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Legal and institutional gaps in the governance of animal genetic resources in Africa: Structural causes, comparative analysis, and reform pathways based on the AU-IBAR 2013–2018 Review

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Abstract: Across Africa, animal genetic resources (AnGR) underpin food security, rural economies, and cultural heritage, yet sustainable management policies remain fragmented or absent across most nations. Drawing on a comparative policy analysis of 40 national policy landscapes from the African Union – Interafrican Bureau for Animal Resources (AU-IBAR) project (2013–2018) and comparative case studies from Uganda, South Africa, Ethiopia, Kenya, Ghana, and Mali, this paper identifies recurring structural constraints associated with this governance gap. Contrary to assumptions of political apathy, the deficit persists despite widespread endorsement of international frameworks like the Nagoya Protocol and Global Plan of Action. Across the reviewed evidence, five interlocking constraints are associated with the shortfall: AnGR is routinely subsumed under broader agricultural mandates, yielding vague legislation; institutional responsibilities are fragmented across uncoordinated agencies; essential data infrastructure remains underdeveloped; chronic funding and technical capacity shortages hinder implementation; and livestock-keeping communities are systematically excluded from policy design. Although continental initiatives like the sub-regional focal points have advanced regional coordination, they have not catalyzed sustained national action. To bridge this implementation gap, we propose a dual reform strategy: enacting dedicated national AnGR legislation and establishing participatory governance frameworks that centre pastoralists and smallholder farmers in conservation and utilization efforts. By mapping systemic barriers and contextualizing country-specific reform pathways, this analysis proposes context-sensitive reform pathways for strengthening AnGR governance across Africa.

A French version of the abstract is available in Supplemental Material 1. Une version française du résumé est disponible dans le Matériel Supplémentaire 1

Keywords: Animal genetic resources policy; biodiversity governance; institutional fragmentation; African livestock breeds; pastoral and livestock-keeper communities.

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Introduction

Africa harbours one of the world's most substantial reservoirs of livestock genetic diversity. The continent is home to over 150 documented cattle breeds, roughly 200 small ruminant breeds, and approximately 185 distinct poultry populations in sub-Saharan regions alone, alongside more than 30 pig breeds and numerous camelid ecotypes, lineages evolved over millennia to thrive across Africa's full agroecological spectrum (FAO, 2015a). This diversity is distinguished not merely by its scale, but by its highly specialized biological traits (Malabo Montpellier Panel, 2020). Among cattle and small ruminants, breeds such as the N'Dama cattle exhibit remarkable trypanotolerance (FAO, 2007); East Africa's Boran zebu has been selected for heat tolerance and tick resistance (FAO DAD-IS; Mwai *et al*, 2015); the Djallonké and Red Maasai sheep show documented resistance to *Haemonchus*

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contortus (Baker *et al*, 1999; Baker *et al*, 2004; Mwai *et al*, 2015). Beyond ruminants, the Ashanti Dwarf pig from Ghana is described as an endangered indigenous breed with hardy, disease-resistant traits under low-input management (Osei-Amponsah *et al*, 2017); Somali and Rendille dromedary ecotypes are indispensable to food security in arid landscapes (Mburu *et al*, 2003). Even widespread poultry, such as the naked-neck chicken, carry well-documented genetic variants that enhance thermotolerance (Desta, 2021). These traits confer resilience to endemic diseases, reliable performance under low-input management, and a buffer against climate variability (FAO, 2015a; Nouala *et al*, 2019).

Despite this ecological and economic importance, this genetic heritage faces intensifying and largely unregulated threats. From the 1960s through the 1990s, continental livestock development strategies overwhelmingly favoured production intensification via the importation of exotic commercial breeds, often at the direct expense of indigenous populations (AU-IBAR, 2019; Nouala et al, 2019). In Tanzania, for instance, extensive crossbreeding programmes precipitated a marked erosion of native livestock diversity (MLFD, 2011). Kenya's national policy framework has historically privileged the commercial sector and its reliance on imported genetics, establishing a dual system where the traditional subsistence sector operates without dedicated governance mechanisms beyond basic veterinary regulations (GeRRI, 2016). Burkina Faso followed a similar trajectory, lacking any coordinated strategy to conserve local breed genetics until a 1997 sectoral guidance note (Ministère des Ressources Animales, 1997). These cases reflect a broader institutional pattern in which African governance structures have consistently failed to establish the legal, institutional, and informational foundations required for the sustainable stewardship of animal genetic resources (AnGR).

A review of the African Union – Interafrican Bureau for Animal Resources (AU-IBAR) spanning 40 national policy environments (AU-IBAR, 2019; Nouala *et al*, 2019) concluded that most countries lack legislation specifically targeting AnGR; where broader livestock policies exist, genetic resources are typically marginalized, with regulatory attention concentrated almost exclusively on animal health. What remains underexplored is the precise architecture of this deficit. This paper interrogates which specific legal instruments are missing, how institutional fragmentation sustains the problem, under what conditions targeted reforms have gained traction, and what a viable reform agenda must entail.

Methodology

Methodologically, this analysis draws primarily on the AU-IBAR dataset comprising 40 national policy assessments conducted between 2013 and 2018. We acknowledge the temporal boundaries of this dataset; where post-2018 developments are documented in peer-reviewed literature or official country reports, they have been integrated into the narrative and reflected in the comparative overview. This study employs a mixed-methods comparative policy analysis combining systematic documentary analysis with primary stakeholder consultation. It is best characterized as a comparative policy analysis rather than a systematic review: while it draws on a comprehensive cross-national dataset and applies a consistent analytical framework, it does not follow a pre-registered protocol or PRISMA-style reporting standards.

The empirical foundation of the national policy assessments rests on structured questionnaires distributed between 2013 and 2018 to the Directorates of Animal Production across all 54 African Union Member States, of which 40 (74%) returned analyzable responses from designated national focal points (Supplemental Material 2). Incomplete returns were followed up via email. The 14 non-responding states are excluded from the questionnaire-based analysis but referenced in country case material where secondary sources permit. The questionnaires captured information across four thematic domains: breed utilization by species, policies and legislation, breeding and conservation practices, and awareness and communication. The dataset comprises all responding Member States, providing broad geographic coverage across Africa's five regions.

The six country case studies (Uganda, South Africa, Ethiopia, Kenya, Ghana, and Mali) were selected to represent variation in governance advancement, geographic region, agroecological context, and reform trajectory. Cases were drawn from the 40-country dataset using three criteria: (1) at least one country per African region, (2) observable variation on governance indicators, and (3) sufficient primary legal and documentary material for in-depth analysis. These six cases are a subset of ten countries profiled in the analysis; the remaining four are included in the comparative overview but lack full case narratives due to limited documentary material.

Complementing the primary dataset, a comprehensive review of secondary sources was conducted, encompassing government policy documents, UN Food and Agriculture Organization (FAO) and AU-IBAR technical reports, peer-reviewed literature, and NGO publications. Sources were identified via FAO DAD-IS, AU-IBAR's repository, FAOLEX, and Google Scholar, covering 2000–2025. The search employed combinations of terms such as 'animal genetic resources,' 'livestock policy,' 'Nagoya Protocol,' and 'access and benefit-sharing' alongside the names of African Union member states. Inclusion criteria required documents to focus on national or regional AnGR governance, legislation, or institutional frameworks, published in English or French. After deduplication and relevance screening, a verified total of 264 documents were reviewed, with two authors cross-checking country-level legal citations against official government sources.

Primary data were further enriched through structured stakeholder consultations conducted during Sub-Regional Focal Point (S-RFP) meetings across Africa's five geographic zones, engaging national focal points, scientists, policymakers, farmer associations, and private sector representatives. Verbal consent protocols ensured the confidentiality of key informant contributions. The analytical framework applied to this combined dataset pursued four objectives: identifying policy gaps; assessing coherence with AnGR objectives; documenting institutional lessons; and informing regional crossbreeding and transboundary frameworks. Documents were assessed against Global Plan of Action (GPA) and Nagoya Protocol criteria.

International policy framework: Obligations and normative standards

Africa's governance of AnGR operates within a complex matrix of international normative commitments, many of

which outstrip national institutional and fiscal capacity. The Convention on Biological Diversity (CBD), universally ratified across the continent, obligates signatory states to formulate national strategies for conserving and sustainably utilizing biological diversity, while mainstreaming these objectives into broader sectoral policies (CBD, 1992, Article 6(b)). The Nagoya Protocol on Access and Benefit-Sharing (ABS), which entered into force in 2014, further strengthens these duties by establishing compliance mechanisms centred on prior informed consent (PIC) and mutually agreed terms, including safeguards for traditional knowledge associated with genetic resources held by indigenous and local communities (Nagoya Protocol, 2010, Articles 6–7 and 15–16). Within the AnGR domain, the GPA serves as the most directly applicable instrument. Endorsed by 109 nations in 2007, the GPA is anchored by the Interlaken Declaration and structured around four strategic priorities encompassing characterization, sustainable use, conservation, and capacity building (FAO, 2007). Strategic Priority Area 10 explicitly directs nations to fortify both *in situ* and *ex situ* conservation programmes. A decade after adoption, the FAO's Second Report (FAO, 2015a) revealed that implementation across most African jurisdictions remained nascent, with acute deficiencies in policy formulation and institutional capacity. Since the GPA's inception, the international normative landscape has evolved substantially.

The Kunming–Montreal Global Biodiversity Framework (GBF), adopted at CBD COP15 in December 2022 (CBD Secretariat, 2022a), establishes an ambitious set of biodiversity targets extending to 2030. Target 13 explicitly mandates the fair and equitable sharing of benefits; CBD COP Decision 15/9 established the multilateral Digital Sequence Information (DSI) benefit-sharing mechanism, and Decision 16/2 adopted its modalities and the Cali Fund (CBD Secretariat, 2022; 2024). As a policy target, Target 13 does not independently establish livestock-specific Property Identification Code (PIC) duties. However, the GBF links biodiversity governance with food system transformation and climate resilience, offering a stronger normative foundation for embedding AnGR into agricultural investments. Concurrently, the framework intensifies state obligations to operationalize Nagoya Protocol compliance.

Target 13 carries three distinct implications for African AnGR: (1) it extends benefit-sharing to livestock DSI, a live obligation as international programmes sequence indigenous breeds and deposit data openly without triggering national PIC, (2) it strengthens indigenous and local community rights over genetic resources and traditional knowledge, and (3) it introduces a contested multilateral DSI benefit-sharing mechanism, acknowledging that Nagoya's bilateral premise is inadequate for globally accessible digitized data. Crucially, the GBF lacks livestock-specific guidance, leaving Target 13's AnGR application in a legal and operational vacuum. African states lacking breed inventories, competent authorities, or ABS legislation remain unprepared to engage.

At the regional policy level, the Comprehensive Africa Agriculture Development Programme (CAADP) commits member states to allocating at least 10% of public expenditure to agriculture and sustainably managing biodiversity (AU, 2003; 2014). The 2025 Kampala update retains the expenditure commitment and adds targets for a 45% agrifood output increase and 15% GDP reinvestment (AU, 2025). Despite these broad commitments, an analysis of 30 National Agriculture Investment Plans found that AnGR was substantively integrated into fewer than five national strategies (AU-IBAR, 2018; Nouala *et al*, 2019). To operationalize the GPA, AU-IBAR and FAO established Sub-Regional Focal Points (S-RFPs) hosted by the five regional agricultural research organizations across Africa's five geographic zones: the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA, in East Africa), the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA, in Southern Africa), the National Institute of Agronomic Research of Algeria (INRAA, in Northern Africa), the Economic Commission for Livestock, Meat, and Fisheries Resources (CEBEVIRHA, in Central Africa), and the West and Central African Council for Agricultural Research and Development (CORAF/WECARD, in West Africa) (AU-IBAR, 2023).

These S-RFPs serve as critical coordination mechanisms for harmonizing transboundary breed management and facilitating information exchange through platforms like the African Animal Genetic Resources Information System (AAGRIS) (AU-IBAR, 2023). Similarly, Africa's active engagement within the Intergovernmental Technical Working Group on Animal Genetic Resources (ITWG-AnGR) has cultivated a cohesive regional voice in international policy fora. Yet, these advances cannot compensate for the absence of domestic policy, legislative, and institutional frameworks across most African states; continental architectures remain inert without national implementation mechanisms. This divergence is well documented by successive FAO reports and AU-IBAR assessments (FAO, 2007; 2015a; AU-IBAR, 2019). What remains underexplored is a structural diagnosis of the drivers sustaining this dissonance, alongside viable pathways for institutional reform.

The structure of the governance deficit: A regional overview

West Africa: Absence compounded by institutional fragmentation

In West Africa, the governance deficit manifests through regulatory voids and acute institutional fragmentation. Mandates for AnGR management are routinely dispersed among ministries of agriculture, livestock, environment, and rural development; inter-ministerial coordination remains scarce. This siloed approach is evident in Nigeria, Côte d'Ivoire, Togo, and Senegal, where policies governing food standards, animal health, quarantine, and livestock production have been formulated in isolation (AU-IBAR, 2019; Nouala *et al*, 2019). This is particularly visible in Burkina Faso, where a retrospective analysis of national livestock policies from independence through 2018 uncovered no coherent strategy for recognizing indigenous genetic resources, leaving artificial insemination providers to import semen without selection criteria or evaluation of impacts on herd diversity (ILRI, 2017; World Bank, 2019). Côte d'Ivoire only adopted a draft law on animal genetic improvement in February 2025, passing in April 2026 (Gouvernement de la République de Côte d'Ivoire, 2025). Mali's livestock policy has prioritized veterinary services and export markets, leaving AnGR governance unaddressed (FAO, 2013; World Bank, 2018; Malabo Montpellier Panel, 2020). Across Benin, Guinea-Bissau, Niger, and Senegal, legislative ambiguity and

institutional undercapacity follow a comparable trajectory. The Gambia is a partial exception: national policy explicitly prioritizes the conservation of trypanotolerant breeds, reflecting a level of policy awareness uncommon elsewhere in the region (DoSA, 1998; Nouala *et al*, 2019).

East Africa: Legislative incompleteness and the persistence of exotic breed bias

East Africa presents a heterogeneous governance landscape, marked by uneven legislative progress and a persistent institutional preference for exotic genetics. Ethiopia has established a relatively advanced legal foundation through Proclamation No. 482/2006, which governs access to genetic resources and traditional knowledge. This legislation predates the Nagoya Protocol and requires substantive revision to meet contemporary compliance standards. Ethiopia's institutional trajectory also illustrates broader historical shifts: early post-independence interventions centred on state-led production improvements, followed by a period of full state monopolization (1974–1991), and eventually a post-1991 liberalization that produced a hybrid sector lacking clear regulatory oversight (Shiferaw, 2017). In Kenya, policy dualism remains entrenched. National frameworks have consistently privileged commercial enterprises and their reliance on imported breeds, marginalizing the traditional subsistence sector that maintains the majority of indigenous livestock. While the Kenya Animal Genetic Resources Centre (KAGRC), established as a state corporation in 2011 and succeeding the Central Artificial Insemination Station established in 1946, maintains critical *ex situ* conservation infrastructure for cattle genetics, it operates without a guiding national AnGR policy (GeRRI, 2016; AU-IBAR, 2019; Nouala *et al*, 2019). Uganda, by contrast, has developed the region's most coherent governance architecture (examined below in 'National reform experiences: Lessons from six cases'). Tanzania exemplifies a common regional pitfall: legislative intent disconnected from implementation. Although the Identification, Registration and Traceability Act (2010) provides a statutory basis for animal identification, no functional national registry was operational at the time of assessment, rendering the legislation largely symbolic (MLFD, 2015; AU-IBAR, 2016; 2019; Nouala *et al*, 2019).

North Africa: Sophisticated legislation, weak AnGR specificity

North African states generally possess more mature legislative infrastructures, yet AnGR governance remains subsumed within broader agricultural and biodiversity frameworks. Algeria maintains extensive agricultural regulations, including Law 2014-07 on Biological Resources, which incorporates access and benefit-sharing provisions. Enforcement remains inconsistent, with many statutes largely dormant in practice (Billal, 2013; AU-IBAR, 2019; Nouala *et al*, 2019). Egypt's 2013 country report described provisions on animal census requirements and breed classification protocols but did not identify a unified policy framework (Ministry of Agriculture and Land Reclamation [Egypt] & FAO, 2013). Morocco's 2005 country report described a conservation strategy and dedicated breeding stations dating from the 1960s; this is historical evidence and does not establish the current legal position (Ministère de l'Agriculture et du Développement Rural [Morocco], 2005).

Southern Africa: Legal bases present, implementation absent

Southern Africa exhibits a distinct pattern: relatively robust legal foundations are routinely undermined by chronic implementation deficits. Statutory provisions frequently exist in principle but suffer from inadequate enforcement, limited dissemination, and insufficient institutional backing. South Africa represents the continent's most advanced jurisdiction (examined below in 'National reform experiences: Lessons from six cases'). Elsewhere, regulatory frameworks often lag behind operational needs. Although Botswana's Registration of Livestock Act governs performance recording and breed society activities, assessments characterize the legislation as outdated and functionally inadequate (Tahal, 2000; MFDP, 2003; Nouala *et al*, 2019). Malawi has embedded conservation objectives within its Environmental Management Act, but institutional capacity constraints have prevented meaningful enforcement (MoIFS, 1998; 1999a; AU-IBAR, 2019; Nouala *et al*, 2019). Similarly, Zambia relies on the Animal Health Act, 2010 (Act No. 27 of 2010), to regulate the import and export of genetic materials. While the Act and its 2022 regulations establish import permit requirements, they contain no mandates specific to AnGR, a gap explicitly highlighted by the 2013 FAO country report (Government of the Republic of Zambia, 2010; Ministry of Agriculture & FAO, 2013, pp. 8–9, 17; Government of the Republic of Zambia, 2020).

Central Africa: The most critical governance deficit

Central Africa confronts the continent's most severe governance shortfall, exhibiting the lowest levels of AnGR-specific policy development and institutional capacity. Across the Democratic Republic of the Congo, Gabon, Republic of the Congo, and Chad, the livestock sector remains marginalized within national economic planning, reflected in negligible budgetary allocations and a near-total absence of regulatory instruments governing AnGR (AU-IBAR, 2015; AU-IBAR, 2019). Cameroon exemplifies the region's institutional fragmentation: jurisdiction is divided among four ministries: the Ministry of Agriculture and Rural Development (MINADER), Ministry of Livestock, Fisheries and Animal Industries (MINEPIA), Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) and Ministry of Forestry and Wildlife (MINFOF). The lack of formal coordination mechanisms has fostered administrative overlap and policy inconsistencies (République du Cameroun, 2009; FAO, 2013). In Chad, state intervention has concentrated almost exclusively on veterinary campaigns, leaving genetic resource governance entirely unaddressed (MERA, 2008; AU-IBAR, 2015). The Democratic Republic of the Congo presents a paradox: despite colonial-era achievements in livestock development, including the creation of synthetic breeds such as the Alur and Mateba cattle, post-independence governments have failed to establish the institutional frameworks necessary to conserve this legacy (FAO, 2013; Miteyo *et al*, 2025).

Comparative governance overview

Table 1 provides a comparative overview of key AnGR governance framework elements across ten selected countries. The post-2018 column shows that institutional progress has occurred since the AU-IBAR baseline assessment. Similar post-2018 instruments exist beyond the profiled countries; for example, Rwanda (2024) and Nigeria (2025) recently adopted national strategies, illustrating that the structural gaps identified here coexist with recent policy attention.

Table 1. Comparative overview of AnGR governance frameworks in selected African countries. Source: AU-IBAR (2016, 2019); Nouala *et al* (2019); national sources post-2018 column compiled from available country reports, ITWG-AnGR submissions and published post-2018 sources. Instruments in the second column are classified as: dedicated AnGR or breeding law (Uganda, South Africa); general biodiversity/ABS law applicable to AnGR by extension (Ethiopia, Kenya); implementing regulation of a general ABS law (Kenya); or absent/draft (all others), as indicated in each cell. AIR, Animal Identification and Recording; NAGRC & DB, National Animal Genetic Resources Centre and Data Bank. UNCST, Uganda National Council for Science and Technology. IBC, Institute of Biodiversity Conservation, renamed the Ethiopian Biodiversity Institute (EBI) in 2013; NEMA, National Environment Management Authority; BABS, Bioprospecting, Access and Benefit Sharing; KAGRC, Kenya Animal Genetic Resources Centre; DFFE, Department of Forestry, Fisheries and the Environment (South Africa); MOFA, Ministry of Food and Agriculture (Republic of Ghana); EPA, Environmental Protection Agency (Ghana); MAWF, Ministry of Agriculture, Water and Forestry (Namibia); AAGRIS, African Animal Genetic Resources Information System; ITWG-AnGR, Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture.

Country	AnGR/ABS legal instrument (type)	Designated competent institution	Operational AIR system	Post-2014 Nagoya compliance measures	Notable post-2018 developments
Uganda	Yes (Animal Breeding Act, 2001 + Access to GR Regulations, 2005)	NAGRC & DB + UNCST	Partial	Under development	NAGRC & DB operational expansion; active ITWG-AnGR engagement; national AnGR strategy under review
South Africa	Yes (NEMBA 2004 + BABS Regulations)	DFFE	Yes (Studbook operational)	Revision in progress	BABS regulations under review; DSI policy consultations initiated; community-breed conservation pilot launched
Ethiopia	Yes (Proclamation No. 482/2006)	IBC	Partial	Amendment required (pre-Nagoya framework)	Nagoya alignment revision initiated; IBC mandate expanded; genomic characterization of livestock breeds advancing
Kenya	Partial (EMCA Regulations, 2006, revoked and replaced by Legal Notice No. 68 of 2025)	NEMA	Partial (KAGRC operational)	Revision in progress	KAGRC mandate under review; wildlife-livestock AnGR coordination strengthened; draft AnGR policy circulated; ABS framework replaced by Legal Notice No. 68 of 2025; Kenya Animal Genetic Resources Centre 2023–2027 Strategic Plan published
Ghana	No (Biodiversity Strategic Action Plan only)	MOFA / EPA	No	No	No significant legislative change; commercial poultry value-chain displacement of indigenous breeds accelerating
Mali	No (draft pending)	Livestock Directorate	No	No	Security situation has severely disrupted livestock governance processes since 2021
Morocco	No (bill at draft stage)	Ministry of Agriculture	No	Ratification in progress	Nagoya Protocol ratification advancing; national breed conservation stations remain active
Tanzania	No (IRT Act 2010, disease traceability only)	MLFD / NLRI Mpwapwa	No (declarative)	No	Livestock Master Plan under revision; national AnGR focal point re-activated; AAGRIS data submission pending
Burkina Faso	No	Directorate of Livestock	No	No	Security crisis has severely disrupted livestock governance capacity since 2022
Namibia	No (parliamentary draft)	MAWF	No	No	Draft legislation progressing; communal conservancy governance model offers institutional synergy for AnGR
Majority of 40 African countries	No	None formally designated	No	No	AAGRIS is now operational as a continental platform; ITWG-AnGR engagement increasing; national uptake remains weak

Structural causes of the governance deficit

The institutional and governance patterns outlined in the regional overview are neither arbitrary nor simply the product of fleeting political disinterest. Rather, they emerge from five interlocking structural drivers that reproduce the AnGR governance deficit across varying national contexts and legislative stages. Table 2 outlines each driver alongside its empirical manifestations and governance implications, with the subsequent subsections providing a detailed examination of the underlying mechanisms.

Subordination of AnGR within general agricultural policy

The most pervasive driver is the systematic marginalization of AnGR within broader agricultural policy architectures. In most African jurisdictions, livestock policy is itself a subsidiary component of agricultural planning, and within that framework, genetic resources rarely receive dedicated attention. Where draft livestock policies exist, conservation and breeding are often relegated to a single paragraph, an approach wholly inadequate for addressing breed characterization, the design of *in situ* and *ex situ* programmes, and compliance with ABS requirements (Nouala et al, 2019). Legislation governing animal health, veterinary services, and import controls is generally robust, reflecting decades of prioritization in disease control. By contrast, statutory frameworks for breed conservation, performance recording, and dedicated conservation funding remain largely absent. This subordination is rooted in post-independence development paradigms that equated productivity with genetic replacement, channelling resources into exotic genetics while overlooking indigenous inventory and conservation (AU-IBAR, 2019; Nouala *et al*, 2019). Contemporary research has thoroughly documented the adaptive advantages of African indigenous breeds (Mwai *et al*, 2015; Nandolo *et al*, 2021; Kambal *et al*, 2023; Pius *et al*, 2024), yet unmanaged crossbreeding can erode indigenous gene pools (Leroy *et al*, 2020; Assan *et al*, 2024; Ramoroka *et al*, 2025), and legislative frameworks remain unaligned with current scientific evidence.

Institutional fragmentation and mandated authority gaps

A second entrenched driver is the fragmentation of AnGR governance across multiple institutions lacking clear mandates or coordination. Essential competencies, veterinary regulation, livestock production, biodiversity and ABS, animal identification, and *in situ* conservation, are typically dispersed across separate ministries, with Cameroon's experience being emblematic (Table 2). In Kenya, ABS competencies are split between the National Environment Management Authority (NEMA) and agricultural bodies, yielding only reactive cooperation. Nigeria exhibits similar policy isolation, producing minimal coherence regarding genetic resources (AU-IBAR, 2019; Nouala *et al*, 2019). Even South Africa faces significant implementation gaps within breed societies

Table 2. The five structural causes of the African AnGR governance deficit: nature, evidence and consequences. Source: Compiled from AU-IBAR (2019), Nouala *et al* (2019) and country-specific sources as cited. See sub-sections below for extended analysis. DAFF, Department of Agriculture, Forestry and Fisheries.

Nature of failure	Country/regional Evidence	Governance consequence
Subordination within general agricultural policy: AnGR receive at most 'little mention' in livestock policy documents; no sector-specific legislation in most countries (AU-IBAR, 2019).	Burkina Faso (no breed-specific strategy until 1997); Côte d'Ivoire (draft decree unsigned for years); Mali (health/export focus, no AnGR framework); Nigeria (fragmented legislation, no AnGR coherence).	No dedicated legal instruments, budget lines, or institutional mandates for characterization, conservation, or ABS governance of livestock breeds.
Institutional fragmentation and authority gaps: AnGR competences distributed across multiple ministries without coordination or lead-authority designation.	Cameroon (MINADER, MINEPIA, MINEPDED, MINFOF); Kenya (NEMA vs. agricultural authorities); South Africa (DFFE vs. DAFF); Nigeria (food standards, health, production, no AnGR coherence).	Inconsistencies, competition and conflicts between administrations; absence of specialist AnGR units; human capital deficit in animal breeding and genetics.
Absence of foundational information infrastructure: No comprehensive breed inventories, characterization data, or operational AIR systems in most countries.	FAO (2015a): > 2/3 of African livestock breed populations uncharacterized; AU-IBAR (2019): no exhaustive national censuses; AIR systems declarative rather than operational (e.g. Tanzania IRT Act 2010).	Cannot define GR subject to ABS obligations; no evidence base for breed prioritization; cannot verify access compliance or monitor crossbreeding impacts.
Chronic financial and human resource constraints: AnGR units typically staffed by a single desk officer; genebanks lack sustainable operating budgets.	AU-IBAR (2019): near-universal shortage of animal breeders and reproductive technology experts in government services; regional genebanks established but sustainability uncertain (AU-IBAR, 2018).	Discontinuation of programmes; erosion of institutional memory; absence of interest by national cadres in animal breeding and genetics; ex situ conservation infrastructure unsustained.
Exclusion of livestock-keeping communities from policy design: Farmers, pastoralists and agro-pastoralists are recipients, not co-designers, of AnGR governance.	AU-IBAR (2019): consistent cross-regional finding that communities rarely consulted in law-making; policies produced by technicians' discretion without active community participation; some reforms resisted/rejected by beneficiaries.	Impoverished characterization data; loss of irreplaceable indigenous knowledge; poor implementation of laws perceived as illegitimate; non-compliance with Nagoya Protocol traditional knowledge provisions.

and registries. This fragmentation is compounded by the near-total absence of dedicated AnGR units, with officials typically handling these responsibilities alongside broader portfolios. The challenge is further exacerbated by a severe expertise shortage, as agencies report a continent-wide scarcity of animal breeders, reproductive biotechnologists, and molecular geneticists (AU-IBAR, 2019; Nouala et al., 2019). This human capital deficit fundamentally constrains the state's capacity to design, enforce, or monitor AnGR regulations, regardless of political intent.

Absence of foundational information infrastructure

Effective AnGR governance is highly data-intensive, yet information infrastructure remains limited across most African states. Three interdependent information categories remain consistently absent: (1) comprehensive breed inventories, (2) phenotypic and genotypic characterization data, and (3) robust animal identification and recording (AIR) systems. The FAO's Second Report noted that over two-thirds of African livestock breeds remain inadequately characterized, a finding corroborated by the AU-IBAR assessment, which highlighted the scarcity of reliable databases, outdated census data, and limited comparative studies on locally adapted populations (FAO, 2015a; AU-IBAR, 2019; Nouala *et al*, 2019). This data vacuum carries direct policy consequences: without inventories, legislators cannot delineate which genetic resources fall under ABS obligations; without characterization metrics, policymakers lack the empirical basis to prioritize conservation efforts or quantify economic value; and without functional AIR systems, monitoring crossbreeding impacts or verifying compliance with access agreements becomes practically impossible. The economic implications are stark. The commercial and research value of breeds (e.g. Red Maasai sheep, Boer goat, naked-neck chicken) ultimately depends on systematic performance recording and scientific validation to quantify traits like disease resistance, reproductive resilience, and thermotolerance (Baker *et al*, 1999; Greyling, 2000; Baker et al, 2004; Yahav et al, 2004; Browning *et al*, 2011). Consequently, investment in data infrastructure is not merely academic; it is a prerequisite for the economic valorization of indigenous genetics and for establishing credible negotiating positions within international ABS frameworks.

This data deficit leaves African states ill-prepared to govern DSI. Encompassing genomic sequences, transcriptomic profiles, and SNP data derived from biological specimens, DSI is not distinct from AnGR, but remains closely tied to the physical genetic resources. Yet, as a policy construct, DSI lacks a universally agreed definition and does not automatically carry legal equivalence to the specimen from which it originates (CBD Secretariat, 2022; FAO, 2023). When researchers sequence and upload genomes of indigenous breeds such as the Azawak zebu or Red Maasai sheep to public repositories, the genetic resources maintained by custodian communities are effectively extracted without triggering benefit-sharing obligations, regardless of subsequent commercial or scientific value. At the same time, international initiatives, including the African BioGenome Project and ILRI, are rapidly addressing characterization gaps that African states remain unable to close domestically.

This creates a profound paradox: the breeds most poorly documented at the national level are simultaneously the most exposed to uncompensated DSI extraction by international researchers, a plausible risk demanding proactive governance. Countries that have not established breed inventories, designated competent AnGR authorities, or enacted ABS legislation lack every institutional prerequisite needed to assert a governance position over the DSI generated from their livestock populations. While the Kunming–Montreal Global Biodiversity Framework's Target 13 introduces provisions for DSI benefit-sharing, their application to livestock genetic resources remains legally ambiguous. Closing this foundational information gap is therefore a prerequisite not only for evidence-based conservation policy, but for constructing any credible domestic DSI governance architecture.

Chronic financial and human resource constraints

The governance deficit is further entrenched by chronic underfunding and human resource shortages. While some countries have established nominal AnGR focal points within broader agricultural divisions, these units consistently lack adequate budgetary support (AU-IBAR, 2019; Nouala *et al*, 2019). Financial constraints are particularly acute in *ex situ* conservation; genebanks require continuous investment in consumables, maintenance, and training. Although AU-IBAR facilitated regional genebanks across Africa's five zones, their long-term viability remains precarious without sustained national and regional funding (AU-IBAR, 2018; Nouala *et al*, 2019). The human resource crisis is equally debilitating. Effective AnGR governance requires interdisciplinary expertise spanning genetics, biotechnology, law, and data management, yet public sector capacity remains critically thin. Drawing on the S-RFP stakeholder consultations described in the Methodology section, participants consistently reported that decades of underinvestment in specialized veterinary and agricultural education, coupled with the persistent outmigration of trained professionals to international agencies or the private sector, have severely depleted national expertise. Reports further highlight waning domestic interest in animal breeding and genetics as career pathways. Compounding this deficit is administrative instability: frequent restructuring and high staff turnover within AnGR programmes have repeatedly eroded institutional memory, undermining long-term conservation and policy continuity.

Exclusion of livestock-keeping communities from policy formulation

Perhaps the most consequential structural driver is the exclusion of livestock-keeping communities (pastoralists, agropastoralists, and smallholders) from the very policies governing their breeds (Nouala et al, 2019). Across regions, producers are treated as passive recipients of top-down directives rather than active participants. Frameworks drafted with minimal consultation often ignore local realities and indigenous practices, leading to resistance and non-compliance. This exclusion generates two governance failures: an informational deficit, as pastoralists hold vital knowledge on breed adaptability and disease resistance; and a motivational deficit, as externally imposed rules are widely viewed as illegitimate. The Nagoya Protocol, building on CBD Article 8(j), requires prior informed consent and equitable

benefit-sharing in accordance with domestic law (Article 7), and Article 6(2) applies specifically where communities have established rights to grant access to genetic resources; these provisions do not impose an unconditional, universal community-PIC rule when utilizing the traditional knowledge of indigenous and local communities. Operationalizing this mandate necessitates recognizing livestock keepers not merely as development beneficiaries, but as legitimate rights-holders and co-managers within AnGR governance frameworks, a paradigm shift that remains largely unactualized across African policy landscapes.

National reform experiences: Lessons from six cases

Amidst the continent-wide governance shortfall, six national jurisdictions demonstrate comparatively advanced AnGR regulatory architectures. Examining the institutional conditions that enabled reform in these contexts yields transferable insights into broader policy development across Africa.

Uganda: The most integrated national AnGR governance framework

Uganda has developed the continent's most cohesive AnGR governance architecture, operating through two interlocking instruments. The Animal Breeding Act (2001, ss. 7-9, 13-15) established the National Animal Genetic Resources Centre and Data Bank (NAGRC & DB) as the central mechanism for genetic improvement, regulatory oversight, and quality assurance. The Act mandates deposition of all genetic materials in a national repository, requires imported materials to comply with biosafety standards, and obliges proponents to submit genetic impact assessments prior to introduction (AU-IBAR, 2016). These provisions are reinforced by the Access to Genetic Resources Regulations (2005, S.I. No. 30), designating the Uganda National Council for Science and Technology (UNCST) as the competent authority and establishing a comprehensive ABS framework encompassing application processing, a Material Transfer Agreement registry, and domestic benefit-sharing mechanisms. The model's strength lies in coupling a dedicated sectoral statute with broader biodiversity governance, creating complementary regulatory layers addressing both production and conservation imperatives. The establishment of the NAGRC & DB with dedicated funding and staff was essential for operationalizing Uganda's Animal Breeding Act 2001 (ss. 7–9, 13–15). Though underutilized, the genetic impact assessment requirement under the National Environment (Access to Genetic Resources and Benefit Sharing) Regulations 2005 (S.I. No. 30) sets a valuable precedent for managing exotic germplasm. Legislative frameworks, though necessary, remain inadequate without sustained fiscal commitment; chronic underfunding of the Centre's research farms continues to be the principal constraint on full implementation (MAAIF, 2023; NAGRC & DB, 2023).

South Africa: The most technically sophisticated framework

South Africa's AnGR governance architecture is distinguished by its technical sophistication, blending a robust tradition of private-sector breed society organization with comprehensive statutory oversight. The Animal Improvement Act (1998) regulates breeding, identification, and the utilization of genetically superior livestock, covering the collection, analysis, registration, and trade of genetic materials. It also mandates a Registrar of Animal Improvement to maintain a national register of technicians, breeding farms, donor animals, and breed societies (AU-IBAR, 2016). This production-focused legislation is complemented by the National Environmental Management: Biodiversity Act (NEMBA) (Republic of South Africa, 2004) and its Bioprospecting, Access and Benefit Sharing (BABS) Amendment Regulations, which establish ABS compliance for indigenous biological resources, including livestock. Notably, NEMBA section 85 and the applicable BABS regulations establish a Bioprospecting Trust Fund that institutionalizes benefit-sharing mechanisms. Despite these advancements, South Africa faces persistent structural vulnerabilities. The AU-IBAR assessment highlights critical gaps, including the absence of targeted conservation policies for community-managed traditional breeds, chronic underfunding of conservation initiatives, and a shortage of specialized technical personnel (Nouala *et al*, 2019). Inter-ministerial coordination between the Department of Agriculture, Land Reform and Rural Development (DALRRD), which oversees the Animal Improvement Act, and the Department of Forestry, Fisheries and the Environment (DFFE), which manages NEMBA and BABS, remains fragmented, reflecting divergent institutional mandates and operational cultures. These deficiencies are further compounded by the enduring legacy of apartheid-era agricultural policies, most notably the Livestock Improvement Act 25 of 1977, which explicitly excluded small and communal farmers from accessing genetic material and breeders' society registration. The post-apartheid Animal Improvement Act 62 of 1998 was expressly designed to remedy this historical marginalization and disenfranchisement of Black farming and pastoral communities (Department of Agriculture, 1998). Consequently, South Africa illustrates that legislative comprehensiveness does not guarantee equitable or fully functional governance; effective inter-agency coordination and historical redress remain indispensable to operational success.

Ethiopia: A general biodiversity framework awaiting AnGR specificity

While Ethiopia's genetic resources framework is procedurally rigorous, its application to livestock remains incomplete. Proclamation No. 482/2006, operationalized by Regulation No. 169/2009, establishes an access protocol encompassing community consent, benefit administration, and standardized application templates. The IBC, renamed the Ethiopian Biodiversity Institute (EBI) under Council of Ministers Regulation No. 291/2013, is the designated competent authority for *in situ* and *ex situ* management. The Ethiopian case yields two insights: (1) it highlights the inadequacy of applying broad biodiversity legislation to animal genetics. The Proclamation lacks provisions addressing breed registries, artificial insemination regulation, genetic impact assessments for imported germplasm, or transboundary management. A general ABS regime cannot substitute for sector-specific AnGR instruments; (2) the framework's temporal limitations are apparent. Drafted prior to the Nagoya Protocol's adoption and enforcement, it requires substantive revision to align with contemporary compliance standards,

including updated utilization definitions, checkpoint mechanisms, and clearing-house functions (Lemma, 2025). For other jurisdictions, new legislative frameworks must be designed with Nagoya compliance as a foundational baseline.

Kenya: The limits of a dual-tier policy approach

Kenya's trajectory illustrates the structural consequences of policy dualism, a pattern that bifurcates livestock governance into a commercially oriented, exotic-breed-focused sector and a marginalized subsistence sector. Although the Kenya Animal Genetic Resources Centre (KAGRC) maintains critical *ex situ* conservation infrastructure, national programmes have disproportionately prioritized exotic animals, leaving indigenous populations largely unprotected (GeRRI, 2016; AU-IBAR, 2019; Nouala *et al*, 2019). This dualism was originally codified in the Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006, Legal Notice No. 160), which explicitly exempted community-level genetic resource exchanges for local use and consumption. These Regulations were revoked in 2025, first by Legal Notice No. 19 and subsequently by Legal Notice No. 68 of 2025, which retains a comparable community-use exemption while broadening the definition of biological resources to include digital genetic information. While ostensibly designed to safeguard traditional practices, this exemption effectively removes the majority of indigenous AnGR transactions from regulatory oversight, while the commercial sector's reliance on imported germplasm also operates with minimal genetic governance. The resulting framework leaves significant regulatory voids at both ends of the value chain. Kenya's 2010 Constitution offers a potential catalyst for reform by vesting natural resource rights in citizens and recognizing community land tenure. The translation of these constitutional principles into operational AnGR legislation and community-level benefit-sharing mechanisms has been slow. The Kenyan experience demonstrates that progressive constitutional recognition, without targeted statutory implementation and resource allocation, remains aspirational.

Ghana: The limits of biodiversity governance as a substitute for AnGR-specific policy

Ghana's management of AnGR illustrates a familiar disjuncture in African biodiversity policy: formal adherence to international agreements has not translated into functional conservation systems. Despite ratification of the CBD in 1994 and the Nagoya Protocol in 2011, enforceable rules for breed conservation, sustainable use, and benefit-sharing remain largely absent (AU-IBAR, 2019; Nouala *et al*, 2019). The shortfall originates in legislative design. The Animals (Diseases and Importation) Act of 1961 addresses only sanitary controls, leaving genetic impact assessments, breed registries, and artificial insemination oversight unregulated. Conservation targets in national biodiversity plans consequently remain declaratory, notwithstanding Ghana's Livestock Development Policy and Strategy, which explicitly addresses breed identification and traceability at the policy level (Ministry of Food and Agriculture Republic of Ghana, 2016); the gap identified here concerns the absence of implementing legislation and secondary regulation, not the absence of policy commitments. Institutional fragmentation compounds this void: AnGR responsibilities are dispersed across the Livestock Directorate, the EPA, and the CSIR-Animal Research Institute, with no single entity holding clear authority or dedicated funding.

The sector faces a pronounced data shortfall: despite harbouring well-adapted indigenous populations. Ghana lacks a national breed inventory or systematic recording framework, a structural gap explicitly documented in the FAO's 2013 Country Report on Animal Genetic Resources, which highlighted a critical "lack of infrastructure of recording system" for livestock improvement (FAO, 2013). Phenotypic and molecular studies at CSIR-ARI have generated useful insights, but these findings circulate within academic literature rather than shaping conservation programming (FAO, 2015a). Meanwhile, commercial pressures accelerate genetic erosion: recent sector analyses confirm that commercial poultry production remains highly dependent on imported proprietary lines, satisfying an estimated 80% of domestic demand (Zamani *et al*, 2022; USDA, 2024; Aboah *et al*, 2025).

Mali: Governance in the absence of the state, community-led instruments and their limits

Mali exemplifies the acute governance challenges facing African AnGR. Despite livestock contributing 15–18% of GDP and supporting over a third of the population, the country operates without functional legislation for breed conservation, sustainable use, or benefit-sharing, a gap intensified by political instability and disrupted pastoral systems (AU-IBAR, 2019; Nouala *et al*, 2019). Post-1991 liberalization dismantled state breeding infrastructure without private-sector oversight, as noted in recent agricultural policy tracking (Philipsson *et al*, 2011). Currently, artificial insemination distributes exotic genetics without impact assessments, and despite recent legislative updates, Mali still lacks a national breed inventory or recording system (Nouala *et al*, 2019; Gouvernement du Mali, 2024).

In this vacuum, civil society has pioneered alternative governance. Supported by AU-IBAR and Natural Justice, Tuareg pastoralists developed a Biocultural Community Protocol (BCP) for Azawak cattle spanning Mali, Niger, and Burkina Faso, asserting that research or commercial use of Azawak genetics requires prior informed consent and benefit-sharing (AU-IBAR, 2017; Nouala *et al*, 2019). However, as a non-binding instrument, it cannot legally bind researchers or commercial actors across jurisdictions. Since 2012, security crises have further eroded governance capacity, severing transhumance routes and gene flow (humanitarian and pastoral-mobility reporting; AU-IBAR, 2017), disrupting mobility and, by population-genetic inference, reducing gene flow among transboundary populations. This compounds genetic erosion even as international interest in Azawak genetics grows without benefiting custodian communities.

Transboundary breeds: A special governance challenge

Any rigorous assessment of Africa's AnGR governance architecture must account for transboundary breeds, which present regulatory complexities fundamentally distinct from those confined within single jurisdictions. Recognized by the FAO as populations distributed across multiple

national borders, these breeds constitute a substantial share of the continent's most economically vital and biologically adapted livestock resources. Among ruminants, several key populations span extensive cross-border ranges. The N'Dama, one of the most trypanotolerant African taurine cattle breeds, is maintained across 12 West and Central African countries. Similarly, the Sahiwal and Azawak zebus, and the Djallonké sheep, span extensive cross-border ranges across East, West, and Central Africa. Because these genetic resources are inherently shared, no single state can legitimately assert exclusive ownership or unilaterally dictate conservation and utilization policies (AU-IBAR, 2019; Nouala *et al*, 2019). For monogastric species, the governance imperative diverges significantly. Indigenous poultry populations, including the naked-neck chicken, the Fayoumi (Egypt and Sudan), and diverse village ecotypes across East and West Africa, face genetic erosion primarily through the vertical integration of commercial breeding sectors. A handful of multinational genetics firms, (e.g. Tyson Foods, EW Group, Hendrix Genetics) dominate the global poultry genetics market, extending their reach into Africa via licensed distributors and joint ventures (Goga & Roberts, 2025). Indigenous breeds face mounting pressure: about 33% of indigenous chicken breeds are already at risk of extinction due to production systems favouring exotic commercial lines. Indigenous pig populations, such as Ghana's Ashanti Dwarf, classified as endangered with station numbers falling from 382 in 2011 to 219 by 2015, face parallel erosion from uncontrolled crossbreeding and funding shortfalls (FAO, 2013; Aryee *et al*, 2024). Most African states lack regulatory mechanisms to monitor this market consolidation or safeguard smallholder access to local germplasm, leaving farmers with minimal bargaining power as European and US regulators, rather than African governments, control these agribusiness mergers (GRAIN, 2025). Consequently, governing monogastric species requires a shift toward market regulation, corporate accountability, and the protection of community-based breeding systems dimensions largely absent from current national AnGR policies.

The application of the Nagoya Protocol to transboundary breeds introduces a pronounced structural paradox (AU-IBAR, 2016). The Protocol operates on the premise of state sovereignty, requiring provider states to grant access through prior informed consent and mutually agreed terms. When a breed spans multiple jurisdictions, determining the legitimate provider state becomes legally ambiguous. Requiring unanimous consent from all range states imposes prohibitive transaction costs, while permitting unilateral access risks a regulatory race-to-the-bottom that undermines collective benefit-sharing and fragments regional conservation efforts. Although Article 11 urges Parties to cooperate in transboundary contexts, it offers no operational framework for structuring such multilateral governance (CBD Secretariat, 2011; Nouala *et al*, 2019). This legal ambiguity is exacerbated by the inadequacy of existing regional institutional architectures. Currently, no formal African regional mechanism provides binding directives for the conservation and management of cross-border AnGR populations (AU-IBAR, 2016). While regional economic communities (RECs [e.g., ECOWAS, IGAD, SADC]) had broad agricultural or pastoral mobility frameworks, they had no specific, binding AnGR governance instruments identified in the assessment.

The governance of transboundary breeds is further complicated by its intersection with pastoral transhumance. Seasonal mobility maintains genetic connectivity across range states by facilitating natural mating, exchange, and the preservation of pan-regional genetic diversity (Nouala *et al*, 2019). When transhumance routes are disrupted by border closures, conflict, or agricultural expansion, these gene flows are severed, triggering inbreeding and progressively eroding the adaptive traits that define the breed (AU-IBAR, 2019). Restricting pastoral mobility, therefore, constitutes not only a socioeconomic disruption but a direct failure of genetic resource governance. Within this constrained landscape, Biocultural Community Protocols (BCPs) have emerged as a pragmatic governance innovation. Endorsed by the African Group during Nagoya Protocol negotiations, BCPs are community-driven instruments that document indigenous knowledge, stipulate access conditions, and establish equitable benefit-sharing. The AU-IBAR project, in partnership with the Réseaux des Organisation Paysannes et de Producteurs de l'Afrique de l'Ouest (ROPPA) and Natural Justice, successfully facilitated the development of a BCP for the Azawak cattle breed, demonstrating that community-led protocols can effectively bridge the gap between formal state regulations and the lived realities of pastoralists managing transboundary populations (AU-IBAR, 2016; AU-IBAR, 2017; Nouala *et al*, 2019).

A reform agenda for African AnGR governance

The preceding diagnostic framework necessitates a reform agenda calibrated to Africa's institutional, ecological, and political realities. Rather than importing generic templates, this context-specific architecture aligns AnGR stewardship with food system transformation, climate adaptation, and emerging genetic technologies. Table 3 outlines six core principles and their implementation pathways, with DSI actions integrated into the sixth principle on international compliance. The section 'DSI governance as a standalone reform priority' further explores this distinct, cross-cutting issue.

Stand-alone national AnGR policy instruments

A foundational step in addressing governance deficits is to separate AnGR management from general agricultural policy. Alternatively, dedicated AnGR provisions can be embedded within broader biodiversity or agricultural frameworks, provided mandates, budgets, and enforcement powers are clearly defined. National AnGR frameworks must set clear statutory boundaries. They should include systematic breed inventory and characterization. Conservation and utilization strategies must assign institutional responsibilities. Breeding policies should regulate exotic germplasm imports through genetic impact assessments. Frameworks must also recognize pastoral and smallholder communities as primary custodians. Financing for AnGR should be embedded within CAADP investment planning. They must anticipate DSI governance in line with GBF Target 13.

Designated institutional arrangements with clear mandates

Overcoming institutional fragmentation requires unambiguous legislative designation of a lead authority endowed with a comprehensive mandate, dedicated funding, and specialized technical personnel. Uganda's NAGRC-DB

Table 3. Reform principles for African AnGR governance: requirements, models, and actionable steps. Source: Developed from AU-IBAR (2016, 2018, 2019), FAO (2007, 2012, 2015a, 2015b), CBD Secretariat (2011, 2022), and national case study evidence. AnGR, Animal Genetic Resources; ABS, Access and Benefit-Sharing; AAGRIS, African Animal Genetic Resources Information System; AIR, Animal Identification and Recording; AU-IBAR, African Union Inter-African Bureau for Animal Resources; BABS, Bioprospecting, Access and Benefit Sharing; BCPs, Biocultural Community Protocols; CAADP, Comprehensive Africa Agriculture Development Programme; CBD, Convention on Biological Diversity; DAFF, Department of Agriculture, Forestry and Fisheries; DFFE, Department of Forestry, Fisheries and the Environment; DSI, Digital Sequence Information; ECOWAP, Economic Community of West African States Agricultural Policy; ECOWAS, Economic Community of West African States; FAO, Food and Agriculture Organization of the United Nations; GBF, Kunming-Montreal Global Biodiversity Framework; GPA, Global Plan of Action for Animal Genetic Resources; IGAD, Intergovernmental Authority on Development; ITPGRFA, International Treaty on Plant Genetic Resources for Food and Agriculture; LiDeSA, Livestock Development Strategy for Africa; NAGRC & DB, National Animal Genetic Resources Centre and Data Bank; PIC, Prior Informed Consent; REC, Regional Economic Community; ROPPA, Réseau des Organisations Paysannes et de Producteurs de l'Afrique de l'Ouest; SADC, Southern African Development Community; UNCST, Uganda National Council for Science and Technology.

Principle	Core requirement	Country/regional model	Key actionable steps
Stand-alone AnGR policy	Dedicated national AnGR policy covering inventory, conservation, breeding guidelines, community rights, and CAADP budget integration.	Uganda (Animal Breeding Act); South Africa (Animal Improvement Act + NEMBA/BABS); GPA Strategic Priority 10.	Draft and adopt stand-alone AnGR Policy Act; mandate national breed inventory; align with GBF Target 13 and Kampala CAADP Declaration 2025.
Designated institutional arrangements	Explicit legislative designation of lead authority with clear mandate, budget, staff cadre, and coordination with animal health, environmental, and rural development authorities.	Uganda NAGRC & DB (animal breeding); UNCST (ABS); South Africa DFFE + DAFF. Avoid portfolio reorganization instability.	Designate lead AnGR institution by law; specify inter-agency coordination mandates; ensure legislative permanence against ministerial portfolio reorganization.
Information infrastructure investment	Three-stage programme: (1) national breed inventories, (2) morphological/productive characterization per FAO (2012), and (3) molecular and genomic analysis. Populate AAGRIS.	Pretoria Declaration AIR Systems (2015); FAO Guidelines for Integrated Multipurpose Animal Recording Systems; AAGRIS as continental aggregation platform.	Initiate national breed census; designate AAGRIS focal point; establish AIR system for priority breeds; secure sustained government and partner budgets.
Community-centred participatory governance	Move from consultation to co-design: livestock-keeping communities as rights-holding stakeholders participating in objectives, instruments, and benefit-sharing.	AU-IBAR/ROPPA/Natural Justice Azawak BCP (West Africa); Nagoya Protocol BCPs; CBD Article 8(j) traditional knowledge provisions.	Develop BCPs; create statutory recognition of community rights over AnGR; integrate traditional knowledge holders into national AnGR committees.
Regional coordination frameworks	Binding REC frameworks for transboundary breed governance: harmonized movements of breeding animals and genetic material, collective ABS governance under Nagoya Art. 11, trans-national BCPs, regional genebank financing.	ECOWAS (ECOWAP framework); IGAD (pastoral mobility); SADC (livestock policy reviews). AU Guidelines on Nagoya implementation as reference.	Develop binding REC AnGR protocols; establish multi-country breed registries for transboundary breeds; fund regional genebanks through REC mechanisms.
International instrument compliance	Design reforms for compliance with CBD, Nagoya Protocol, ITPGRFA, GPA, LiDeSA, GBF, and Kampala CAADP Declaration 2025 from the outset; address DSI governance proactively.	Ethiopia's Proclamation 482/2006 as cautionary case (pre-Nagoya, requires costly amendment); Uganda's complementary layered approach as positive model.	Design new ABS frameworks for full Nagoya compliance; establish national DSI governance position aligned with GBF Target 13; use FAO ABS Elements and AU Practical Guidelines as operational guidance.

offers a viable template, though institutional configurations must align with national administrative traditions. The mandate must encompass the entire AnGR governance cycle, from characterization and conservation to access regulation and benefit-sharing, with statutory coordination mechanisms insulating the institution from ministerial reorganizations that frequently disrupt policy continuity.

Foundational investment in information infrastructure

Effective governance is contingent upon robust information infrastructure. Closing the data gap requires a phased investment strategy: systematic breed censuses; morphological and productive characterization aligned with FAO standards (FAO, 2012); and molecular and genomic analyses to map adaptive traits and population-level diversity. This must be underpinned by integrated AIR systems, as outlined in the Pretoria Declaration (2015) and FAO's multipurpose recording guidelines. Viewed as a strategic asset rather than an administrative cost, this informational foundation is indispensable for evidence-based policy and the economic valorization of indigenous genetics.

Community-centred participatory governance

Meaningful reform must embed pastoral and livestock-keeping communities as co-architects of governance, shifting

from passive consultation to participatory co-governance in conservation objectives, priority setting, and regulatory instruments. BCPs, referenced in Nagoya Protocol Article 12(1), offer a mechanism for legitimizing community rights over genetic resources and traditional knowledge, though their force depends on domestic legislative recognition (AU-IBAR, 2017). Extending BCPs to cover DSI would recognize that communities maintaining indigenous breeds hold a normative claim to consent rights over genomic research. This remains a policy proposal, contingent on national ABS legislation and the Nagoya Protocol's Articles 5–7 and 12, rather than an established legal entitlement.

DSI governance as a standalone reform priority

African states should develop explicit national DSI governance positions aligned with GBF Target 13 and CBD Decision 16/2 (CBD Secretariat, 2022; 2024). Four interlocking policy measures are proposed: depositing genomic data in national repositories before international upload to establish sovereign attribution baselines; ensuring Material Transfer Agreements explicitly cover derivative DSI (Morgera *et al*, 2014); mandating national AnGR authorities as livestock DSI checkpoints; and integrating DSI governance into transboundary breed frameworks recognizing shared populations such as the N'Dama, Azawak, and Sahiwal (AU-IBAR, 2019). Absent these measures, genomic value will continue flowing to external actors, structurally excluding custodian communities from GBF-committed benefits.

Regional coordination frameworks for transboundary breeds

Transboundary breed populations necessitate coordinated regional governance. RECs must develop binding AnGR frameworks standardizing intra-regional movement protocols, establishing collective ABS mechanisms consistent with Nagoya Article 11, formally recognizing cross-border BCPs, and securing sustainable financing for regional genebanks. The analytical groundwork produced by the AU-IBAR project provides a substantive foundation for advancing these frameworks across African economic zones (AU-IBAR, 2018).

Compliance with international instruments

Domestic reforms must align prospectively with the CBD, Nagoya Protocol, ITPGRFA, GPA, LiDeSA, the GBF, and the 2025 Kampala CAADP Declaration. Ethiopia's experience, developing an ABS regime predating Nagoya compliance requirements, illustrates the costs of retrospective legislative amendment. Contemporary reforms should embed full Nagoya compliance at the design stage, incorporating utilization definitions, checkpoint mechanisms, clearing-house functions, and traditional knowledge safeguards. Operationalization can be facilitated through FAO's ABS Elements (FAO, 2015b; AU-IBAR, 2016) and the AU's Practical Guidelines on Access and Benefit-Sharing.

Conclusions

The failure to establish functional AnGR governance remains one of the most consequential gaps in continental agricultural and environmental policy. Indigenous breeds face rapid genetic dilution, adaptive traits refined through millennia are disappearing, and pastoral communities remain excluded from benefits. Driven by five interlocking structural weaknesses: fragmented policies, ambiguous mandates, poor data, underfunding, and community exclusion. This deficit persists regardless of political will. Evidence from six countries shows effective reform requires dedicated legislation, funded institutions, breed inventories, and governance models that position pastoralists as co-authors rather than subjects. Three priorities emerge: (1) AnGR stewardship must be integrated into CAADP investments and national climate plans, (2) urgent regulatory frameworks are needed to counter corporate consolidation and uncompensated DSI use, and (3) closing the data gap through breed inventories, systematic measurement, and dedicated legislation is essential to secure GBF-promised community benefits. Without these foundations, Africa's adaptive livestock heritage and genetic sovereignty will continue to erode.

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Author contributions

N'Guetta Austin Bosso, Edward Musiwa Nengomasha, and Simplice Fonkou Nouala contributed substantially to the study design, execution, data analysis, and interpretation of the findings. All authors collaborated in drafting and critically revising the manuscript and provided final approval for its submission.

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The authors declare no conflicts of interest, financial or personal, relevant to the submitted work.

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Supplemental data

Supplemental Material 1. Abstract in French – Résumé en français

Supplemental Material 2. Questionnaire. Directorate of Animal Production. The State of Animal Genetic Resources in Africa

Data availability

The primary data underlying this analysis are derived from the AU-IBAR national policy assessments (2013–2018). These datasets are held by the African Union – Interafrican Bureau for Animal Resources (AU-IBAR). Requests for access to the underlying country-level questionnaire responses and the anonymized 40-country coding matrix compiled for this analysis may be directed to the corresponding author or to the AU-IBAR AnGR Programme (ibar.office@au-ibar.org), subject to AU-IBAR's data-sharing conditions. This article is a secondary analysis of questionnaire and consultation data collected under the 2013–2018 AU-IBAR project; no new primary data were collected for this paper. Where confidentiality agreements with respondent institutions permit, an anonymized country-level coding matrix will be deposited as supplementary material upon acceptance.

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