



Diffusion of climate change technology, innovation and practices for small-scale farmers

SJRP: Agriculture value chain deep dive

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Problem statement

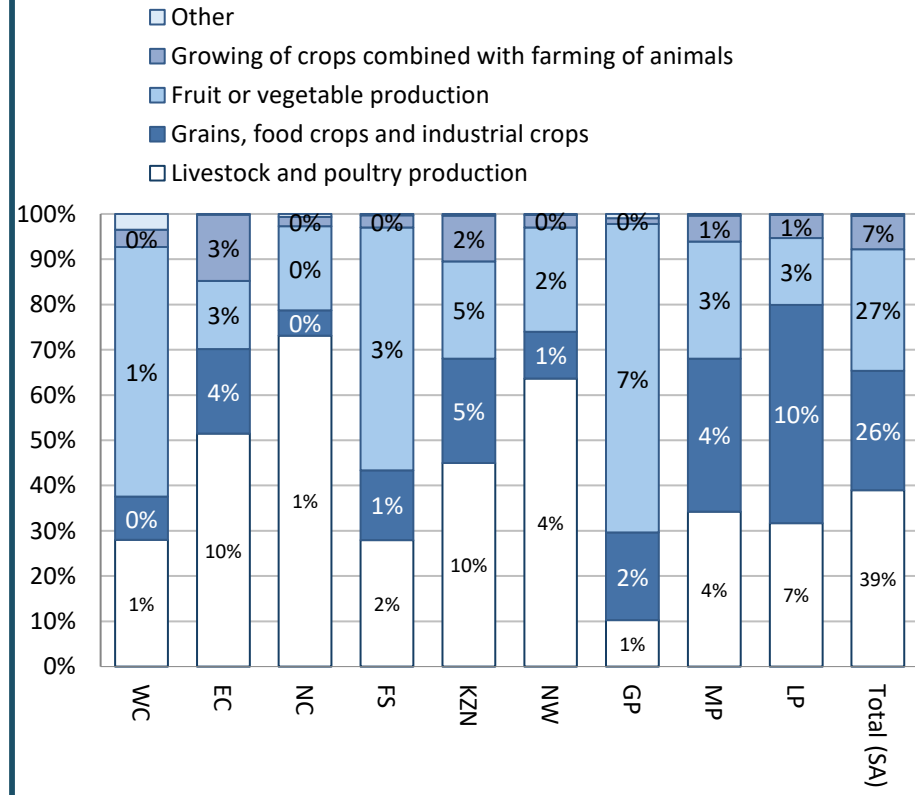
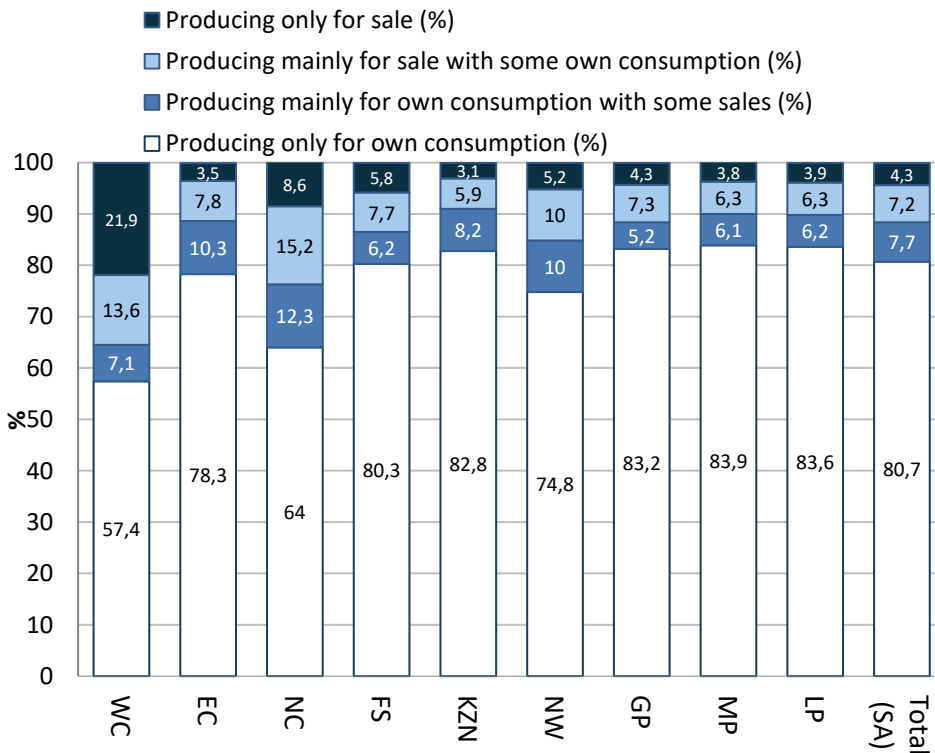
- ❑ Climate change has intensified vulnerabilities in the agricultural sector
- ❑ Increasing & frequent climate-events:-floods, drought etc.
- ❑ Several studies show a range of CC adaptation or mitigating tech/innovation is available in SA
- ❑ E.g (WB,2020) 75% Disruptive Agri-Tech (incl-smart farming) are operating in Kenya, SA, Nig).
- ❑ World Bank & CCARDESA (2022) 57 Agri-Tech firms in SA: digital advisory services, smart farming, etc.
- ❑ But diffusion and uptake remain uneven,
- ❑ LSF have access & adopted these technologies more rapidly (DEFF, 2019; Blignaut et al., 2025)
- ❑ By access to industry networks, government programmes, and finance
- ❑ Disproportionate burden, SSF still face barriers— fewer assets and limited access to formal credit + system environment

Overview 'SSF & Households in Agriculture'

- Census of Agricultural Households (2022) 2 463 215 (SSF and Households)
- 'Mainly own consumption'/subsistence = 80% or 1 988 825
- 'Mainly for sale with some own consumption' = 7.2% or 177 907
- **'Mainly for own consumption with some sales' = 7.7% or 189 371**
- Vulnerabilities (Consump = food insecurity) & (Sale = loss of income, inability to re-invest/debt, etc.) | Livestock & crops (loss of crops, declining production, pests, mortality)

Def and # of SFF
unclear est +/-
200 000

Households involved in Agriculture by Province

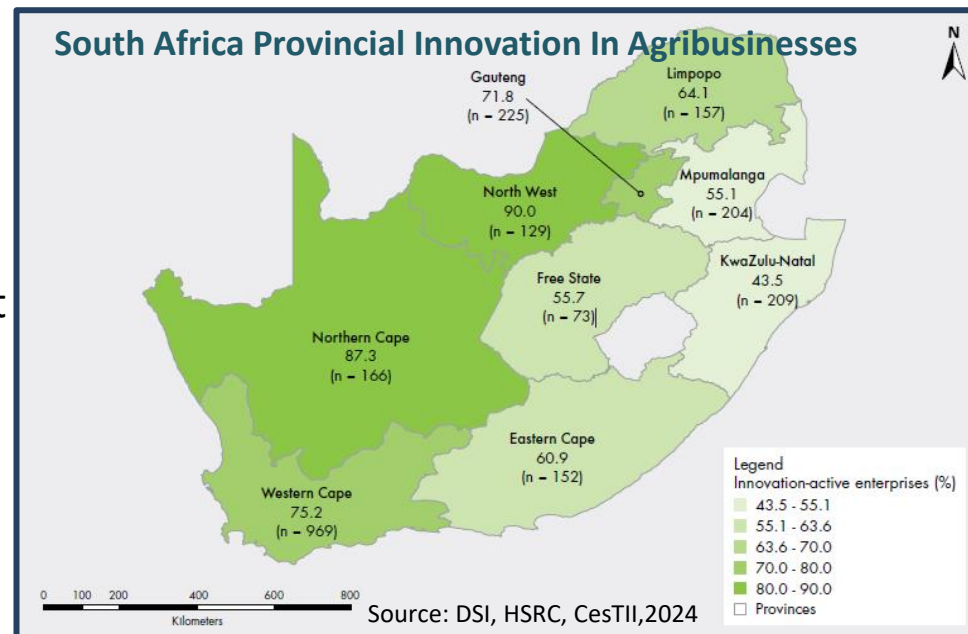
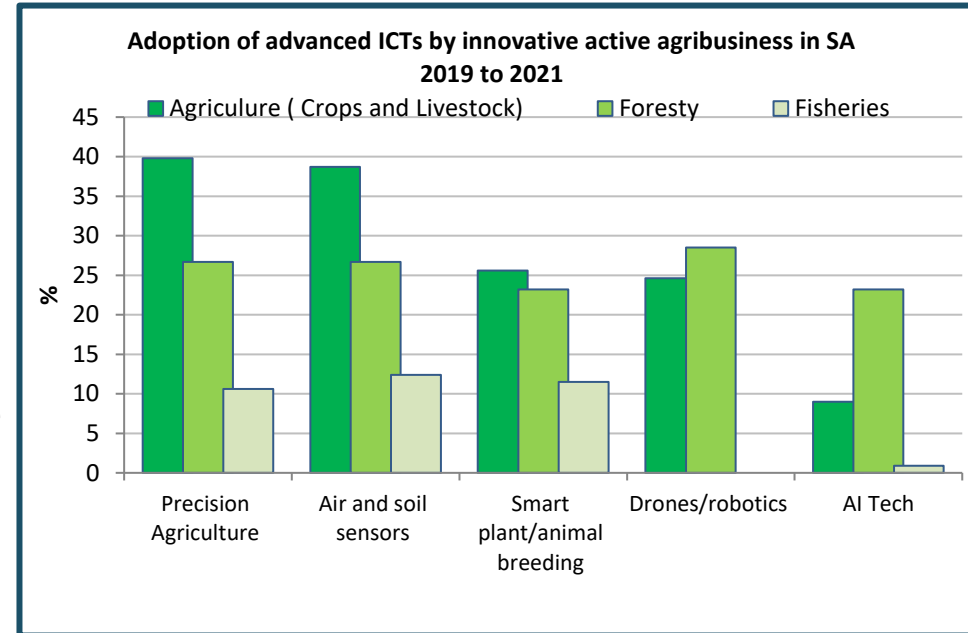


CC Adaptation & mitigating tech, innovation & practices

Type	Description: (CC –Floods, Drought, Frost, Heat, Pests, Diseases)	Level	Impact on farmers
Soil Conservation	☐ Improves the soil conditions (No till, reduced till, silt fences to combat erosion, mulching, compost, cover crops , nitrogen fixing)	Low to medium	Promotes resilience and adaptation
Climate Smart Practices	☐ Netting against weather risks , i.e., heavier hail and windstorms. ☐ Non-chemical methods for pest control - pest-predator plants/insects	Low	Mitigation, resilience, and reduce costs
Precision /smart agriculture	☐ Advanced, data-driven technologies Precise, efficient application ☐ Sensors, drones, satellites, monitoring devices to collect real-time info on soil , crop health, nutrients, weather patterns, pests, and diseases	Adv	Can improve efficiency, productivity
Biotechnology & gene editing	☐ High-yielding varieties drought-tolerant crop resilient livestock breeds DNA testing, used to improve cattle breeds	Adv	Resilience and mitigate pests, diseases, and early detection, adaptation
	☐ Alternative feeds - grazing land declines	Medium	
	☐ Pests - Vaccines - biosecurity tech Point of Care (POC) diagnostics kits	Adv	
Water management innovation	☐ Rainwater harvesting Smart irrigation systems Seasonal hydrological forecasting – IoT- Apps ☐ Soil-moisture enhancer products, i.e., hydrogel polymers	Medium to advanced	Water efficiency, adaptation
Climate-smart equipment, machinery, and infrastructure	☐ Climate Controlled Structures Greenhouses, plastic tunnels, etc. shading structures vertical farming	Medium	Productivity, resilience, and water efficiency Early disease detection
	☐ Solar drying – preserving Delay –ripening, Ethylene Adsorption Packaging.	High	
	☐ Drones & GIS - crop monitoring, precision agriculture. E.g. horticulture robotics vision for detection of pests, plant diseases, in orchards	Adv	
Weather initiatives	☐ Agrometeorology: Use of weather, climate information and monitoring. ☐ Geosciences: Animal biomass and grazing capacity mapping	Medium	Better forecast and prediction and prevention

Findings: Access to tech for SSF?

- ❑ **SSF with access to tech is not straightforward.**
- ❑ Several but fragmented studies by public and private (gov, NGOs, industry, academia, etc.)
- ❑ Complexity: some focus on crops, livestock or types of technology | add spillovers
- ❑ Difficulty in tracking cumulative impact
- ❑ Largest survey **DSI, HSRC, CESTII (2024)** – Large ‘South African Agricultural Business Innovation Survey’,
- ❑ Tech used – climate change-related Graph 1
- ❑ High adoption for NC (87.3%), NW (90.0%) | WC (75.2%), GP (71.0%) and LP (64.1%).
- ❑ Lesser in KZN (43.5%), | FS (55.7%) | MP (55.1%), with EC at (60.9%) (more SSF+ Households)
- ❑ Other: Stellenbosch, BFAP & Grain SA (Truter et al., 2025), precision farming in field crops
- ❑ Senyolo et al (2021) – Use of drought-resistant crops in Limpopo
- ❑ Conclusion: disparities in access and uptake – skewed to LSF , continuous barriers for SSF



Findings Initiatives: Govt, industry, NGOs & academia

Technology and Innovation Supported

Low to medium

- ☐ Conservation & smart agriculture practices
- ☐ Intercropping, multi-species cover crops
- ☐ Mulching, soil covers, micro tunnels, smart pockets, shaded nets

- ☐ Watercourses, terraces, trench-beds

High tech

- ☐ Aquaculture **diagnostic test kits** – Nile tilapia virus
- ☐ Genetics breeding resistance livestock
- ☐ Provision of drought-resistant and disease-free cuttings, planting material
- ☐ **Alternative feeds** – Black soldier fly protein feed

- ☐ Post-harvest **Decision support software** – i.e., Rain for Africa weather & climate Infor

- ☐ Bio-security App – visuals of diseases, link to the nearest diagnostic clinic

Advanced tech

- ☐ Precision farming: low flow irrigation
- ☐ GIS and drone-based mapping
- ☐ Livestock Identification and Traceability System (RFID tags)
- ☐ DNA Fingerprinting for Timber Small Growers

Change Agents

Profiled

Public sector

ARC

TIA

CSIR

Industry

Citrus Growers Association

Hortgro

SA-

Canegrowers

Grain SA

Academia and NGOs

UP

FABCO

Siyazisiza

Rethink Africa

Methods to Promote Diffusion

Practical training

- ☐ **Technical demonstration plots, field days (more successful)**

- ☐ Roadshows/outreach/awareness events

- ☐ Modifying traditional adaptations

Theory-based training

- ☐ Workshops and seminars

- ☐ Study/learning groups

- ☐ Knowledge transfer courses, i.e., Citrus Academy, -public extension

Centres supporting innovation

- ☐ Farmer support

centres

- ☐ le Farm Ru - Limpopo sustainable farming

- ☐ Agri-hubs, i.e., Ulundi – seed propagation

Test beds

- ☐ On-farm trials & Experimental plots

- ☐ Participatory variety trials

- ☐ Communities of Practice

Digital and print Media

- ☐ Manuals, e-books, fact files

- ☐ e-extension, Webinars & CA videos

Findings : Major challenges & constraints

Institutional Constraints

- ❑ Decline in extension officers: **2210 (2008/09) → 1 942 (2023/24)**
- ❑ Current **1:1400** vs Recommended ratio **1:250**

Infrastructure Constraints

- ❑ Lack of basic on-farm equipment to practice tech
- ❑ Ageing/poor water infrastructure (dams and canals)
- ❑ Limited cell-tower coverage & unreliable connectivity

Financial & Affordability Barriers

- ❑ High cost of tech (drones, DNA testing) or memberships
- ❑ Profitability concerns & immediate livelihood pressures

Knowledge & Skills Gaps

- ❑ Low digital literacy among farmers
- ❑ Difficulty interpreting predictive model outputs

Technological & Farm-Level Constraints

- ❑ Insufficient tailoring of tools to smallholder contexts
- ❑ Difficult terrain and spatial identification challenges

Climate & Biosecurity

- ❑ Shifting climate change complicates vaccination scheduling and treatment planning

DSI/HSRC/CesTII Large Agribusiness Survey

- ❑ Access to finance top ranking barrier (livestock +crops) (47.3%) and forestry (46.6%)
- ❑ Access to land (24.5%) and water (39.8%) are barriers to their innovation.
- ❑ **Aware** of government support to use facilities for innovation: 32% (livestock, crops, forestry, fisheries)
- ❑ **Awareness** of gov support for innovation: large 48% | medium 62% | small 34%

Conclusion and key takeaways

Climate change increases vulnerability: loss of incomes and food insecurity

Research shows SA harbours a wide range of climate-resilient technologies

Diffusion and uptake remain uneven between LSF and SSF

Small-scale farmers still face persistent challenges

Various but fragmented public and private initiatives. Difficult to assess cumulative impact

Conclusion: Pathways to foster diffusion & access & adoption

Pathway	Pathway
Bridge Data on small holders	☐ Leverage existing survey/infrastructure DSI HSRC\CESTII. Extend the frame to include SSF – provincial rollout? ☐ DoA ‘Farmer Register System’ ☐ Feedback of private initiatives into national statistics
Methods of diffusion	☐ Leverage routine farmer interactions with service providers, i.e., agro-dealers, tractor service providers, input suppliers, and financiers ☐ Scale up farmer field schools and demonstration plots, innovation hubs
Skills and Personnel	☐ PPP to expand extension capacity. E.g., CGA – Citrus Academy / SA Canegrowers – SASRI-DoA ☐ Expand digital e-extension services
Access to Climate Finance	☐ Promote cooperative/hub purchasing models for tech / memberships ☐ Leverage ‘Agricultural Trust & Statutory Levy Funds’ to support access to innovation & technologies
Improving Infrastructure Rollout	☐ Increase awareness of government facilities for innovation ☐ Invest in ICT infrastructure, connectivity, and power-storage solutions, ☐ Decentralised water solutions including boreholes,

National and Municipal Department of Agriculture and ARC | DSI /TIA | Business | NGOs | Farmer cooperatives | Academia | Other international org





Thank you

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