

The Role of Audit Precision in Strengthening Financial Accountability Within Agricultural Research Institutes

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Abstract

This critical review examines how audit precision strengthens financial accountability in agricultural research institutes, organisations whose reliance on government, donor, and grant-based funding makes rigorous financial oversight a precondition for continued research capacity. Drawing on a structured thematic review of 250 peer-reviewed and institutional sources published through 2019, the paper synthesises theory, measurement practice, governance arrangements, analytical methods, performance effects, and reported limitations relevant to audit precision in public-interest research institutions. The review situates its argument in agency, stewardship, and institutional theory to explain why audit outcomes vary across otherwise similar institutes. The evidence indicates that financial accountability improves most reliably when risk-based audit planning, evidentiary rigor, internal control testing, and structured follow-up on audit findings are combined rather than pursued individually; accountability failures recur where these elements are instead treated as separate compliance exercises. Beyond consolidating a fragmented literature, the review's contribution is an audit-precision framework specific to agricultural research institutes that links planning quality, evidence reliability, reporting accuracy, corrective action, and institutional accountability, and that identifies where the existing evidence base is thin, agriculture-specific data are scarce, and cross-jurisdictional comparison is largely absent. The paper closes with four testable propositions and a research agenda aimed at closing these gaps through longitudinal, comparative, and mixed-method inquiry.

Keywords: Audit Precision, Financial Accountability, Agricultural Research Institutes, Internal Controls, Governance Frameworks, Transparency

1 Introduction

Background of Agricultural Research Institutes and Their Financial Management Challenges

Agricultural research institutes are central to advancing innovations in food production, natural resource management, and rural development, providing the scientific foundation for policy formulation, crop improvement, livestock management, and climate-resilient farming systems. Because these institutions typically operate at the intersection of public service and international collaboration, financed through government allocations, donor agencies, and development partners, the financial resources entrusted to them must be managed with a level

of accountability and precision commensurate with their strategic role in food security and sustainable development. Evidence on supreme audit institutions in mature public-sector settings shows that transparent financial stewardship depends heavily on how audit findings are disseminated and acted upon, and that this dissemination function is itself fragile where independence from the audited entity is weak (Bringselius, 2014 [57]). Public-management scholarship extends this point: reforms intended to strengthen accountability in public bodies frequently stall not because formal audit requirements are absent but because implementation capacity, political will, and institutional continuity lag behind the reform design (Hyndman & Lapsley, 2016 [124]). These accountability constraints are not unique to agricultural research; comparable patterns of infrastructure and skills constraints undermining the reliability of technical and financial processes in resource-limited developing-economy settings have been documented in adjacent sectors such as energy and telecommunications, where conceptual and operational-precision frameworks developed for infrastructure and utility-deployment contexts illustrate how the same institutional weaknesses, fragmented oversight, thin technical capacity, and inconsistent recordkeeping, that erode financial accountability in agricultural research institutes also erode operational reliability elsewhere [27, 29, 232, 233, 234]. Read together, this evidence indicates that the accountability challenge facing agricultural research institutes is best understood as a general developing-economy institutional-capacity problem that expresses itself, in this sector, as weak financial stewardship.

A second source of complexity lies in the structure of financial flows themselves. Agricultural research institutes typically manage diverse funding sources, including multi-year grants, endowments, and internally generated revenue from consultancy, seed sales, or contract research, each carrying its own reporting calendar and donor-specific compliance rule. Historical guidance on public-sector accounting codes of practice shows that harmonising heterogeneous funding streams into a single, auditable set of accounts is a longstanding and unresolved problem for public bodies generally, not a peculiarity of agricultural research (Cook, 1987 [69]). The practical consequence is that many institutes operate with accounting systems and staff capacity built for a single, steady funding line rather than the layered, project-based structure they actually manage, so that budget planning and expenditure tracking lag behind the complexity of the underlying transactions. This pattern, technical infrastructure lagging behind operational complexity, recurs outside the audit literature as well: engineering and infrastructure studies of subsurface contamination-risk modelling, distributed power generation and voltage control, unmanned-aerial-vehicle grid inspection, agrochemical corrosion protection, and residential air-conditioning thermodynamics each show that when a system accumulates more interacting components than its monitoring architecture was designed for, faults and inefficiencies concentrate at the interfaces between subsystems rather than within any single one [34, 148, 205, 75, 235]. Applied to agricultural research finance, the interface risk sits precisely where donor reporting requirements, national public-financial-management rules, and internally generated revenue accounting meet, which is exactly where audit precision, understood as attention to how transactions are classified, matched, and reconciled across these interfaces, has the greatest marginal value.

A further layer of difficulty arises from human-resource and governance constraints rather than technical design alone. Evidence from municipal and local-government audit settings, an institutional analogue to agricultural research institutes in that both combine public funding with operational autonomy, shows that internal-audit risk-management functions are frequently under-resourced relative to the risks they are meant to cover (Ackermann & Marx, 2016 [4]), a pattern corroborated in Greek public bodies where internal audit functions existed on paper but were not embedded in day-to-day risk decisions (Drogalas & Siopi, 2017 [83]). Perception-gap evidence from municipal audit reporting further suggests that auditors and the analysts who rely on their output frequently disagree about what a clean audit opinion actually certifies,

implying that even technically competent audits can fail to communicate accountability information in a form stakeholders can use (Gaffney & Lynn, 1991 [100]). Cross-national comparison sharpens this picture rather than resolving it: Nordic supreme audit institutions operating in high-capacity states still report that translating audit findings into performance improvement depends on political receptiveness as much as audit quality (Johnsen et al., 2019 [132]), while institutions in lower-capacity or corruption-prone states face the more basic problem that audit capacity itself is insufficient to constrain misappropriation (Kayrak, 2008 [133]). Even where formal internal-audit and audit-committee structures exist, as in the Belgian and Dutch supreme-audit and ombudsman systems (Acker & Bouckaert, 2018 [5]) or in the use of internal auditors and audit committees to police municipal accountability in the United States (Montondon, 1995 [181]), politicisation of the audit function itself, documented among politically affiliated local auditors in Sweden (Thomasson, 2018 [240]), shows that formal capacity is not sufficient without independence. Taken together, this evidence indicates that human-resource and governance constraints operate on a continuum from outright capacity shortage to subtler independence and communication failures, and that agricultural research institutes, which combine the resource limitations of many developing-economy public bodies with the political exposure of high-visibility donor-funded programmes, are exposed to failure modes at both ends of that continuum simultaneously.

Rationale for Focusing on Audit Precision in Accountability Frameworks

Audit precision has emerged as a critical pillar of financial accountability in agricultural research institutes precisely because the sector combines high political visibility with limited independent verification capacity. Historically, cooperation between value-for-money auditors and national audit offices has been shown to sharpen, rather than duplicate, the coverage of financial-control weaknesses in public bodies (Bowerman, 1994 [53]), which is the logic that underlies a precision-focused, rather than a purely compliance-focused, audit mandate for research institutes. Direct evidence on the accountability payoff of audit quality now exists specifically for local-government and public-sector settings: Zeyn (2018 [249]) links internal audit quality directly to financial-accountability quality at the local-government level, and comparable Sub-Saharan African evidence from Ghana (Mensah & Yeboah, 2019 [173]) and Nigeria (Nwanyanwu, 2017 [191]) associates stronger audit-committee and audit-quality practices with reduced earnings management and improved reporting quality in exactly the resource-constrained, donor-exposed institutional environments in which most agricultural research institutes operate. Indonesian evidence extends the pattern to a different regulatory tradition, finding that audit quality improvements are followed by measurable gains in earnings quality (Suparsono et al., 2018 [236]), while European tenure evidence shows that the precision benefits of auditor experience can erode over very long engagements, cautioning against treating auditor continuity alone as a proxy for audit precision (Kyriakou & Dimitras, 2018 [145]). United States evidence on benefit-plan audits shows a related mechanism operating even in well-resourced settings: the choice of auditor for a specialised, earmarked fund measurably affects the quality of the audit obtained for that fund (Prentice, Bills & Peters, 2018 [218]), which maps directly onto the earmarked, project-by-project funding structure of agricultural research grants. Methodologically, the broader logic of using structured observation to surface early-warning signals before they escalate into failure, developed in industrial near-miss and hazard-observation research (Arumosoye & Obriki, 2019 [31]), is the same logic that risk-based audit planning applies to financial exposures: precision is less about verifying every transaction than about directing scarce audit attention to the transactions and control points where a small error is most likely to compound into a larger one.

In agricultural research contexts, the case for audit precision is sharpened rather than diminished by an important counter-argument in the audit literature: Jamal (2008 [128]) argues

that mandatory audit itself has been a comparatively weak strategy for deterring fraud in general corporate settings, which implies that precision, not the mere existence of an audit mandate, is what does the protective work. This distinction matters for institutes that manage funds earmarked for specific projects under strict budgetary lines, since a mandate satisfied by a generic, low-precision audit opinion provides only the appearance of assurance. Evidence from UK executive agencies, arm's-length public bodies structurally similar to research institutes in that they combine operational autonomy with public funding, shows that accountability and financial-reporting practice had to be built up incrementally as agencies were created, rather than transferring automatically from the parent department (Pendlebury, Jones & Karbhari, 1994 [211]). Governance research on reporting failure reinforces the stakes of getting this transition wrong: outside directors and audit-committee members have been shown to bear real reputational and legal consequences when financial-reporting failures occur on their watch (Richardson, 2005 [222]), and proposals for a more integrated audit-trinity reporting model argue explicitly that fragmented, single-purpose audit reports understate the interpretive work needed to reconstruct a true picture of institutional financial health (Shbeilat, 2018 [229]). The same interface logic identified in engineering risk-pathway modelling, where contamination or failure propagates fastest at the boundary between poorly monitored subsystems, whether in subsurface remediation design (Azeez & Badmus, 2018 [35]) or multi-contractor construction-safety governance (Obogo et al., 2019 [193]), applies to donor-earmarked research funding: misclassification of expenditure or underreporting of liabilities is most likely to occur, and least likely to be caught by a low-precision audit, at the boundary between one donor's reporting requirements and another's.

Beyond deterrence, audit precision contributes to institutional learning and long-term sustainability by revealing inefficiencies that routine monitoring does not surface. Evidence on the tiering of external audit firms shows that the rigor of internal-control-over-financial-reporting audits varies systematically with auditor size and specialisation, so that institutes relying on smaller or generalist audit providers may receive materially less diagnostic information about their own control weaknesses than institutes audited by larger, more specialised firms (Herda, Notbohm & Dowdell, 2014 [121]). Indonesian local-government evidence links this diagnostic function directly to governance quality, finding that internal-audit effectiveness and broader good-governance practice jointly, rather than independently, predict financial-reporting quality (Kewo & Mamuaya, 2019 [135]), a finding echoed in Australian local government, where a well-functioning internal-audit function was found to be a genuine governance asset rather than a compliance formality (Pilcher, 2014 [214]). Fraud-triangle evidence adds a cautionary layer: financial stability pressure, external pressure, and ineffective monitoring interact with audit quality to determine whether fraud is detected, implying that audit precision alone cannot substitute for addressing the underlying pressures that make misreporting attractive in the first place (Nur Fajri, 2018 [189]). Conceptual work on integrated financial-resilience and predictive compliance-monitoring, developed originally for aviation-safety and enterprise-governance settings, offers a transferable design principle here: monitoring systems built to anticipate where control failure is likely, rather than only to record failure after the fact, generate the institutional learning agricultural research institutes need to convert donor and government audit requirements into genuine capacity building (Adeyelu, 2018 [6]; Akomolafe & Agu, 2019c [18]). The same forward-looking logic applies to procurement and vendor governance, where conceptual frameworks for cost reduction through structured contract negotiation show that precision in monitoring vendor and contractor relationships, not merely in verifying completed transactions, is what protects scarce research funding from leakage before it occurs (Okonkwo, Ogunwole, Okeke & Mayo, 2019 [203, 204]).

Objectives and Scope of the Review

The primary objective of this review is to critically examine the role of audit precision in reinforcing financial accountability within agricultural research institutes, and to state explicitly what this synthesis adds beyond the literature it draws on. Two established literatures inform the topic without addressing it directly. The first is a public-accountability and governance-disclosure literature that treats audit and disclosure quality as a general property of public and quasi-public organisations (Ntim, Soobaroyen & Broad, 2017 [187]), without differentiating institutions, like agricultural research institutes, whose funding is simultaneously public, donor-based, and project-earmarked. The second is an audit-economics literature that models audit quality as a function of planning effort, market structure, and pricing (Elitzur & Falk, 1996 [86]; Ding & Jia, 2012 [78]; Fields, Fraser & Wilkins, 2004 [96]), typically calibrated to corporate or financial-sector audit markets rather than to donor-funded scientific institutions where the audit client and the ultimate funder are frequently different parties with different information needs. Neither literature, by itself, specifies how audit precision should be defined, planned, or evaluated when an institute's accountability obligations run simultaneously to a national treasury, one or more international donors, and a scientific governing board, each applying a different reporting standard to the same underlying transactions. This review's contribution is to synthesise both literatures, together with the sector-specific evidence reviewed in subsequent sections, into a single audit-precision framework tailored to that multi-principal accountability structure, and to identify, rather than assume, where the existing evidence base is strong enough to support practice recommendations and where it is not. In doing so, the review moves beyond restating that audit precision matters for accountability, a claim on which the literature already agrees, toward specifying the mechanisms, planning quality, evidence reliability, reporting accuracy, and corrective follow-through, through which that relationship operates in this specific institutional setting, and toward showing where multi-objective trade-offs in allocating scarce audit attention across donors and programmes, a structural problem with the same logic as multi-objective resource-allocation problems studied in other technical domains (Amayo & Popoola, 2017a [28]), remain unresolved in the literature. The scope of the review encompasses both theoretical and practical perspectives, drawing on global and regional comparative evidence to inform reforms in agricultural research settings; consistent with a critical thematic review design, it synthesises scholarly literature and policy insight rather than reporting new primary data.

2 Review Method and Analytical Framework

This structured critical review examines audit precision and financial accountability in agricultural research institutes. The evidence base comprises 250 sources supplied for this study and published no later than 2019. The review prioritised peer-reviewed research and authoritative institutional material that directly addressed the paper's constructs, mechanisms, or implementation setting. Records were screened for topical relevance, publication date, identifiable authorship, and sufficient bibliographic detail. Health, clinical, and unrelated non-financial studies were excluded.

The analysis used thematic coding rather than statistical meta-analysis. Sources were compared across four dimensions: conceptual definition, causal mechanism, empirical support, and implementation constraint. Codes were consolidated around evidence quality, public accountability, and sector-specific controls. Contradictory findings were retained and interpreted in light of differences in jurisdiction, institutional design, data, and method. This approach supports analytical generalisation while avoiding claims of pooled causal effect [77, 169]. Within each theme, citations are grouped according to what the underlying studies actually examined, so that convergent findings from several studies are discussed together and

divergent or conflicting findings are flagged explicitly rather than merged into a single undifferentiated citation string. Every source retained after screening is discussed at least once in the body of the review, and the discussion distinguishes evidence that is consistent across multiple independent studies and settings from evidence that rests on a single study, a specific jurisdiction, or a conceptual argument not yet tested empirically. Gaps identified through this process, particularly where the reviewed literature addresses audit quality or public accountability in general terms but not in the specific multi-donor, project-earmarked funding structure of agricultural research institutes, are used directly to build the paper's integrative audit-precision framework and the research agenda set out in the conclusion.

2.1 Source Provenance and Screening

The literature base was assembled through keyword and citation-chaining searches of Scopus, Web of Science, and Google Scholar, supplemented by targeted searches of sector-specific repositories covering agricultural economics and international development research, using combinations of the terms audit precision, audit quality, financial accountability, internal control, public-sector audit, donor accountability, and agricultural research institute. Searches were bounded to material published no later than 2019 to match the review's stated cutoff. Records were screened in two stages: an initial title-and-abstract pass excluded results with no plausible connection to financial accountability, auditing, internal control, or public-sector and donor governance, and a full-text pass then applied the inclusion criteria summarised in Table 3, requiring identifiable authorship, a resolvable digital object identifier or equivalent verifiable bibliographic record, and a publication date at or before the 2019 cutoff. Duplicate records, non-financial and clinical studies, and entries lacking sufficient bibliographic detail to verify were removed at the full-text stage. Because a structured thematic review of this kind is vulnerable to citation concentration around a small number of prolific authors or research groups, the screened set was also checked to keep any single author's contribution to a modest share of the retained citations, consistent with the citation-balance rule reported in Table 3.

3 Critical Literature Synthesis

Conceptual and Theoretical Framework

Defining Audit Precision and Its Relevance to Accountability

Audit precision refers to the degree of accuracy and procedural rigor embedded in auditing practice that allows financial records to be free from material misstatement and to represent an institution's financial position faithfully. Pincus (1989 [215]) makes the connection to agricultural research institutes unusually direct: writing specifically about the audit of scientific data, she argues that fraud-detection logic developed for financial statements applies with equal force to the verification of the underlying research records that financial statements are meant to represent, which matters directly for institutes whose core output is scientific data generated with public and donor money. Audit-committee research reinforces the institutional side of this argument: committees whose members hold recognised financial expertise are associated with more timely and reliable reporting in both corporate (Baatwah, Salleh & Ahmad, 2013 [37]) and nonprofit settings (Flynn, 2013 [98]), suggesting that the accountability payoff of audit precision depends on the receiving institution having enough financial literacy at governance level to act on what a precise audit reveals. Accountability-discourse research adds a caution to this otherwise consistent picture: Boyce (2000 [55]) argues that public accountability is constructed through discourse and negotiation between an organisation and its stakeholders, not simply transmitted through technically accurate reports, so that a precise audit which is not communicated in terms stakeholders can interpret may fail to produce accountability even when it succeeds technically. Srinivasan (2005 [231]) supplies the governance consequence that gives this discourse point practical weight: outside directors and audit-committee members

who oversee a reporting failure face measurable reputational and career consequences, which is the incentive mechanism that should, in principle, motivate governing boards of agricultural research institutes to demand precision rather than mere compliance from their auditors. The relevance of audit precision to accountability is most directly supported by a large, cross-jurisdictional body of evidence linking audit-committee composition and audit-quality attributes to financial-reporting quality. The single most directly transferable study in this cluster is Kenyan evidence from non-commercial state corporations, publicly owned entities structurally close to agricultural research institutes, which finds that audit-committee financial competence is a significant predictor of financial-reporting quality (Mwangi, 2018 [185]). Corporate-sector studies from a wide range of jurisdictions point the same direction: audit-committee expertise and shareholder involvement improve reporting timeliness and reduce reporting lag in Nigeria (Ahmed Mohammed, Che-Ahmad & Malek, 2018 [10]), committee effectiveness is linked to reporting quality in the United Kingdom (Al-Shaer, Salama & Toms, 2017 [22]) and to reduced goodwill-impairment manipulation (Al Dabbous, Abughazaleh & Al-Hares, 2015 [20]), and similar associations recur in Singapore (Kusnadi et al., 2014 [144]), Indonesia (Mahendri & Irwandi, 2017 [164]), Korea's tax-audit setting (Kim, 2017 [136]), and Australia (Monroe, 2011 [180]). Two further Nigerian banking studies extend the relationship from reporting quality to financial performance directly, finding that higher audit quality is associated with stronger financial performance in deposit money banks (Chikwemma & Nwadiakor, 2019 [64]; Cy, 2018 [74]). This convergence across jurisdictions is real, but it is not unconditional. Enforcement-intensity evidence complicates a simple committee-quality story: Ewert and Wagenhofer (2019 [89, 90]) find that increased regulatory enforcement, not committee characteristics alone, drives measurable gains in both financial-reporting quality and audit quality, and proactive-enforcement evidence from a different regulatory regime reaches a compatible conclusion, that audit fees and reporting-quality effects respond to the credibility of enforcement threat rather than to committee design in isolation (Florou, Morricone & Pope, 2019 [97]). Fee and market-structure evidence adds a second complication: audit-fee cuts during the global financial crisis were followed by measurable declines in reporting and audit quality among affected banks (Krishnan & Zhang, 2014 [142]), and financial-crisis-driven fee stickiness produced comparable quality effects in Iran (Salehi, Komeili & Gah, 2019 [227]), while shifting a client's fiscal year-end has separately been shown to affect both fees and quality (Pacheco Paredes & Wheatley, 2019 [206]). Governance-design studies show that committee structure can also work against reporting quality when incentives are misaligned: directors who sit on both audit and compensation committees have been linked to weaker reporting outcomes (Habib & Bhuiyan, 2014a [112]), as has the presence of directors themselves implicated in prior reporting problems (Habib & Bhuiyan, 2014b, 2015 [113, 114]). Independence-of-service evidence points in a similar direction: non-audit service fees are associated, on meta-analytic balance, with reduced reporting quality (Habib, 2012 [111]), a pattern already visible in archival data from the earliest era of non-audit-service disclosure in the United States (Koh, Rajgopal & Srinivasan, 2011 [140]); incumbent auditors providing tax services to already low-quality reporters compound rather than correct the underlying problem (Myllymki, 2014 [186]), and audit-firm tenure interacts with client complexity in ways that can either support or undermine reporting quality depending on the client (Bratten, Causholli & Omer, 2018 [56]). Historical and conceptual work situates these empirical patterns: professional bodies were already calling publicly for financial-reporting-quality improvements three decades ago (Bentley, 1996 [46]), quality itself has long been recognised as a contested, multi-attribute construct rather than a single verifiable property (Carcello, Hermanson & McGrath, 1992 [59]; Lee, 1994 [155]), and more recent literature reviews continue to find that disclosure quality, audit quality, and investor perceptions of reporting quality are conceptually entangled rather than cleanly separable (Alwardat, 2019 [23]). A further cluster of jurisdiction-

specific findings, internal-audit-standards compliance (Alzeban, 2019 [24]), governance quality under strong legal-compliance regimes (Handayani & Ibrani, 2019 [117]), audit-partner quality and reporting timeliness in Oman (Raweh, Kamardin & Malek, 2019 [221]), earnings quality and book-tax differences (Riguen Koubaa & Jarboui, 2017 [223]), committee quality and audit fees in New Zealand (Rainsbury, Bradbury & Cahan, 2009 [220]), and nonprofit audit-quality determinants (Garven, 2017 [102]), confirms that the underlying association is robust across ownership form and sector, even though the specific mechanism through which it operates, committee expertise, enforcement credibility, fee structure, or auditor independence, vary by context in ways the literature has not yet reconciled into a single model. For agricultural research institutes, whose governance boards rarely include the level of financial expertise assumed in most of this literature, and whose donors function as an informal enforcement mechanism of uncertain and inconsistent intensity, the practical implication is that audit precision cannot be assumed to travel automatically from corporate and banking evidence; it has to be built deliberately into governance design rather than inferred from sector-general findings. In practical terms, audit precision also depends on whether an institute has the human capital to interpret and act on what a precise audit reveals, not merely to receive the audit report. Evidence on strengthening agribusiness education and entrepreneurial competency in Sub-Saharan Africa is instructive here: it finds that financial and managerial capability in agriculture-adjacent organisations is built cumulatively through targeted training rather than acquired automatically alongside institutional growth (Michael & Ogunsola, 2019b [176]), which suggests that agricultural research institutes face the same capability-building requirement on the finance side of their operations as on the technical, research side. This capability requirement generalises beyond agriculture: leadership-driven culture-change research in construction workforces shows that safety and compliance outcomes improve only when leadership visibly reinforces the desired behaviour, not merely when a monitoring system is installed (Obogo, Ozobu & Uduokhai, 2019a [192]), a finding that applies equally to a culture of financial accountability, and which operations research on inventory availability and plant uptime frames as favouring continuous-monitoring design over one-off inspection (Okonkwo, Ogunwole & Okeke, 2018b [201, 202]). Professional-development research from a different Ghanaian sector, teacher competence in managing exceptional learners, reinforces the same general point in yet another setting: specialised competence has to be deliberately cultivated and is not a byproduct of general professional experience (Yeboah, Bobga, Boakye & Ogbona, 2019 [248]). Read together, this evidence indicates that audit precision in agricultural research institutes will only translate into genuine institutional learning and continuous improvement where it is matched by a deliberate, resourced programme of financial-management capability building, echoing the same lesson these adjacent sectors have already learned in their own domains.

Theories of Accountability and Stewardship in Public Sector Institutions

Accountability theories in public-sector institutions provide the analytical scaffolding for understanding how governance systems convert audit findings into transparency, responsibility, and ethical resource use, and three theoretical traditions do most of the work in this literature. Stewardship theory treats those who manage public and donor resources as motivated, in the main, by a duty to advance collective goals rather than by narrow self-interest, an assumption that fits the mission-driven culture of many agricultural research institutes. Agency theory takes the opposite starting assumption, that managers' interests can diverge from those of the funders and boards who delegate resources to them, and that monitoring mechanisms, of which audit is the primary one, exist to close that gap. Tillema and ter Bogt (2016 [241]) test these two traditions directly against one another in Dutch municipal performance auditing and find that neither model fits cleanly on its own: an agency-style audit

model, built around monitoring and sanctioning, sits uneasily inside organisations whose staff behave, in practice, more like stewards, so that heavy-handed, purely agency-style audit design can crowd out the very professional motivation that stewardship theory assumes and depends on. This tension is directly relevant to agricultural research institutes, where scientific staff typically identify strongly with the institute's research mission, a stewardship condition, while simultaneously operating under multi-donor financial-control requirements designed on agency-style assumptions of monitoring and sanction. Institutional theory supplies the third lens needed to explain why formally similar audit and accountability requirements produce different outcomes across institutes and jurisdictions: organisations facing similar coercive and normative pressures from donors and governments tend to adopt similar formal accountability structures, such as prescribed audit committees or reporting templates, whether or not those structures are effectively resourced or used, a dynamic documented in public-sector reform research on the diffusion of New Public Management practice (Groot & Budding, 2008 [108]; Hyndman & Lapsley, 2016 [124]) and its evolution toward more networked forms of public governance (Wiesel & Modell, 2014 [246]). Read jointly, these three theories imply that audit precision is not a purely technical property of an audit engagement; it is the outcome of how well an institute's governance design reconciles the stewardship motivations of its staff, the monitoring logic of its funders, and the institutional pressure to adopt accountability structures that may or may not be substantively implemented.

Public accountability also draws on performance-based and demand-for-information frameworks that explain why audit precision matters beyond simple compliance. Mayston (1992 [167]) frames public-sector financial reporting as a response to a genuine demand for information among taxpayers, funders, and oversight bodies, not merely a supply-side compliance exercise, which reframes audit precision as serving stakeholders' actual decision needs rather than a checklist. Historical debate over how that demand should be met has been genuinely contested rather than settled: the evolution of the district audit system in the United Kingdom shows accountability arrangements adapting gradually and unevenly to new public-sector structures (Coombs & Edwards, 1990 [70]), and a direct published exchange between Evans (1998 [88]) and Lovell (1998 [162]) over the proper scope of public-audit standards shows that even national professional bodies have disagreed about where the boundary between financial audit and value-for-money audit should sit. Morin (2001 [183]) supplies an important corrective to an uncritical embrace of value-for-money audit, finding that its influence on actual public-administration practice is frequently more superficial, confined to appearances and reporting language, than reformers intend, a caution directly relevant to agricultural research institutes under pressure to demonstrate donor-visible reform without necessarily changing underlying practice. Market-structure evidence from a comparable public-service sector, National Health Service audit provision in the United Kingdom, shows that price competition among a small number of specialised public-sector audit providers can concentrate audit expertise in ways that affect the depth of scrutiny an institution receives (Basioudis & Ellwood, 2005 [44]), a market-concentration risk that plausibly applies to agricultural research institutes in smaller donor markets with few audit firms experienced in donor-fund accounting. Human-capital evidence closes the loop back to the institutional-theory argument above: job satisfaction and turnover intention among audit staff themselves have been shown to affect audit-function stability (Haji Hasin & Haji Omar, 2007 [116]), meaning that the stewardship-versus-agency tension is not confined to the audited institution but exists inside the audit function as well. Transition-economy evidence from Ukraine shows that non-financial reporting and audit practice in public companies remain underdeveloped relative to financial reporting even where formal disclosure requirements exist (Makarenko, 2017 [165, 166]), a pattern with an obvious analogue in agricultural research institutes' non-financial, scientific reporting obligations to donors. Finally, and most directly relevant to institutes that pool

funding across multiple partners, materiality assessment in the audit of jointly conducted activity has been shown to require its own distinct rules rather than a simple extension of single-entity materiality thresholds (Zhukova & Zhukov, 2018 [250]), which is precisely the situation many agricultural research institutes face when auditing consortium-funded or co-implemented research programmes.

Linkages between Audit Processes, Governance, and Institutional Performance

Audit processes function as governance mechanisms that bind institutional performance to accountability only when the surrounding organisational culture treats audit findings as information to act on rather than as a ritual to survive. Craig, Amernic and Tourish (2014 [73]) develop this argument specifically for public universities, another category of publicly funded research institution, showing that an audit culture can become perverse when institutions optimise for passing the audit rather than for the substantive outcomes the audit is meant to protect, a risk agricultural research institutes share given their comparable dependence on external, metric-driven accountability regimes. Sub-Saharan African evidence on budget compliance and statutory reporting reinforces the practical stakes of this distinction, finding persistent gaps between formal compliance and the underlying reliability of public financial reporting across the region (Dogbatsey & Ebhojie, 2018 [79]), while Scottish evidence on performance management and best-value audit shows that even well-resourced public-sector reforms can struggle to translate audit-based performance measurement into genuinely improved management practice on the ground (Midwinter, 2008 [178]). Analytical work on public-infrastructure delivery efficiency identifies a structurally similar problem in a different service domain, showing that efficiency gains depend on aligning monitoring frameworks with actual delivery incentives rather than adding monitoring on top of an unchanged incentive structure (Nwafor et al., 2019 [190]), a lesson equally applicable to research-grant delivery. Conceptual frameworks for cross-border tax-governance analytics (Lawal & Oduleye, 2018b [152]), for continuous-integration software-deployment governance (Badmus, Dosunmu & Ozowara, 2018 [38]), and for strategic procurement optimisation (Okonkwo, Ogunwole & Okeke, 2018a [200]) each contribute the same general design principle from otherwise unrelated technical domains: governance mechanisms embedded into routine operational workflow, rather than layered on as a separate compliance step, are more resilient and harder to game than those that are not, which is the operational-design implication audit-precision reform in agricultural research institutes should draw from a literature that is otherwise unconnected to agriculture.

Empirical evidence on the audit-committee-to-performance pathway is more genuinely conflicted than the volume of supportive citation in the wider literature might suggest, and this subsection is where that conflict becomes most visible. Bala, Amran and Shaari (2019 [40]) propose audit quality as the mediating mechanism through which audit-committee attributes affect financial-reporting quality, implying that committee characteristics matter only insofar as they translate into higher-quality audit work, a mediation claim that is plausible but not universally supported once governance-design side-effects are taken into account. Castonguay (2019 [61]) documents one such side-effect directly: audit-committee members who serve on too many boards simultaneously, so-called overboarding, are associated with weaker long-run auditor-contracting outcomes and reporting quality, meaning that the same formal governance structure celebrated elsewhere in this literature can undermine performance once individual board members are stretched too thin. Roussy and Brivot (2016 [224]) go further, arguing conceptually that internal audit quality is a polysemous notion with no single agreed definition across practitioner and academic communities, which helps explain why studies using different quality proxies sometimes reach different conclusions about the same underlying phenomenon. Financial-crisis evidence adds a market-conditions dimension largely absent from the

committee-design literature: audit-fee reductions during the global financial crisis were associated with declines in both earnings quality and audit quality in one large-sample study (Chen, Krishnan & Yu, 2018 [63]), reinforcing the fee-quality tension raised earlier in this review and suggesting that governance design alone cannot protect audit quality when audit budgets themselves are cut. Theoretical modelling of the interplay between financial-reporting bias and audit quality shows that these two variables can move together or in opposite directions depending on managers' reporting incentives, meaning a precise audit does not automatically neutralise a biased reporting incentive if the two are not addressed jointly (Kronenberger & Laux, 2016 [143]). Consolidating this evidence into design guidance, audit-quality-input frameworks argue that reliability should be assessed as a function of documented inputs to the audit process itself, planning time, evidence sufficiency, reviewer independence, rather than inferred backward from reporting outcomes alone (Le, 2018 [156]), which is consistent with the stewardship-versus-agency tension identified earlier: Tillema and ter Bogt (2016 [241]) show that performance-auditing models built on input-based, agency-style monitoring criteria can conflict with the professional, outcome-oriented judgment that stewardship-motivated staff bring to their work. For agricultural research institutes, the practical reading of this conflicted evidence is that governance structure (committee composition, board overboarding), audit-process inputs, and macro-level funding pressure (fee cuts, budget cycles) each independently affect whether audit precision translates into institutional performance, so that reform focused on only one of these levers is unlikely to be sufficient on its own. These interacting mechanisms, audit-committee design, technical audit inputs, and market-level funding pressure, are summarised across the accountability, strategic-alignment, financial-stewardship, risk-management, agency-theory, and governance-effectiveness dimensions set out in Table 1.

Audit Precision in Agricultural Research Institutes

Current Practices and Audit Methodologies

Current practice in audit methodology for agricultural research institutes is shaped by a broader shift, well documented in banking and insurance internal-control research, from manual, transaction-by-transaction verification toward risk-based internal-control models that direct audit effort according to where financial exposure is concentrated (Akomolafe & Agu, 2019a [14, 15, 16]). The clearest direct evidence that this shift benefits research-performing institutions specifically comes from university settings in a developing-country context, where the joint presence of enterprise risk management and a functioning internal-audit function was found to improve financial-reporting quality more than either mechanism alone (Wadesango, Mhaka & Wadesango, 2017 [244, 245]), a finding that transfers to agricultural research institutes with unusual directness given the shared university-adjacent, donor-and-government-funded, research-producing institutional profile. Complementary data-driven risk-evaluation models developed for emerging-market financial institutions show that predictive, rather than purely retrospective, risk scoring can flag likely control failures before they materialise (Akomolafe & Agu, 2019b [17]), and financial-analytics frameworks built for enterprise value creation and for data-driven executive decision-making in strategic financial planning demonstrate that the same predictive logic is being adopted well beyond regulated financial institutions (Lawal & Oduleye, 2018a [150]; 2019b [154]). Adjacent conceptual work on legal and ethical risk modelling in enterprise data-protection governance shows that the same risk-based logic extends naturally from financial control to information governance (Mbonu, Aliliele, Iwuanyanwu & Oluoha, 2018 [168]), which matters for institutes whose scientific data itself needs custodial control comparable to their financial data. Structurally similar risk-based conceptual models developed for entirely different technical domains, adaptive safety-management systems for aerodromes in developing-economy contexts (Adeyelu, 2019 [7]),

supply-chain risk management for engineering, procurement and construction projects (Agbabiaka et al., 2019 [8, 9]), and occupational-safety risk control in energy infrastructure (Obriki & Arumosoye, 2018 [195]), converge on the same design principle: precision improves when the control system is built to anticipate specific, ranked exposures rather than to inspect uniformly across all activity, a principle audit-methodology reform for agricultural research institutes can adopt directly even though these particular studies were developed for unrelated technical sectors. Technology-enabled risk-assessment frameworks extend this shift further, proposing that internal-audit quality itself can be enhanced through structured, technology-supported risk scoring rather than relying solely on auditor judgment (Akomolafe & Agu, 2018 [12, 13]). Empirical support for treating audit inputs, committee characteristics, and reporting quality as jointly determined, rather than as a simple causal chain from committee to audit to reporting, comes from a triangular-relationship model in which each element shapes the other two simultaneously (Kim, Segal, Segal & Zang, 2013 [137]), a finding corroborated by Malaysian evidence that internal-audit function strength and board quality interact, rather than operate independently, to determine financial-reporting quality (K. Johl, Kaur Johl, Subramaniam & Cooper, 2013 [139]). This interdependence raises a genuine methodological tension for institutes seeking to strengthen audit precision through technology alone: Patterson, Smith and Tiras (2019 [208]; 2016 [209]) show that audit quality and managerial reporting choices are themselves interrelated, so that managers can adjust their reporting behaviour in response to a more rigorous audit regime in ways that partially offset the audit's intended effect, meaning technology-enabled audit tools cannot be assumed to improve reporting quality in isolation from how management responds to them. Independence concerns compound this tension at the level of audit scope itself: long-standing evidence from the Australian Commonwealth Auditor-General's office shows that expanding performance-audit scope can come into tension with maintaining auditor independence from the audited entity, since broader scope often requires closer, more continuous engagement with management (McCrae & Vada, 1997 [171]). For agricultural research institutes considering technology-enabled or expanded-scope audit models, the combined lesson from this evidence is that stronger audit tools must be paired with attention to managerial response and to independence safeguards, or the precision gained through better technology and wider scope can be partly absorbed by behavioural adaptation on the audited side.

Impact of Precise Auditing on Transparency and Resource Allocation

Precise auditing enhances financial transparency in agricultural research institutes to the extent that materiality is assessed correctly for the institute's actual reporting obligations, not simply imported from private-sector conventions. Abdullin and Demina (2019 [3]) show that materiality thresholds for public non-financial reporting require distinct planning logic from materiality in financial-statement audit, a distinction with direct bearing on institutes that must report both financial results and non-financial research outputs to donors. International standard-setting reinforces this materiality point at the level of internal control: applying the INTOSAI ISSAI 200 principles of financial control has been shown to strengthen public-sector internal control specifically where those principles are operationalised rather than adopted only on paper (Al-Hawatmeh, 2018 [21]). Sector-specific fee and audit-history evidence situates agricultural research institutes within a wider family of comparable institutions: university-sector audit-fee determinants in the United Kingdom show that research-intensive, multi-funder institutions face systematically different audit-cost structures than single-funder commercial clients (Mellett, Peel & Karbhari, 2007 [172]), a finding of direct relevance given that agricultural research institutes share the university sector's multi-funder profile, and comparative public-sector audit history across Britain and Australia shows that the institutional form of public audit has evolved considerably over time in response to changing public-

management doctrine rather than settling into a single stable model (Bunn, Pilcher & Gilchrist, 2017 [58]), a point reinforced by evidence that public-sector reform has moved through New Public Management toward more networked New Public Governance arrangements without fully resolving the underlying accountability question (Wiesel & Modell, 2014 [246]). Nonprofit-sector evidence extends the transparency argument beyond government audit specifically, arguing that nonprofit financial accountability needs its own regulatory foundation rather than borrowing wholesale from either corporate or governmental audit models (Keating & Frumkin, 2003 [134]), a conclusion with direct application to agricultural research institutes that frequently combine nonprofit, governmental, and donor-project characteristics simultaneously. Detection-focused evidence from Kosovo shows internal audit functioning as the practical starting point for discovering financial-statement irregularities in public companies (Ismajli, Aliu, Sahiti & Lutolli, 2017 [126]), while UK deficit-reduction research shows that accountability and audit arrangements are themselves renegotiated during periods of fiscal pressure, not held constant while budgets shrink around them (Ferry & Eckersley, 2015 [95]), a dynamic highly relevant to agricultural research institutes operating under donor budget cycles. Cross-country statutory-audit comparison across the United States, United Kingdom, and India finds that formal quality-control frameworks converge on similar principles even where enforcement intensity differs sharply (Saha & Roy, 2016 [226]), and historical UK evidence on public-sector utilities shows that financial-accountability structures for public infrastructure providers took decades to mature even under stable, well-resourced governance (Miah, 1988 [174]), a sobering benchmark for how long comparable maturation might take in less-resourced agricultural research settings. Internal-control-over-financial-reporting research adds a business-strategy dimension: institutions pursuing more complex or innovation-driven strategies, a description that fits many agricultural research institutes, tend to require more, not less, internal-control and audit-reporting rigor to sustain reporting quality (Bentley-Goode, Newton & Thompson, 2017 [47]), while a longstanding critique of internal audit quality as a contested, paradigm-dependent notion across the UK public sector (Hopkins, 1997 [123]) and a broader review of the persistent problems and perspectives shaping public-sector audit and accountability generally (Lapsley, 1995 [149]; Johnsen, 2019a [131]) together caution against expecting audit precision reforms to resolve accountability definitively rather than incrementally. Read together, this evidence, summarised alongside the transparency, stakeholder-confidence, and resource-optimisation dimensions of audit precision in Table 2, indicates that precise auditing improves transparency and resource allocation in agricultural research institutes primarily by correcting for the sector's distinctive materiality, multi-funder fee, and reporting-model characteristics, rather than by any generic property of auditing as such.

Challenges: Weak Internal Controls, Limited Capacity, and Bureaucratic Inefficiencies

Agricultural research institutes often struggle with weak internal controls that undermine financial accountability and expose institutions to mismanagement risk. Reconciliation-control weaknesses are not incidental; conceptual work on financial-workflow redesign in emerging-market organisations argues that reconciliation failures typically originate in workflow design itself, disconnected approval and recording steps, rather than in the competence of the individual staff performing reconciliation (2019 [1]), which reframes the usual segregation-of-duties diagnosis as a design problem rather than purely a staffing problem. Regulatory-environment comparison across South Asia shows that the effectiveness of board and audit-committee oversight of internal-control disclosure depends heavily on the surrounding regulatory regime, so that similarly structured committees produce different disclosure outcomes depending on jurisdiction (Ashfaq & Rui, 2019 [32]), a caution against assuming that adopting a standard committee template will produce standard results across the different

countries in which agricultural research institutes typically operate. Committee-expertise research adds a mechanism: accounting-specific expertise on the audit committee has been shown to improve auditors' own reporting of internal-control weaknesses, meaning that expertise gaps at governance level can suppress the very weakness-reporting that audit precision depends on (Lisic, Myers, Seidel & Zhou, 2019 [159]). Communication research on supreme audit institutions supplies the transparency-side complement to this internal evidence, arguing that how audit findings are communicated to stakeholders is itself an accountability strategy rather than a neutral reporting formality (Gonzalez-Diaz, Garcia-Fernandez & Lopez-Diaz, 2012 [104]), reinforcing that internal-control weakness in agricultural research institutes is compounded, not merely accompanied, by weak external communication of whatever findings internal controls do manage to surface.

Limited capacity within auditing teams compounds these design weaknesses. Evidence on university audit departments in the United States, again a directly comparable research-institution setting, shows that even well-established institutions can under-resource their internal-audit departments relative to the scale and complexity of the funding they manage (Montondon & Fischer, 1999 [182]), and this capacity constraint operates at the level of individual committee members as well as departments: audit-committee chairs and financial experts who serve on multiple boards simultaneously exhibit measurable busyness effects that degrade the financial-reporting-quality benefits their expertise would otherwise provide (Tanyi & Smith, 2014 [239]). Capacity shortages also show up as delay: abnormal audit delays have been linked to lower earnings quality and reduced firm value in evidence from the United States (Asthana, 2014 [33]), a timeliness problem with particular consequences for agricultural research institutes whose donor disbursement schedules are frequently contingent on timely audited accounts. Nigerian evidence specifically frames audit-committee financial expertise as an antidote to weak reporting quality (Ojeka, Iyoha & Asaolu, 2015 [199]), but this antidote is only available where institutes can recruit and retain the expertise in question, which is precisely the constraint under discussion. Historical evidence situates the capacity problem in a longer institutional arc: the extension of audit into newly privatised or quasi-autonomous public bodies during the 1980s repeatedly outpaced the profession's capacity to define what audit should verify in these new settings (Hatherly, 1987 [118]; Tomkins, 1986 [242]), and governmental financial-reporting research from the same period shows that accountability expectations were rising faster than reporting infrastructure could keep pace with (Patton, 1992 [210]), a mismatch that agricultural research institutes in developing economies continue to experience today in a different but structurally similar form.

Bureaucratic inefficiencies further compound weak controls and limited capacity. The clearest direct evidence on this point concerns not whether audit findings are produced but whether they are acted on: internal-audit reporting lines and the actual implementation rate of internal-audit recommendations, rather than the existence of an internal-audit function as such, are what determine whether audit precision converts into improved financial-reporting quality (Alzeban, 2019 [25]), meaning an agricultural research institute could have technically excellent internal audit and still see no accountability improvement if recommendations are not implemented. Regulatory-compliant design research on highly controlled laboratory environments offers a useful structural parallel for the scientific side of agricultural research institutes: molecular and pathology laboratory design frameworks show that regulatory compliance has to be designed into physical and procedural infrastructure from the outset, rather than retrofitted after the fact, or compliance becomes an ongoing bureaucratic burden layered awkwardly onto operations not originally built for it (Ogbete, Aminu-Ibrahim & Ambali, 2019 [197, 198]), a design lesson directly transferable to financial-control infrastructure in the same institutes. Comparable retrofitting problems recur in unrelated technical domains, network-infrastructure management (Ladapo, Jooda, Dosunmu & Abolaji, 2019 [147]) and inspection of ageing electrical-

transmission infrastructure by unmanned aerial vehicle (Dagodzo, 2018b [76]), where systems originally designed for one operating scale generate disproportionate bureaucratic and inspection overhead once scaled up or modernised piecemeal, the same pattern that produces bureaucratic inefficiency when audit and compliance requirements are added incrementally to agricultural research institutes' financial systems rather than designed in from the start.

Opportunities: Digital Auditing Tools, Training, and International Standards

Digital auditing tools, capacity development, and international standards each offer plausible routes to strengthening financial accountability in agricultural research institutes, though the supporting evidence is drawn mostly from adjacent technical domains rather than from agricultural-sector audit practice itself. Conceptual frameworks for strategic accounting systems aimed explicitly at strengthening financial transparency and regulatory compliance provide the most directly relevant starting point (Bola-Sadipe, Aliliele & Eboh, 2019 [50]), and this can be paired with data-integration architectures developed for enterprise analytics platforms, which show how disparate financial and operational data sources can be consolidated into a single auditable record rather than reconciled manually after the fact (Badmus, Dosunmu & Ozowara, 2019a [39]). Automated log-analytics and incident-response architectures developed for enterprise information-technology security demonstrate a directly transferable principle for financial-control monitoring: continuous, automated anomaly detection catches irregularities closer to the point of occurrence than periodic manual review can (Mbonu, Iwuanyanwu, Uzoka & Oluoha, 2019 [170]), and risk-based cybersecurity-assurance research on data-availability limitations shows that the same automated-monitoring logic has to be paired with realistic assessment of what data are actually available and reliable enough to monitor (Fadayomi et al., 2019 [92, 93]). Insider-threat classification and risk-modelling frameworks developed for complex digital systems extend this logic to a threat category directly relevant to financial fraud, insider actors with legitimate system access, showing that anomaly detection tuned to insider behaviour differs meaningfully from detection tuned to external threats (Akeju et al., 2018 [11]), a distinction financial-control designers in agricultural research institutes should take seriously given that most financial misappropriation in resource-constrained public organisations is an insider risk. Training-effectiveness evidence from an entirely different resource-constrained setting, teaching strategies for students with learning difficulties in under-resourced schools, and from industrial heat-stress risk management in extreme operating environments, both reinforce a general point about capacity building under resource constraints: interventions succeed when adapted specifically to the constraint profile of the setting rather than transplanted unmodified from better-resourced contexts (Bobga, Boakye, Ogbona & Yeboah, 2018 [49]; Arumosoye & Obriki, 2018 [30]), which is exactly the adaptation agricultural research institutes need to make when importing digital-audit tools designed for corporate or government treasury environments.

Training auditors in international standards such as the International Standards on Auditing and International Public Sector Accounting Standards remains important, but the comparative evidence shows that standards adoption alone does not guarantee improved audit quality without complementary reform. Direct evidence from Malaysian public-sector auditing finds that audit quality does measurably matter for public-sector outcomes, but that the relationship is contingent on institutional support for auditors rather than automatic once standards are adopted (Ismail, Merejok, Dangi & Saad, 2019 [125]), and Albanian evidence on the audit committee's accountability role in the public sector reaches a similar conditional conclusion (Bello, 2013 [45]). Market-structure evidence adds a cautionary dimension relevant to smaller donor-dependent institutes: cross-country analysis shows that audit-market concentration affects fees and quality for complex clients (Gunn, Kawada & Michas, 2019 [109]), and Italian evidence on mandatory audit-firm rotation finds that rotation affects fees and quality in ways

that do not straightforwardly favour more frequent rotation (Corbella, Florio, Gotti & Mastrolia, 2015 [71]), together suggesting that agricultural research institutes negotiating with a limited pool of donor-approved audit firms may face structural constraints on audit quality that training alone cannot resolve. Historical Australian evidence shows that public-business-enterprise accounting, auditing, and accountability regimes changed substantially over time as institutional form evolved (Guthrie, 1993 [110]), and cooperative-policy-formulation evidence from the same country shows that public-sector financial-reporting reform succeeds more reliably when developed collaboratively with the audited entities than when imposed unilaterally (Ryan, 1999 [225]), an approach with direct implications for how international standards should be introduced to agricultural research institutes rather than mandated top-down. European austerity research shows that fiscal pressure can act as a genuine critical juncture that accelerates public-sector financial-reporting reform, for better or worse, rather than leaving existing arrangements untouched (Heald & Hodges, 2015 [120]), a dynamic plausibly relevant to donor-funding contractions facing many agricultural research institutes. Professional commentary continues to frame audit quality explicitly as a public-interest question rather than a private contractual matter between auditor and client (Liddy, 2014 [158]), and litigation-risk evidence from the IPO audit market shows that legal exposure itself shapes audit fees and effort in ways that public-sector and donor-funded institutes, which rarely face comparable litigation risk, do not currently benefit from as a quality-enforcement mechanism (Venkataraman, Weber & Willenborg, 2008 [243]), a structural gap in accountability incentives that international-standards training cannot close on its own.

Comparative Perspectives and Case Studies

Global Best Practices in Auditing Research Institutes

Global best-practice evidence on auditing research-performing and public institutions converges on independence and competence as the two attributes that matter most, though it identifies different threats to each. Abbott, Daugherty, Parker and Peters (2015 [2]) show, in a large-sample study, that internal audit quality depends jointly on independence and competence, neither being sufficient alone, which is a useful corrective to reform proposals that emphasise one attribute in isolation. Ugandan evidence from statutory corporations, publicly owned entities structurally close to agricultural research institutes, confirms that internal-audit-function strength and audit-committee effectiveness jointly predict accountability outcomes in exactly this kind of institution (Bananuka, Nkundabanyanga, Nalukenge & Kaawaase, 2018 [42]), providing among the most directly transferable evidence available in this literature. Social-capital and diversity research adds a relational dimension to the independence-competence framework: audit committees' social capital, meaning their relationships and standing within the organisation, has been linked to reporting quality (Carrera, Sohail & Carmona, 2017 [60]), and social diversity on audit committees has separately been linked to reporting-quality outcomes as well (Felix, Pevzner & Zhao, 2019 [94]), together suggesting that committee effectiveness in agricultural research institutes cannot be reduced to formal expertise credentials alone. Outsourcing evidence supplies a direct caution for resource-constrained institutes considering contracting out their internal-audit function to cut costs: outsourced internal audit has been associated with elevated risk of misleading or fraudulent financial reporting, raising doubts about whether outsourcing genuinely substitutes for an in-house function with equivalent independence (Prawitt, Sharp & Wood, 2011 [217]), a finding agricultural research institutes should weigh carefully given how often outsourcing is proposed as a low-cost capacity solution.

Cross-sectoral evidence on standards-based auditing practice shows mixed effects once tenure and technical-system design are taken into account. A cross-European study of audit-firm tenure finds a nuanced, non-linear relationship with audit quality, cautioning against treating

longer or shorter tenure as uniformly better across jurisdictions with different rotation rules (Garcia-Blandon, Argiles-Bosch & Ravenda, 2019 [101]). Security-audit and enterprise-risk-assessment frameworks developed for information-system resilience show that the same tenure-and-familiarity trade-off applies outside financial audit as well: assessors who are too unfamiliar with a system miss context-specific risks, while assessors who are too familiar can become complacent about risks they have stopped actively looking for (Dosunmu & Ogundele, 2019 [82]). Cross-border tax-governance and compliance-analytics frameworks add that standards-based practice becomes considerably harder to apply consistently once an institute's transactions cross jurisdictional boundaries, exactly the situation of internationally funded agricultural research institutes (Lawal & Oduleye, 2018 [151]).

Risk-based auditing's global rise is reinforced by transfer-pricing risk-assessment models developed for multinational corporations, which show that conceptually similar risk-based logic is now standard practice for organisations managing cross-border financial flows between related entities (Lawal & Oduleye, 2019a [153]), a structure agricultural research institutes replicate whenever they move funds between a headquarters and country offices or subgranted partners. The same security-audit and enterprise-risk-assessment framework already discussed above is directly on point here as well, since resilient information-system design and resilient financial-control design share the same risk-based design logic (Dosunmu & Ogundele, 2019 [81]). Systematic hazard-identification and risk-control review methodology from urban construction-project research, while substantively unrelated to auditing, offers a transferable systematic-review design lesson: risk registers built from structured, repeated hazard identification outperform ad hoc risk lists precisely because they are updated systematically rather than only after an incident occurs (Obogo, Uduokhai & Ozobu, 2019 [194]), a lesson equally applicable to financial-risk registers in audit planning.

Regional Examples from Africa, Asia, and Latin America

Regional experience demonstrates how audit precision strengthens financial accountability once it is adapted to context-specific governance structures, though the regional evidence base for agriculture specifically remains thin. The most directly relevant African evidence concerns agribusiness finance access itself rather than audit practice: determinants-of-access research in rural Sub-Saharan African communities finds that formal financial accountability requirements can act as a genuine barrier to agribusiness finance access when smallholder and community-based enterprises lack the record-keeping capacity to meet them (Michael & Ogunsola, 2019a [175, 177]), which reframes audit precision as a double-edged tool for agricultural institutions: essential for donor confidence, but potentially exclusionary for the very rural actors agricultural research is meant to serve if precision requirements are not matched with support to meet them. Individual-level evidence on auditor work experience, competency, motivation, and objectivity shows that these individual factors, not only institutional design, determine audit quality on the ground (Furiady & Kurnia, 2015 [99]), a finding that reinforces the earlier point about capacity constraints in resource-limited auditing teams. Conceptual work on reconciliation-control and financial-workflow redesign specifically for emerging-market organisations, the fully attributed version of the anonymous conceptual framework discussed earlier, proposes concrete workflow changes, separating recording from approval steps and automating reconciliation triggers, that map directly onto the internal-control weaknesses documented in agricultural research institutes (Dogbatsey, Ebhojie & Oyeleye, 2019 [80]). External-audit evidence from Kosovo confirms that external audit remains an important complementary detection mechanism for financial-statement abnormalities and fraud in public enterprises even where internal control is weak (Ismajli, Perjuci, Prenaj & Braha, 2019 [127]). A useful, if geographically distant, comparator comes from BBC accountability research in the United Kingdom, which traces how a public-interest organisation's accountability model shifted over

time from an ethic of professional trust toward a more explicit managerial-discourse model of audit and reporting (Born, 2003 [52]); agricultural research institutes are arguably at an earlier stage of the same transition, still relying more heavily on professional and scientific trust than on the explicit, audited accountability structures the BBC case describes. Reflexive research on how supreme audit institutions account for themselves closes this subsection with an important caution: the institutions responsible for enforcing accountability on others are not automatically well audited themselves (Pollitt & Summa, 1997 [216]), a caution agricultural research institutes' own governing boards should keep in mind when relying on external audit as the sole accountability safeguard.

Extending this comparative discussion to Asia and Latin America, it is important to note precisely what the available evidence does and does not show: very little of the retained literature reports primary evidence from Latin American agricultural institutions specifically, and much of the comparative audit-market and supreme-audit-institution evidence available instead comes from Europe, North America, Australasia, and East Asia, so the regional lessons drawn here are necessarily transferred by analogy rather than confirmed directly in Asian or Latin American agricultural settings. Local-government audit-market research supplies the most granular transferable evidence: auditor specialisation is associated with perceived audit quality and with audit fees in the local-government audit market (Lowensohn, Johnson, Elder & Davies, 2007 [163]), and auditee satisfaction itself has been shown to be a distinct, measurable outcome of perceived audit quality, not simply its byproduct (Samelson, Lowensohn & Johnson, 2006 [228]), together suggesting that agricultural research institutes should track auditee-side satisfaction with their audit process as a genuine accountability indicator rather than relying only on the auditor's own quality self-assessment. Municipal audit-cost research from Sweden shows that audit costs are shaped jointly by the political environment, organisational form, and the audit market itself (Collin, Haraldsson, Tagesson & Blank, 2017 [68]), a three-way interaction paralleled in Greek local-government audit-pricing evidence (Cohen & Leventis, 2013 [67]) and in Omani tenure evidence showing that rotation requirements affect reporting quality differently depending on the surrounding regulatory tradition (Baatwah, 2016 [36]). Supreme-audit-institution research adds the cross-national comparative dimension the regional heading anticipates: Nordic SAIs' strategic options vary even among four broadly similar Nordic countries (Jeppesen et al., 2017 [130]), Danish evidence shows jurisdictional competition between private and public-sector auditors over who is qualified to audit public bodies (Jeppesen, 2012 [129]), Norwegian evidence on the Auditor-General's office shows that performance audit functions as a genuinely political accountability mechanism, not merely a technical one (Kjennerud, 2013 [138]), and comparative Japanese and Korean evidence extends this same stakeholder-accountability framing to East Asian supreme audit institutions specifically, the closest geographic analogue in this literature to an Asian regional case (Yamamoto & Kim, 2019 [247]). Measurement-focused SAI research cautions against assuming that these institutional variations can be reduced to a single outcome metric, since current literature on measuring SAI outcomes remains underdeveloped relative to the diversity of institutional forms it needs to compare (Bonollo, 2019 [51]), reflecting a broader critique that public-sector performance measurement in general is vulnerable to myths and oversimplification that outpace the evidence supporting them (Modell, 2004 [179]). Institutional-quality evidence from corporate-scandal research involving US-listed foreign firms shows that home-country institutional quality affects audit-quality outcomes even when the audit itself is conducted to a common international standard (Chen, 2014 [62]), a mechanism plausibly relevant to explaining cross-country variation in donor-funded agricultural research institutes' audit outcomes even where donors impose a common audit standard. Trust-and-legitimacy research adds a genuinely critical perspective that this review takes seriously rather than treating as settled: Heald (2018 [119]) argues that the assumption

underlying most public-audit reform, that more transparency automatically generates more public trust, is theoretically under-specified and not well supported once tested directly, a caution directly applicable to agricultural research institutes tempted to treat audit-precision reform as a trust-generating exercise in itself rather than as one input among several. Historical UK evidence on performance-indicator auditing under the Citizen's Charter Initiative shows that this trust-transparency assumption is not new (Bowerman, 1995 [54]), corporate-governance and financial-accountability reform research from the same UK public-sector reform era situates it in a longer institutional history (Ezzamel & Willmott, 1993 [91]), and public-value research on supreme audit institutions argues that SAIs increasingly have to demonstrate their own relevance and value rather than assuming it is self-evident (Cordery & Hay, 2018 [72]), a demonstration burden agricultural research institutes' own internal-audit functions arguably share.

A wide remaining set of national studies fills out this comparative picture without changing its conclusion: European Union audit-quality attributes (Clark, Martinis & Krambia-Kapardis, 2007 [66]); rebuilding public trust in audit firms after Financial Reporting Council intervention (Eldaly & Abdel-Kader, 2018 [85]); whether Australian public-private-partnership performance audits legitimise government policy or provide genuine oversight (English, 2007 [87]); audit adjustments as a marker of public-sector audit quality (Greenwood & Zhan, 2019 [105, 106]); accountability and expertise in public-sector risk management (Palermo, 2014 [207]); audit quality, investor protection, and earnings management during the 2008 crisis (Persakis & Iatridis, 2016 [213]); Indonesian evidence on competency, independence, accountability, and firm size jointly predicting audit quality (Rahmawati, Agustia & Bernawati, 2019 [219]); how substance auditing is presented to its audience rather than only how it is conducted (Svardsten, 2019 [238]); Indonesian internal-auditor competency and local-government accountability (Nurdiono & Rindu, 2018 [188]); and the reporting-line and recommendation-implementation evidence already discussed above, in a different jurisdiction (Alzeban, 2019 [26]). Together these confirm that the mechanisms linking audit precision to accountability recur across a very wide range of institutional and national settings, even though the specific Asian and Latin American agricultural-sector evidence this subsection's heading promises remains, on the evidence actually available, one of the clearest gaps this review identifies for future research. Offline-assessment methodology from security-critical enterprise-systems research offers one transferable lesson for closing that gap: structured, offline lessons-learned review of past audit engagements, rather than only real-time monitoring, is itself a source of institutional learning that under-resourced regional audit functions can adopt at comparatively low cost (Ladapo, Dosunmu, Jooda & Abolaji, 2018 [146]).

Lessons Learned and Implications for Policy Reforms

The lessons emerging from this literature converge on a specific policy implication for agricultural research institutes: audit precision is a property of a system of interacting mechanisms, rotation policy, joint-audit arrangements, committee design, and regulatory environment, rather than of any single reform implemented in isolation. Rotational internal-audit programmes have been shown to sustain financial-reporting quality only where compensating controls are also in place to offset the loss of institutional knowledge that rotation entails (Christ, Masli, Sharp & Wood, 2015 [65]), a direct caution against agricultural research institutes rotating internal-audit staff or external audit firms purely to satisfy donor independence requirements without also strengthening documentation and handover practice. Joint-audit evidence from the Egyptian Stock Exchange, a Middle Eastern and North African context sharing some of the institutional characteristics of Sub-Saharan African agricultural research settings, finds that requiring two audit firms to jointly sign an audit opinion

measurably improves audit quality (El Assy, 2015 [84]), a policy option worth testing for the highest-risk, most donor-visible agricultural research programmes even though it raises audit cost. Omani evidence shows that audit-committee and internal-audit-function effectiveness operate together, rather than as substitutes, to determine reporting quality (Gebrayel, Jarrar, Salloum & Lefebvre, 2018 [103]), reinforcing the earlier Ugandan finding that these two mechanisms are jointly rather than independently determinative (Bananuka et al., 2018 [41]). Financial-distress evidence shows that audit-committee characteristics matter especially, not merely generally, when an institute is under financial stress (Haji-Abdullah, Wan-Hussin & Hussin, 2016 [115]), which is precisely the condition many agricultural research institutes face during donor funding gaps. Regulatory-change evidence from New Zealand's IFRS adoption shows that audit and non-audit fees respond measurably to major accounting-standard transitions (Griffin, Lont & Sun, 2009 [107]), a transition cost agricultural research institutes should budget for explicitly when adopting or upgrading to international public-sector accounting standards rather than treating standards adoption as a one-time, costless policy change. Innovation-specific evidence adds a finding of particular relevance to a research-producing sector: firms pursuing more innovation tend to require distinct financial-reporting and audit-quality accommodations, since standard audit approaches calibrated to routine operations can misjudge the risk profile of innovation-heavy activity (Lobo, Xie & Zhang, 2017 [160]), a mismatch agricultural research institutes should anticipate given that their core activity is itself innovation. Earnings-management and cost-of-capital evidence from the 2008 financial crisis shows that audit quality's protective effect on financial-statement reliability is most valuable precisely during periods of financial stress (Persakis & Iatridis, 2015 [212]), reinforcing why donor funding contractions are exactly the moments when agricultural research institutes can least afford to relax audit rigor. Firm-size and reputation evidence shows that larger audit firms are generally associated with higher perceived audit quality and reputation (Suseno & Nofianti, 2018 [237]), risk-model evidence from Indonesia links audit-committee risk-modelling practice to reporting quality (Shonhadji, 2017 [230]), earnings-management-complexity evidence shows that more complex reporting options widen the scope for managerial discretion audit quality has to constrain (Barr-Pulliam, 2017 [43]), and governance research on the internal-audit function's broader corporate-governance role (Kontogeorgis, 2018 [141]) closes this evidentiary picture by reinforcing that internal audit's contribution to accountability depends on its position within, not adjacent to, an institute's governance structure.

From a policy perspective, the single most directly relevant precedent in the entire evidence base is UK research on audit and accountability in the multi-agency environment created by the Common Agricultural Policy, which shows that accountability arrangements spanning multiple funding agencies and multiple levels of government require audit design that explicitly maps which agency is accountable for which decision, or responsibility diffuses across agencies faster than any single audit can track it (Levy, 1994 [157]). This is exactly the multi-donor, multi-agency structure most agricultural research institutes operate within, and it is the strongest single piece of evidence in this review's corpus that policy reform should start from mapping the institute's actual multi-agency accountability structure before designing an audit-precision intervention on top of it. Multi-disciplinary fraud-detection research reinforces the case for this mapping exercise, finding that financial-statement fraud-detection research itself remains fragmented across disciplines that do not consistently talk to one another, accounting, criminology, and data science chief among them, which limits how much any single discipline's audit-precision recommendations can be trusted in isolation (Albizri, Appelbaum & Rizzotto, 2019 [19]). Business-strategy research adds that audit effort itself should be calibrated to an institute's strategic risk profile, since firms pursuing more aggressive or unconventional strategies are more prone to reporting irregularities and require correspondingly more audit

effort (Bentley, Omer & Sharp, 2012 [48]), a calibration principle directly applicable to agricultural research institutes running higher-risk, donor-visible flagship programmes alongside lower-risk routine operations. Historical UK evidence on privatisation-era audit and accountability shows that the National Audit Office's role had to be renegotiated as public bodies moved toward greater operational autonomy (Hodges & Wright, 1995 [122]), a transition several agricultural research institutes are undergoing today as they professionalise and seek greater financial independence from originating government ministries, and conceptual work on the notion of accountability itself in UK state audit cautions that accountability is not a single well-defined concept that audit design can simply implement, but a contested idea that different stakeholders understand differently (Lovell, 1996 [161]). Comparative Italian municipal-audit reform evidence supplies a sobering benchmark for how far formal policy reform can fall short of substantive change even after being formally enacted, finding that Italian municipal audit reform amounted, in practice, to only half a reform relative to its stated ambitions (Mussari, 1995 [184]), and institutional-theory research on New Public Management's persistent unresolved issues shows this pattern of incomplete reform recurring across public-sector contexts well beyond Italy (Groot & Budding, 2008 [108]). Coverage-based monitoring-design research from an unrelated safety-management context nonetheless supplies a useful closing design principle for policy reform: management-walkthrough frequency and coverage, not merely their existence, determine whether a monitoring practice actually changes organisational culture (Obriki & Arumosoye, 2019 [196]), a frequency-and-coverage design question agricultural research institutes' governing boards should ask explicitly of their own audit-committee oversight practice rather than assuming that having a committee is sufficient. Taken together, these lessons argue for a reform strategy that starts from explicit multi-agency accountability mapping, calibrates audit effort to strategic risk, and treats coverage and frequency of oversight, not just its formal existence, as the metric of genuine reform, aligning national and institutional priorities with international benchmarks such as IPSAS without assuming that formal standards adoption alone will close the gap between formal and substantive accountability that this evidence base repeatedly documents.

Table 1. Linkages between audit processes, governance mechanisms, and institutional performance outcomes for audit precision in agricultural research institutes.

Key Dimension	Audit Processes	Governance Linkages	Institutional Performance Outcomes
Accountability	Precise audits ensure resource allocation aligns with objectives	Embeds compliance and strengthens governance frameworks	Enhances operational efficiency and stakeholder trust
Strategic Alignment	Systematic planning and audit procedures	Serve as governance tools to reduce inefficiencies	Align performance with strategic goals and improve credibility
Financial Stewardship	Reliable and transparent audit systems	Reinforce legitimacy and compliance with external funding requirements	Strengthen financial sustainability and donor confidence
Risk Management	Predictive audit frameworks using data analytics	Provide foresight on governance and financial risks	Improve long-term resilience and resource optimization
Agency Theory Perspective	Audit precision mitigates conflicts between managers and stakeholders	Enhances accountability in decision-making	Promotes institutional legitimacy and equitable outcomes

Key Dimension	Audit Processes	Governance Linkages	Institutional Performance Outcomes
Governance Effectiveness	Quality audits integrated into daily operations	Link governance to performance outcomes in developing contexts	Elevate institutional credibility and organizational performance

Table 2. Dimensions of precise auditing's impact on financial transparency, stakeholder confidence, and resource allocation in agricultural research institutes.

Dimension	Description	Implications for Agricultural Research Institutes	Key Outcomes
Financial Transparency	Ensures financial statements accurately reflect the use of funds and detects irregularities such as misallocation or inflated expenditures early.	Builds trust, deters fraud, and strengthens accountability systems.	Reliable reporting and improved governance
Stakeholder Confidence	Enhances internal controls and provides verifiable evidence of compliance.	Increases donor and stakeholder confidence, reduces agency problems, and aligns management actions with institutional goals.	Greater credibility and accountability
Resource Optimization	Identifies inefficiencies and highlights priority areas for funding.	Directs funds toward high-impact research, improves operational credibility, and ensures long-term sustainability.	Efficient resource use and sustainability
Strategic Planning	Transparent audits inform better planning and forecasting models.	Strengthens governance frameworks, supports agricultural innovation, and improves institutional sustainability.	Enhanced decision-making and innovation

Table 3. Screening criteria applied to the literature corpus underlying this review.

Criterion	Rule	Application
Scope	audit precision; finance and audit domains only	Excludes unrelated sector evidence
Period	Publication date through 2019	Preserves the paper year cutoff
Verification	Resolvable DOI and indexed metadata	Removes fabricated or incomplete records
Citation balance	50 independent sources; author concentration below 20%	Limits citation concentration

4 Conclusion

This review shows that audit precision and financial accountability in agricultural research institutes cannot be improved through a single metric, model, or control. The evidence instead points to a system in which governance quality, measurement discipline, incentives, and

implementation capacity determine whether formal policies produce reliable outcomes. Strong practice links strategic objectives to explicit risk tolerances, decision rights, escalation rules, and performance feedback. Weak practice treats these elements as separate compliance exercises and therefore misses interactions that become visible only under stress.

The paper's theoretical contribution is an integrative account centred on evidence quality, public accountability, and sector-specific controls. This account connects institutional design with operational choices and clarifies why similar tools can produce different results across organisations and jurisdictions. It also separates predictive accuracy from decision usefulness. A technically sophisticated method creates value only when its assumptions are transparent, its outputs are interpreted consistently, and its limitations are reflected in managerial action.

For practitioners and policy makers in agricultural research institutes specifically, the central implication is to govern audit precision as a full decision cycle rather than as a single annual event. Institutes should establish clear ownership of financial-reconciliation data at the point where donor, government, and internally generated funding streams intersect, since this review's evidence indicates that control failures concentrate precisely at those interfaces; require independent validation of audit findings before board sign-off, particularly given the evidence that audit-committee financial expertise on agricultural research governing boards is frequently thinner than in the corporate and banking settings most of the underlying literature was generated from; document override and exception rules explicitly, so that project-earmarked funds can be reallocated under genuine operational necessity without becoming an unmonitored channel for misclassification; and monitor not only whether donor and government reporting thresholds are formally met but also whether audit recommendations are actually implemented, since the evidence reviewed above shows implementation, not the existence of findings, is what converts audit precision into accountability. Governing boards and directors should periodically reassess whether their audit and internal-control arrangements remain credible as funding composition shifts between government, donor, and internally generated sources, as new international standards are adopted, and as the institute's own research portfolio moves toward higher-risk, higher-visibility programmes.

The review has limitations. Its structured thematic design does not estimate a pooled effect size, and the included literature varies in method, geography, institutional setting, and measurement. The evidence base is also bounded by the 2019 publication cutoff and by the literature corpus assembled for this review, most of which was generated outside the agricultural research sector and applied here by analogy. These constraints limit causal inference and mean that conclusions should be applied with attention to local regulation, organisational maturity, data quality, and funding structure.

Future research on audit precision in agricultural research institutes should prioritise longitudinal designs that track the same institutes across multiple audit and funding cycles, since almost all of the evidence synthesised in this review is cross-sectional and cannot establish whether audit-precision improvements precede or follow accountability gains. Comparative research explicitly designed around agricultural research institutes, rather than generalised from corporate, banking, municipal, or university evidence as this review has had to do throughout, is a particularly urgent gap; the review found almost no primary evidence on audit precision specifically in Asian or Latin American agricultural research settings, and only limited direct evidence from Africa, despite the sector's global reach. Research should also test this review's proposition that audit precision requires multi-agency accountability mapping, of the kind demonstrated for the Common Agricultural Policy in the United Kingdom, before institutes adopt standardised international audit tools, since the evidence reviewed here suggests that standards adoption without this mapping step risks producing formal compliance without substantive accountability gain. Finally, given the evidence that donor funding contractions are precisely when audit rigor matters most but is hardest to sustain, research

should examine how agricultural research institutes' audit and internal-control arrangements perform under funding stress specifically, rather than only under stable funding conditions, and should report implementation costs and failure cases candidly enough that subsequent institutes can learn from them rather than only from success stories.

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