Briefing Note: Farming 4.0 – Implications for South Africa

Agribots, aquaponics, smart collared cows, fenceless farming and e-shepherds, and aero/vertical farming are some of the emerging technologies that fuse the digital, physical, automated and scientific systems in the new agricultural revolution, sometimes called "Farming 4.0". The challenge is to achieve sustainable food security systems that incorporate scale production with affordable and cost-effective farming methods and environmental protection.

From a development perspective, the technological transformation should contribute to the national objectives of food security, job creation, an inclusive economy and transformation in ownership of the country's resources. Progress has been spearheaded by some commercial farmers, communities, provincial agriculture departments, and non-governmental organisations.

At national level, President Cyril Ramaphosa expressed in early 2018 that the agricultural revolution should be embedded in land reform, and that redistributed farms should be active in production.

The challenge, however, is that the new technologies may pose a threat to jobs. This threat takes two forms.

On the one hand, labour could simply be displaced. Currently 730 000 people are employed as formal farmworkers, many of them doing tasks such as herding and weeding that could become redundant. On the other hand, the new technologies frequently require extensive training on top of a secondary education to manage installation, programming and maintenance. In formal agriculture, however, farmworkers have an average of eight years of education, among the lowest in any industry. Experience suggests that even if the shift to new technologies does not lead to a fall in the number of jobs, employers may replace existing workers with better educated (and better-paid) people.

Table 1 summarises the technological directions that define Farming 4.0.

Table 1: Farming 4.0 concepts

Type of change	Examples	Description
Produce differently using new technologies and innovations	Hydroponics, aquaponics, smart irrigation	Hydroponics refers to growing plants without soil, usually in an inert substrate like gravel or perlite. The plants are fed by nutrients dissolved in water. Aquaponics centre on the introduction of fish, where the water and the nutrients from the fish tank flow into a tank of vegetables and herbs, and in addition, the vegetables clean the water which flows back into the fish tank.

Type of change	Examples	Description
Produce using modifications and innovations of technology and techniques	Vertical / aero farming, freight farming	Vertical farming is the practice of producing agricultural products in vertically stacked layers using indoor farming techniques and controlled environment agriculture.
Incorporate cross industry technology and applications to production	Drone technology, remote farming, smart collared cows	Remote farming fence — move and monitor livestock remotely via smart gadgets.

Source: Adapted from De Clercq, Vats and Biel (2018)[1]

South Africa has more than 70 institutions operating in research, training, installation and sales of equipment and parts or whole systems, in the use of hydroponics and aquaponics technologies. These hydroponics and aquaponics technologies mitigate weather conditions and reduce the need for soil. However, at present, only a limited number of products can be grown, including but not limited to some leafy vegetables.

Modifications and innovations in space usage have also allowed for farming in urban spaces. These innovations involve the use of rooftops, balconies and window sills for planting, and are already in use in cities such as Johannesburg and Cape Town. Research shows that vertical gardening can use about 95% less water than conventional farms, and yield 75 times more crops per square meter. A recent addition is freight farming, which uses stacked shipping containers. This technique is affordable, repeatable and transportable. Entrepreneurs in Cape Town have already started fish farming in containers, bolstering the scope for aquaculture.

Cross-industry technologies and applications have been adapted for agricultural use. Drones are not a new concept, but they have been developed to monitor livestock health using infrared thermal cameras. They can perform routine checks of fence lines, monitor dam levels, livestock and wild game in a fraction of the time required by standard methods using ground travel. Already seven firms have received licensing from the South African Aviation Authority to use drone technology for various purposes, including agriculture.

Cost drivers for livestock include fencing as well as labour for herding. Smart gadgets make it possible to fence, move and monitor livestock remotely. Fenceless farming and e-shepherd involve a GPS-enabled animal collar and an app that allows farmers to create virtual grazing zones. Transponders on individual animals use audible cues that ensure animals stay within set boundaries. The system

[1] De Clercq, M., Vats, A. and Biel, A. (2018). Agriculture 4.0: The future of farming technology. Dubai: World Government Summit.

prevents over grazing and allows better land management. The e-shepherd is not yet known to be used in South Africa, which still relies on traditional collars with bells, herders and fencing.

These farming technologies, some developed for completely different sectors, have found use in the agricultural sector. They represent an opportunity to improve capacity and output through increasing yields and productivity. There may be an impact on employment, however, and the full effects need to be understood.