

AGRICULTURAL BUSINESS INNOVATION SURVEY 2019-2021



For a more innovative South Africa

*INCLUDING FARMING, FORESTRY AND FISHERIES

Modernising South Africa's agricultural sector through innovation



Results from the South African Agricultural
Business Innovation Survey, 2019 – 2021



Science and Innovation
Statistics South Africa



HSRC
Human Sciences
Research Council



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PREFACE

In 2019, the Centre for Science, Technology and Innovation Indicators at the Human Sciences Research Council (CeSTII-HSRC) undertook a baseline survey of innovation in South African commercial agribusinesses, covering the 2016-2018 period.¹

This pioneering research, planned and carried out in close consultation with sector stakeholders, including the Department of Science and Innovation (DSI) and Statistics South Africa, yielded baseline results tabled at a virtual multi-stakeholder forum in November 2021. With wide representation from the private and public sectors, the media and academia, the forum provided a platform for policy debate, the coordination of South Africa's agricultural innovation system, productivity and efficiency. It highlighted the vital role of data and evidence to inform decision-making across the system. The Agriculture and Agro-processing Sector Master Plan (2022), as well as the DSI's Science, Technology and Innovation Decadal Plan (2022-2032), were reinforced as the policy and planning coordinates for which agricultural innovation research evidence would increasingly play a vital role.²

In August 2023, after the conclusion of fieldwork and data collection for South Africa's second Agricultural Business Innovation Survey for the 2019-2021 period, CeSTII-HSRC researchers and DSI officials met with stakeholders to reflect on priorities for agricultural innovation in South Africa. These included sector-related policy issues, the negative consequences of climate change and low productivity, underscoring the need for accurate data to guide policy action.

The analysis contained in this report, situated at the research-policy nexus, supports greater alignment of evidence and indicators with recent developments in innovation and South African agricultural policy. It also reflects on the current innovation policy mix with its focus on sustainable and inclusive development, and the imperatives to achieve food security and global competitiveness.

In the context of South Africa's evolving agribusiness environment, the survey data, and the analysis presented here, contributes to the innovation-driven modernisation of the agricultural sector, envisioned by the National Development Plan.

The report provides agribusiness leaders, extension workers, industry association executives, economists, and policy implementers with insight into the state of innovation in agriculture, including forestry, farming and fisheries agribusinesses. Using the data it provides, actors can benchmark their activities against those of other agribusinesses and industries, learn more about the evolving national innovation landscape, and develop evidence-informed action plans to strengthen the sector. Agribusiness role players can also use the report and its analyses in ongoing planning for R&D, policy development, industry coordination initiatives and business investments.

¹ Available for download at <https://hsrc.ac.za/about-cestii/business-innovation-surveys/>

² Various national governmental role-players were involved in the preparation of the Master Plan, including the Department of Agricultural, Land Reform and Rural Development, the National Agricultural Marketing Council, and the Department of Trade, Industry and Competition.

DEFINITIONS



Agribusiness:

This is an agglomerative term used to describe the agriculture (animal and crop farming), forestry and fisheries businesses in South Africa.



Agriculture:

"The science, art, or practice of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation and marketing of the resulting products ("agriculture," Merriam-Webster, n.d.)



Fisheries:

"The science of producing fish and other aquatic resources to provide human food, although other aims are possible, such as sport or recreational fishing, obtaining ornamental fish, or developing fish products, such as fish oil" (IGI Global, n.d)



Forestry:

The science and practice of planting and producing and managing trees, forests, and their associated resources for human benefit (adapted from IGI Global, n.d)



Innovation:

The definition used is from the OECD's Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. It is defined as, "a new or improved product or process (or combination thereof) that differs significantly from the units' previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)." This differs from the definition used in the previous South African Agricultural Business Innovation Survey, 2016-2018, derived from the third edition of the Oslo Manual (OECD 2005).³ The 2018 Oslo Manual combines business innovations to include process innovations and organisational as well as marketing innovations.



Product innovation:

Product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market.



Business process innovation:

Business process innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use by the firm.



Innovation activities:

Innovation activities include all developmental, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm.

³ The third edition of the Oslo Manual (2005) included four types of innovation that businesses introduced namely: product innovation (goods and/or services), process innovation, organisational innovation and marketing innovation.



Digital-based innovations:

Digital-based innovations include product or business process innovations that contain ICTs, as well as innovations that rely to a significant degree on information and communication technologies (ICTs) for their development or implementation (OECD, 2018).



Innovation-active firm:

An innovation-active firm is a firm engaged in innovation at some time during the observation period in one or more activities to develop or implement new or improved products or business processes for an intended use. Both innovative and non-innovative firms can be innovation-active and a firm that had only ongoing or abandoned activities is still innovation-active.



Innovative firm (or innovator):

An innovative firm (or innovator) is a firm that reported one or more innovations within the reference period. This applies equally to a firm that is individually or jointly responsible for an innovation. Innovation activities can result in an innovation or they can be ongoing, postponed or abandoned. Not all innovation activity results in an innovation.



Non-innovation active firm:

A non-innovation active firm is a firm without any innovation activities.

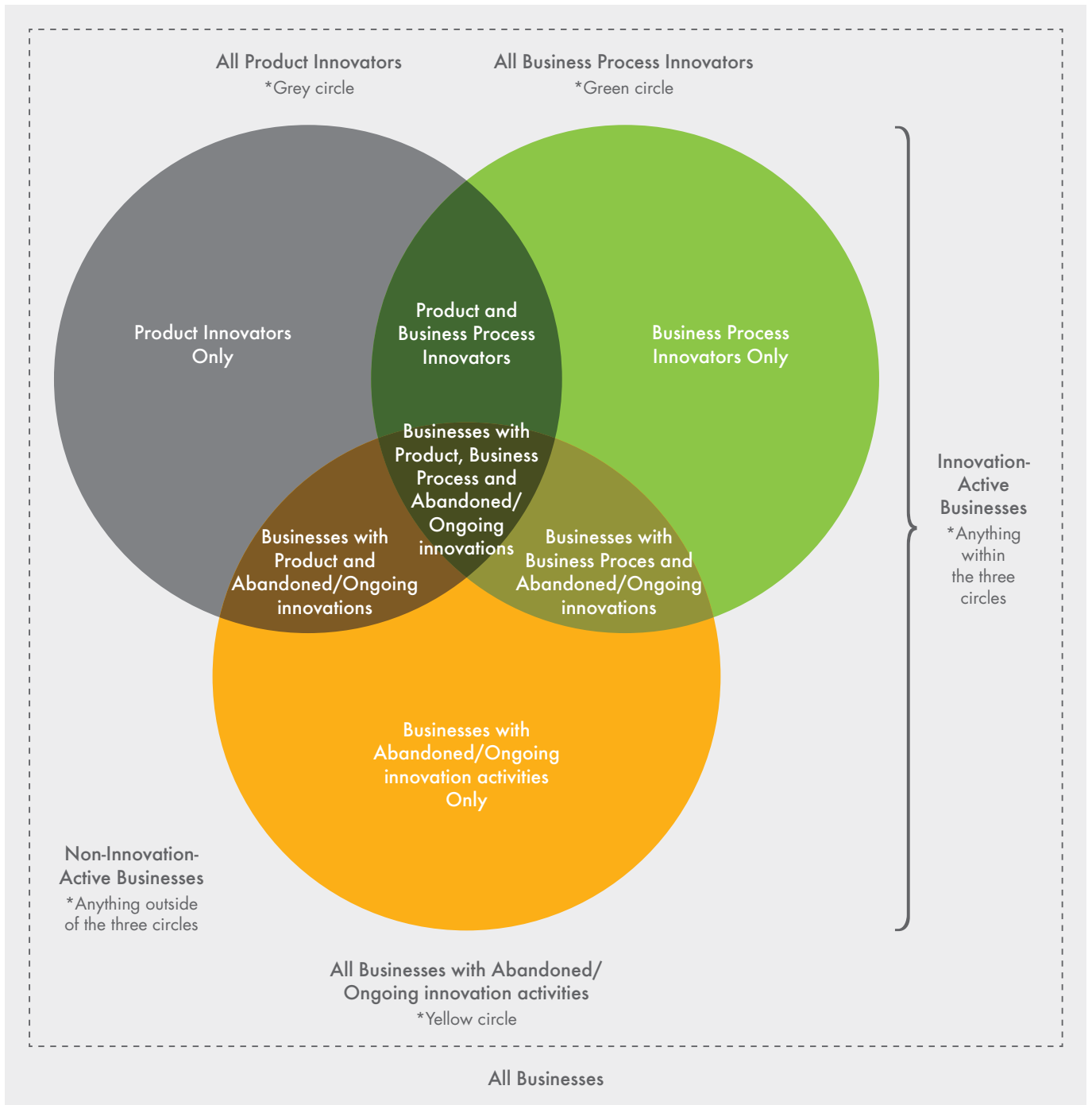


Firm sizes:

The criterion to determine size classes was turnover. Table 1 classifies firm sizes used in the AgriBIS 2019-2021, according to their annual turnover. Note that this pertains to commercial agribusinesses and does not include smallholder and subsistence farming businesses.

Table 1: Business size definition

Firm size	Annual turnover
Large businesses	> R40 000 000
Medium-sized businesses	R24 000 000 - R40 000 000
Small businesses	R4 000 000 - R24 000 000
Very small businesses	≤ R4 000 00



WHAT THE RESULTS COVER

SURVEY REFERENCE PERIOD:



AGRIBUSINESS SUBSECTORS COVERED:

SOUTH AFRICAN COMMERCIAL AGRICULTURE, FORESTRY AND FISHERIES BUSINESSES ("AGRIBUSINESSES")*

"AGRICULTURE SUBSECTOR"

(includes farming of crops, animals or mixed)



"FORESTRY SUBSECTOR"



"FISHERIES SUBSECTOR"



TOTAL NUMBER OF BUSINESSES:

SOUTH AFRICAN COMMERCIAL AGRICULTURE, FORESTRY AND FISHERIES BUSINESSES:

AGRICULTURE SUBSECTOR: 2 856

FORESTRY SUBSECTOR: 276

FISHERIES SUBSECTOR: 274



3 405

TOTAL NUMBER OF PEOPLE EMPLOYED:



404 003

BUSINESS SIZES:



LARGE (889)



MEDIUM (391)



SMALL (1 663)



VERY SMALL (461)

TYPES OF INNOVATION:



PRODUCT INNOVATION

BUSINESS PROCESS INNOVATION

NOVELTY LEVELS:



NEW TO THE FIRM
NEW TO THE MARKET
NEW TO THE WORLD

* For the purposes of this report, the term agribusiness/es refers to the agglomeration of companies surveyed within the agriculture, forestry and fisheries sub-sectors. Note that the number of businesses cited in this infographic refers to the population size and not the sample size.

EXECUTIVE SUMMARY

Key results from the South African Agricultural Business Innovation Survey, 2019-2021

#1 The Covid-19 pandemic had a significant impact on how agribusinesses innovated during 2019-2021.

- The global pandemic created notable disruptions and reprioritisation of innovation efforts, mostly in the forestry subsector, followed by the agriculture (animal and crop farming) and fisheries subsectors. This included putting innovation activities or projects on hold delaying or causing them to be abandoned.

#2 More than two thirds of South African agribusinesses were actively involved in innovation activities.

- Of all agribusinesses in the target population, 67.1% engaged in innovation activities.
- The remaining 32.9% of agribusinesses did not engage in any innovation activity, i.e., they were non-innovation active.

#3 Medium-sized agribusinesses had the highest innovation rate and very small agribusinesses had the highest proportion of non-innovation-active businesses.

- The highest proportion of innovation-active businesses (72.9%), was observed among medium-sized agribusinesses, followed by large agribusinesses (70.8%).
- Small businesses had a moderately lower innovation activity rate of 66.4%. Meanwhile, 57.2% of very small agribusinesses were classified as innovation-active.
- Very small businesses had the highest proportion of non-innovation-active businesses (42.8%), while medium-sized businesses had the lowest proportion of agribusinesses in this category (27.1%).

#4 Business process innovation was the most prevalent type of innovation across all the agricultural subsectors.

- The proportion of agribusinesses that implemented business process innovation (63.6%) was higher than the proportion that implemented product innovation (38.5%).
- Business process innovation was more prevalent in the fisheries (71.3%) and agriculture (animal and crop farming) (66.6%) subsectors than in the forestry (24.5%) subsector.
- The forestry subsector presented a different picture, with a higher proportion of businesses performing product innovation (33.7%) than business process innovation (24.5%).

#5 There was wide diversity across the agribusiness subsectors that performed business process innovations.

- In the fisheries subsector a higher proportion of businesses implemented business process innovations to improve yields, while for the forestry subsector there was higher prevalence of implementation of business process innovations to address climate change (86.9%) and to mitigate the negative effects of climate change (65.8%).

#6 Novelty of product innovations differed across the three subsectors of agribusinesses.

- Across the three subsectors, a considerable proportion (66.5%) introduced innovations new to the firm and a lower proportion (34.7%) introduced product innovations new to the South African market. New to the world innovations were the least common (6.4%) across all the subsectors.

#7 Training, acquisition of machinery and equipment and acquisition of computer software were the top three innovation activities innovation-active agribusinesses engaged in.

- The three most popular innovation activities innovation-active agribusinesses engaged were training (60.1%), acquisition of machinery and equipment (50.1%) and acquisition of computer software (49.5%).
- Other innovation activities including intramural R&D (35.8%), extramural or outsourced R&D (25.5%), and acquisition of agricultural land (19.6%).

#8 Innovation-active businesses varied in their investment in innovation activities based on size.

- Over half of innovation expenditure by large businesses were directed to in-house research and development (56.1%).
- A considerable proportion of medium-sized businesses also conducted in-house R&D (43.2%) and made a comparatively higher investment in various other innovation activities (54.8%) in comparison to their larger counterparts.

#9 Northern Cape, North West, and Western Cape provinces had the highest proportion of innovation-active agribusinesses.

- The top three provinces that had the highest proportions of innovation-active agribusinesses were Northern Cape (87.3%), North West (90.0%) and Western Cape (75.2%).
- These were followed by KwaZulu-Natal (43.5%), Free State (55.7%) and Mpumalanga (55.1%).

#10 The most widely adopted advanced ICTs were precision agriculture, air and soil sensors, and smart plant/animal breeding with almost 40% of all innovation-active agribusinesses using or implementing these technologies.

- Drones/robotics, blockchain technologies, and other types of advanced technologies enjoyed varying levels of adoption across the different subsectors.
- Over 50% of innovation-active businesses involved in growing cereals and fruits adopted precision agricultural technologies. Additionally, a high number of innovation-active businesses in the production of livestock adopted precision livestock farming (PLF) technologies.

#11 Adoption of advanced ICTs anticipated in 2022-2024.

- The gradual adoption of AI technologies is anticipated for 2022-2024, with livestock farming indicating the highest future adoption rates (27.0%) and agricultural and animal husbandry services the lowest (4.7%).
- Moderate anticipated adoption rates were observed for drones/robotics, smart plant/animal breeding technologies, and other advanced technologies. Blockchain technologies showed minimal anticipated future adoption across the subsectors.

#12 A higher proportion of employees worked in innovation-active businesses.

- The highest percentage of employees worked in innovation-active businesses, notably in the agriculture (animal and crop farming) subsector (82.4%), fisheries (69.8%) and forestry (59.1%).

#13 The proportion of employees with degrees or diplomas was higher among innovation-active businesses.

- This was most prominent in the fisheries subsector (5.8%), followed by the agriculture (animal and crop farming) subsector (5.1%). Forestry reported the lowest proportions (2.6%).

#14 The proportion of male employees was higher than the proportion of female employees involved in innovation activities in innovation-active businesses.

- 57% of male employees were engaged in innovation activities, while 43% of female employees were involved in innovation activities in innovation-active businesses.

#15 Agribusinesses across the three subsectors prioritised varied innovation outcomes.

- In the agriculture (animal and crop farming) subsector, approximately 22.7% of businesses rated the importance of increased revenue resulting from innovations as “high”.
- Reduced costs resulting from innovations were rated higher by forestry businesses (21.4% of innovation-active businesses) compared to agriculture (13.2%) and fisheries (10.6%).
- Agriculture (animal and crop farming) businesses placed higher importance on soil fertility, with 26.2% of businesses rating its importance as “high”.
- 41.0% of forestry businesses highlighted the importance of increased water preservation
- Biodiversity preservation was considered highly important by 16.7% of agriculture businesses compared to forestry (3.5%) and fisheries (1.8%).

#16 Agribusinesses made use of internal sources of information, external market resources and external institutional sources for their innovation.

- In the forestry subsector the highest proportion of businesses (73.3%) rated sources within their enterprise or enterprise group as highly important for innovation. Notably fewer agriculture (animal and crop farming) businesses (40.8%) considered internal sources as significant.
- Agriculture (animal and crop farming) and forestry subsector businesses both rated the importance of suppliers of equipment, materials, components, or software (41.0% and 46.3%, respectively) and clients or customers (36.9% and 42.8%, respectively) as highly important sources of information for innovation.

#17 Many agribusinesses preferred to lead in product innovation independently, some engaged in collaborative approaches and adaptation of existing innovations.

- Across subsectors a large majority of businesses opted to develop innovations within their own firms. Agriculture (animal and crop farming) had the highest percentage of innovation-active businesses, and mainly relied on their own enterprise for product innovation (55.4%).
- Collaborative product innovation included collaboration with other enterprises or institutions (12.8%), collaboration with other enterprises in their enterprise group (14.1%), and collaboration with consultants, commercial labs, or private R&D institutes (16.7%).

#18 Awareness of, and application for government support was relatively low among innovation-active agribusinesses.

- Overall awareness of government financial support for innovation was moderate among innovation-active businesses with a total of 49.1% awareness rate. However, application for government financial support remained lower than 20% in total.
- Awareness of government research facilities for innovation, was also relatively low, with 32.5% of all innovation-active businesses indicating awareness. Of these, 17.7% applied for their use.

#19 Barriers to innovation included human capital, technological and market access barriers.

- Businesses in the forestry subsector faced significant challenges related to labour shortages. 87.6% of businesses rated the lack of access to labour as a highly important factor impeding innovation.
- Access to ICTs was rated a highly important barrier for approximately 15% of businesses in agriculture (animal and crop farming) and 17.9% of forestry businesses.

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INTRODUCTION

Contextualising the modernisation of agriculture in South Africa

The South African agricultural sector is characterised by a mixture of large-scale commercial farms and smallholder subsistence farms, all contributing at different scales to food and nutrition security, export performance, employment and livelihoods. Agriculture now accounts for approximately 3% of gross domestic product (GDP) and 5% of total employment and exports, respectively, and South Africa's agribusinesses are among the most productive and competitive in the world (DALRRD, 2022).⁴

In 2022, primary agricultural production in South Africa was valued at R419 765 million, with an estimated R145 048 million contribution to the country's GDP (DALRRD, 2022).⁵ As a consequence, agriculture's GDP share increased, rising from 2.2% in 2009 to 2.4% in 2022. Primary agriculture is a major economic sector in South Africa, even though it accounts for a very small percentage of the country's GDP. Particularly in rural areas, agriculture continues to be a major employer and a considerable source of foreign currency earnings. As a result of its backward and forward linkages to other sectors, agriculture plays a significant yet indirect role in the economy. Purchases of products like chemicals, fertilisers and tools link back to the manufacturing sector, but the provision of raw materials creates forward connections to the manufacturing sector. The industry uses over 70% of agricultural production for intermediate goods. For these reasons, agriculture is an essential industry and a major development driver for the whole economy.

Despite South Africa's abundant land resources, about 13% of which is suitable for farming, the agricultural sector has faced a plethora of challenges in recent decades, impacting its influence on the economy and broader society. These include drought and extreme weather events, rising input costs, logistics bottlenecks and load shedding, increased global competition, and low levels of government support. All these challenges point to the immediacy of innovation as a medium to advance the overall performance of sector value chains in line with the objectives set out in the Agriculture and Agro-Processing Master Plan.⁶

Recent innovation policy developments in South Africa reinforce the centrality of innovation as a driver of inclusive and sustainable development. Central to this are the principles outlined in both the 2019 White Paper Policy on Science, Technology, and Innovation (STI) and its accompanying Science, Technology and Innovation Decadal Plan 2022-2032. In particular, the White Paper highlights the importance of technological innovation for the modernisation of agriculture in South Africa and its increased global competitiveness.⁷ The adoption of advanced technologies such as precision agriculture, robotics and other related information and communication technologies (ICTs), together with implementation of sustainable farming and land use practices can maximise productivity on farms, reduce wastage, minimise negative environmental impacts and reduce greenhouse gas emissions.

South African innovation policy and planning also emphasises the importance of proactively addressing challenges facing the sector, such as loss of arable land, high input costs, low technological innovation, and inadequate advisory services, to ensure the long-term viability of the sector. The AgriBIS 2019-2021 report is structured around four key dimensions derived from three essential documents: the 2019 White Paper, the 2022-2032 STI Decadal Plan, and the OECD's Oslo Manual 4 for measuring innovation (Figure 1):

1. Business innovations (product, process, novelty, innovation activities)
2. Digital-based innovations (adoption of new technologies for improved farming practices and enhanced productivity – i.e. adoption of advanced ICTs)
3. Human capital development and skills development
4. Sustainability initiatives for equitable and sustainable growth.⁸

⁴ DALRRD: 2022 Economic Review of the South African Agriculture.

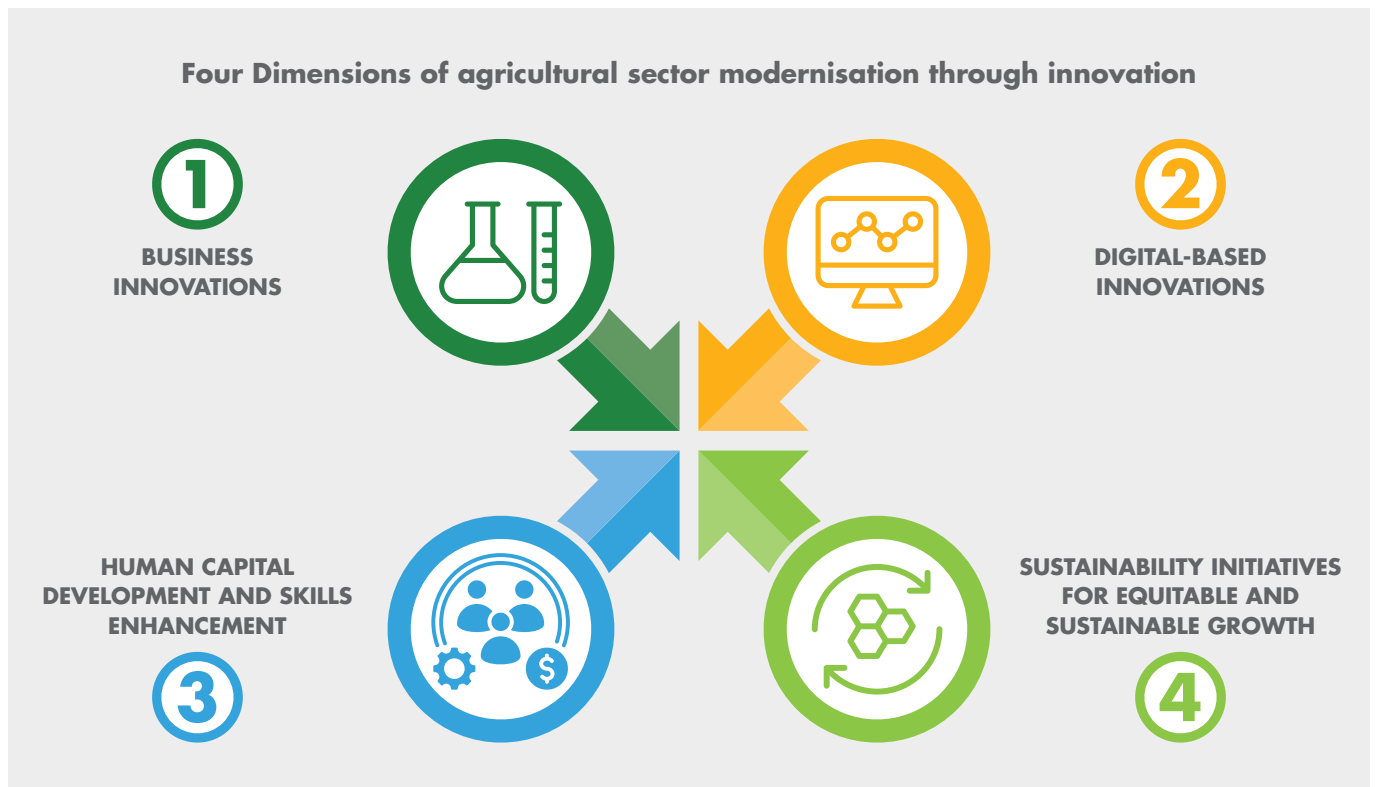
⁵ In nominal terms (income levels) and not real terms (production levels).

⁶ Even after the implementation of sector reforms in the mid-1990s, government support has remained consistently below 5% of farm profits.

⁷ DSI's 2019 White Paper notes that: "Agriculture will be modernised to increase global competitiveness (for instance with precision agriculture approaches)" and with respect to the 4IR: "South Africa can benefit from these emerging market opportunities by using technology to modernise sectors such as agriculture and mining, and increase exports to growing markets in Africa and other emerging economies".

⁸ The Decadal Plan notes that sustainability and the circular economy remain a key Societal Grand Challenge. It includes STI focus areas such as sustainable and modernised agriculture. (Decadal Plan, Ch. 6).

Figure 1: Conceptualising the dimensions of agricultural sector modernisation through innovation



Dimension 1: Business innovations

To explore this dimension through the report, our analysis focuses on how agribusinesses innovate using key indicators defined by the OECD’s Oslo Manual 2018. These include, the rate of innovation, types of innovation (including product and business process innovations), and the novelty levels of innovations (whether new to the firm, new to the market, or new to the world) as well as the different innovation activities performed by agribusinesses.

The first dimension of the conceptual model is also guided by the White Paper’s emphasis on modernising productive sectors like agriculture through innovation. The White Paper explicitly states that **“it remains necessary...to modernise and strengthen productive sectors such as manufacturing, mining, and agriculture”**.

Dimension 2: Digital-based innovations

The second dimension of the conceptual model centres around the adoption of digital-based innovations to improve farming practices and enhance productivity. The White Paper emphasises this by stating: **“There is potential to increase the productivity of the South African economy through...information and communications technology (ICT).”** The successful modernisation of agriculture depends on the widespread adoption of advanced ICTs by farmers. Some of the advanced ICTs surveyed included precision agriculture, drones and robotics and sensor technologies. The use of these advanced ICTs to meet circular economy principles necessitates a detailed analysis of how these technologies are being used within the agricultural sector to further inform policy supporting the modernisation of agriculture through the adoption of ICTs.

Dimension 3: Human capital development and skills enhancement

The White Paper stresses the significance of skills development in the context of modernising sectors such as agriculture, stating: **“The government...will design instruments to re-skill workers, where appropriate.”** Given that the agriculture sector has a substantial number of low-skilled employees, there is a recognised need for proactive measures to equip the workforce with the skills required for modern agriculture.

This serves as a guide to analyse human capital development and skills development, which can play a critical role in the successful modernisation of agriculture. This is particularly relevant as the White Paper consistently advocates for skills development, regulatory reform, and investment in ICT to drive economic productivity.

To operationalise this dimension, the report analyses several indicators related to the demographic characteristics of employees engaged in innovation activities, including race, gender and age and examines the distribution of skilled employees within the agricultural sector. This provides an understanding of the current state of human capital and skills development in South African agriculture, with valuable insights for policymakers and stakeholders invested in the sector's modernisation.

Dimension 4: Sustainability initiatives for equitable and sustainable growth

The DSI's STI Decadal Plan 2022-2032 highlights the essential role of science, technology, and innovation (STI) in achieving circularity in the agricultural sector. The model's fourth dimension aligns with this emphasis on greening the economy and adopting sustainable practices, as highlighted in the White Paper. Specifically, the Decadal Plan notes that ***"STI interventions offer opportunities for waste elimination and chemical pollution reduction by embracing biorefining innovation opportunities"***.

The Decadal Plan also notes that: ***"For agriculture, STI contributions can drive the circularity of the sector by adopting reformative agricultural practices and improving resource utilisation through the implementation of precision and digital tools that are central to the regenerative model of the circular economy."*** Equally, the White Paper states that, ***"Greening the economy will be an important adjunct to such efforts."*** Furthermore, it notes that, ***"STI contributions can drive the circularity of the sector...through the implementation of precision and digital tools."*** This highlights the interconnectedness of green agricultural practices, technological innovation, and circular economy principles in promoting sustainable agricultural practices.

The fourth dimension aims to understand how innovation contributes to sustainability initiatives and how the outcomes of innovation foster circularity and sustainable growth in South Africa's agriculture. For instance, the report examines the extent to which agribusinesses consider the outcomes of innovation related to environmental sustainability, such as improved soil fertility and reduced greenhouse gas emissions. This analysis sheds light on where policymakers can implement STI interventions to promote a circular and sustainable agriculture in South Africa.

Together these dimensions, which are complementary and mutually reinforcing, support the path to the ongoing modernisation of South African agriculture in a way that not only increases productivity and improves food security but also leads to inclusive and sustainable development.

Report structure

Drawing from this policy context, and the conceptualisation of modernisation, the report showcases key results of the South African Agricultural Business Innovation Survey, 2019-2021 in two parts:

- **Part 1** examines how the agricultural sector is using innovation to drive modernisation through the four dimensions in Figure 1. It also reflects how the Covid-19 pandemic affected agribusiness innovation activities during the reference period 2019-2021.
- **Part 2** discusses the enablers and barriers of innovation in the sector. Data on collaboration and cooperation efforts in support of innovation, how innovation impacted the ability of agribusinesses to access new markets and the potential of innovation to unlock export opportunities in international markets, is also presented.



PART 1: MODERNISATION THROUGH INNOVATION



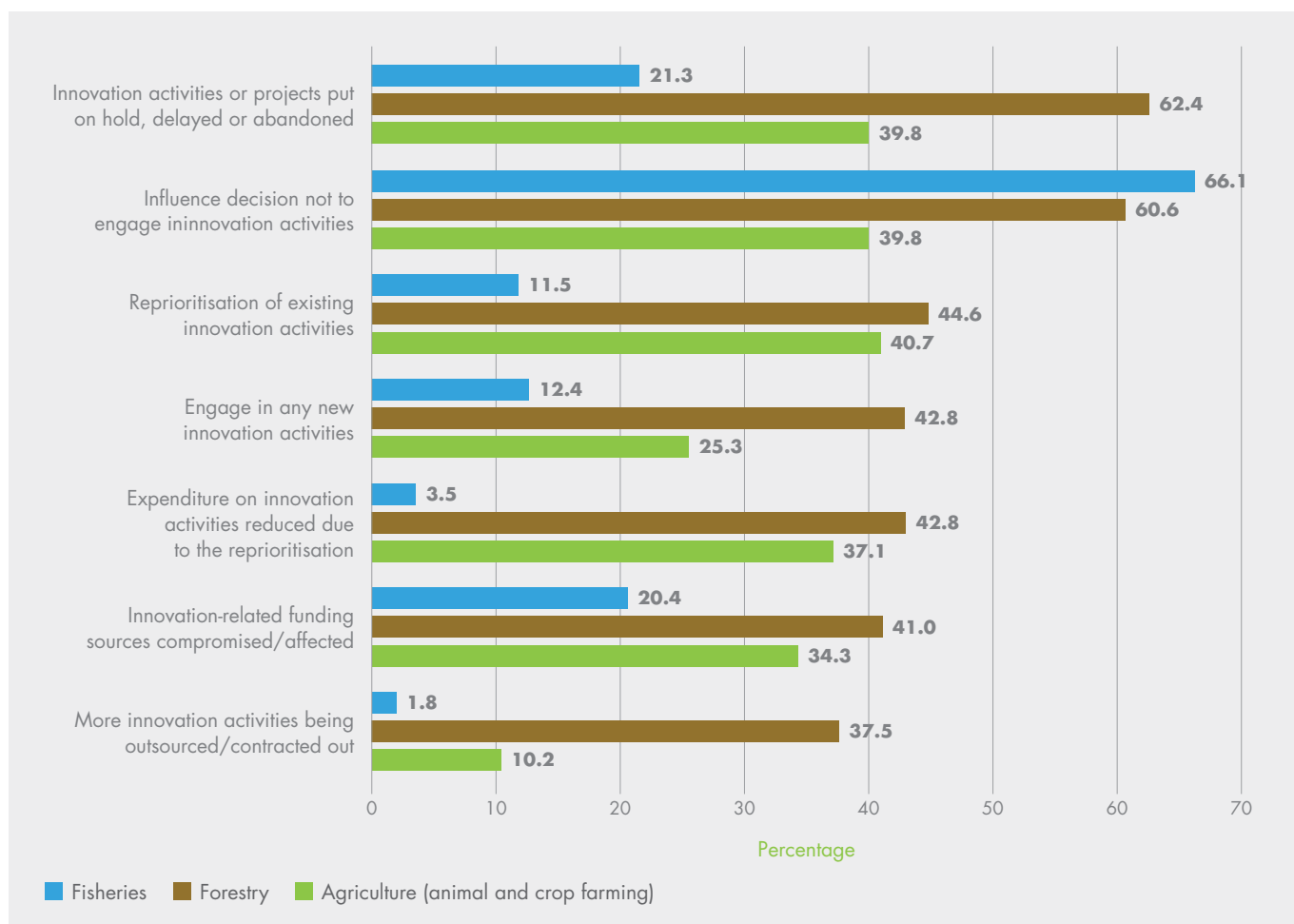
Dimension 1: Business innovations

Characteristics of the agricultural innovation landscape in South Africa, 2019-2021

The Covid-19 pandemic had a significant impact on how agribusinesses innovated during the period 2019-2021 and the report recognises the profound impact of the pandemic on the sector when interpreting the survey results.

The forestry subsector was the most significantly affected in terms of innovation challenges, while the agriculture (animal and crop production) and fisheries subsectors, despite differences in innovation profiles, both experienced notable disruptions and reprioritisation of innovation efforts. Figure 2 illustrates how the Covid-19 pandemic affected innovation activities within the different subsectors of South Africa's agricultural sector.

Figure 2: Effects of Covid-19 on innovation activities, 2019-2021⁹



Source: Appendix table A22.2

⁹ In the context of Covid-19, innovation activities or projects categorised as put on hold, delayed or abandoned refer to those put on hold, delayed, or interrupted temporarily due to pandemic-related challenges. These are distinct from completely abandoned innovation initiatives, with this distinction applicable only for the reference period impacted by the pandemic.

Forestry stood out with the highest proportion of businesses with innovation activities or projects put on hold, delayed or abandoned due to the pandemic (62.4%). Agriculture (animal and crop farming) businesses also experienced a significant impact (39.8%), while fisheries had a relatively lower proportion of businesses affected (21.3%).

With respect to the decision not to engage in innovation activities, all three subsectors were significantly impacted, however, the forestry and agriculture (animal and crop farming) subsectors were most affected with 66.1% and 60.6% of businesses, respectively, not engaging in innovation activities because of the pandemic.

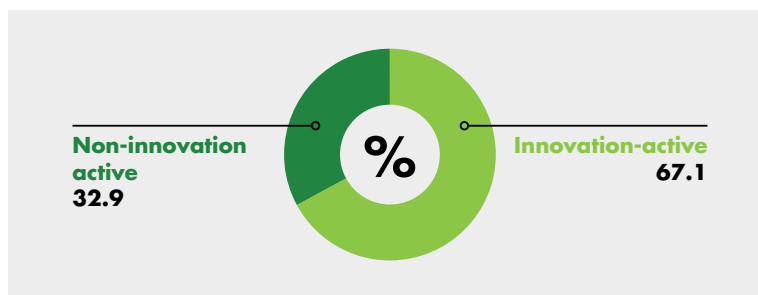
A relatively lower proportion of businesses in all subsectors engaged in new innovation activities during the pandemic, with forestry having the highest proportion (42.8%). The data indicates that while some businesses continued their innovation efforts, many adopted a cautious approach to engaging in new innovation activities during the pandemic.

The pandemic also affected innovation-related funding sources in all subsectors, to varying degrees. Agriculture and forestry experienced relatively higher impacts on their innovation-related funding sources (34.3% and 41.0%, respectively), while fisheries experienced a lower impact (20.4%). The agriculture (37.1%) and forestry (42.8%) subsectors experienced a significant expenditure reduction for innovation activities due to funding challenges. In particular, forestry (37.5%) saw a substantial proportion of businesses outsourcing or contracting out innovation activities during the pandemic.

The agricultural sector’s innovation rate in South Africa

During 2019-2021, approximately 67.1% of all agribusinesses engaged in innovation activities. These encompassed a range of activities, including scientific, technological, organisational, financial and commercial initiatives, all aimed at introducing new innovations to the market. Figure 3 illustrates the split between innovation-active versus non-innovation-active agribusinesses.

Figure 3: Innovation-active versus non-innovation-active agribusinesses, 2019-2021



Source: Appendix table A1.2

Further disaggregation into the various subsectors that make up agriculture and the distribution of innovation-active and non-innovation-active businesses across these, highlights the heterogeneous landscape of innovation activity within South Africa’s agribusinesses. Figure 4 illustrates the distribution of innovation-active and non-innovation-active businesses within the agriculture, forestry and fisheries subsectors.

Figure 4: Distribution of South African innovation-active and non-innovation-active agribusinesses, 2019-2021



Source: Appendix table A1.2

Fisheries, with 73.2%, was the subsector with the largest share of innovation-active enterprises for the reference years 2019–2021, as shown in Figure 4. Agriculture (crop and animal farming) businesses were more likely to engage in innovation activity as compared to forestry businesses, with 69.4% of businesses classified as innovation-active, while only 36.2% of forestry businesses fell into the same category.

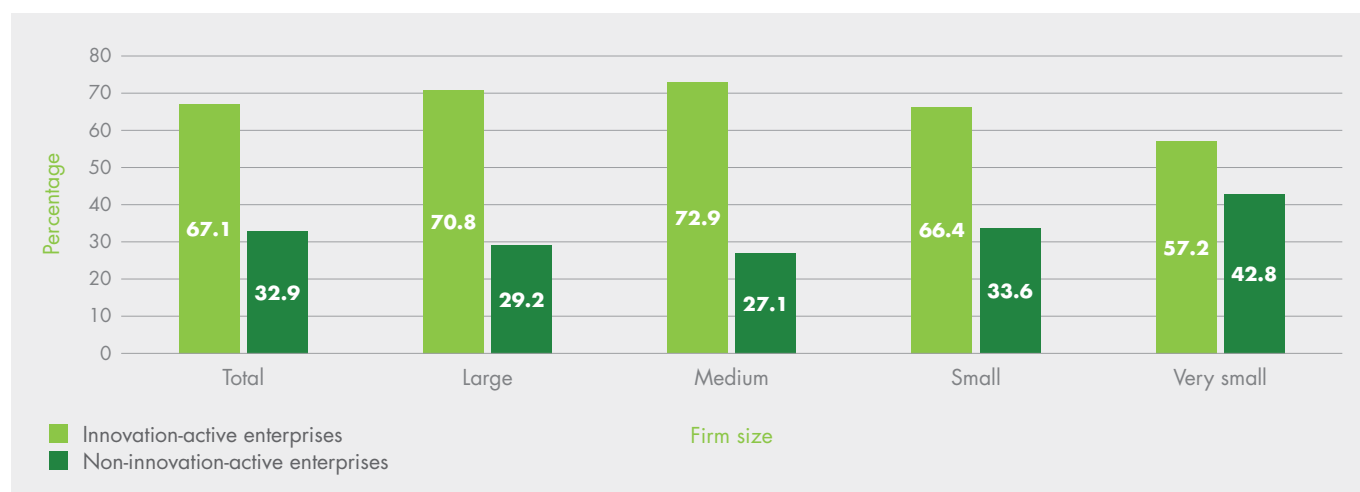
There was a notable contrast in the proportion of businesses not involved in innovation activity. Forestry accounted for a disproportionately large share of these businesses (63.8%), in contrast, agriculture (crop and animal farming) and fisheries businesses recorded lower percentages of non-innovation-active businesses, with 30.6% and 26.8%, respectively.

Size variations among innovation-active and non-innovation-active businesses

Medium-sized businesses reported a high rate of innovation activity, with 72.9% falling into this category. Large agribusinesses also reported a high proportion, with 70.8% classified as innovation-active, slightly higher than the total average of 67.1%.

In contrast, small businesses in the agricultural sector had a moderately lower rate of innovation activity than their larger counterparts of 66.4%, slightly below the sector’s total average of 67.1%. Meanwhile, 57.2% of very small businesses were classified as innovation-active.

Figure 5: Size distribution of South African innovation-active vs non-innovation-active agribusinesses, 2019-21



Source: Appendix table B1.2

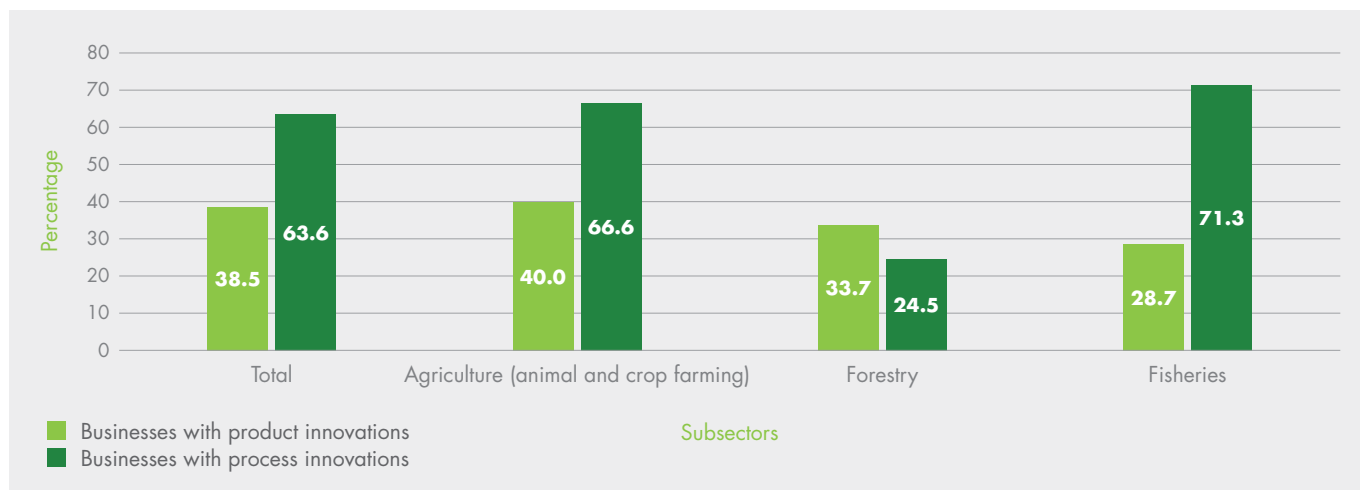
In terms of non-innovation-active businesses, Figure 5 highlights the reverse trend, with very small enterprises having the highest proportion and medium-sized businesses the lowest proportion of non-innovation-active businesses at 42.8% and 27.1% respectively.

Types of innovation implemented by agribusinesses

Businesses may implement two types of innovations—product and business process.¹⁰ Figure 6 highlights sector-specific patterns in the types of innovation and suggests that each sector has a unique innovation profile. Across the three subsectors, a significant proportion of businesses implemented business process innovation, with an overall total average of 63.6% compared to product innovation with 38.5%. Zooming into the three subsectors, the fisheries and agriculture (animal and crop farming) subsectors had higher proportions of businesses that implemented business process innovations than the forestry subsector at 71.3% and 66.6% respectively. On the other hand, the forestry subsector had a higher proportion of businesses that implemented product innovation (33.7%) than process innovation (24.5%).

¹⁰ Some businesses that implemented process innovations may also may have implemented product innovations.

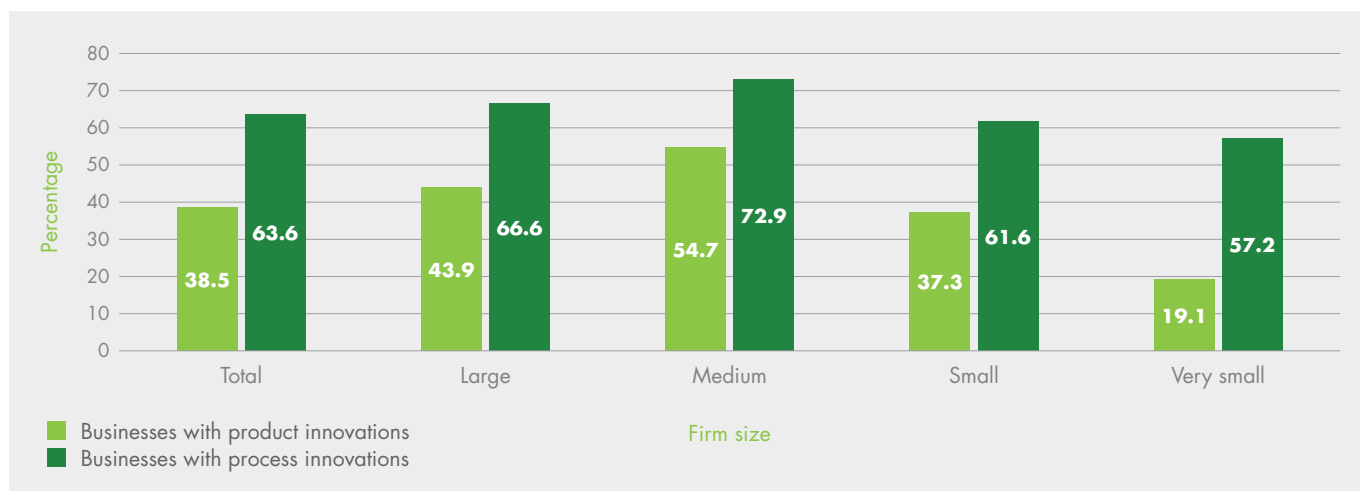
Figure 6: Percentage of South African agribusinesses that implemented product and process innovation, 2019-2021



Source: Appendix table A13.2

Across all sizes of business, the overall proportion of businesses with process innovations was higher (63.6%) than the proportion with product innovations (Figure 7). Medium and large businesses had the highest proportion of process innovations, with 72.9% for medium-sized businesses and 66.6% for large businesses. Small and very small businesses also performed more process innovations, but at a relatively lower percentages than the total average, with 61.6% and 57.2%, respectively.

Figure 7: Proportion of South African agribusinesses that implemented product and business process innovation, 2019-2021

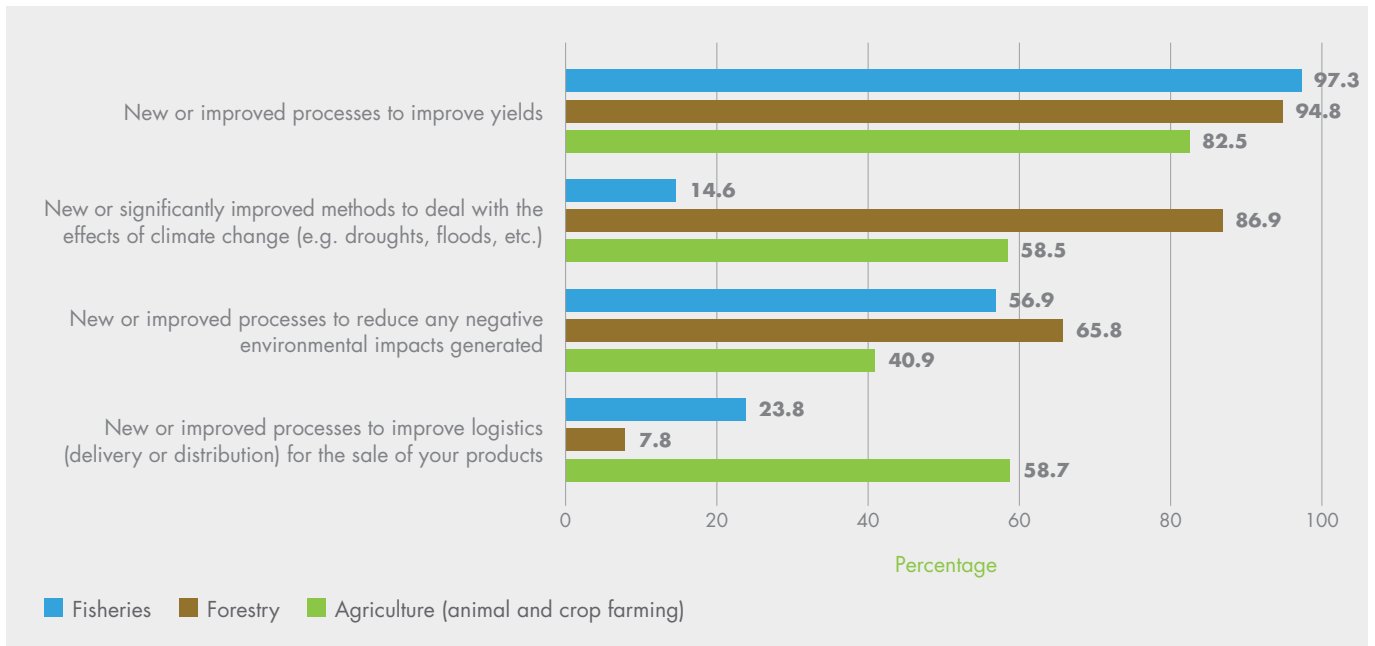


Source: Appendix table B10

Patterns of agribusiness process innovation

The survey results showcase the diversity among businesses that implemented specific process innovations within the three subsectors (Figure 8).

Figure 8: Specific process innovations by South African agricultural subsector, 2019-2021



Source: Appendix table A11

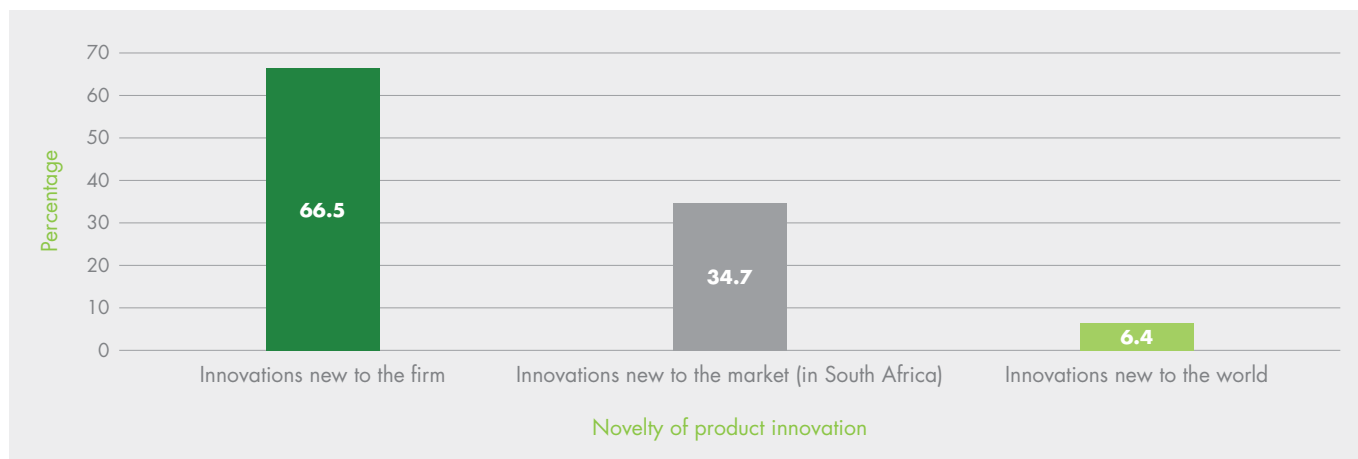
As illustrated in Figure 8 there was a high propensity to implement process innovations to improve yields across all three subsectors. Fisheries had the highest proportion of businesses that implemented specific innovations to improve yields at 97.3%. With the growing global focus on eco-friendly farming practices, businesses in South Africa’s agriculture, forestry, and fisheries subsectors also recognised the importance of minimising their environmental footprints.

All three subsectors showed a strong commitment to reducing negative environmental impacts through process innovations, with percentages ranging from 40.9% in agriculture to 65.8% in forestry. The forestry subsector had a higher proportion of businesses that implemented process innovation, to deal with climate change at 86.9%.

Novelty of product innovations across subsectors

Novelty levels of innovation can be categorised into three types: 1) innovations new to the market (in South Africa), 2) innovations new to the firm, and 3) innovations new to the world. However, these are not mutually exclusive, and agribusinesses can implement innovations at various novelty levels concurrently. For instance, a business can have innovations new to the firm, new to the world, and new to the market. As shown in Figure 9, the most noticeable pattern was that a significant proportion of agribusinesses (66.5%) introduced innovations new to their respective firms, while 34.7% of the businesses introduced product innovations that were new to the South African market. Business that introduced innovations new to the world represented the smallest proportion, at 6.4%. Thus, a small number of agribusinesses in South Africa were engaged in ground-breaking innovations that were new to the world.

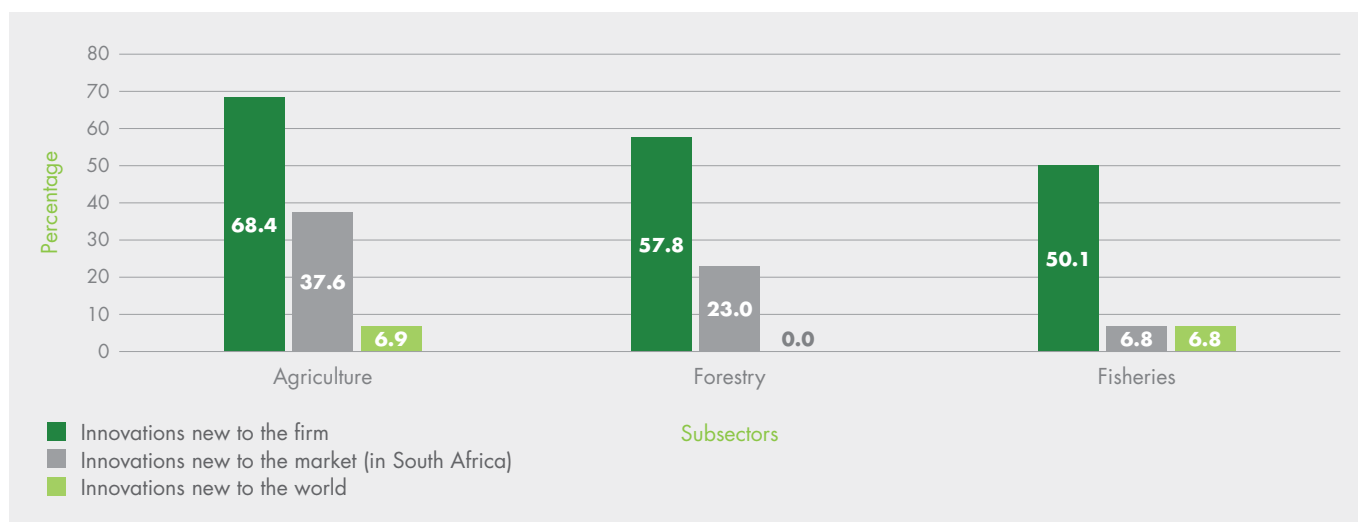
Figure 9: Novelty of product innovations by South African agribusinesses, 2019-2021



Source: Appendix table A13.2

However, examining the different subsectors in further detail reveals a notable difference across the three subsectors as shown in Figure 10. A significant proportion of businesses across the agriculture (animal and crop farming) (68.4%), forestry (57.8%) and fisheries (50.1%) subsectors implemented innovations that were new to their firms. Agriculture (animal and crop farming) stood out with a relatively higher percentage of innovations that were new to the market in South Africa (37.6%).

Figure 10: Novelty of product innovations across South Africa’s agriculture, forestry and fisheries subsectors, 2019-2021

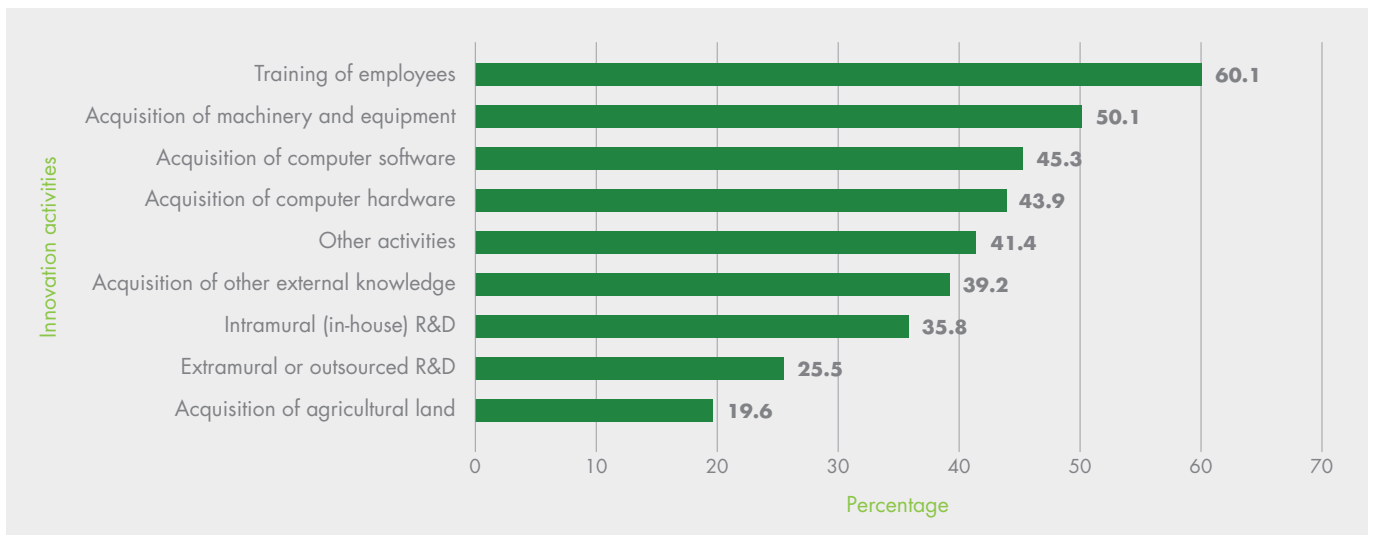


Source: Appendix table A13.2

Innovation activities agribusinesses engaged in

Across all the innovation activities, training (60.1%), acquisition of machinery and equipment (50.1%), and acquisition of computer software (45.3%) emerged as the top three reported innovation activities in all innovation-active agribusinesses (Figure 11). Other activities such as intramural R&D (35.8%), extramural or outsourced R&D (25.5%), and acquisition of agricultural land (19.6%) had lower percentages, indicating a comparatively lesser focus on these areas among innovation-active businesses.

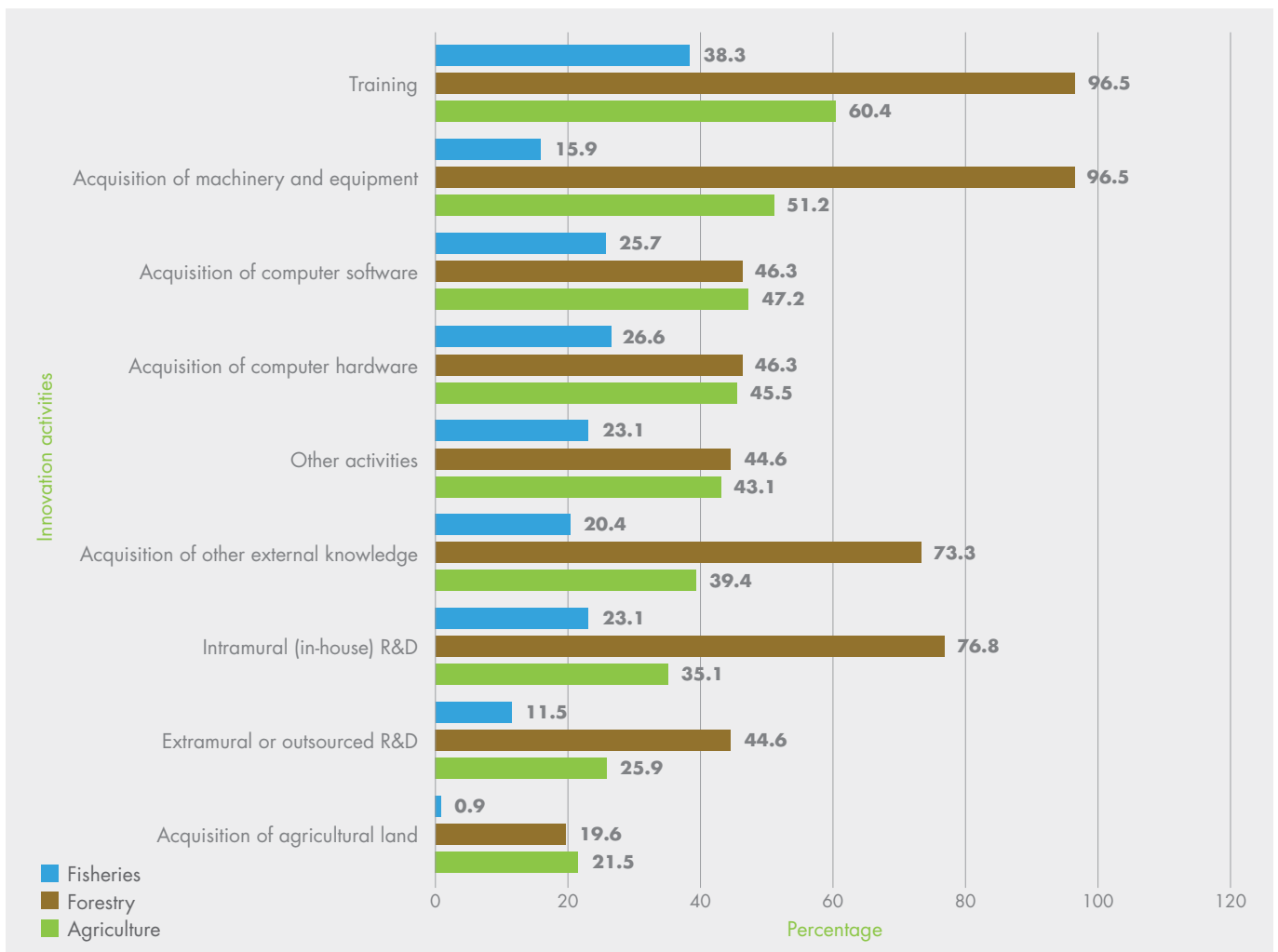
Figure 11: Investment by South African agribusinesses in innovation activities, 2019-2021



Source: Appendix table A14.2

The choice of innovation activities varied across subsectors, as illustrated in Figure 12. For example, the agriculture subsector placed significant importance on machinery and equipment acquisition, while forestry businesses were more likely to engage in training and acquisition of machinery, in-house R&D and acquisition of external knowledge.

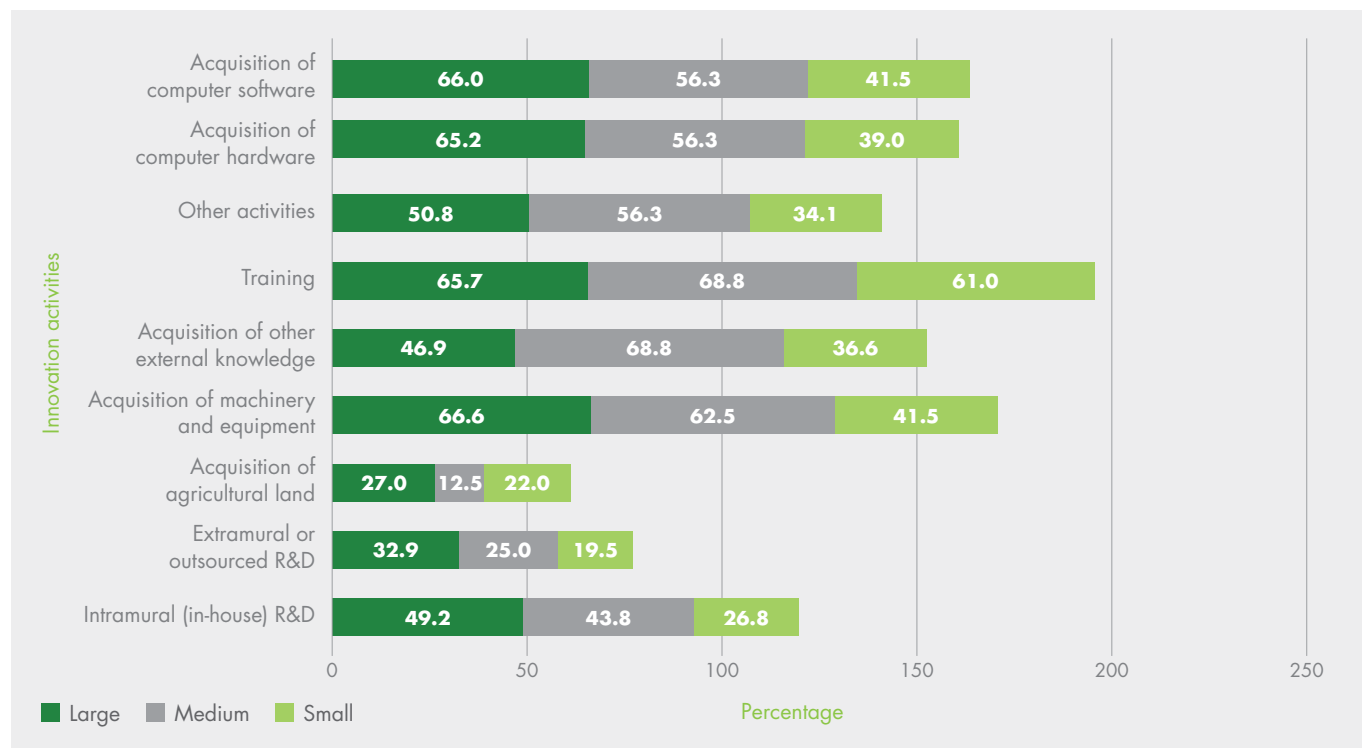
Figure 12: Innovation activities by South African innovation-active agribusinesses, 2019-2021



Source: Appendix table A14.2

In the terms of innovation-activities by size, as illustrated in Figure 13, large businesses showed a broader scope of engagement in innovation activities, including substantial engagement in R&D, acquisition of land, and acquisition of technologies (hardware and software). Large businesses also reported the highest investments in the acquisition of machinery and equipment (66.6%), acquisition of computer hardware (65.2%), and acquisition of computer software (66.0%).

Figure 13: Innovation activities by South African agribusiness size class, 2019-2021



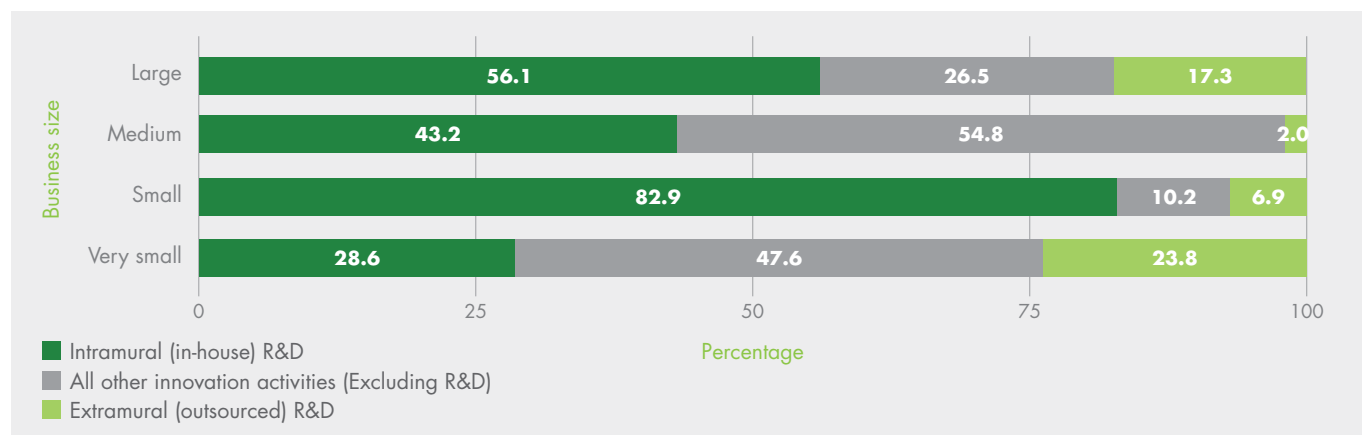
Source: Appendix table B14.2

Medium-sized businesses, had a notable participation in specific activities, particularly training (68.8%) and acquisition of external knowledge (68.8%). Small businesses generally had lower participation across various innovation activities, with the exception of investment in training (61%).

Investment by innovation-active businesses in specific innovation activities by size

Large agribusinesses allocated a substantial portion of their innovation activities budget to intramural (in-house) R&D (56.1%) (Figure 14). A substantial number of medium-sized agribusinesses also engaged in intramural R&D (43.2%) and allocated a relatively higher budget to all other innovation activities (54.8%) compared to large agribusinesses.

Figure 14: Expenditure on innovation activities across different firm sizes

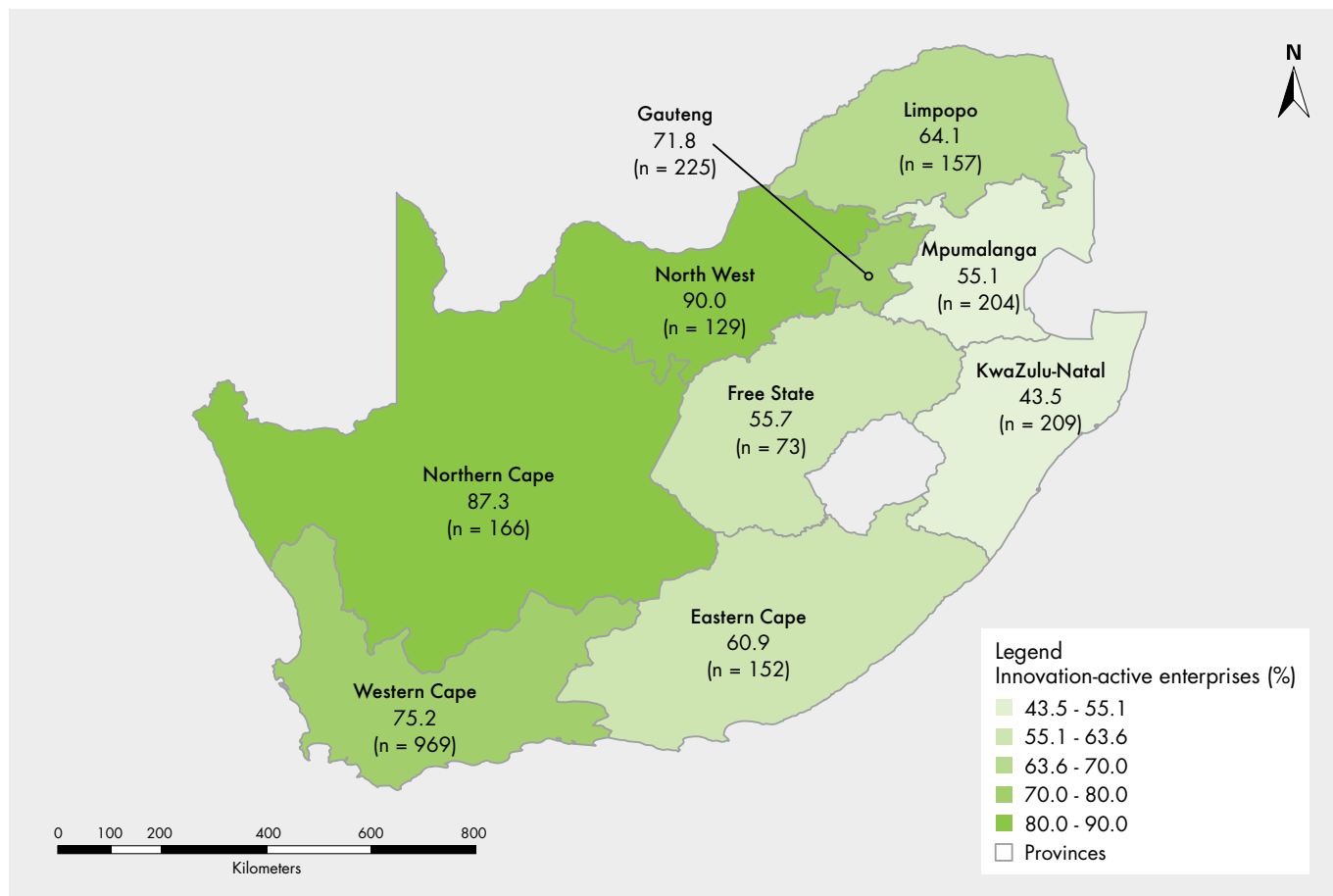


Source: Appendix table B15

Provincial location of innovation-active businesses

Overall, the results indicate that innovation in agribusinesses was not limited to specific regions, but was distributed across the country, as shown in Figure 15. The proportion of innovation-active agribusinesses was highest among agribusinesses in the Northern Cape, North West and Western Cape provinces (87.3%, 90.0% and 75.2% respectively). There were also relatively high proportions of innovation-active agribusinesses in Gauteng (71.8%) and Limpopo (64.1%), with Limpopo known for its citrus and tropical fruit production. Of agribusinesses in the Eastern Cape, about 60.9% were innovation-active. Proportions of innovation-active agribusinesses were lower among agribusinesses in KwaZulu-Natal (43.5%), Free State (55.7%) and Mpumalanga (55.1%).

Figure 15: Provincial distribution of South African innovation-active businesses, 2019-2021

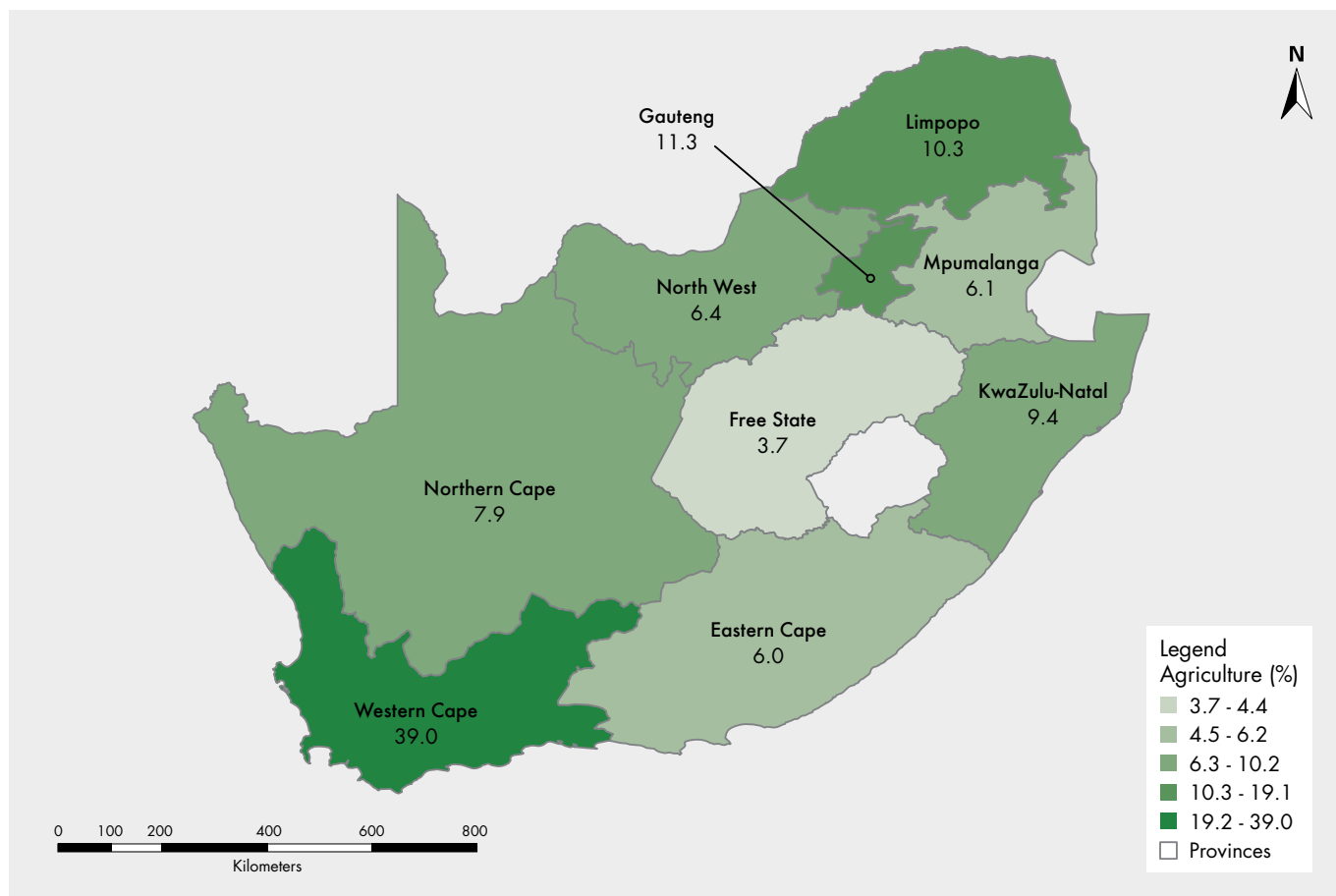


Source: Appendix table C1.2

Provincial distribution of innovation-active businesses in agriculture, forestry and fisheries

The Western Cape had the highest proportion of the country's innovation-active agribusinesses (39%) followed by Gauteng and Limpopo with the second and third highest proportions of innovation-active agribusinesses, with 11.3% and 10.3% respectively (Figure 16).

Figure 16: Provincial distribution of innovation-active businesses within the agriculture (animal and crop farming) subsector, 2019-2021

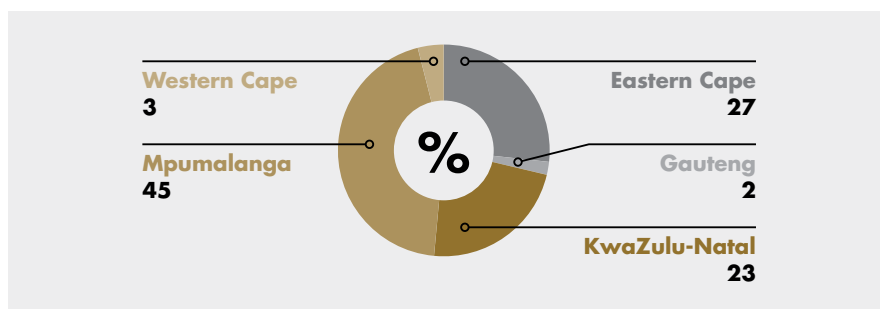


Source Appendix table A23

Meanwhile, other provinces such as KwaZulu-Natal (9.44%), Mpumalanga (6.1%), and Northern Cape (7.9%) accounted for moderate proportions of South Africa’s innovation-active agribusinesses. The Eastern Cape, North West, and Free State lagged behind, with the lowest proportions of innovation-active agribusinesses, at 6.0%, 6.4% and 3.7%, respectively.

The distribution of innovation-active businesses in the forestry subsector, shows that Mpumalanga had the largest proportion of innovation-active enterprises at 44.6%, followed by the Eastern Cape at 27.0% and KwaZulu-Natal at 23.2%. The Western Cape had the lowest at 3.5%, followed by Gauteng at 1.8% (Figure 17).

Figure 17: Provincial distribution of innovation-active businesses within the forestry subsector, 2019-2021



Source: Appendix Table A23

In the fisheries subsector, the majority of innovation-active businesses were located in the Western Cape, accounting for 96.5%. The Eastern Cape (2.6%) and North West (less than 1%) were the two other provinces that also had some innovation-active businesses in this subsector.

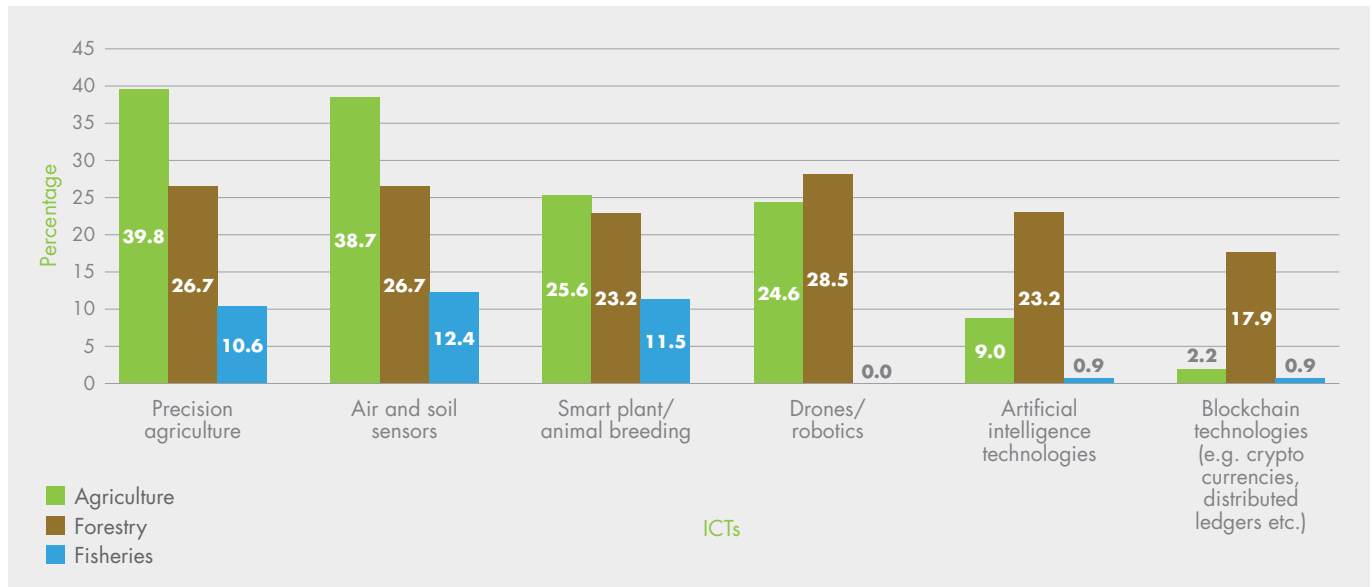


Dimension 2: Digital-based innovations

Adoption of advanced ICTs by innovation-active agribusinesses

The data highlight the South African agricultural sector's evolving approach to modernisation through the adoption of advanced information and communication technologies. Figure 18 highlights variations in the adoption rates of advanced ICTs by innovation-active agribusinesses across different subsectors.

Figure 18: Adoption of advanced ICTs by innovation-active agribusinesses, South Africa 2019-2021



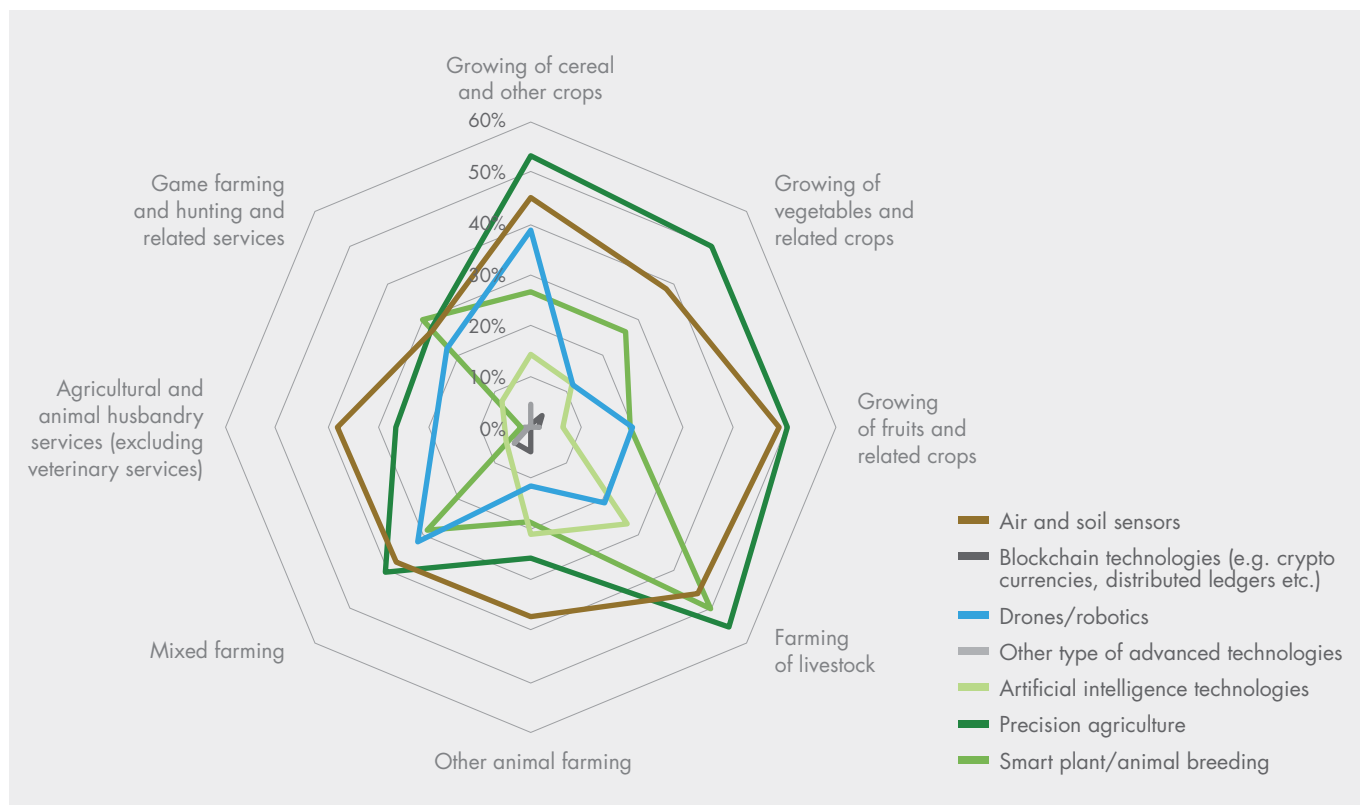
Source: Appendix table A18.1

In the agriculture (animal and crop production) subsector, precision agriculture together with air and soil sensors emerged as the most widely adopted advanced ICTs, with almost 40% of all innovation-active businesses using or implementing these technologies. In contrast, the adoption rates of artificial intelligence (AI) and blockchain technologies remain relatively low in this subsector with less than 10% of innovation-active businesses adopting them.

Patterns of advanced ICT adoption in the agriculture subsector

The overarching trend is the relatively high adoption rate of precision agriculture (the outermost ring in Figure 19), across several animal and crop farming activities. More specifically, over 50% of innovation-active businesses involved in the growing of cereals and fruits adopted precision agricultural technologies. Moreover, a high number of innovation-active businesses (54.9%) in the production of livestock also adopted precision livestock farming (PLF) technologies, that use technology and data-driven solutions to optimise livestock production and management. The results also show varying adoption of sensor technologies across the different animal and crop farming activities. Like precision livestock farming, sensor technologies, represented by the second ring in Figure 19, show a wide range of adoption rates with businesses in livestock farming leading.

Figure 19: Disaggregated analysis of advanced technologies usage in farming activities, 2019-2021



Source: Appendix table A18.4

With respect to AI technologies, adoption rates vary across the different animal and farming activities, with the highest adoption in farming of livestock (27.0%) and the lowest in agricultural and animal husbandry services (4.7%). These adoption rates, while relatively modest overall, reflect a gradual embrace of AI technologies in the animal and crop farming subsector.

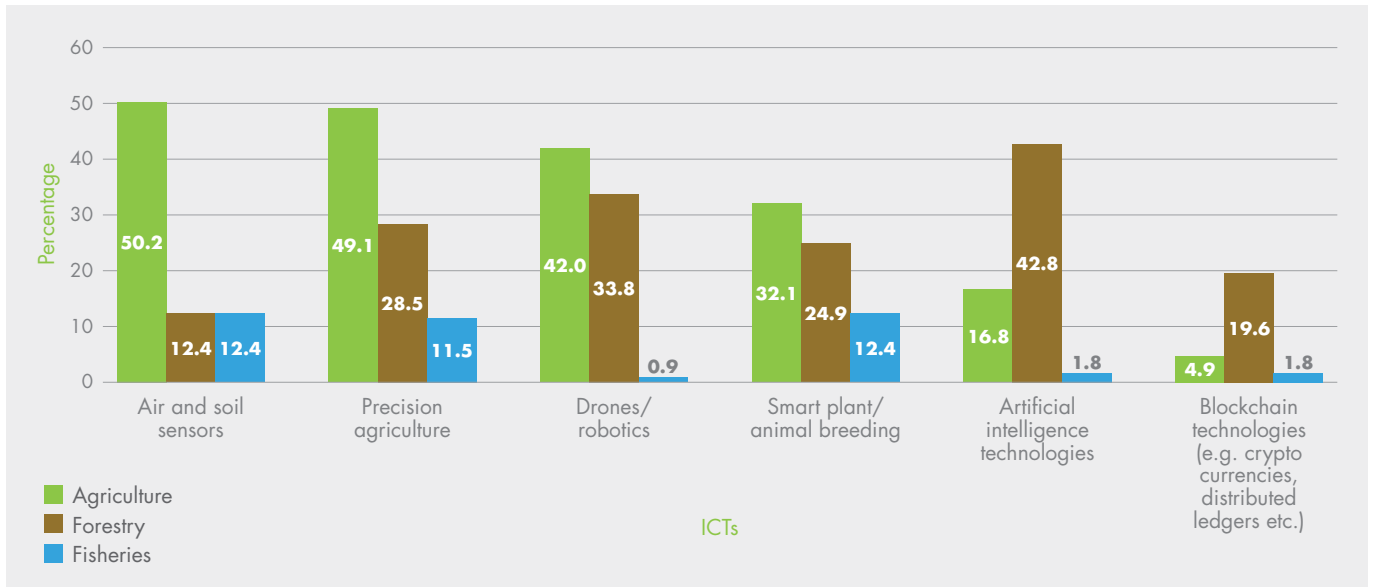
Drones/robotics and smart plant/animal breeding technologies and other types of advanced technologies represented by the inner rings in Figure 19, had moderate adoption rates across activities. These technologies were adopted to varying degrees, reflecting their potential to enhance efficiency and productivity.

Blockchain technologies, represented by the innermost ring, show minimal adoption across most subsectors, with innovation-active businesses in some categories having no adoption at all. The limited adoption of blockchain technologies by innovation-active agribusinesses shows that there is room to further enhance supply chain transparency and traceability in South African agriculture, which could improve market access and competitiveness. In sum, Figure 19 highlights the diverse landscape of technology adoption in the agriculture (animal and crop farming) subsector and reflects both progress and areas for further modernisation.

Trends anticipated in advanced ICT adoption: 2022-2024

Anticipated trends in the adoption of advanced ICTs for agricultural innovation during 2022-2024 by innovation-active businesses varies significantly among the different subsectors. As illustrated in Figure 20, the agriculture (animal and crop farming) subsector reported a higher anticipated adoption of advanced ICTs in many areas. A significant number of businesses in the forestry subsector showed particular interest in the future adoption of AI (42.8%) and drones/robotics (33.8 %). On the other hand, businesses in the fisheries subsector, with a different operational context, showed relatively lower interest in the future adoption of most advanced technologies compared to agriculture and forestry.

Figure 20: Anticipated trends adoption of advanced ICTs, 2022-2024



Source: Appendix table A18.3

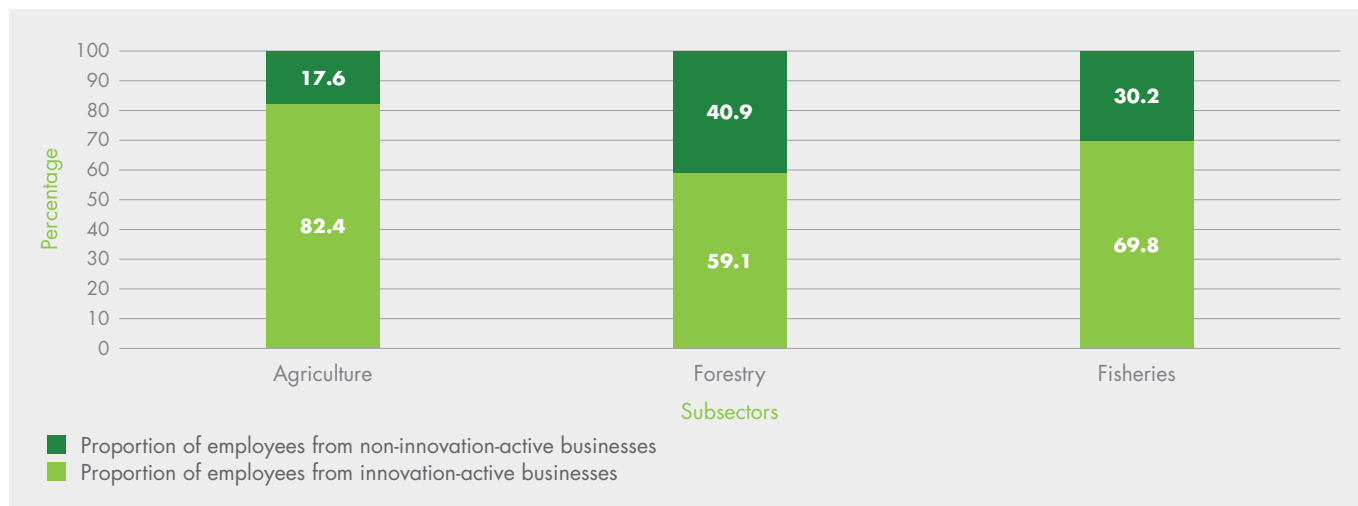


Dimension 3: Human capital and skills development

Distribution of employees across innovation-active and non-innovation-active agribusinesses

There is a higher proportion of employees in innovation-active agribusinesses, than non-innovation-active agribusinesses. Figure 21 shows that agriculture has the highest percentage (82.4%) of employees in innovation-active businesses, followed by the fisheries (69.8%) and forestry (59.1%) subsectors.

Figure 21: Distribution of employees across innovation-active and non-innovation-active agribusinesses, 2019-2021



Source: Appendix table A2

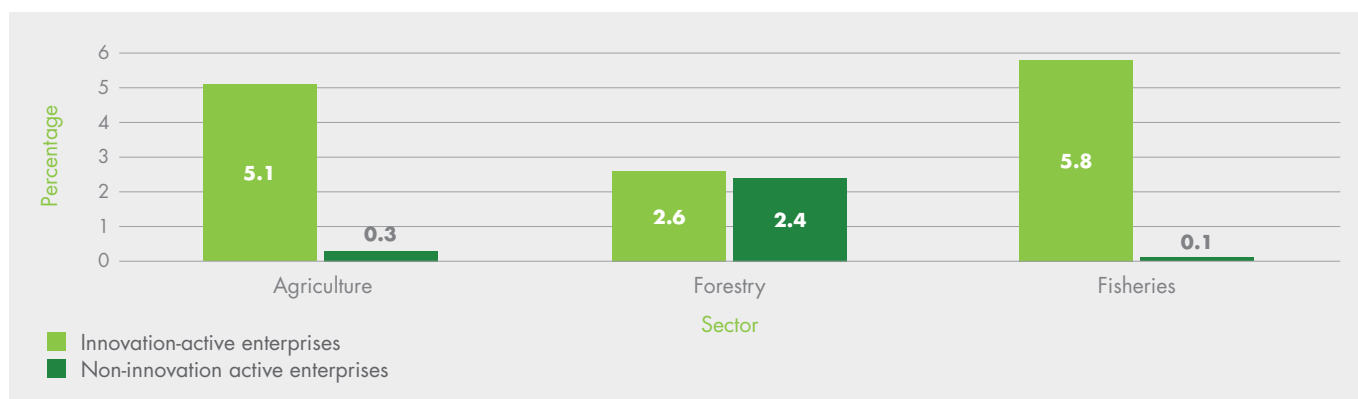
Distribution of skilled employees by subsector and agribusiness size

Across the agriculture (animal and crop farming), forestry, and fisheries subsectors, innovation-active businesses consistently had a higher proportion of employees with degrees or diplomas compared to their non-innovation-active counterparts, although this figure remained generally low at less than 6% across all subsectors (Figure 22).

The fisheries subsector stood out with the highest percentage of skilled employees among innovation-active businesses at 5.8%, followed by agriculture at 5.1%. Conversely, the fisheries subsector was the only sector with a different pattern compared to the other two subsectors.

Forestry subsector businesses reported the lowest percentage of skilled employees within innovation-active businesses at 2.6%, but had more businesses with skilled employees within non-innovation-active businesses.

Figure 22: Percentage of employees with degrees or diplomas, 2019-2021

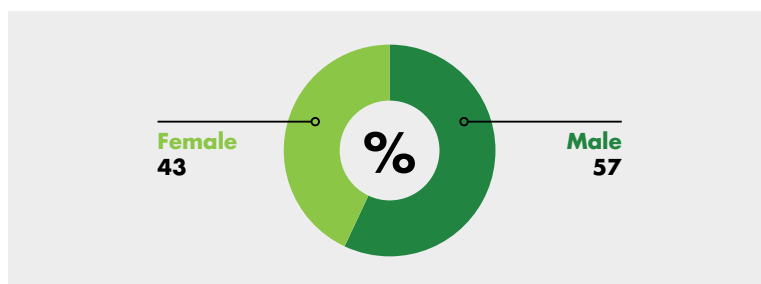


Source: Appendix table A3

Demographic distribution of employees involved in innovation activities

The data indicates that, in innovation-active businesses, the proportion of males (57%) engaged in innovation activities was greater than that of females (43%). Figure 23 illustrates the gender distribution of employees involved in innovation activities within the three subsectors—agriculture (animal and crop farming), forestry, and fisheries.

Figure 23: Gender distribution of employees involved in innovation activities across agriculture, forestry and fisheries businesses, 2019-2021

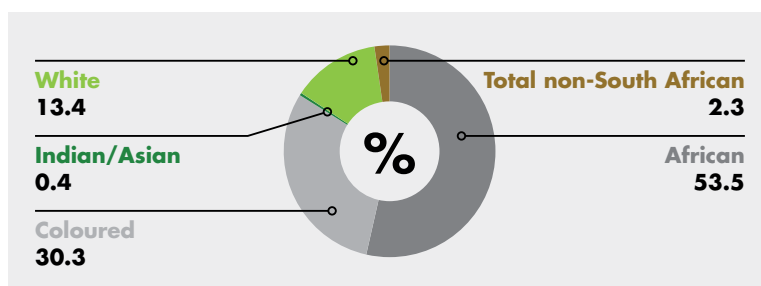


Source: Appendix table A4

Race distribution of employees involved in innovation activities

In terms of the race distribution of employees involved in innovation activities, Figure 24 shows that employees classified as African constituted the majority of employees engaged in innovation-activities in the agriculture (animal and crop farming), forestry, and fisheries subsectors making up 53.5%. Coloured employees involved in innovation-activities accounted for the second highest at 30.3%, while White employees made up 13.4%. Employees categorised as Indian/Asian made up the smallest percentage, at only 0.4%. Non-South Africans involved in innovation-activities represented 2.3%.

Figure 24: Race distribution of employees involved in innovation-activities across agriculture, forestry and fisheries businesses, 2019-2021

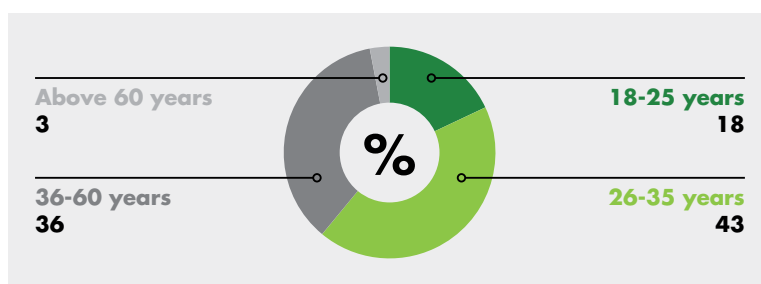


Source: Appendix table A4

Age distribution of employees involved in innovation activities

The largest age group, comprising 42.4% of employees engaged in innovation activities, was within the 26-35 age range. The age group 36-60 also made up a substantial percentage of employees involved in innovation-activities, accounting for 36.4% (Figure 25). Employees aged between 18-25 made up 17.9% of employees involved in innovation activities. Employees aged 60 and above were only 2.7% of the employees involved in innovation activities across the three subsectors.

Figure 25: Age distribution of employees involved in innovation-activities across agriculture, forestry and fisheries businesses, 2019-2021



Source: Appendix table A4



Dimension 4: Initiatives for equitable and sustainable growth

Financial outcomes of innovation in agribusinesses and variation across subsectors

There was a noticeable difference in the importance attributed to financial outcomes across the three subsectors (agriculture, forestry, and fisheries) (Figure 26). In the agriculture (animal and crop farming) subsector, approximately 22.7% of businesses rated increased revenue as a highly important outcome. Reduced costs was also rated as a highly important outcome by 21.4% of forestry businesses, while only 13.2% of agriculture and 10.6% of fisheries businesses considered it as a highly important outcome to their innovation.

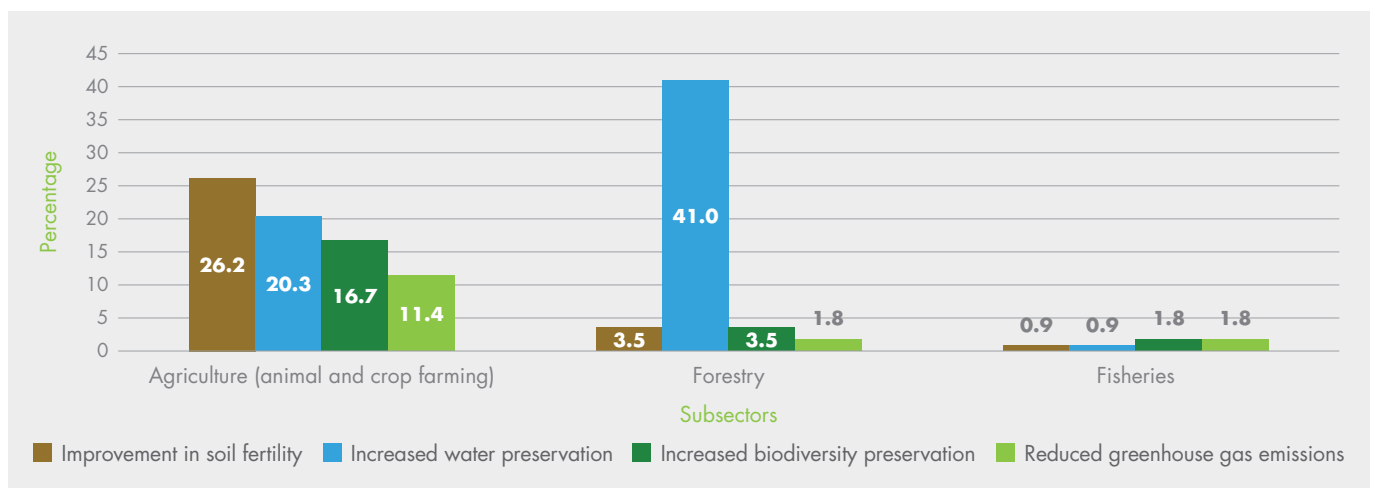
Figure 26: Financial outcomes rated as highly important by innovation-active agribusinesses, 2019-2021



Source: Appendix table A16.2

Specific environmental outcomes, including improved soil fertility, increased water preservation, increased biodiversity preservation, and reduced greenhouse gas emissions, resulted from innovations (see Figure 27).

Figure 27: Environmental innovation outcomes rated as highly important by innovation-active agribusinesses, 2019-2021



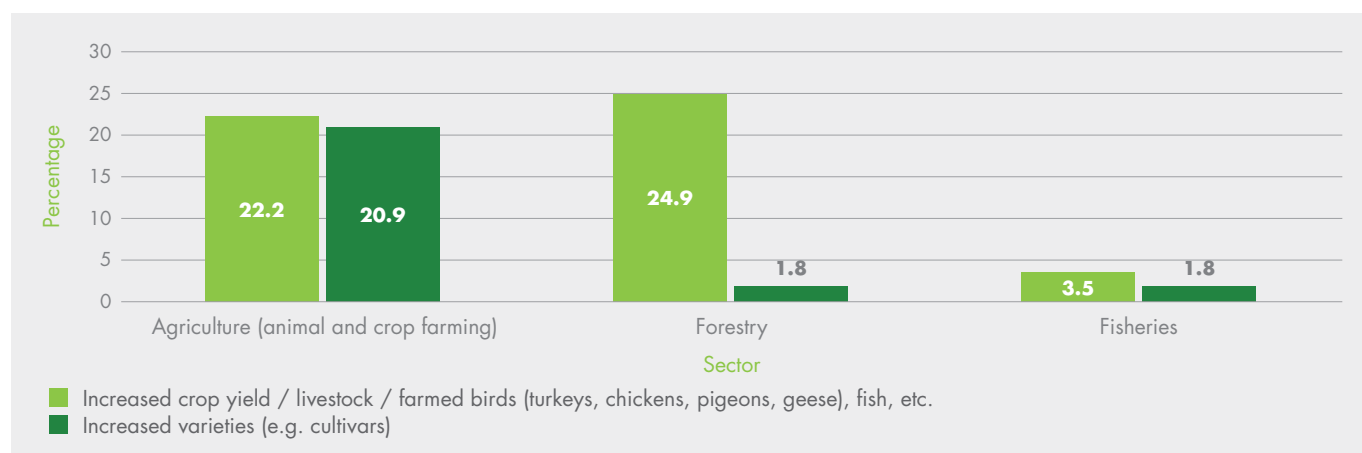
Source: Appendix table A16.2

Agriculture businesses placed higher importance on soil fertility, with 26.2% of businesses rating its importance as a highly important outcome to their innovation. In forestry, 41.0% of businesses highlighted the importance of increased water preservation, in addressing resource challenges specific to the sector. Biodiversity preservation as an innovation outcome was considered highly important by 16.7% of agriculture businesses compared to forestry businesses (3.5%) and fisheries (1.8%). Across all subsectors,

there was a relatively low recognition of the importance of reducing greenhouse gas emissions, with only 11.4% of businesses in agriculture acknowledging its significance.

The importance attributed to product and process outcomes varied across the three subsectors (Figure 28). Both agriculture (animal and crop farming) and forestry sectors emphasised the importance of increased yields. In agriculture, 22.2% of businesses rated increased yield as a “highly important outcome” to their innovation, while in the forestry sector, this figure was 24.9%. Meanwhile, 20.9% of agriculture businesses also considered increased crop varieties (e.g., cultivars) as a highly important outcome to their innovation compared to less than 2% for both forestry and fisheries businesses.

Figure 28: Product and process innovation outcomes rated as highly important by innovation-active agribusinesses, 2019-2021



Source: Appendix table A16.2

Two significant strategic outcomes can result from innovation: reaching new markets and developing new intellectual property (IP) (Figure 29). The forestry subsector had the highest proportion of innovation-active businesses that rated reaching new markets (35.7%) as a highly important outcome/benefit of innovation. Agriculture (animal and crop farming) businesses also highly valued this outcome (21.2%), although with a lower proportion of businesses. In contrast, only 2.6% of fisheries businesses placed a high importance on developing new IP. On the other hand, less than 10% of businesses in the agriculture subsector considered the development of new IP a highly important outcome.

Figure 29: Strategic outcomes rated as highly important by innovation-active agribusinesses, 2019-2021

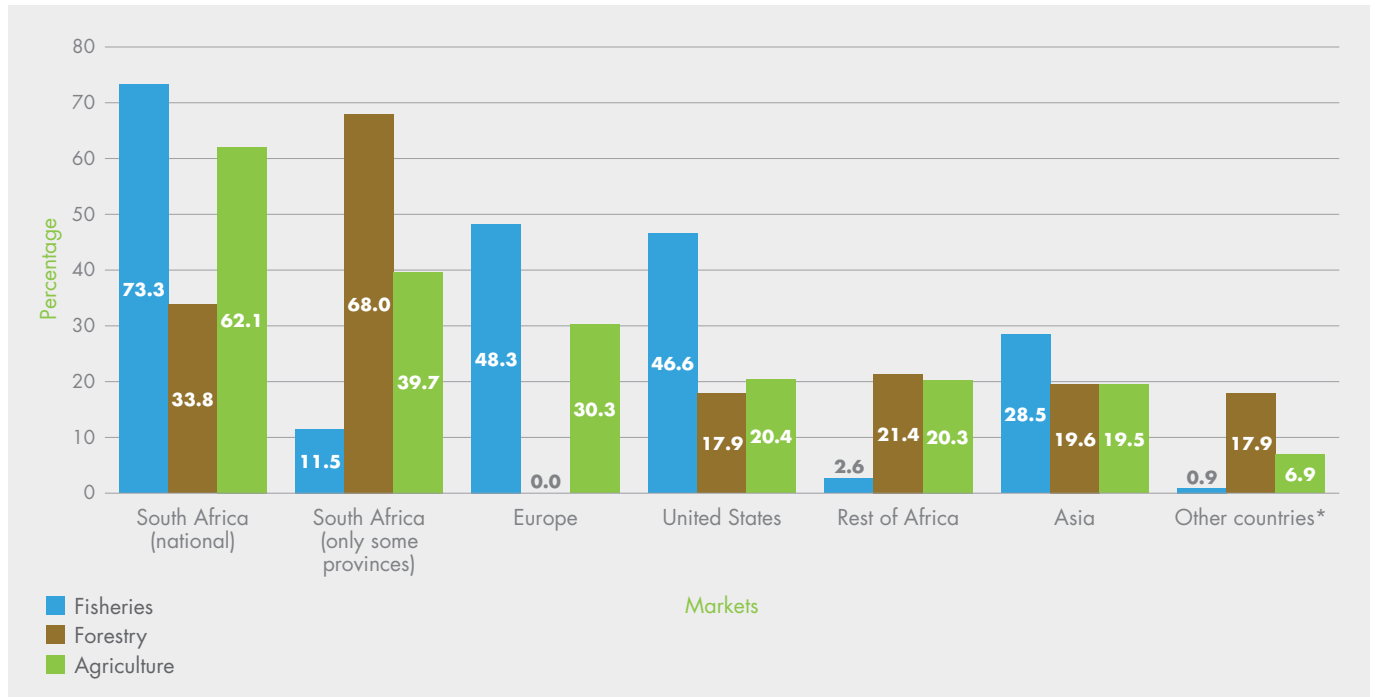


Source: Appendix table A16.2

Innovation to reach new markets and realise export potential

Innovation-active agribusinesses in South Africa sold or exported their products or services to diverse markets during the reference period 2019-2021. The data shows that there was a strong emphasis on national and domestic markets. Most innovation-active agribusinesses across all subsectors, including agriculture, forestry, and fisheries, primarily sold their products or services within South Africa (Figure 30).

Figure 30: Geographic markets for goods and services reached by innovation-active agribusinesses, 2019-2021



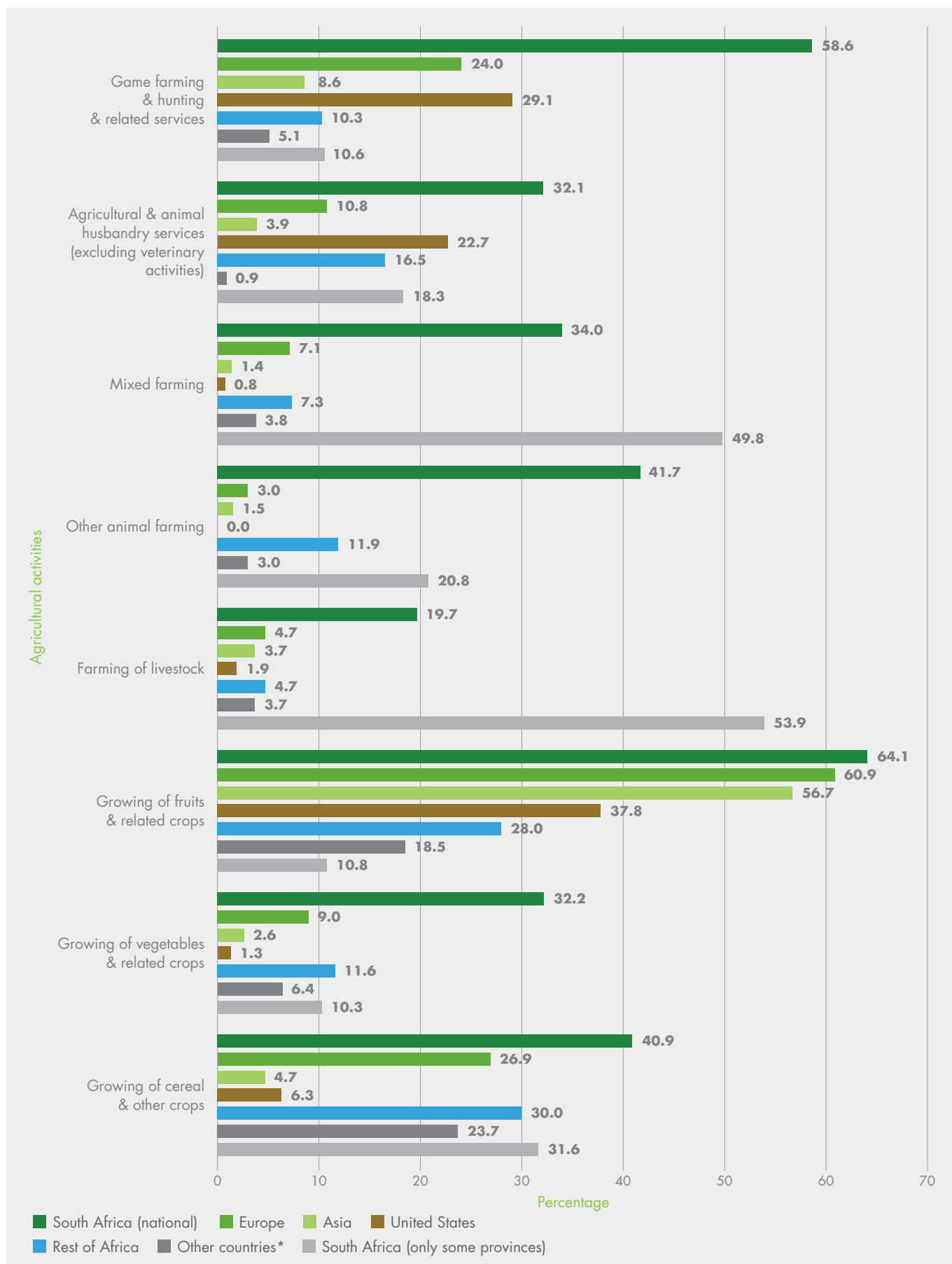
Source: Appendix table A8.2

The fisheries subsector innovation-active businesses were relatively successful at engaging with international markets. Almost half of innovation-active businesses were able to sell their goods and services to European markets (48.3%), while 46.6% of businesses sold to the US and 28.5% Asian markets. While some forestry innovation-active businesses participated in international markets, the percentage selling goods or services to regions outside South Africa were relatively low in the other subsectors. With respect to forestry subsector, the largest markets outside South Africa for innovation-active businesses were African markets (21.4%), followed by Asian markets (19.6%) and the USA (17.9%) market as well as other unspecified markets at 17.9%.

Agriculture subsector had a notable presence in Europe, with 30.3% of innovation-active businesses selling goods or services there. While innovation-active agriculture (animal and crop farming) businesses had a presence in the African market outside South Africa, the percentage of businesses selling goods and services in Africa remained relatively low with agriculture having 20.2% and forestry and fisheries less than 5% each.

Figure 31 provides a detailed breakdown of innovation-active businesses in the agriculture subsector (animal and crop farming) showcasing their engagement with specific geographic markets during 2019-2021.

Figure 31: Geographic markets for goods and services reached by businesses in the South African agriculture (animal and crop farming) subsector, 2019-2021



Source: Appendix table A8.2

Different agricultural categories, such as the growing of cereals, vegetables, fruits, farming of livestock, and more, reported distinct patterns of market focus. A substantial proportion of businesses across all agricultural categories prioritised the South African national market, with percentages ranging from 19.7% to 64.1%. Nevertheless, fruits and related crops reported a significant presence in the European market (60.9%).

The data also show that innovation-active businesses had a limited presence in the United States market across all agricultural categories while there was some growth in the Asian market for some agribusinesses. In particular, fruits and related crops, as well as vegetables and related crops, showed growth in Asia (56.7% and 3.7% respectively). Exports to the rest of Africa varied across agricultural categories but was relatively low for most categories within the farming subsector.

After presenting an analysis of the trends in innovation guided by the dimensions of modernisation, we now provide an in-depth analysis of the barriers and enablers shaping innovation in the sector. While the four dimensions provide insights into the sector's current state of innovation and alignment with the modernisation agenda, analysing the barriers and enablers provides a more complete perspective of the factors that support, but also impede, innovation in South African agribusinesses.



PART 2: BARRIERS AND ENABLERS OF INNOVATION

Innovation barriers can be defined as those factors that prevent businesses from engaging in innovation activities or from introducing specific types of innovation. Part 2 presents findings about the share of businesses reporting selected items as barriers to innovation. These are particularly useful to inform policymaking and contributing to the creation of a conducive environment for innovation in the agricultural sector.

Sources of information for innovation by agribusinesses

There are two categories of information sources that a firm can leverage for innovation. These are: a) internal sources and b) external sources. Internal sources are defined as any sources of information a firm can use for innovation from within its own enterprise or group. While external sources include suppliers, clients, competitors, public and private knowledge producers and other sources such as conferences and scientific journals. Understanding the sources of information used to innovate can provide critical policy insight to facilitate and support innovation in more businesses.

South African agribusinesses relied on a wide range of information sources to innovate. Table 2 provides a summary of the sources of information that innovation-active businesses in the agricultural sector found highly important during the reference period 2019-2021. The choice of information sources for innovation varied across subsectors.

Table 2: Sources of information for innovation, 2019-2021

Sources of information	Agriculture	Forestry	Fisheries
Internal sources			
Within the enterprise or enterprise group	40.8%	73.3%	13.3%
External market resources			
Suppliers of equipment, materials, components or software	41.0%	46.3%	11.5%
Clients or customers	36.9%	42.8%	3.5%
Competitors or other businesses in the sector	16.8%	1.8%	1.8%
Consultants, commercial labs or private R&D institutes	23.9%	3.5%	0.0%
External institutional sources			
Universities/higher education institutions	9.3%	3.5%	2.6%
Government and public research institutes	41.0%	46.3%	11.5%
Private research institutes	41.0%	46.3%	11.5%
External other sources			
Conferences, trade fairs, exhibitions	11.7%	1.8%	11.5%
Scientific journals and trade/technical publications	14.1%	19.6%	10.6%
Professional and sector associations	21.6%	39.2%	10.6%

Source: Appendix table A17.2

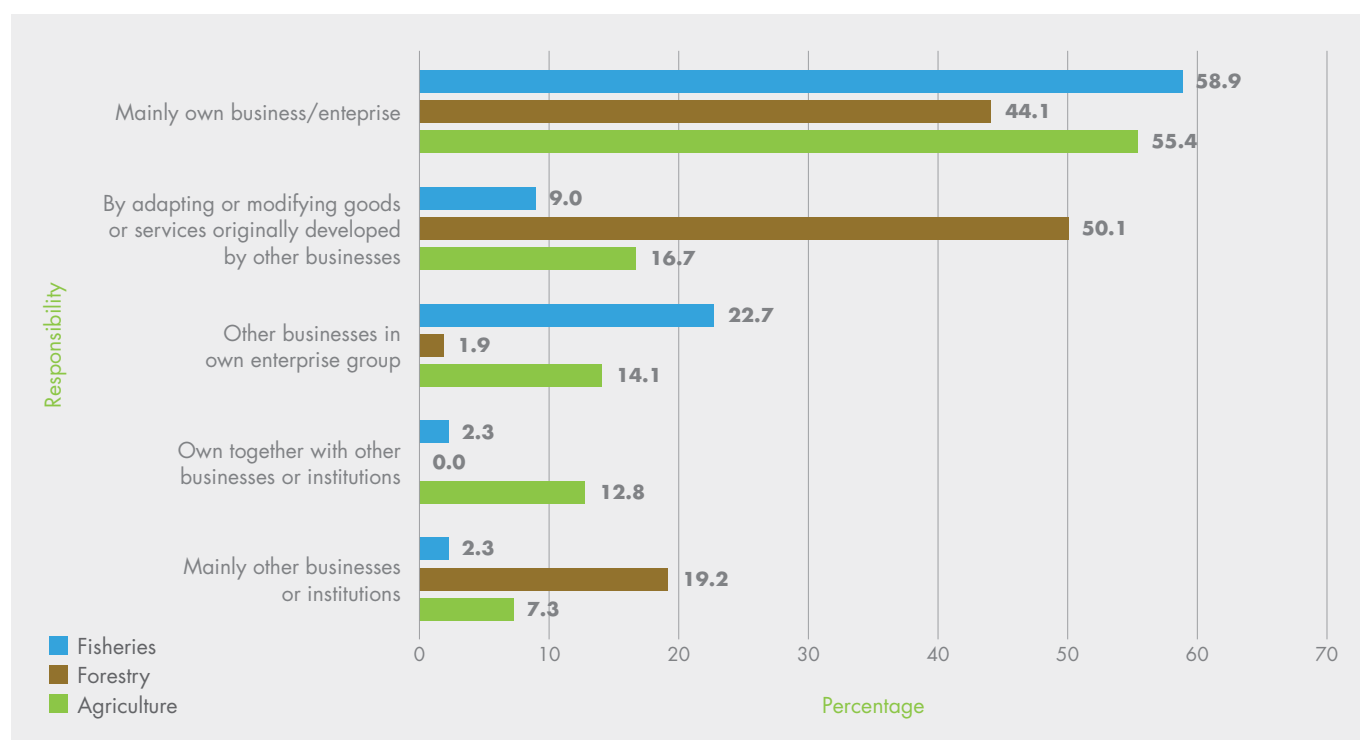
The forestry subsector reported the largest proportion (73.3%) of businesses that rated sources within their enterprise or enterprise group as highly important for innovation. Agriculture (animal and crop farming) businesses (40.8%) also considered internal sources as significant but were notably lower than forestry businesses. Agriculture (animal and crop farming) and forestry businesses both rated the importance of suppliers of equipment, materials, components, or software (41.0% and 46.3% respectively) and clients or customers (36.9% and 42.8% respectively) as highly important sources of information for innovation. Innovation-active businesses in both sectors placed a high level of importance on government and public research institutes (41.0%) in providing valuable research-based information and support for innovation.

Private research institutes were highly valued by both agriculture (animal and crop farming) (41.0%) and forestry (46.3%) businesses. However, agriculture (14.1%) and forestry (19.6%) businesses showed lower reliance on scientific journals and trade/technical publications. Forestry businesses rated professional and sector associations as highly important sources of information for innovation (39.2%), while agriculture businesses valued them less (21.6%). Conferences, trade fairs, and exhibitions were moderately important for agriculture and fisheries businesses with 11.7% of agriculture (animal and crop farming) businesses and 11.5% of fisheries businesses.

Collaboration for product innovation: partners and approaches

South African agribusinesses shared responsibility for the development of product innovations during the reference period 2019-2021 (Figure 32). While many businesses across the agricultural subsectors preferred to lead in product innovation independently, some also engaged in collaborative approaches and adaptation of existing innovations.

Figure 32: Responsibility for the development of product innovations, 2019-2021



Source: Appendix table A12

A significant proportion of businesses took the lead for innovation internally (Figure 32). Across all three subsectors (agriculture, forestry, and fisheries), a large majority of businesses opted to develop innovations from within their own firms. The agriculture (animal and crop farming) subsector reported the highest percentage of innovation-active businesses and one of the highest percentages of businesses relying on their own enterprise for product innovation (55.4%), with fisheries having the overall highest (58.9%).

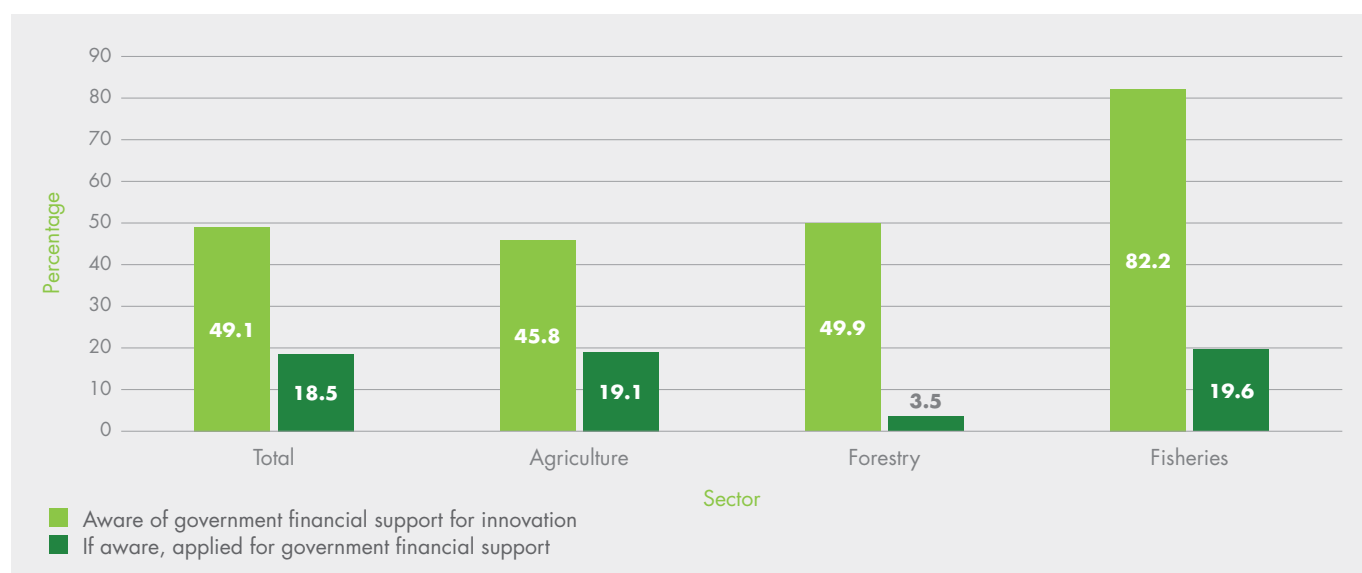
Collaboration was less common in forestry, with a notable absence of businesses sharing responsibility for product innovation with other businesses or institutions. Forestry businesses preferred to adapt and modify innovations from other businesses (50.1%). In the agriculture (animal and crop farming) subsector, this proportion was 16.7%, while in fisheries, it was 9.0%.

The fisheries subsector showed a more diversified approach to responsibility for product innovations, with businesses in various categories, including those collaborating with other businesses or institutions and those adapting existing innovations.

The role of government financial support in facilitating innovation

Overall awareness of government financial support for innovation was moderate among innovation-active businesses with a total of 49.1% awareness (Figure 33). However, application for government financial support remained lower than 20% in total. Looking at the specific subsectors, the fisheries subsector businesses had the highest awareness of government support, at 82.2%, while agriculture businesses reported 45.8% awareness rate, with a very low application rate of less than 20%. Despite having fewer innovation-active businesses, forestry businesses, surprisingly, reported a higher awareness rate of almost 50%, but with the lowest application rate for government financial support at 3.5%

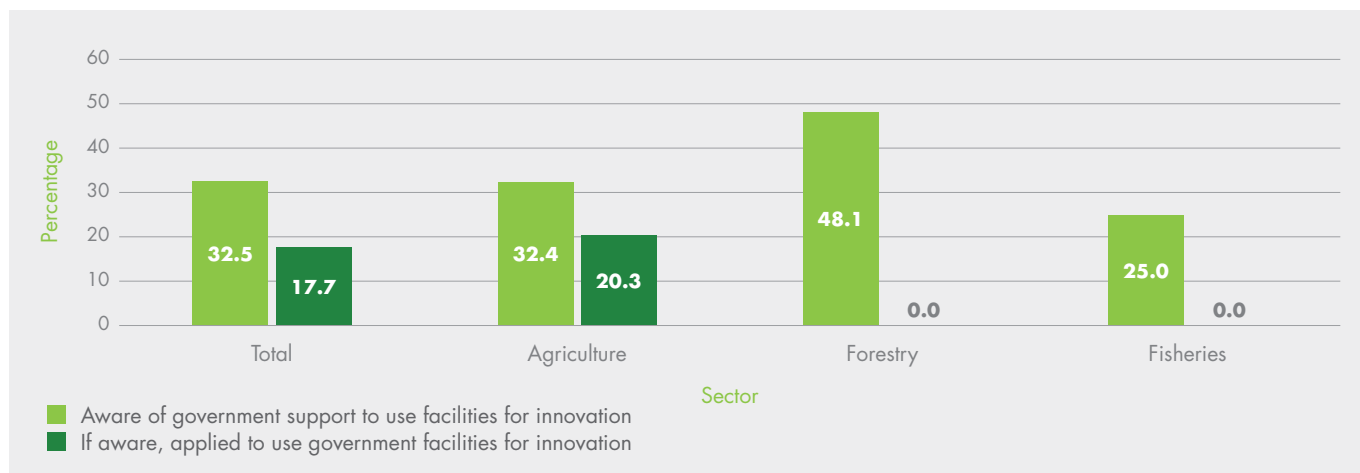
Figure 33: Awareness and application for South African government financial support by innovation-active agribusinesses, 2019-2021



Source: Appendix table A21

Regarding awareness of government research facilities for innovation as a support mechanism, and access to research facilities for innovation, forestry businesses had a substantial awareness rate of 48.1%, followed by agriculture (crop and animal farming) subsector businesses at 32.5%. Fisheries businesses, had a comparatively lower awareness rate (25.0%) of government research facilities compared to other subsectors. Despite moderate awareness of government research facilities support, the application rates are relatively low across all subsectors. Agriculture (crop and animal farming) subsector businesses, reported approximately 20.3% application rate, with no businesses reporting application in the forestry and fisheries subsectors.

Figure 34: Awareness and application for government facilities for innovation by innovation-active businesses, 2019-2021

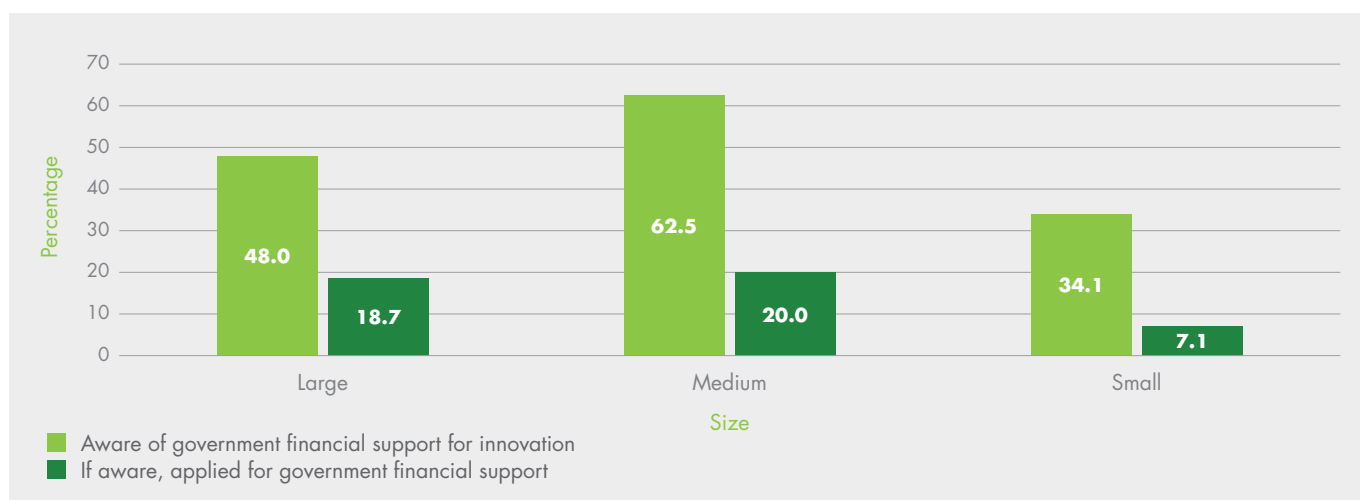


Source: Appendix table A21

Awareness of government support and application rate by size of business

When disaggregated by size class, Figure 35 illustrates the awareness and application for government support among different size classes of agribusinesses.

Figure 35: Awareness and application for South African government financial support by innovation-active agribusiness size class, 2019-2021

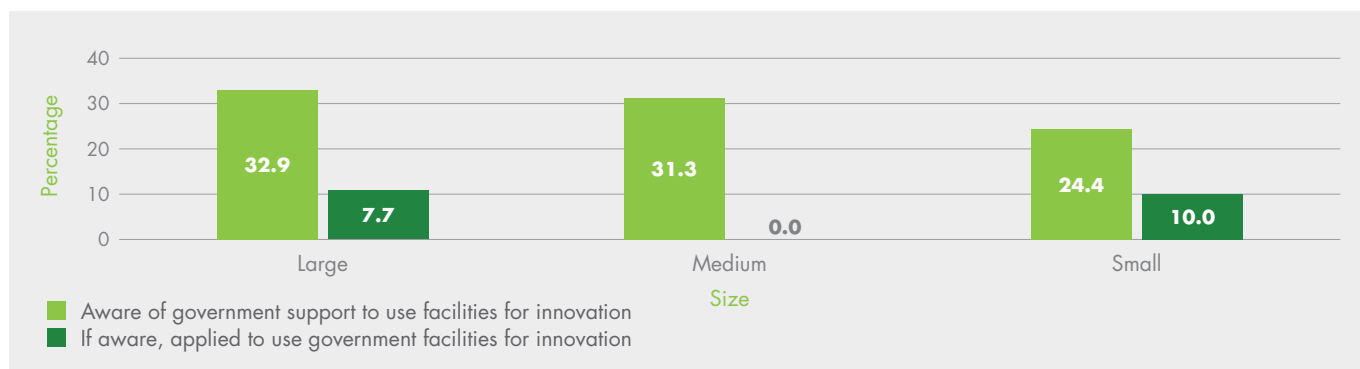


Source: Appendix table B21

The results reveal that medium agribusinesses reported higher awareness (62.5%) and application rates for government support and research facilities for innovation. Large agribusinesses reported just below 50% awareness of government financial support but the rate of application remained below 20%. A similar trend was also observed with small businesses having higher awareness rates (34.1%) but lower application rates (7.1%).

With respect to awareness of government support to use facilities for innovation, large businesses report the highest awareness at 32.9%, but application rates to use facilities remained lower than 10%. A similar trend was observed with medium and small businesses.

Figure 36: Awareness and application for government research facilities for innovation by business size, 2019-2021

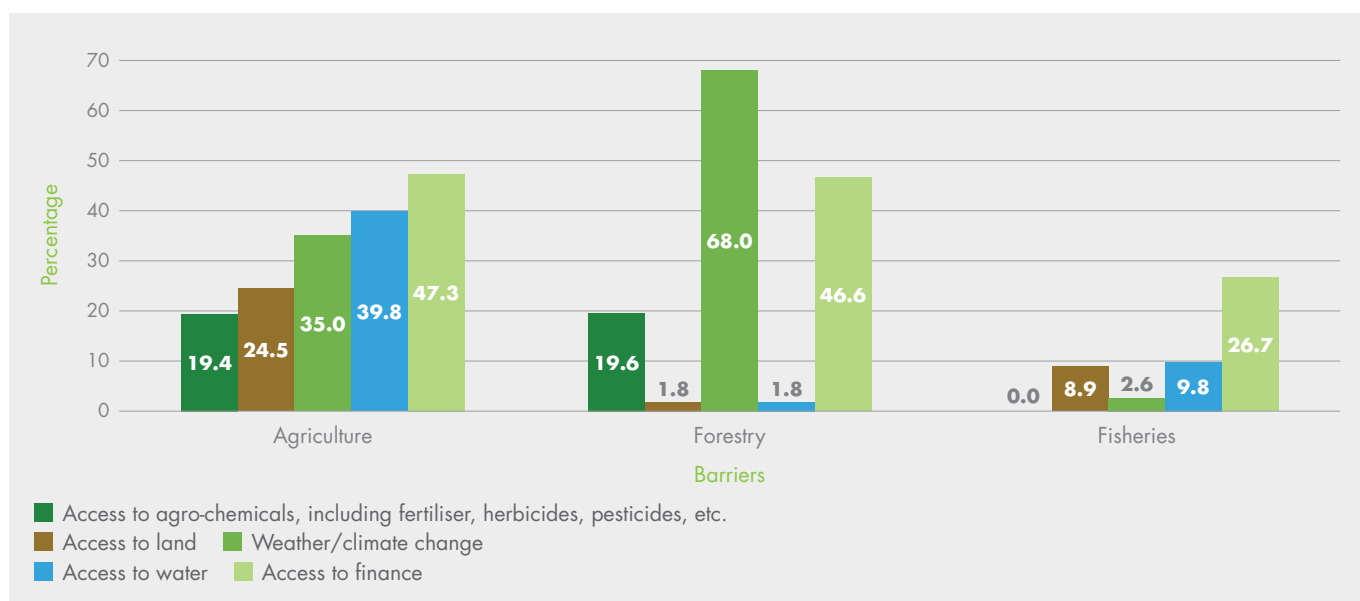


Source: Appendix table B21

Resource and environmental barriers to innovation

Access to finance was considered a highly important barrier to innovation by a significant proportion of innovation-active businesses in all three subsectors, with agriculture (47.3%) and forestry (46.6%) ranking it the top barrier (Figure 37). This suggests that securing adequate funding remained a major barrier for agricultural innovation across the board. Agriculture (animal and crop farming) businesses placed a high importance on access to land (24.5%) and water (39.8%) as barriers to their innovation.

Figure 37: Resource and environmental barriers facing South African agribusinesses, 2019-2021



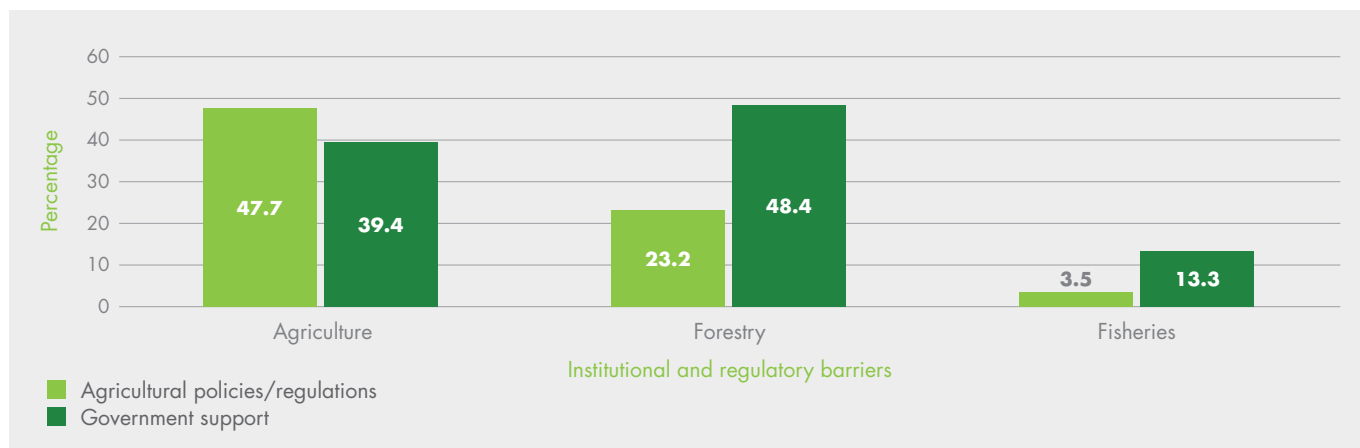
Source: Appendix table A20.2

In contrast, as shown in Figure 37, a very small proportions of forestry and fisheries businesses considered access to land and water to be highly important barriers to innovation. Forestry businesses rated weather and climate change as a highly important barrier for 68% of businesses. Agriculture businesses also recognised the significance of this barrier (35%).

Institutional and regulatory barriers to innovation

As illustrated by Figure 38, the survey results highlight the diverse institutional and regulatory barriers to innovation faced by South Africa’s agribusinesses.

Figure 38: Institutional and regulatory barriers, 2019-2021



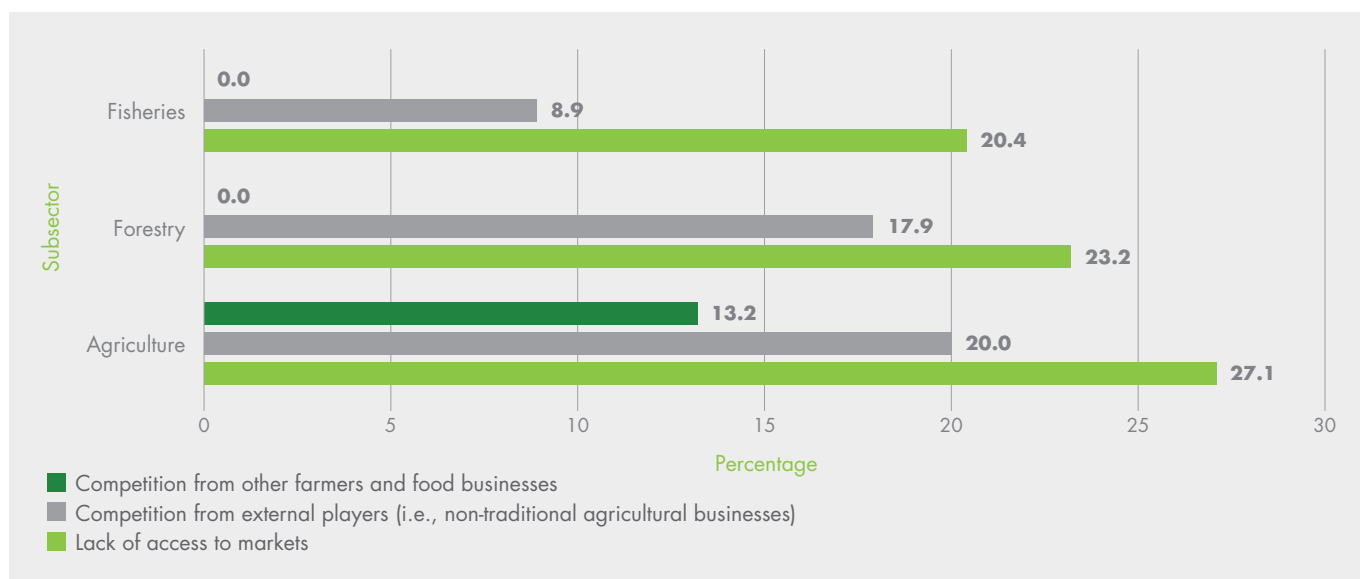
Source: Appendix table A20.2

In the agriculture (animal and crop farming) subsector, nearly half of innovation-active businesses (47.7%) reported that agricultural policies and regulations were a key impediment to their innovation. This concern was substantially less pronounced in forestry (23.2%) and even less for fisheries subsector businesses (3.5%). Almost half of all the innovation-active forestry subsector businesses rated government support (48.4%) as a highly important barrier to their innovation. Agriculture businesses also expressed a significant concern about the lack of government support, with almost 40% of businesses in this subsector rating this barrier as “highly important”.

Market access barriers and competitive challenges faced by agribusinesses

The market access and competitive forces impeding agricultural innovation, rated as “highly important” by innovation-active businesses, are illustrated in Figure 39.

Figure 39: Market access barriers, 2019-2021



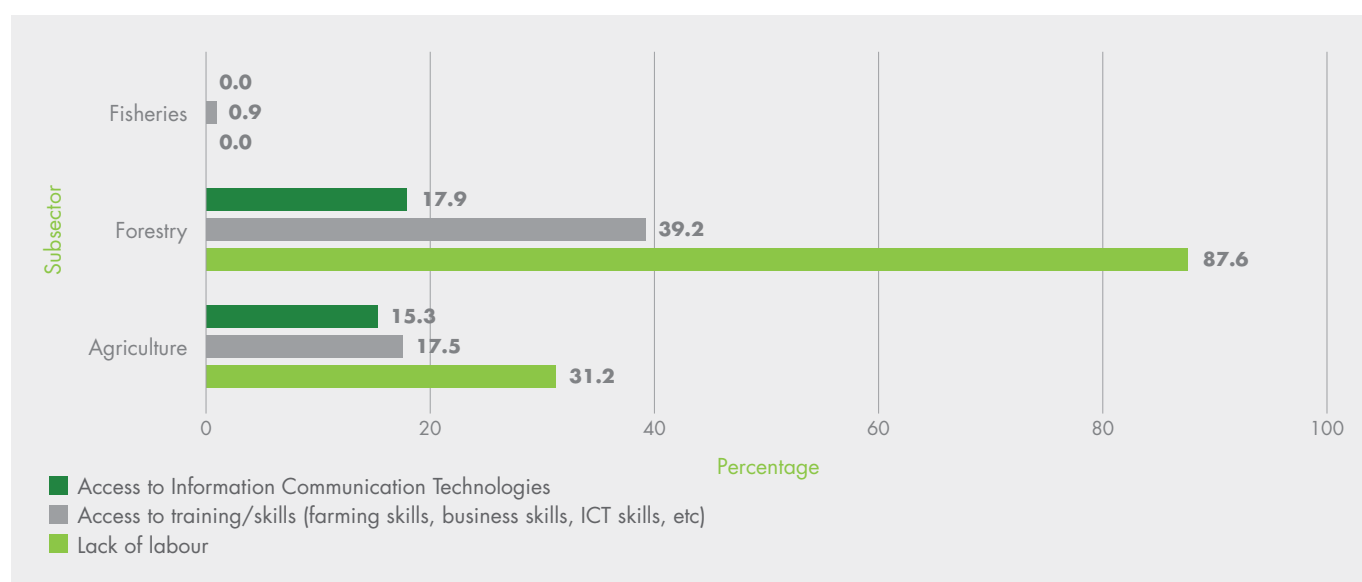
Source: Appendix table A20.2

Lack of access to markets was rated as a significant barrier to innovation for all three subsectors – Agriculture (animal and crop farming) (27.1%), forestry (23.2%), and fisheries (20.4%) businesses rated “lack of access to markets” as a significant barrier to their innovation (Figure 39). With respect to competition from external players, the agriculture subsector recorded a relatively high concern (20%) compared to other sectors, regarding competition from external players, such as non-traditional agribusinesses. The agriculture subsector also stood out with only 13.2% of businesses rating competition from other farmers and food businesses as a highly important factor impeding innovation.

Human capital and technological barriers to innovation

The human capital and technological challenges impeding agricultural innovation and rated “highly important” by innovation-active businesses are shown in Figure 40. The forestry subsector businesses, in particular, faced significant challenges related to labour shortages and skills development. In total, 87.6% of forestry businesses reported lack of access to labour as a highly important factor impeding their innovation. Agriculture (animal and crop farming) businesses also reported the importance of skills development and faced a set of workforce-related challenges. Access to ICTs was considered a significant barrier for approximately 15% of businesses in agriculture (animal and crop farming) and 17.9% in forestry.

Figure 40: Human capital and technological barriers, 2019-2021



Source: Appendix table A20.2

CONCLUSION

This report provides a foundation for understanding the agricultural sector's modernisation efforts within the context of the post-Covid-19 recovery and existing challenges faced by the sector. Underpinned by four key dimensions—business innovations, digital-based technologies, human capital development, and sustainability initiatives—the report highlights the state of innovation in agribusinesses during reference period 2019-2021.

Despite the disruptions caused by the Covid-19 pandemic, the agriculture sector showed some resilience, with agribusinesses reprioritising some of their innovation activities. Medium-sized agribusinesses emerged as leaders with higher rates of innovation activity compared to other size categories. Business process innovation was the most prominent type of innovation, overshadowing product innovation. Regional variations were observed in innovation activities across the different provinces.

Trends in the existing and future adoption of advanced ICTs suggests a transformative period for the sector, with a clear willingness to modernise farming practices, especially in precision agriculture. These trends align seamlessly with the 2019 White Paper on Science, Technology and Innovation as well as the 2022-2032 STI decadal plan, which highlight the need to use ICTs, and increased productivity in the agriculture sector.

The dimension of human capital development and skills development highlighted a link between innovation-active businesses and employment, with progress in addressing historical racial imbalances. Most innovation-active businesses prioritised investment in training and reskilling their employees as their top innovation activity. In terms of gender disparity, a higher percentage of male employees were involved in innovation activities compared to females. This suggests areas for policymakers to target.

With respect to sustainability initiatives, the report showed that there were diverse priorities across subsectors and firm sizes. This was indicated in the importance of innovation outcomes such as increased revenue, reduced costs, water preservation, and biodiversity preservation.

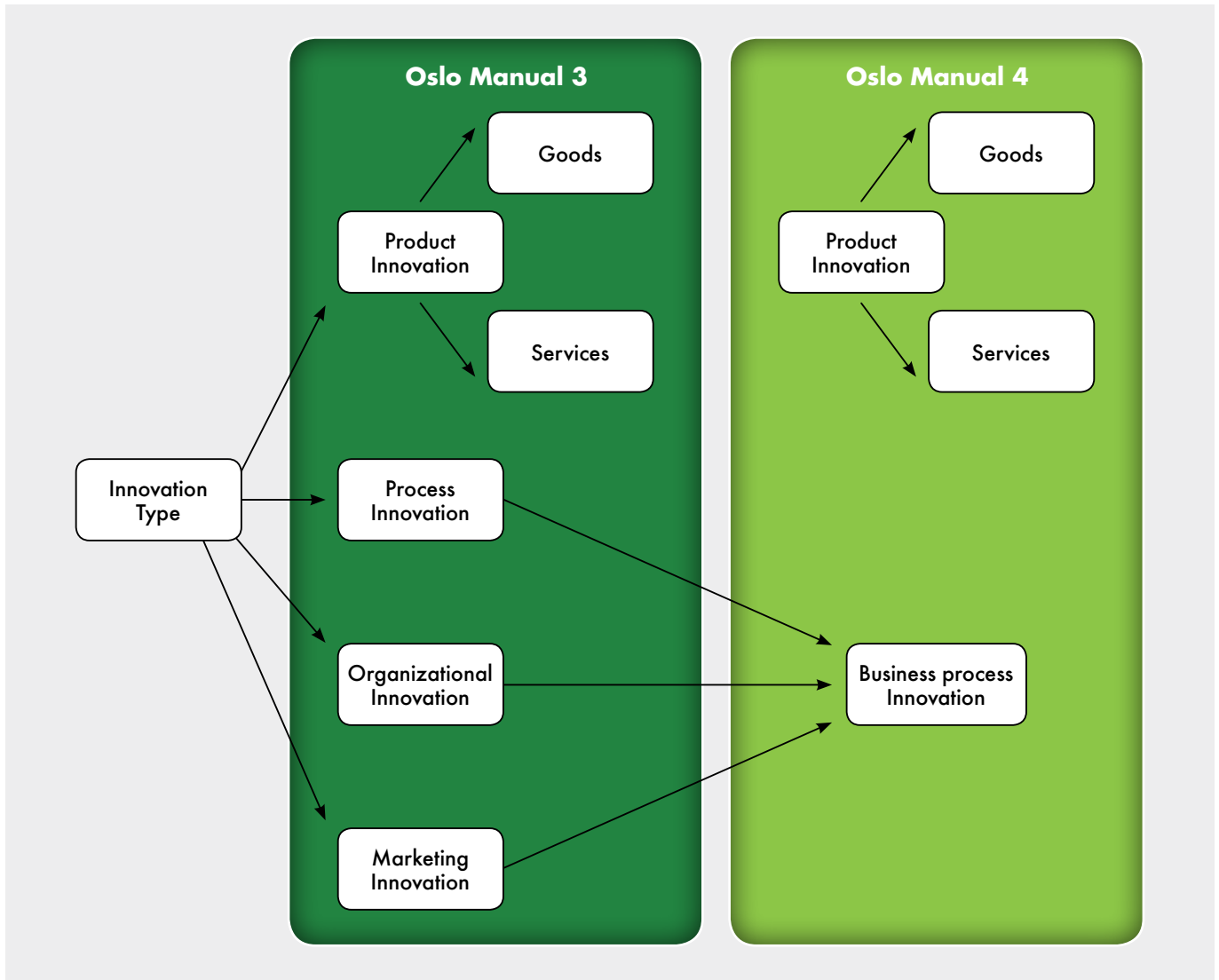
Finally, this AgriBIS shows that innovation remains a key driver of the modernisation of the South African agricultural sector. As the sector continues to recover from the negative effects of Covid-19, while navigating its long-standing challenges (e.g. climate change) and evolving and emerging new challenges (e.g. regulatory challenges), adopting and implementing more innovations, using advanced technologies, promoting more collaboration, and making use of government support for innovation will be critical to achieve an inclusive, sustainable, resilient, productive and innovative agricultural sector.

SUMMARY OF METHODOLOGY

Survey design

The first three editions of the OECD Oslo Manual, on which the methodology for the South African Business Innovation Survey is based, mainly focus on the manufacturing and services sectors, and largely exclude the agricultural sector. The design of the South African Agricultural Business Innovation Survey, 2019-2021, utilised the broader definition of innovation contained in the latest edition of the Oslo Manual (OECD, 2018).

Figure 41: Changes in Oslo Manual from Edition 3 to Edition 4



The first step in the design of the second round of the AgriBIS 2019-2021 project was to align the survey with the Oslo Manual (2018) approach (Figure 41). At the outset, the survey design team drew on the wealth of expertise and experience of multiple stakeholders in South Africa’s agricultural sector, including partners in government, universities, public research institutes, industry associations and other agricultural bodies. By working closely with these groups at all stages of the research cycle, including research design, data analysis, and dissemination, the survey aimed to be inclusive of and responsive to the needs of the sector. Stakeholder knowledge and ideas were supplemented by assessing the previous round of the survey, the baseline AgriBIS 2016-2018.¹¹

¹¹ https://www.dst.gov.za/images/SA_AGRICULTURAL_BUSINESS_INNOVATION_SURVEY_2016-2018_REPORT.pdf

Drawing on existing practice in South Africa, and given limited time and resources, the baseline survey used the subject-based approach of the Oslo Manual and Community Innovation Surveys (CIS) questionnaire to adapt survey questions and make them suitable for the agricultural sector. The approach adopted was to measure innovation at agricultural business level. The benefit of this (which began with the baseline study) was the ability to generalise the results to the entire population. In the current second round of the survey, AgriBIS 2019-2021, innovations were profiled at a higher level of aggregation for the agriculture, forestry and fisheries subsectors.

Sampling, collection and response

In terms of coverage, the AgriBIS 2019-2021 included three main subsectors, with data collected at the level of an agribusiness. These subsectors were agriculture (e.g. crop producers, wineries, livestock and poultry farmers, and the like), forestry and fisheries. A sample was drawn by Stats SA, using SIC codes 11, 12 and 13, with representative sample sizes of 1 564 for the agriculture subsector, 72 for the forestry subsector and 68 for the fisheries subsector respectively, giving a total sample of 1 704 businesses. The BIS 2019-2021 covered agri-food businesses (food, beverages and tobacco) under the manufacturing sector (SIC 3) and, hence, these were not included in the sample.

The measure of business size used was turnover. This was derived from the Value Added Tax or Income Tax turnover as reported by the enterprises to the South African Revenue Services (SARS). The businesses were categorised into four size groups or categories viz.

- sizegrp1 (large),
- sizegrp2 (medium),
- sizegrp3 (small) and
- sizegrp4 (very small or micro)

The cut off between each category was done based on the 2003 Department of Trade and Industry (DTI) size boundaries. It should be noted that the boundaries are the same for all three divisions within the agricultural sector (i.e. SIC 11, 12 and 13). Below are original boundaries (unadjusted):

Firm size	Annual turnover
Large businesses (size group 1)	Turnover > R5 000 000
Medium sized businesses (size group 2)	R3 000 000 < Turnover ≤ R5 000 000
Small sized businesses (size group 3)	R5 000 000 < Turnover ≤ R3 000 000
Very small sized businesses (size group 4)	0 ≤ Turnover ≤ R500 000

Following the analysis of the sampling frame, in consultation between Stats SA and the Centre for Science, Technology and Innovation Indicators, the above boundaries were adjusted by a factor of 8.0 for the AgriBIS 2019-2021. Below are the final boundaries after adjustment:

Firm size	Annual turnover
Large businesses	Turnover > R40 000 000
Medium businesses	R24 000 000 < Turnover ≤ R40 000 000
Small businesses	R4 000 000 < Turnover ≤ R24 000 000
Very small businesses	R0 ≤ Turnover ≤ R4 000 000

The indicators for the AgriBIS 2019-2021 were adapted from the set of standardised business innovation indicators. The standard CIS questions were adapted to be more agriculture specific and relevant, drawing on inputs from stakeholders and the literature. For example, the factors that promote or constrain innovation are distinctive, hence new items were designed to assess the adoption of new digital technologies specific to the agricultural sector, such as crop sensors, precision engineering and livestock biometrics. The order of questions was changed, and fewer questions were included than the typical BIS, to accommodate respondents in farming businesses and boost the response rate.

Sample cleaning identified 631 of the initial sample of 1 704 businesses to be invalid. These businesses were found to be either not identifiable or untraceable through several methods, duplicates or inactive businesses. Invalid businesses were excluded from the original sample, resulting in a final survey sample of 1 073 businesses. Online digital tools were used to conduct data collection. In particular, Everlytic (a bulk email service) was used for dispatch and to direct potential respondents to either:

- an online questionnaire created in the REDCap survey tool licensed by Vanderbilt University to the Human Sciences Research Council, or
- a downloadable Adobe form (with English and Afrikaans translations available).

Everlytic and REDCap were also used to monitor the status of questionnaires, in terms of whether the respondent contact had opened a survey request email, or responses to the questionnaire had been attempted or completed. This enabled informed, targeted and efficient fieldwork follow up.

In a difficult business climate, 531 businesses responded to the survey over a short and intensive fieldwork period of nine months from August 2022 to April 2023. On this basis, the survey achieved an overall response rate of 49.5%, rounded off to 50.0%.

Non-response survey

Non-response is the number of entities surveyed where the respondent did not complete and/or return the questionnaire. With the achieved response rate of 49.5%, rounded up to 50%, a non-response survey based on a simple random sample of non-responders was conducted as recommended by the revised Oslo Manual (OECD, 2018), for surveys achieving response rates of less than 70%. The purpose of conducting the non-response survey is to correct for bias that might arise due to enterprises that did not respond to the survey being less or more innovative than those enterprises that did respond. The Oslo Manual (OECD, 2018) recommends that the non-response survey is based on a simple random sample of 10% of non-responders. For the AgriBIS 2019-2021, the non-response survey covered 15% of the agribusinesses that did not respond to the main survey (83 enterprises), and 55 firms completed the non-response survey. This corresponds to an overall response rate of 66.3% for the non-response survey.

Data quality and extrapolation to the target population

An assessment of the quality of the survey was conducted using selected quality indicators of the South African Statistical Quality Assessment Framework (SASQAF) (Stats SA, 2010). The correction for bias due to non-response was implemented by adjusting the probability weights that are used to extrapolate the sample results to the target population of agribusinesses. The weights-adjusting methodology first adjusts the target population for invalid agribusinesses (untraceable or found to have merged or been liquidated), based on the sample results. Then the resulting weights were adjusted for potential bias due to non-response by using the results from the non-response survey. The adjusted weights were then used to extrapolate the sample survey results to the target population of South African agribusinesses (adjusted for invalid agribusinesses) in the three subsectors (agriculture, forestry and fisheries) and size-groups (large, medium, small and very small businesses).

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Your participation matters.

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AGRICULTURAL BUSINESS INNOVATION SURVEY 2019–2021



For a more innovative South Africa

*INCLUDING FARMING, FORESTRY AND FISHERIES

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