

E A R M A R K

White Paper

The Compliance Graph for Regulated Agriculture

Why the record — not the audit — is the moat

A system-of-record thesis for animal-agriculture compliance
Swine-first · producer-direct · vet-in-the-loop

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Executive summary

Regulated agriculture runs on claims. A pig is *raised without antibiotics*; a certificate of veterinary inspection says an animal is fit to move across a state line; a welfare certification says a barn meets a standard; a nutrient-management plan says manure is applied within limits. Each of these is a claim a business already runs on — and each is only as valuable as the record underneath it can be made to hold up when someone questions it.

Today, those records live in the wrong places and the wrong forms: a spreadsheet, a drawer of paper directives, a folder of PDFs, or — increasingly — a point tool that captures one document and knows nothing about the others. The compliance *events* (the annual audit, the label review, the packer's yearly farm visit) are well-tooled. The *record* those events sample is an afterthought. That inversion is the gap this paper is about.

The thesis is simple to state and consequential in practice: **the durable asset in agricultural compliance is not the audit and not the seal — it is the continuous, tamper-evident record the audit feeds from.** Point tools, periodic audits, and spreadsheets each fail this in a specific, structural way. A system that connects a producer's, a vet's, and a packer's scattered compliance regimes into one tamper-evident, consent-shared graph does not.

This paper argues four things:

- **The problem is a system-of-record gap, not a documentation gap.** More diligence does not fix a record that dies to one sentence.
- **The right category is a compliance graph — a system of record — for regulated agriculture.** This is investor and acquirer language; the buyer still buys a job. Both are true at once.
- **Three capabilities, combined, define the white space:** AI-drafted compliance, a tamper-evident evidence chain, and auto-revoke-on-treatment claim-defense. No incumbent ships all three.
- **The move that cracks adoption is to produce the paper.** Generate the documents producers and vets are already required to make; the tamper-evident chain is the free by-product.

A closing note on honesty, because it is load-bearing to the argument: the final section states plainly what is live in the product today and what is on the roadmap. A system-of-record thesis that overclaims its own coverage undermines the very property — verifiable truth — it is selling.

1. The problem: compliance is a system-of-record gap

Ask a swine veterinarian or a producer where their compliance lives and you will get a list, not a system: the veterinary feed directives in one place, the movement records in another, the antibiotic-free attestations in a third, the nutrient-management documentation with the agronomist, the welfare paperwork in a binder for the annual audit. Each artifact is real. None of them are connected. And the connection is the part that matters.

The regulatory and commercial load on this pile is rising, not falling. Since the FDA's Guidance for Industry #263 brought the remaining over-the-counter medically important antibiotics under veterinary oversight, every one of those products now requires a veterinary feed directive or prescription¹ — more compliance work per animal, per practice, per year. At the same time, the bar for what counts as a *substantiated* claim is moving from a signed annual affidavit toward continuous verification.

The clearest signal of that shift is a residue finding. When USDA's Food Safety and Inspection Service, with USDA-ARS, screened animals sold into *raised without antibiotics* markets using a broad multi-drug method, roughly one in five samples came back positive for antibiotic residues². Every one of those animals came from an operation that had, at some point, passed an audit. The audit was not dishonest. It simply was not present on the day the record diverged from the truth.

This is the shape of the problem. Compliance is enforced episodically, but risk accrues continuously. A periodic audit certifies a moment; the exposure lives in the interval between moments — and the record that is supposed to bridge those intervals was never built to be trusted.

Having records versus having evidence

The distinction that carries the entire argument is the difference between **having records** and **having evidence**. A record is something you kept. Evidence is something that holds up when a counterparty does not want it to. The useful way to measure any record is adversarial: *what would it cost someone to convince a third party that this record is wrong?*

For a spreadsheet, the cost is one sentence — “*anyone could have edited this.*” Nobody has to prove tampering; they only have to observe that it was silently possible, and the burden flips to the producer, who is now reconstructing intent from memory while a premium or a shelf placement hangs on it. For a chained record — where each entry is cryptographically bound to the one before it, and where the database itself refuses to rewrite sealed history — that same sentence gets a boring, mathematical, conversation-ending answer. That jump, from *as good as your word* to *as good as the cryptography*, is the jump from record to evidence. It is not a matter of being more organized. It is a property of how the record layer was built.

¹FDA Guidance for Industry #263 (implemented June 2023) transitioned the remaining medically important antibiotics from over-the-counter to marketing status requiring veterinary oversight (VFD or Rx). Source: U.S. FDA, GFI #263.

²FSIS/USDA-ARS sampling of liver and kidney from cattle at slaughter establishments, using a >180-drug residue method, detected antibiotic residues in approximately 20% of samples from animals marketed as 'Raised Without Antibiotics.' This finding is the stated justification for the strengthened FSIS substantiation guideline (FSIS-GD-2024-0006, Aug 2024).

2. Why point tools, periodic audits, and spreadsheets fail

Three approaches dominate the field today. Each fails the system-of-record test in a distinct, structural way — not because the vendors are careless, but because of what each was built to be.

Approach	What it is good at	Why it fails as a system of record
Point tools	Producing one document extremely well — an eCVI, a VFD, an antibiotic-use log.	Each holds one node and is blind to the edges. The tool that issues the VFD never hears about the claim it defeats; the claims tool never hears about the VFD. No single tool can bind them.
Periodic audits	Certifying, credibly, that records were in order on the day of inspection — backed by recognized seals and auditor relationships.	A snapshot cannot see the interval. The treated animal that slips through between annual visits is exactly the ~20% residue mechanism. The model samples the record; it does not maintain it.
Spreadsheets & paper	Flexibility, familiarity, and near-zero cost to start.	Silently editable, un-timestamped, un-shareable as proof. Dies to one sentence. Complete records are still not evidence.

The common thread: none of the three *connects* the records. And the connections — the edges between the VFD and the claim, the movement and the certificate, the treatment and the audit — are where both the value and the switching cost live. A point tool you rip out costs you a document generator. A connected record you rip out costs you your operating history.

There is also a cautionary lesson in the other direction. Multi-party “shared ledger” and blockchain-traceability efforts in food and shipping — TradeLens, and pork-adjacent pilots such as ripe.io — largely underperformed or shut down³. The lesson is not that tamper-evidence is worthless — it is that *leading with the ledger* is a mistake. A working chain does not summon a network or a willingness to pay. The record earns its place by making the paperwork people are already required to do easier; the tamper-evidence is the upgrade, not the pitch.

3. The category: a compliance graph — a system of record

The category worth owning is a **compliance graph** — a system of record — for regulated agriculture. Not “a VFD tool,” not “herd records,” not “another eCVI vendor.” Those are commodity nodes that a system of record sits above. The graph turns a producer's, a vet's, a packer's, and a brand's scattered compliance regimes into one tamper-evident, consent-shared record where an event on one node updates the others.

A candid caveat belongs here, because it disciplines the strategy. **“Compliance graph” is upstream language — for investors, acquirers, and platform buyers — not a buyer's headline.** The veterinarian and the producer buy a job: renew the certification before it lapses, emit the certificate, defend the

³Maersk/IBM's TradeLens shipping ledger shut down in 2022; several blockchain food-traceability ventures (incl. ripe.io, which ran a National Pork Board pilot) remained sub-scale after ~8 years. Lesson: a working ledger does not, by itself, generate adoption.

antibiotic-free claim when a treatment lands. The right move is not to pick one framing but to sequence them — lead the buyer with the job, narrate the graph upstream to capital. Both are honest; they simply address different audiences.

Why does the system-of-record framing matter beyond marketing? Because it is where durable enterprise value has accrued in every adjacent software market. The tax-compliance system of record (Avalara) was taken private for roughly \$8.4 billion⁴; the financial-data connective layer (Plaid) was so central that a \$5.3 billion acquisition was blocked on antitrust grounds, after which it re-rated higher as an independent company⁵. Category research is blunt about the prize: the category *king* tends to capture the large majority of a category's total market capitalization⁶. Owning the record — not merely a feature of it — is what earns that position.

The honest boundary on this claim: the premium is real *only if you actually become the record* — multi-party adoption, embedded workflow, regulatory content others cannot cheaply assemble. A graph architecture without live, multi-sided customers is a point tool with a nice schema. The moat is earned on the go-to-market side, the same place the acquisition premium is.

4. The three capabilities only Earmark combines

Individually, each of the following exists somewhere in the market. What no livestock-compliance platform ships is all three, bound together, on one record. That combination is the white space.

4.1 AI-drafted compliance

The routine drafting — the veterinary feed directive, the certificate, the renewal, the attestation, the visit-note extraction — is done by AI, and then decided and signed by the veterinarian. The AI does the typing; the human does the judgment. Crucially, **every AI action is itself written to the audit trail**, so the assist never becomes an unaccountable black box. The incumbents' certificate engines are rules-based, not generative; the antibiotic-tracking tools do no drafting at all. (Live today: AI visit-note extraction, outcomes-aware renewal, and a compliance copilot, each with a full AI audit trail.)

4.2 A tamper-evident evidence chain

Records are cryptographically chained, and historical edits are refused *by the database itself* — not merely logged in an audit column. The result is a record that is self-authenticating and exportable, and that lets a recipient re-verify the math independently, without trusting a dashboard or making a phone

⁴Avalara was taken private by Vista Equity Partners for approximately \$8.4 billion in 2022 — a system-of-record for multi-jurisdiction tax obligations, the closest structural analogue to a multi-state, multi-program agricultural-compliance system of record.

⁵Visa's \$5.3B acquisition of Plaid was abandoned in January 2021 after a November 2020 DOJ antitrust suit; Plaid then re-rated to a ~\$13.4B valuation (April 2021 Series D) — more than 2.5x the deal price — as an independent 'system of connection.' A point tool never draws an antitrust challenge for being too important.

⁶Play Bigger (Ramadan, Lochhead, Peterson, Maney, 2016) finds the category king typically captures ~76% of the category's total market value — the economic argument for naming and owning the category narrative early.

call. Self-authenticating electronic business records are a recognized category in the rules of evidence⁷, which means a chained, self-verifying record is built to clear a legal bar — but the everyday value is simpler: it survives a skeptical packer's QA lead. (Live today, with on-demand verification and data-layer edit refusal.)

4.3 Auto-revoke-on-treatment claim-defense

This is the sharpest differentiator and the one incumbents structurally cannot retrofit. The instant a treatment is recorded against a lot — or a residue test fails — the affected lot **loses its claim eligibility automatically**, cryptographically, in real time, with the reason written to the record. No human has to remember to flip a flag; the event is the trigger. A rules engine that only issues the VFD has no downstream claim to revoke; a periodic-audit program has no real-time model to revoke within. (Live today across claims: on VFD and residue-test failure for the antibiotic-free case, and on Prop 12 housing-breach for welfare certification — one primitive, many claims.)

The producer-side leverage is concrete, not abstract. Antibiotic-free margins are thin and hinge on the *qualifying percentage*: one analysis finds that if only 70% of pigs from an ABF flow actually qualify, the effective cost gap rises from roughly \$4.40 to \$6.29 per hundredweight⁸. A producer who cannot prove *which* animals are clean must discount the whole lot; a system that knows, per lot and as of the market date, lets the producer capture the premium on exactly the qualifying animals. The same primitive protects the buyer: a packer paying a non-carcass-merit premium — which under the Packers & Stockyards Act must be documented⁹ — gains a signal when a claim it relied on had auto-revoked as of the ship date, an exposure control the annual-affidavit world does not offer.

5. “Have the paper”: produce the document the gatekeeper recognizes

A system of record is only worth as much as the records it actually holds — and the cheapest, most natural reason a vet or producer starts using one is not “trust our chain.” It is: **this produces the paperwork I am already legally required to make**. The proof that this is the adoption motion is the incumbent that won this exact buyer: the dominant food-animal compliance platform earned its place by streamlining the *required documents* — certificates, directives, prescriptions — not by selling billing or a ledger.

So the posture is to **produce the document, and let the tamper-evident chain be the by-product**. Re-skin the evidence layer not as a cryptographic verification page but as the audit document a human

⁷Federal Rule of Evidence 902(13) provides for self-authentication of certified records generated by an electronic process or system, reducing the need for a live custodian witness. A chained, self-verifying record is designed to sit in this category; admissibility is further supported by FRE 901(b)(9).

⁸Illustrative ABF economics: production cost premium ~\$9–11/head (~\$4.40/cwt); at a 70% qualifying rate the effective gap rises to ~\$6.29/cwt. Precise per-lot eligibility lets a producer capture the premium on exactly the qualifying animals rather than discounting the whole lot. Sources: The Pig Site; National Hog Farmer; SDSU Extension.

⁹Under the Packers & Stockyards Act, non-carcass merit premiums and discounts (which include ABF/welfare/process-verified premiums) must be documented; marketing-contract premium schedules are filed in the USDA AMS Swine Contract Library (9 CFR Part 206).

gatekeeper already recognizes — the compliance story up front (attestations, directives, lot-eligibility determinations, the auto-revoke provenance), with the chain proof as the backstop.

The discipline is knowing which documents to be the source of, which to route to, and which to merely facilitate:

- **Be the source of** the documents no incumbent produces: the treated-animal segregation record, the lot-eligibility determination, the continuous antibiotic-claim substantiation packet, the connective record that ties movement to claim to treatment to audit.
- **Route to** the canonical system where one exists: emit and chain the certificate, then help the veterinarian submit it through the state-approved platform; ingest and anchor the accredited lab's residue result; hold and anchor the third-party certificate. Rent those rails; do not rebuild them.
- **Facilitate** the professional author: the nutrient-management plan a certified planner signs, every attestation a veterinarian signs. The software pre-fills, seals, and stores; the human authors and signs. That line keeps document-correctness liability where it belongs.

This posture also answers the credibility question incumbents raise. It does not claim to replace the state's system, be the lab, or be the certifier. It claims, precisely, to *produce and chain the artifact, route it where it belongs, and own the connective record that makes the audit trivial*. (Live today: per-record and printable attestation, printable federal interstate certificate, and nutrient-management exports. A one-click bundled evidence packet is on the near roadmap.)

6. Why now: the demand converging on 2026

Two forces create demand in this market: the law sets the floor, and large buyers set the ceiling. An unusual number of both are dated to 2026, and they resolve to the same underlying need — continuous, verifiable, revocable proof of a claim.

Driver	Timing	What it forces
FDA GFI #263	In force	Remaining OTC medically important antibiotics now require veterinary oversight — more VFD/Rx workload per practice.
FSIS RWA substantiation guideline	Aug 2024	Strengthened expectations (testing / third-party verification) for antibiotic-free label claims — annual affidavits giving way to continuous proof.
Whole Foods welfare-certification requirement	Dec 31, 2026	Third-party welfare certification on all fresh, frozen, and prepackaged meat/poultry (all species; no crates/cages/tethers for pork). A firm, dated, delist-or-comply forcing function for every supplier.
State eCVI mandates (e.g., MN)	2026 (phased)	Electronic certificates of veterinary inspection displacing paper — a demonstrated, already-partly-live need to emit compliant e-CVIs.
NPDES Phase-2 eRule (CAFO)	Live Dec 2025	Electronic discharge-monitoring reporting whose burden grows linearly with site count — multi-site quarterly documentation.

The welfare cliff deserves a specific note because it is the sharpest dated example — and because it illustrates the right way to tool for demand. On December 31, 2026, a large national grocer will require recognized third-party welfare certification on every piece of meat and poultry it sells¹⁰. But brand commitments, unlike statutes, get walked back — several cage-free pledges softened under the recent egg-price shock. The correct response is not to build a module for one grocer's checklist; it is to build for the *primitive* every commitment shares: a certification is a clocked, revocable claim, and the buyer needs to know it is still true. This is live, not aspirational: welfare-certification tracking and Prop 12 sow-housing auto-revoke run today on the same event-driven record that defends antibiotic claims — the same primitive, pointed at a welfare claim.

7. A forward view

The direction of travel in agricultural compliance is from *periodic and attested* to *continuous and verified*. Residue findings erode trust in the annual affidavit; large buyers demand proof they can check without sending an auditor to every farm; regulators explore lower-cost third-party verification lanes. Each of these pushes the center of gravity toward a live, tamper-evident record and away from the once-a-year binder.

In that world, the winning position is neither the seal nor the audit — both of which have entrenched, relationship-based incumbents worth partnering with rather than fighting. The winning position is the **neutral record layer beneath the audit**: the substrate every auditor can feed from, that closes the between-audit gap, and that a producer can carry to any buyer or program. Neutrality is itself a structural advantage — a multi-party compliance record requires a party that is not the packer, not the integrator, not a competitor to the vet or producer. That trust position is difficult for an operator-owned system to occupy and straightforward for an independent one.

The architecture generalizes across species and claims — the same chained, event-driven record that defends an antibiotic claim in swine extends to welfare and housing claims, and to cattle and poultry, as those come online. But the discipline is depth before breadth: earn the system of record in one species, with real records and real gatekeeper acceptance, before generalizing the layer. Density is the moat; breadth is the option it buys.

For a strategic acquirer, the logic is the Visa-and-Plaid shape: a buyer whose supply chain increasingly depends on verified claims eventually wants to own the embedded record those claims run on, rather than rent it or rebuild it. Species breadth is table stakes; the tamper-evident chain, the auto-revoke primitive, and the multi-party graph are the valuation. Build the record, and the record becomes the reason to buy the company.

¹⁰Whole Foods Market's animal-welfare standards require third-party welfare certification (accepted programs include GAP Animal Welfare Certified, A Greener World's Animal Welfare Approved, Certified Humane, and Regenerative Organic Certified) across fresh, frozen, and prepackaged meat and poultry by end-2026, with no crates/cages/tethers for pork. Confirm current scope and phasing against the live Meat Quality Standards page at time of use.

8. A note on scope: live today vs. on the roadmap

A paper arguing that verifiable truth is the product would be self-refuting if it blurred its own capabilities. Honesty-as-moat is a feature here, not a disclaimer — the product literally badges its own mock integrations. In that spirit:

Live today. Tamper-evident chain with on-demand verification and data-layer edit refusal; antibiotic-free auto-revoke on VFD and on residue-test failure; welfare-certification tracking with Prop 12 sow-housing records, housing-breach auto-revoke, and a producer-to-brand welfare-cert feed; lot- and group-level claim eligibility as of the market date; antibiotic-use stewardship tracking with expiry exceptions; multi-state CAFO/NPDES and nutrient-management records with chained history and state export; movement records with a printable federal interstate certificate; a two-party, chained vet-of-record handshake; producer-side brand-access controls (scoped read, acknowledgment, revocation, chained read receipts); CSV import; AI visit-note extraction, outcomes-aware renewal, and a compliance copilot, each with a full AI audit trail; producer self-onboarding.

On the roadmap (named honestly, not implied live). A brand-side verification dashboard (producer-side controls exist today; the brand's login vantage is next); a one-click bundled evidence-packet export (today: per-record plus printable attestation/certificate and nutrient-management exports); direct electronic filing of the e-CVI to the state (printable exists; e-file does not); a live feed-directive distributor integration (CSV import is real; the in-app card is honestly badged as a mock); bundled welfare evidence-document upload (welfare-cert tracking is live; the attached-document store is infra-gated); transport and quality-assurance modules; chickens and cattle (the architecture generalizes; swine ships first); and a SOC-2 certificate (the discipline it would certify is already how the system is built and tested).

If a future version of this document adds a capability claim, it should be checked against that boundary before it is stated in the present tense. The credibility of every other claim in this paper depends on it.

Sources & references

Numbered notes above carry the specific attributions. Principal public sources consulted:

1. U.S. FDA — Guidance for Industry #263 (veterinary oversight of medically important antimicrobials).
2. USDA FSIS — Guideline FSIS-GD-2024-0006, “Substantiating Animal-Raising or Environment-Related Labeling Claims” (Aug 2024); Federal Register notice 2024-19696.
3. USDA FSIS / ARS — multi-drug residue sampling of “Raised Without Antibiotics” market animals (~20% positive).
4. Whole Foods Market — Meat Quality Standards / animal-welfare certification requirements (end-2026).
5. USDA AMS — Packers & Stockyards Act; Swine Contract Library (9 CFR Part 206); documentation of non-carcass merit premiums.
6. Federal Rules of Evidence 902(13) and 901(b)(9) — self-authentication of electronic business records.
7. Avalara / Vista Equity Partners take-private (~\$8.4B, 2022); Visa–Plaid abandoned merger (2020) and subsequent re-rating.
8. Ramadan, Lochhead, Peterson & Maney, “Play Bigger” (2016) — category-king economics.
9. TradeLens closure (2022); blockchain food-traceability adoption analyses (incl. ripe.io / National Pork Board pilot).
10. ABF pork economics — The Pig Site; National Hog Farmer; SDSU Extension.

Prepared by Earmark Ag LLC (Minnesota). This paper describes a product and a market thesis; capability statements are bounded by §8. Dated regulatory and retailer facts should be re-verified against primary sources at time of use, as brand commitments and guidance evolve.