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Agricultural Extension Services and Smallholder Farmers' Resilience in The Gambia: Challenges, Opportunities, and Pathways for Sustainable Agricultural Development

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Abstract

Agricultural extension is an important mechanism for translating agricultural research, climate information, improved technologies, and public policy into practical knowledge for farming communities. In The Gambia, the effectiveness of extension services is particularly important because many smallholder farmers depend on rain-fed production and face interacting constraints involving soil fertility decline, irregular rainfall, drought, flooding, salinity, limited access to inputs, weak market linkages, and restricted access to finance. This review examines the contribution of agricultural extension to sustainable agricultural development and climate resilience in The Gambia. It synthesizes evidence from peer-reviewed literature, development-agency reports, national climate-resilience documents, and agricultural project materials. The review argues that extension should move beyond one-way technology transfer toward pluralistic, demand-driven, gender-responsive, market-oriented, and climate-informed advisory systems. Farmer field schools, participatory demonstrations, mobile-based agro-meteorological advisories, strengthened farmer organizations, and closer coordination among government, research institutions, civil-society organizations, private service providers, and development partners are identified as important pathways. Particular attention is given to women and youth, whose access to land, finance, information, and productive assets can shape the distribution of extension benefits. The paper proposes an integrated framework linking extension quality, access to productive resources, technology adoption, resilience, productivity, and livelihood outcomes. It concludes that extension investments are most likely to generate sustained benefits when advisory services are combined with timely inputs, affordable finance, irrigation and water management, functional markets, and locally relevant climate information. The manuscript provides a research and policy agenda for strengthening agricultural extension in The Gambia.

Keywords: Agricultural extension; The Gambia; smallholder farmers; climate-smart agriculture; farmer field schools; agricultural innovation

1. Introduction

Agriculture remains central to rural livelihoods, food security, employment, and poverty reduction in The Gambia. The sector is dominated by smallholder production systems that are highly exposed to rainfall variability and environmental degradation. Many farming households operate under conditions of limited access to improved seed, fertilizer, irrigation, mechanization, credit, market information, and post-harvest facilities. These constraints are intensified by climate-related risks, including drought, flooding, high temperatures, saline-water intrusion, soil erosion, and changes in the timing and distribution of rainfall (FAO, 2017; CCAFS, 2021; Government of The Gambia, 2021).

Agricultural extension is commonly understood as the organized provision of information, knowledge, skills, facilitation, and innovation support to farmers and other actors in agricultural value chains. Contemporary extension is broader than the traditional transfer of production recommendations from experts to farmers. It includes facilitation of farmer learning, support for collective action, market and business advisory services, climate information, digital communication, nutrition-sensitive agriculture, and linkages among farmers, researchers, input suppliers, financial institutions, and policymakers (Swanson and Rajalahti, 2010; Davis, 2008).

In The Gambia, extension services have an important role in helping farmers interpret climate information, select appropriate crop varieties, improve soil and water management, control pests and diseases, diversify production, and connect with markets. National and development-partner initiatives have emphasized climate-smart agriculture, tidal irrigation, horticulture, farmer field schools, agroforestry, and improved farmer organizations (Government of The Gambia, 2021; IFAD, 2020; ROOTS Project, 2026).

However, the presence of extension personnel or projects does not automatically result in sustained technology adoption or improved livelihoods. Advisory services may be constrained by inadequate operational resources, limited transport, staff turnover, weak research–extension linkages, insufficient attention to women farmers, and the high cost or limited availability of the technologies being promoted. Farmers may also receive technically sound recommendations that are difficult to implement because of insecure land tenure, lack of finance, unreliable input markets, or poor infrastructure (IMF, 2025; World Bank, 2026).

This paper therefore reviews the role of agricultural extension in supporting sustainable agricultural development and smallholder resilience in The Gambia. It addresses five questions: (1) What are the principal agricultural and climate-related challenges facing smallholders? (2) How can extension contribute to technology adoption and resilience? (3) What institutional and social factors influence extension effectiveness? (4) Which approaches appear promising in the Gambian context? and (5) What policy and research priorities should guide future extension investments?

2. Objectives of the Review

The general objective is to examine how agricultural extension can contribute to improved productivity, climate resilience, food security, and rural livelihoods among smallholder farmers in The Gambia.

The specific objectives are to:

• review the agricultural, socioeconomic, and environmental context in which extension services operate;

• examine the contribution of extension to the adoption of improved and climate-smart agricultural practices;

• identify institutional, gender, financial, infrastructural, and informational constraints affecting extension delivery;

• discuss promising approaches, including farmer field schools, digital advisory services, and pluralistic extension; and

• propose a practical framework and policy agenda for strengthening agricultural extension in The Gambia.

3. Methodology

This article adopts a narrative and analytical review design. Relevant evidence was drawn from peer-reviewed research, international-agency publications, national climate and agricultural documents, and project reports addressing agricultural extension, climate adaptation, smallholder farming, food security, and rural development in The Gambia. The review combines country-specific evidence with established extension and innovation-system literature.

The analysis is organized thematically around: agricultural production constraints; climate risks; extension approaches; adoption and learning; gender and social inclusion; institutional coordination; digital advisory services; and monitoring and evaluation. Because the paper does not report a new household survey or experimental dataset, it does not estimate causal effects or present original statistical results. Country-specific findings are interpreted in relation to the scope and methods of the underlying sources.

The review has two limitations. First, the quality and geographic coverage of available evidence vary across topics and regions. Second, project reports may document implementation achievements without providing comparable counterfactual evidence. Accordingly, recommendations are presented as evidence-informed policy options rather than as claims that one extension model is universally superior.

4. Agricultural and Rural Development Context in The Gambia

4.1 Smallholder dependence and production constraints

Smallholder agriculture in The Gambia includes food crops, cash crops, horticulture, livestock, fisheries-related livelihoods, and agroforestry. Production systems differ across ecological zones and along the River Gambia, where upland, lowland, valley, and tidal environments create different opportunities and risks. Rice, groundnuts, millet, maize, vegetables, and livestock are important components of rural livelihoods, while horticulture has potential for income generation, nutrition, and diversification.

Productivity is affected by low soil organic matter, declining soil fertility, limited water control, inadequate access to quality seed and fertilizer, pest and disease pressures, post-harvest losses, and weak market coordination. The country's climate-resilience planning documents identify crop diversification, improved soil management, drought-tolerant crops, agroforestry, water management, and stronger extension as important adaptation priorities (Government of The Gambia, 2021).

4.2 Climate variability and agricultural risk

Climate change creates both gradual and sudden pressures on farming. Erratic rainfall can delay planting, shorten growing periods, or cause crop failure. Intense rainfall may produce flooding, erosion, and damage to rural roads and storage facilities. In low-lying and tidal areas, saline-water intrusion can reduce the suitability of land for particular crops. Higher temperatures can increase evapotranspiration, livestock heat stress, and the pressure on water resources (CCAFS, 2021; IMF, 2025).

These risks have implications for extension content and timing. Farmers require advice that is location-specific, seasonal, and connected to decisions such as when to plant, which varieties to select, how to manage soil

moisture, when to apply fertilizer, how to protect crops, and how to manage water and livestock. Extension systems that do not integrate climate information may provide recommendations that are technically correct but poorly matched to actual seasonal conditions.

4.3 Gender, youth, and unequal access to services

Women and youth are important contributors to agricultural production, processing, marketing, and household food security. Nevertheless, access to land, credit, inputs, extension contacts, equipment, and producer organizations may be unequal. A recent climate-adaptation study in The Gambia reported that gender, education, access to extension, farmer-group membership, and access to other resources were relevant to adaptation decisions (Lambarraa-Lehnhardt et al., 2024). The World Bank (2026) also identifies gender-related constraints involving land, credit, technical support, and participation in agricultural value chains.

Gender-responsive extension should therefore address more than the number of women attending training. It should examine whether women receive timely information, control productive resources, can experiment with technologies, participate in decision-making, and obtain benefits from improved production and marketing. Youth-oriented extension should include entrepreneurship, digital skills, mechanization services, aggregation, processing, logistics, and other value-chain opportunities.

Table 1. Major constraints affecting smallholder agriculture and corresponding extension needs

Constraint	Likely implications	Extension and advisory response
Rainfall variability and drought	Poor germination, yield instability, crop failure	Seasonal climate advisories, early-maturing varieties, moisture conservation, adjusted planting calendars
Flooding and saline intrusion	Damage to crops and soils; reduced land suitability	Water-management advice, drainage, tidal-irrigation guidance, salt-tolerant options, land-use planning
Low soil fertility	Low yields and inefficient input use	Integrated soil fertility management, composting, legumes, agroforestry, site-specific nutrient advice
Limited access to quality inputs	Low adoption of recommended technologies	Input-market linkages, demonstrations, seed information, collective procurement
Weak market access	Low farm-gate prices and post-harvest losses	Market information, aggregation, grading, storage, value addition, contract and buyer linkages
Limited finance	Inability to invest in seed, fertilizer, irrigation, and equipment	Financial-literacy support, credit linkages, savings groups, risk-management information
Gender and youth barriers	Unequal access to knowledge and productive assets	Inclusive scheduling, women and youth groups, targeted services, childcare-sensitive training, entrepreneurship support

5. Conceptualizing Agricultural Extension for Sustainable Development

The role of extension can be understood through agricultural innovation-system and farmer-learning perspectives. An innovation system includes farmers, researchers, extension organizations, input suppliers, financial institutions, processors, traders, civil-society organizations, policymakers, and consumers. Innovation emerges through interaction among these actors rather than through a one-directional flow of technology from research stations to farmers (Leeuwis and van den Ban, 2004; Klerkx, van Mierlo, and Leeuwis, 2012).

From a farmer-learning perspective, knowledge is more likely to be useful when farmers can observe, test, adapt, and discuss technologies in their own production environments. Participatory demonstrations and farmer field schools can support experiential learning, peer exchange, problem diagnosis, and local experimentation. Extension agents become facilitators of learning and coordination rather than simply distributors of instructions (Davis, 2008; FAO, 2016).

For The Gambia, these perspectives suggest that extension effectiveness depends on the interaction of four elements: the quality of advice; farmers' access to complementary resources; the suitability of technologies to local agroecological conditions; and the institutional environment that supports adoption. A farmer may understand the value of improved seed but still be unable to adopt it if seed is unavailable, credit is unaffordable, land tenure is insecure, or market incentives are weak.

Table 2. Proposed conceptual framework linking extension to agricultural outcomes

Stage	Key mechanisms	Illustrative indicators
Inputs	Extension staff, training, operating funds, research knowledge, climate data, digital tools	Staff coverage; training days; transport availability; number of advisory products
Extension processes	Farmer diagnosis, demonstrations, field schools, group learning, referrals, feedback	Farmer contacts; field schools; participation by women and youth; farmer feedback
Immediate outcomes	Improved knowledge, confidence, problem-solving, and access to information	Knowledge scores; perceived usefulness; climate-information access; advisory satisfaction
Intermediate outcomes	Adoption and adaptation of improved practices; stronger farmer organizations	Adoption rates; area under improved practices; group marketing; input access
Final outcomes	Productivity, resilience, income, nutrition, reduced losses, and sustainable resource use	Yield; gross margins; income stability; food-security measures; soil and water indicators

6. Priority Extension Approaches for The Gambia

6.1 Farmer field schools and participatory learning

Farmer field schools provide a practical platform for learning through observation, experimentation, and group analysis. They are especially relevant for integrated pest management, rice and vegetable production, soil fertility, water management, climate adaptation, and nutrition-sensitive agriculture. In The Gambia, project documentation has described farmer field schools for rice and horticulture, including training on integrated production and pest and disease management (IFAD, 2020).

For field schools to be effective, curricula should be locally adapted and linked to the agricultural calendar. Sessions should address the complete production cycle, including land preparation, seed selection, planting, soil and water management, pest management, harvesting, storage, marketing, and record keeping. Demonstration plots should compare farmers' usual practices with improved options while documenting costs, labor requirements, risks, and returns.

6.2 Climate-informed extension

Climate-informed extension integrates seasonal forecasts, short-term weather information, local observations, and agronomic interpretation. The value of a forecast depends on whether it is translated into a clear decision. For example, an advisory may recommend delaying planting until adequate soil moisture is received, selecting

a shorter-duration variety, protecting seedlings from intense rainfall, or adjusting fertilizer application to reduce losses.

The Gambia's climate-resilience planning has proposed agro-meteorological advisory services delivered through mobile phones and supported by multidisciplinary interpretation of weather, soil, water, and crop information (Government of The Gambia, 2021). Such systems should use accessible languages and formats, provide uncertainty information, and allow farmers to give feedback on whether advisories were understandable and useful.

6.3 Digital and mobile advisory services

Mobile phones, interactive voice response, radio, messaging platforms, and digital farmer registries can extend the reach of advisory services. Digital tools may be particularly useful for weather alerts, pest identification, market prices, input availability, financial literacy, and reminders about agricultural operations. However, digital extension should complement rather than automatically replace face-to-face services. Connectivity, phone ownership, literacy, language, affordability, and unequal control of household devices can shape access.

A practical digital-extension strategy for The Gambia should combine several channels: community radio for broad dissemination; voice-based services for farmers with limited literacy; mobile messages for time-sensitive information; extension agents and lead farmers for local interpretation; and feedback systems for reporting crop, pest, and weather conditions.

6.4 Pluralistic and demand-driven extension

A pluralistic extension system involves public agencies, farmer organizations, nongovernmental organizations, private input and service providers, research institutions, and development projects. Pluralism can expand service coverage and specialization, but it requires coordination, quality standards, transparent responsibilities, and mechanisms to avoid duplication. Public institutions retain important responsibilities for inclusion, public-good information, plant and animal health, environmental protection, and accountability.

Demand-driven extension begins with farmers' expressed needs and local problem diagnosis. Needs assessments should be disaggregated by gender, age, location, production system, wealth, and value-chain role. Farmer organizations can help aggregate demand, organize demonstrations, negotiate input purchases, and connect producers with buyers and financial institutions.

6.5 Extension for value-chain development

Production advice alone may not improve livelihoods if farmers cannot sell produce profitably. Extension should therefore include post-harvest handling, quality standards, grading, storage, processing, packaging, record keeping, business planning, and market negotiation. Horticulture, rice, groundnuts, livestock, and emerging value chains may require different technical and commercial advisory packages.

Extension agents should develop referral relationships with financial institutions, input suppliers, processors, transporters, and market-information services. Where commercial services are promoted, safeguards are needed to ensure that farmers receive transparent information and are not exposed to inappropriate credit, unsafe chemical use, or unfair contractual arrangements.

Table 3. Suggested extension packages by farming system

Farming system	Technical priorities	Organizational and market priorities
Rain-fed cereals and legumes	Early-maturing varieties, planting-date decisions, soil fertility, conservation agriculture, drought-risk management	Seed access, group purchasing, storage, collective marketing, weather information

Rice and lowland production	Water control, tidal irrigation, salinity management, improved varieties, pest management	Water-user associations, maintenance arrangements, milling, quality standards, buyer linkages
Horticulture	Irrigation scheduling, soil health, integrated pest management, safe pesticide use, post-harvest handling	Women's groups, cold-chain and storage options, market information, packaging and value addition
Livestock-integrated systems	Feed resources, animal health, fodder trees, water management, manure use	Veterinary referrals, producer groups, feed markets, risk management
Agroforestry and diversified systems	Tree–crop integration, erosion control, soil moisture, multipurpose species	Nursery enterprises, community rules, tenure-sensitive planning, ecosystem services

7. Gender-Responsive and Youth-Inclusive Extension

Extension systems can reproduce existing inequalities if they rely on male household heads, hold meetings at inconvenient times, use communication channels that exclude women, or promote technologies requiring assets that women do not control. Gender-responsive extension should identify the practical and structural barriers that shape access to advice and adoption.

Important measures include recruiting and supporting women extension personnel; scheduling activities around women's workloads; working with women's producer groups; providing training in locally accessible languages; including nutrition, processing, and marketing; supporting access to land, credit, equipment, and improved inputs; and monitoring participation and benefits separately for women and men. The objective should be meaningful access and improved outcomes, not simply numerical participation.

Youth-inclusive extension should recognize young people as farmers, entrepreneurs, service providers, digital communicators, and innovators. Training can include machinery operation, irrigation services, seed multiplication, drone or digital data services where appropriate, processing, logistics, business management, and climate-smart enterprises. Youth engagement is more likely to be sustained when training is connected to finance, mentoring, equipment, and real market opportunities.

8. Institutional and Operational Requirements

8.1 Strengthening public extension capacity

Public extension agencies require adequate staffing, mobility, training, supervision, communication tools, and operational budgets. Extension agents should receive regular technical updates on climate-smart agriculture, soil and water management, integrated pest management, gender inclusion, nutrition, digital tools, and facilitation skills. Performance assessment should consider the quality and usefulness of services rather than only the number of visits or meetings.

8.2 Research–extension–farmer linkages

Research institutions and extension agencies should jointly identify priority problems, test technologies under farmer conditions, and translate findings into practical recommendations. Farmers should participate in defining research questions and evaluating innovations. Feedback from extension workers and farmers can help researchers identify why a technology performs differently across locations or why adoption remains low.

8.3 Coordination among projects and service providers

The Gambia has received support from multiple development partners and agricultural projects. Such investments can expand infrastructure and services, but fragmented implementation may create parallel training

systems, inconsistent messages, and short-lived project structures. A common extension coordination mechanism could align curricula, geographic coverage, farmer databases, climate-information products, monitoring indicators, and training standards.

8.4 Financing and sustainability

Extension programs should be designed with realistic recurrent-cost plans. Demonstration plots, field schools, digital platforms, transport, staff training, and monitoring require ongoing resources. Project financing should include transition arrangements so that useful services can continue after project closure. Cost-sharing or private service models may be appropriate for some commercial activities, but essential public-good functions should not depend entirely on farmers' ability to pay.

9. Monitoring, Evaluation, and Learning

Monitoring and evaluation should distinguish between activities, outputs, outcomes, and impacts. Counting training sessions or farmer contacts is insufficient to determine whether extension improves livelihoods. Evaluation should examine whether farmers understood the advice, had access to complementary inputs, adopted practices, achieved improved productivity, reduced risk, or experienced changes in income and food security.

A learning-oriented monitoring system should combine quantitative indicators with qualitative feedback. Baseline and follow-up assessments can measure knowledge, adoption, yields, costs, profitability, resilience, and inclusion. Participatory reviews can identify barriers that numerical indicators may miss, such as labor burdens, intra-household decision-making, land insecurity, distrust of institutions, or difficulties using digital services.

Table 4. Illustrative indicators for evaluating agricultural extension

Dimension	Example indicators	Possible data sources
Reach and inclusion	Farmers served by sex, age, location, and production system; proportion of women and youth participants	Extension records; farmer registry; attendance sheets
Service quality	Timeliness, relevance, clarity, technical accuracy, and farmer satisfaction	Farmer surveys; focus groups; service-quality assessments
Knowledge and learning	Knowledge-test scores; farmer ability to diagnose problems; confidence in decisions	Pre/post tests; field observations; interviews
Adoption	Use of improved seed, soil practices, water management, IPM, record keeping, and climate advisories	Farm visits; farmer diaries; remote or administrative data where appropriate
Economic outcomes	Yield, production cost, gross margin, sales, post-harvest losses	Farm budgets; crop cuts; market records
Resilience and sustainability	Yield stability, recovery after shocks, soil cover, water-use efficiency, diversification	Panel surveys; plot assessments; climate and environmental data
Institutional learning	Feedback acted upon; coordination meetings; curriculum updates; staff capacity development	Program records; supervision reports; review workshops

10. Discussion

The evidence reviewed suggests that agricultural extension can contribute to resilience in The Gambia, but extension should not be treated as an isolated intervention. Knowledge is a necessary but not always sufficient condition for adoption. Farmers' decisions are shaped by expected benefits, risk, labor, cash requirements, land tenure, access to inputs, market conditions, social norms, and the reliability of supporting institutions.

The relationship between extension and climate adaptation is particularly important. Evidence from The Gambia indicates that access to extension services is associated with adaptation decisions, while climate perceptions, education, farmer-group membership, and access to government support also matter (Lambarraa-Lehnhardt et al., 2024). This implies that extension strategies should combine technical messages with support for collective action, resource access, and risk management.

The review also indicates that climate-smart agriculture should be interpreted locally. Practices suitable for upland rain-fed farming may differ from those required in lowland or tidal systems. Likewise, a technology that increases yield may not be attractive if it substantially increases labor, requires unavailable inputs, or exposes farmers to financial risk. Extension should therefore communicate costs, labor implications, uncertainty, and trade-offs rather than presenting technologies as universally beneficial.

Finally, the effectiveness of extension should be judged by farmer outcomes and institutional learning. A resilient extension system is one that can update recommendations as climate and market conditions change, listen to farmers, coordinate with other actors, and maintain services beyond the lifespan of individual projects.

11. Policy and Practice Recommendations

1. Develop a national extension coordination framework. Align public, private, civil-society, research, and project-based advisory services around shared priorities, curricula, geographic responsibilities, and monitoring standards.

2. Institutionalize climate-informed advisory services. Integrate seasonal forecasts, local observations, agronomic interpretation, and farmer feedback into radio, mobile, field-based, and community communication channels.

3. Expand farmer field schools and participatory demonstrations. Prioritize rice, horticulture, soil fertility, integrated pest management, agroforestry, livestock integration, and water management, with curricula adapted to local farming systems.

4. Bundle advice with productive resources. Link extension with quality seed, fertilizer, irrigation, finance, mechanization, insurance or other risk-management tools, and market services so that recommendations are feasible.

5. Make extension explicitly gender-responsive. Track access and benefits by sex; strengthen women's groups and women extension personnel; address land, finance, labor, mobility, and technology-control barriers.

6. Create youth-oriented agricultural service pathways. Support training and mentoring in mechanization, irrigation, digital advisory services, processing, logistics, input supply, and agribusiness.

7. Strengthen research–extension–farmer feedback loops. Use farmer-led trials, joint problem diagnosis, adaptive research, and regular review of recommendations.

8. Invest in extension personnel and operating systems. Provide mobility, supervision, continuous professional development, digital tools, and adequate recurrent funding.

9. Adopt outcome-oriented monitoring and evaluation. Measure knowledge, adoption, productivity, profitability, resilience, inclusion, and farmer satisfaction rather than relying only on activity counts.

10. Plan for institutional sustainability. Ensure that project innovations, databases, training materials, and service platforms can be maintained by national and local institutions after external funding ends.

12. Future Research Agenda

Future research should generate stronger empirical evidence on the effectiveness, equity, and cost-effectiveness of extension approaches in The Gambia. Priority questions include:

• What is the effect of farmer field schools on adoption, yields, profitability, and resilience compared with conventional extension contacts?

• Which combinations of extension, improved inputs, finance, irrigation, and market access generate the greatest benefits for different farming systems?

• How do women and youth experience extension services, and which institutional arrangements improve their access and control over productive resources?

• What forms of climate information are most trusted, understandable, timely, and actionable for farmers in different regions?

• How do digital advisory services affect farmers with different levels of literacy, phone access, connectivity, and language preference?

• What are the recurrent costs and institutional requirements for sustaining pluralistic extension systems?

• How can extension outcomes be measured in terms of resilience, nutrition, environmental sustainability, and income stability rather than yield alone?

13. Conclusion

Agricultural extension has a strategic role in supporting sustainable agricultural development in The Gambia. It can help farmers access and interpret knowledge, test improved practices, respond to climate risks, organize collectively, improve market participation, and connect with complementary services. However, extension cannot overcome structural constraints by itself. Its contribution depends on the availability of appropriate technologies, finance, infrastructure, land and water resources, markets, and supportive institutions.

A future-oriented extension system for The Gambia should be pluralistic, participatory, climate-informed, gender-responsive, youth-inclusive, and focused on measurable farmer outcomes. Farmer field schools, digital and radio-based advisories, stronger research–extension linkages, farmer organizations, and integrated service packages provide practical pathways. The central policy challenge is to move from fragmented information delivery toward coordinated agricultural innovation and learning systems that enable farmers to make informed decisions under changing environmental and economic conditions.

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