperbolic sine to account for zeros and negative values in the distribution.

Figure 9: Annual Milk Production Per Cow: Treatment vs Comparison

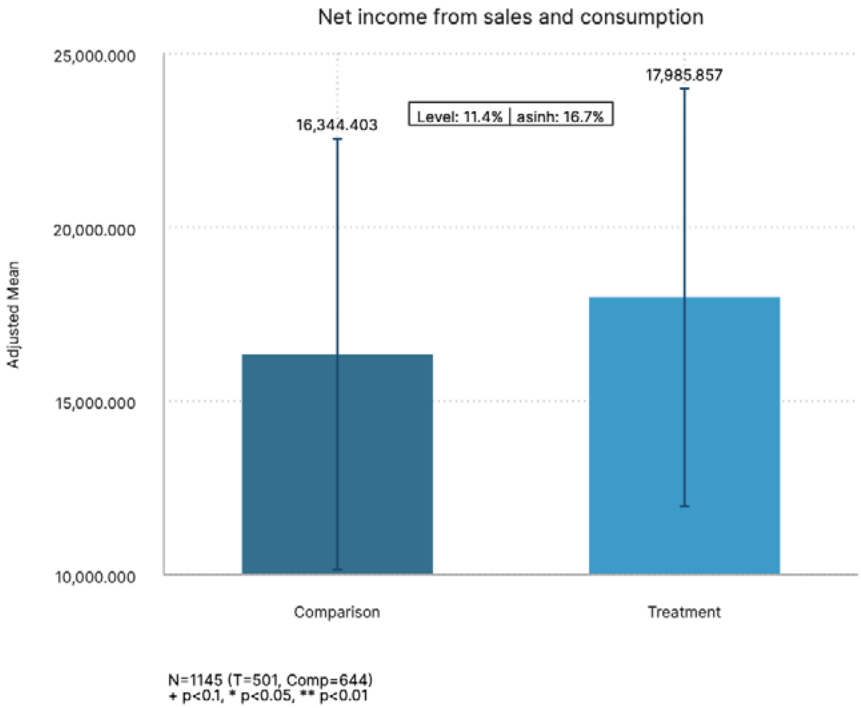


Treatment farmers produced on average 49 more litres of milk per cow per year than comparison farmers (comparison mean: 679 litres), a 6.7% effect that is not statistically significant ($p>0.10$). The inverse hyperbolic sine specification yields a similarly small and insignificant effect (2.8%).

3.4 Net Income Results

Net income from cattle rearing was higher for DigiCow farmers, but statistically insignificant.

Figure 10: Net Income from Cattle



We also examine net income from cattle in two specifications: untransformed levels and transformed with the inverse hyperbolic sine to account for zeros and negative values in the distribution. In levels, treatment farmers earned approximately KES 1,641 more from cattle per year than comparison farmers (comparison mean: KES 16,344). This difference is not statistically significant. The inverse hyperbolic sine specification also shows no significant effect (coefficient 0.154, 16.7%).

3.5 Other Outcomes Results

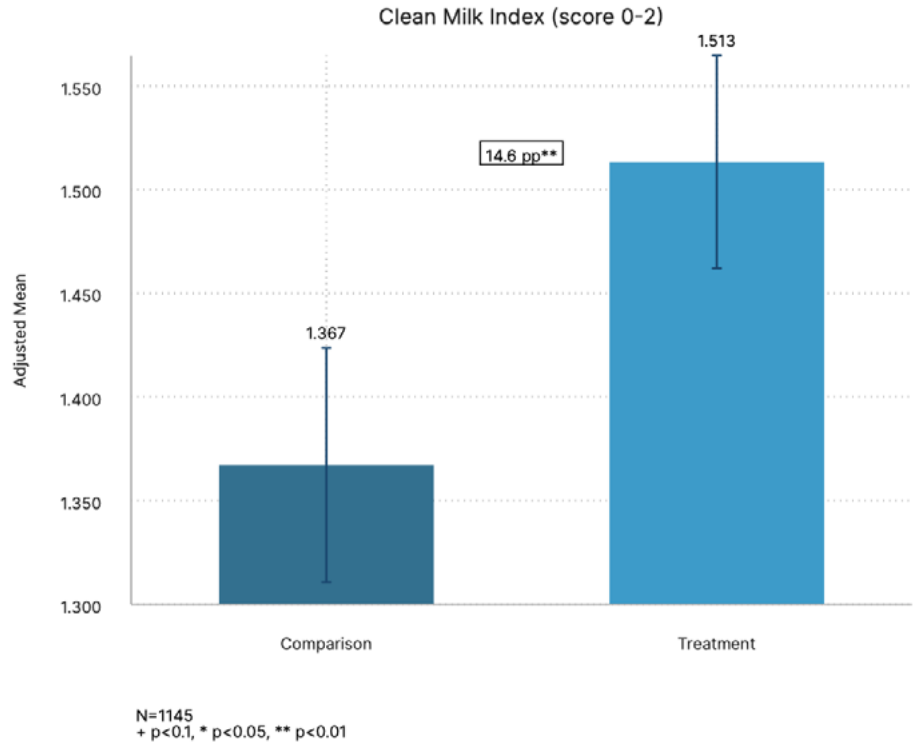
Clean milk production & Biogas adoption

Across the livestock farming management practices examined, we found a statistically significant impact on clean milk production, but no detectable effects on biogas use.

Clean Milk Production

Treatment farmers scored 0.15 points higher on the clean milk production index (scale of 0–2, measuring adoption of practices to (i) reduce aflatoxin and (ii) antibiotic contamination), compared to comparison farmers, a statistically significant difference ($p<0.01$). This represents a 14.6-percentage-point improvement. These statistically significant results indicate that DigiCow's advisory contributed to improved adoption of food safety practices in milk production.

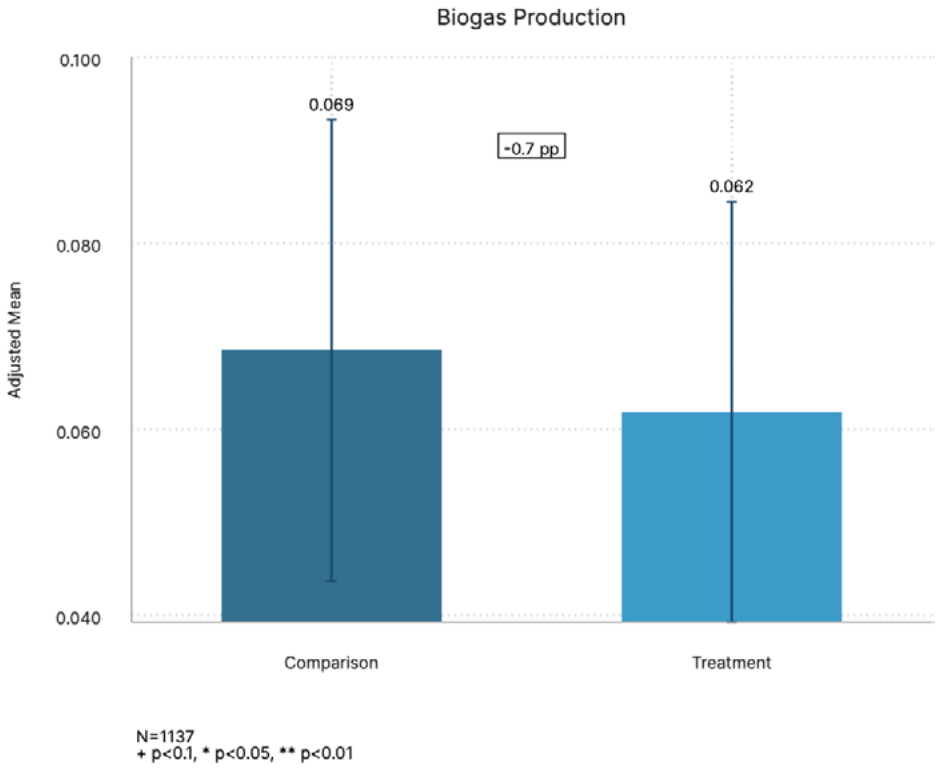
Figure 11: Clean Milk Production



Biogas Adoption

We found no evidence of DigiCow's influence on biogas use in our sample. Adoption rates were low and similar across both groups, 0.069 among treatment farmers and 0.062 among comparison farmers. This difference was not statistically significant and is consistent with what we see in DigiCow's internal documentation, where only 7% of 13,764 farmers reported interest in adapting biogas when the training was conducted in 2022.

Figure 12: Biogas Production



4. Insights & Implications

4.1 What's Working Well

- **Strong livestock advisory reach:** 74% access rate and 33% active use rate demonstrate strong farmer demand for training on good livestock keeping practices
- **Demonstrated impact on cattle health practices:** Statistically significant improvement in vaccination, health monitoring, and heat detection, indicating the use of DigiCow's platform to monitor cattle health
- **Measurable productivity gains:** Statistically significant differences in daily milk production among DigiCow farmers are economically meaningful
- **Increased farmer awareness on clean milk production:** Statistically significant differences in practices to reduce aflatoxin and antibiotic contamination in milk for human consumption
- **Female farmers reach:** Similar engagement patterns between male and female farmers indicate that DigiCow's services are accessible to women farmers, an important achievement in agricultural extension, where women often face greater barriers.
- **Geographic breadth:** DigiCow services extended across 24 counties

4.2 Areas for Further Exploration

- **Advisory service implementation barriers:** The gap between active use (33%) and engaged use (17%) suggests barriers to sustained adoption of livestock advice. Understanding these barriers could strengthen advisory services' impact
- **Complementary service uptake:** Low engagement with financial service uptake, such as cattle insurance and biogas adoption, suggests opportunities for DigiCow's intervention

5. Methodology Appendix

5.1 Data Collection Approach

Sample and Survey Design

DigiCow provided a list of all unique farmer IDs (N= 39,550) in their database. IDinsight selected a random sample of 1,200 farmers using a stratified sampling approach, oversampling female farmers to achieve a 60/40 gender split. IDinsight conducted Computer-Assisted Telephone Interviews (CATI) using SurveyCTO software. The survey captured demographic information, livestock portfolio, cattle health practices, input expenditures, and revenue data for the last year.

Ethical Compliance

The study received IRB approval from AMREF Health Africa Ethics and Scientific Review Committee (Protocol Number: P1874-2025). Verbal informed consent was audio-recorded at the start of each interview.

Data Collection Team and Training

IDinsight hired 32 enumerators and 3 supervisors to conduct phone surveys. The team completed a 3-day in-person training covering survey content, phone interview techniques, use of the SurveyCTO platform, research ethics, and quality control procedures. The training also included mock interviews, a pilot study, and a detailed review of the study design and DigiCow's products and services.

Field Implementation

Data collection occurred from August 7th to 27th, 2025. Interviews were conducted in Swahili, English, and other local languages as appropriate.

- **Response rate:** The overall response rate was 39.1%, representing the proportion of farmers who answered calls.
- **Call back protocol:** Enumerators made up to 7 contact attempts before marking cases as unreachable, varying call times across morning, afternoon, and evening slots. Appointments were scheduled when respondents requested specific callback times.
- **Survey Duration:** The mean survey duration was 34 minutes.
- **Participant Compensation:** All respondents who completed interviews received KSH 250 (~$2) as compensation for their time.

5.2 Data Quality Assurance

Field Supervisors conducted random spot checks, listening to live interviews to provide real-time feedback. Audio audits covered 10-20% of surveys, including verification of consent sections, key skip-pattern triggers, and numeric value inputs.

Daily high-frequency checks monitored survey length, enumerator efficiency, "Don't know" or "Refuse" response rates, outlier values, partner recognition rates, and skipped sections. Issues identified were addressed through daily enumerator debriefs and data correction processes.

Data cleaning incorporated enumerator feedback and corrections for outliers identified through high-frequency checks. To address extreme values during indicator creation, component variables (e.g., prices, quantities) were winsorized at the 1st/99th or 5th/95th percentiles, depending on distribution, using one-tailed (top only) or two-tailed approaches as appropriate.

5.3 Impact Evaluation Methodology

Outcome details

Primary outcomes: the cattle health index is an additive score (0-6) across six binary practices, each with a 12-month recall period. Annual milk production per cow is a derived continuous variable. Net income from cattle is a continuous variable that includes both cash and non-cash components.

Secondary outcomes: the clean milk index (0-2) captures two food safety practices. Biogas production is binary.

Outlier treatment

Outlier treatment was applied to component variables before constructing derived indicators.

- **Milk price:** all milk prices were converted to a per-litre basis before use in revenue calculations. Approximately 5% of farmers reported prices in cups and 1% in kilograms; cup prices were divided by 4 and kilogram prices multiplied by 1.03 to convert to per-litre equivalents. After conversion, prices outside KSH 15-100 per litre were set to missing and imputed at the county mean. This range is based on farmgate averages of KSH 46-50 reported by the Kenya Dairy Board in 2023-2024.
- **Cattle sale prices:** revenue from live cattle sales was capped at KSH 400,000, based on industry reports showing dairy cow prices of KSH 150,000-350,000 per head.
- **Daily milk production per cow:** topcoded at 20 litres per day based on the plausible upper bound for smallholder dairy cows in Kenya. National averages for smallholders range from 7-9 litres per day, with well-managed zero-grazing systems reaching 15-25 litres.
- **Annual milk production per cow:** winsorized at the 5th and 95th percentiles after construction from daily production, days milked, and weeks milked.
- **Input costs (feeds, watering, breeding, veterinary, transport, housing, other):** each component winsorized at the 5th and 95th percentiles before aggregation into total cost.
- **Revenue from live cattle sales:** winsorized at the 5th and 95th percentiles by cattle herd size, after applying the KSH 400,000 cap.
- **Milk consumption quantity:** missing values (225 observations) were imputed using county-by-household-size medians, with household-size medians as a fallback for remaining missings. Milk unit price (7 missing values) was imputed at the county mean after unit conversion.
- **By-product revenue (draft power, manure):** each component winsorized at the 5th and 95th percentiles.

Total cost and total revenue were not separately winsorized because their components were already treated individually.

Sample

We surveyed 502 DigiCow farmers drawn from DigiCow's beneficiary listing using a stratified random sample that oversampled female farmers at a 60/40 split. We surveyed 775 comparison farmers drawn from the KALRO livestock farmer registry, from the same counties as DigiCow beneficiaries. For analysis, our matched sample after nearest-neighbor matching (k=5, with replacement) was: T=501, C=635-644 depending on outcome.

Matching approach

To estimate DigiCow's impact, we need to answer the question: What would DigiCow farmers' outcomes have looked like if they had not used DigiCow's services? Since we cannot observe this directly, we use propensity score matching to construct a comparison group.

Propensity Score Matching (PSM) constructs a statistical comparison group by pairing each treated unit with one or more untreated units with a similar predicted probability of receiving the treatment, based on observed characteristics in the sample (Rosenbaum & Rubin, 1983). We use this approach to estimate program impacts in the absence of baseline data by assuming that, conditional on observable covariates, the comparison group approximates the counterfactual outcome for treated units (Caliendo & Kopeinig, 2008).

The idea is that if two farmers look similar on wealth, education, gender, crop yields, age, and market access, then the remaining difference in their outcomes is more likely to reflect the effect of DigiCow's services rather than pre-existing differences between the groups.

We use nearest-neighbor matching (k=5, with replacement), which matches each treatment farmer to the five closest comparison farmers based on propensity scores.

Matching covariates

Covariates for the propensity score model were selected using Post-Double-Selection (PDS) LASSO (Belloni, Chernozhukov & Hansen, 2014), estimated separately for each outcome. The final consolidated control set combined LASSO-selected covariates with theory-driven covariates: the asset/wealth index, gender (female), age category (45+), and the ratio of household members to rooms.

The full set of candidate covariates considered by PDS LASSO spanned: gender, education categories, age categories, market access, roof material, durable goods (7 items), protected water source (binary indicators); wealth index, household adults, children, rooms, household-to-room ratio, distance to tarmac road, distance to market (continuous, both winsorized at 1st/99th percentiles).

The asset index was constructed using principal factor analysis on nine binary indicators: electricity access, finished floor material, finished wall material, and six durable goods items. The first factor was extracted and standardized to have a mean of zero and unit variance (following Filmer & Pritchett, 2001).

We intentionally did not incorporate baseline outcome levels into the matching design. While pre-treatment outcome levels can strengthen matching, collecting them would have required retrospective recall, which introduces measurement error that could bias the match rather than improve it. Our matching approach instead relies on a comprehensive set of observable covariates that predict livestock farming outcomes,

under the assumption that conditional on these covariates, treatment assignment is independent of potential outcomes.

Missing values in matching indicators were imputed using county-level medians for continuous variables and county-level modes for categorical and binary variables. Observations with remaining missing values after imputation were excluded.

Post-matching balance

The matched sample (T=501, C=635-644 depending on outcome) achieves acceptable balance on selected regression controls. Geographic composition is balanced by design, since the comparison sample was drawn from the same counties as DigiCow beneficiaries.

Matching estimation

We estimate treatment effects using OLS regression on the propensity-score-matched sample, with matching weights applied and heteroskedasticity-robust standard errors (Huber-White sandwich estimator):

$$f(Y)_i = \beta_0 + \beta_1 Treatment_i + X_i + \mu_c + \delta_s + \varepsilon_i$$

where:

- $f(Y)_i$ isthe outcome for farmer i, in levels for binary and index outcomes;
- β_0 is the intercept
- β_1 is the coefficient of interest, representing the Intent-to-Treat effect
- X_i is the vector of matching covariates selected for each partner
- μ_c is a main crop fixed effect, included for crop-specific continuous outcomes
- δ_s is a state fixed effect
- ε_i is the error term

For continuous primary outcomes (milk production, net income), we run two specifications: levels and asinh-transformed. Binary and index outcomes (cattle health, clean milk, biogas) are estimated in levels only. Observations with missing outcome values are excluded from the regression, so the estimation sample varies by outcome.

5.4 Key Caveats

- The matched evaluation estimates are suggestive of program effects rather than definitive causal quantities. Several factors limit the strength of causal inference:
- We did not collect baseline outcome data. Our matching relies on observable covariates under the conditional independence assumption, without pre-treatment outcome levels. If unobserved factors such as motivation or prior livestock management experience differ between DigiCow and comparison farmers, matching cannot eliminate this source of bias.
- DigiCow farmers chose to register with the platform. The KALRO comparison farmers were drawn from a government research registry with a different selection process. Unobserved characteristics associated with DigiCow enrollment may independently affect outcomes.
- Agricultural and livestock outcomes are self-reported via phone survey. Responses varied considerably, particularly for income and revenue, as reflected in wide confidence intervals. Given the reliance on recall, these outcomes are subject to measurement error.
- There is no pre-post analysis for DigiCow. The evaluation relies on the matched comparison only.
- Breadth data relies on farmer recall and self-reporting, which may be subject to social desirability bias or memory limitations.

6. References

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