SUPPORTING FUTURE FARMING SYSTEMS AT SUB-NATIONAL LEVEL IN THE FACE OF THE 4th INDUSTRIAL REVOLUTION

Sub-Theme: The Role of Policy in Defining Future Farming Systems

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Abstract:

Although consensus is still to be reached on its name, it is commonly accepted that economic, social and political systems will be disrupted by the so-called "4th Industrial Revolution". Furthermore, it is expected that farming may carry the brunt of this disruption. It can be argued that autonomous vehicles, 3D printing, advance robotics, new materials, digital as well as biological developments are some of the key drivers which will lead to this disruption and potential impacts will be found in the economic, employment, workplace, business, crime, government and conflict spheres of society.

In this paper these drivers and impacts were described in a sub-national context; The Agricultural Sector of the Western Cape Province of South Africa. Although the Provincial Department of Agriculture's support of the Sector has been developed over time and is based on well considered logic, it is important to debate the question whether this logic will remain relevant over the next decade. To this end the Department is currently developing a plan of action to maximise the positive and minimise the negative impacts of the 4th Industrial Revolution.

Keywords*: 4th Industrial Revolution; agricultural policy response; sub-national; South Africa*

1. INTRODUCTION

Who amongst us can still remember the popular mobile phone urban legend of the 1990's? The gist of the story is of the young guy (why was it always a guy?) talking loudly on his mobile in a lift full of people; and then the mobile rang! The moral of

the story was that the guy wanted to impress the people in the lift by showing his success as manifested in owning one of the latest pieces of technology; but the technology exposed him as a fraud. Today it is difficult to remember a life without being connected (and at work?) 24/7. Indeed, it is impossible for the generation born after the turn of the Century to imagine a life without their smartphones with the result that the current marketing narrative is all about using social media and reaching millennials.

The story of the mobile is to illustrate the rapid change experienced over the past couple of decades and all indications are that the speed of change will only increase. Even more important, Vinning (2016) argues that farming will be one of the industries which will carry the brunt of disruption with more change to be experienced in the next two decades than farmers had to face the past 250 years.

How should a sub-national government department of agriculture react to these trends? What should be done to maximise the positive and minimise the negative elements given the constraints associated with limited powers? Rather than attempting a definitive answer, the purpose of this paper will rather be to start the process of exploring trends, impacts and interventions. In the first part of the paper the Agricultural Sector of the Western Cape Province of South Africa will be described. This will be followed by explaining the logic behind the current series of interventions at Provincial level after which the main trends and impacts of the so-called "4th Industrial Revolution" will be explored. In the final part of the paper the initial response by the Western Cape Department of Agriculture will be explored.

2. DESCRIPTION AND METHODS:

2.1. Brief overview of the Western Cape Agricultural Sector.

The total value of agricultural production in the Western Cape Province amounts to R31,3 billion ($2.35 billion) with labour intensive, export focussed, irrigated long term crops such as apples (17,4%), wine grapes (16,9%), table grapes (8,3%), pears (6,4%) and others being responsible for 68% of the total income of the Sector (WCDOA, 2013). For various reasons these industries are also the most vulnerable

to disruption. The Gross value added by Primary Agriculture amounted to R18,5 billion ($1,39 billion) in 2014 (StatsSA, 2016) and Agri processing added another R21,9 billion ($1,65 billion) (Partridge, 2016). The implication is that Agriculture and Agri processing were responsible for more than 7,8% of the value added in the Western Cape economy during 2014.

This economic activity is being generated by 6 653 commercial (StatsSA, 2009) and 9 844 smallholder (WCDOA, 2010) farmers. At the same time the Agricultural Sector of the Western Cape provides employment to 166 000 people; just over 23% of South Africa's agri workers. The Agri processing Sector adds another 122 708 agri processing workers in the Province. If we were to add the 91 370 support workers (e.g. security guards, cleaners, cooks, lawyers, etc.) backing these workers, we find that about 380 000 people in the Western Cape Province is currently working in the agri processing and related sectors of its economy. Indeed, this is 16.2% of the 2,35 million people employed in the Province (Calculated from, StatsSA, 2016b).

2.2. Supporting the Agricultural Sector at sub-national level.

Support to this Sector of the economy commenced after the Chairperson of the Agricultural Society of the Cape of Good Hope wrote a petition to the Parliament of the Colony of the Cape of Good Hope on 3 July 1883. The purpose of this petition was to request the establishment of a Department of Agriculture and its immediate result was the creation of the Elsenburg Agricultural College (Serfontein, J, 1998). Elsenburg eventually became the Head Office of the Winter Rainfall Area of South Africa's Department of Agriculture. As Agriculture is designated as a Schedule 4 (concurrent) function by South Africa's Constitution (Act 108 of 1996), the Western Cape Department of Agriculture was subsequently established in 1996 with the resources of the Winter Rainfall Region at its core and Elsenburg as its Head Office.

To determine the focus areas of its support, the Department argues in its current Annual Performance Plan (WCDOA, 2017) that a successful farming operation can only exist in an environment which can be controlled by farmers. This "agricultural space" can be defined as the area where the triple bottom line of sustainability

intersects (see Figure 1). Outside this area are a number of environmental factors which have to be noted and will definitely have an impact on the Agricultural Sector, but which cannot be influenced.

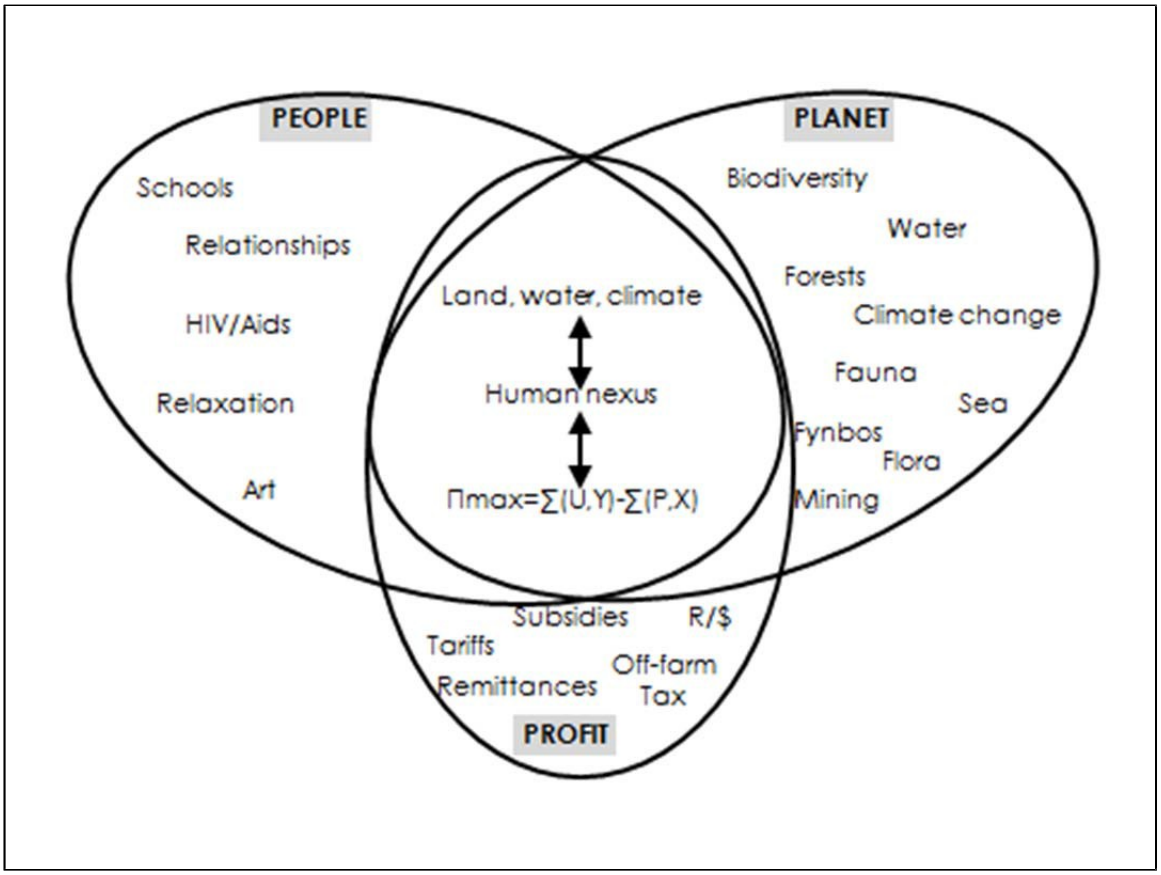

Figure 1: The Agricultural space in which the Department's interventions can make a difference.

In the agricultural space four controllable elements can be identified. The first is natural resources with specific reference to land, water and climate. The quality of land can be improved and, at the same time, land usage can be controlled. Water-use efficiency can be improved and the climate can be controlled (through controlled atmosphere production) to a limited extent. The second area of control is the profit function which can normally be described as the sum of income minus the sum of expenditure. Expenditure is derived from the number of inputs used multiplied by their cost and income from the number of outputs times their price. However, in this instance one very important difference from the normal approach was introduced by using "utility" instead of price of output. In this way the non-financial benefits of

food farming (e.g. household food security, interaction with nature, etc.) can be included in the equation. The third element of control is people whom control the other elements. This control can be improved via human capital development. The fourth element of control is institutions which regulates the relationships between the various elements. It has long been recognised that institutional development can solve numerous problems.

Within this framework of controllable elements each of the Departmental Strategic Goals (DSG) is targeted towards a specific controllable element. DSG 1 (maintain export position) intends to improve the utility value of the profit function. DSG 2 (land reform success) supports a specific group of clients to optimise the way in which inputs are combined in the profit function. DSG 3 (increase production) targets the same part of the profit function, but addresses a wider group of clients with the focus on efficiency gains. The objective of DSG 4 (natural resources) is to maximise the land, water and climate nexus and DSG 5 (rural nodal development) focuses on the human element in specific nodes as well as the institutional frameworks in these areas. The objective of DSG 6 (agri processing) is to develop new forms of utility for agricultural products whilst DSG 7 (human capital development) also strengthens the human nexus. Towards this end the Department is embarking on a number of specific actions and these actions are measured by a range of strategic, sector and provincial indicators.

3. RESULTS

3.1. Trends underlying the 4th Industrial Revolution

It is important to ask the question whether this approach will remain the most appropriate over the medium to long term. A whole range of commentators argues that the world's economy is currently on the brink of fundamental change. Some call it the 4th Industrial Revolution, others the 2nd Digital Revolution and still others the 2nd Machine Age. Although disagreement on a name for this fundamental shift still exists, everybody does agree that the shift will be significant and that society in its totality (from business people, workers to support institutions) will have to adapt.

Klaus Schwab, in his book "The Fourth Industrial Revolution" (Schwab, 2016), provides an excellent overview of the drivers of change as well as the impacts we could expect. He argues that the 1st Industrial Revolution took place from 1760 to 1840 with the introduction of railways and the steam engine which made mechanical production possible. During the 2nd Industrial Revolution, from the late 19th Century to the early 20th Century, the introduction of electricity and the assembly line led to mass production. The 3rd Industrial Revolution, often called the Digital Revolution, started in the 1960's and gave rise to personal computing and the internet.

He further argues that the 4th Industrial Revolution is not merely an extension of the Digital Revolution (a so-called "Version 3.2"), but that the world is at an inflection point. Virtual and physical systems of manufacturing, combined with new developments in the fields of gene sequencing, nanotechnology, renewables and quantum computing enables systemic changes across the physical, digital and biological domains that makes the 4th Industrial Revolution fundamentally different from its three predecessors. In a world where 17% (1,3 billion people) of the population has not yet reached the 2nd Industrial Revolution (they have no access to electricity) and 4 billion people (almost 50% of the world's population of whom most live in the developing world) is still not connected to the internet (i.e. has not reached the 3rd Industrial Revolution), how will society be impacted by the 4th revolution? In 1990 the three biggest companies in Detroit, USA (a prime example of 2nd revolution manufacturing) had a combined market capitalisation of $36 billion with 1,2 million employees. The three biggest companies in Silicon Valley, USA (iconic of the 3rd revolution), in 2014 had a market capitalisation of $1,09 trillion (33 times higher) and 137 000 employees (9 times lower).

Whilst new and unforeseen drivers may develop overnight, the following drivers underpinning the 4th Industrial Revolution can be identified:

a) Autonomous vehicles: In addition to driverless cars, trucks, drones, aircrafts, boats and other vehicles are slowly but surely being introduced in our society. Indeed, the technology required for precision farming (and to whom farmers became used) has developed to the level where CASE has just released a totally driverless tractor without any semblance of a steering wheel (CASE 2016) and the use of agricultural drones has become a common sight.

b) 3D Printing: By using additive (3D) rather than subtractive ("normal") manufacturing practices, previously impossible forms and shapes can be developed at places which were not possible in the past. In the near future this technology may even lead to the "printing" of animal as well as human cells and organs.
c) Advanced robotics: Robots have become fairly commonplace pieces of equipment performing routine and precision tasks in the manufacturing environment (e.g. in the car manufacturing Industry). However, "biomimicry", advance sensors, machine learning and connections to other robots via the cloud will lead to robots performing tasks in environments and areas not previously imagined.
d) New materials: "Smart" materials which are lighter, stronger, recyclable and adaptive are coming onto the market. They may be adaptive to their environment, self-healing, self-cleaning and/or may have a "shape memory".
e) Digital: The "internet of all things" is a relationship between things (products, services, places, etc.) and people made possible by connected technologies. Applications include real-time tracking of products, new forms of building trust relationships (e.g. Bitcoin) and on-demand sharing (e.g. Uber and Airbnb). Interestingly enough, Uber and Airbnb, the world's largest taxi company and accommodation provider, respectively owns no vehicles or property.
f) Biological: Genome sequencing has become commonplace and relatively affordable. The next step will be synthetic biology allowing us to grow new organs and create "designer babies". It is evident that this will lead to a whole range of ethical questions.

3.2. Potential impacts of the 4th Industrial Revolution.

As the very core of the 4th Industrial Revolution is rapid change, its impacts are very difficult to predict. However, based on the trends and current observations some general effects can be postulated:

a) Economic: Due to the nature of the services in the 4th Industrial Revolution, not all consumer benefits and productivity increases are currently captured in official data. This may imply that its current impact, and certain growth indicators, may be different than reported.

b) Employment: Whilst new types of work will be created, other categories will be destroyed. It is uncertain whether the net effect will be positive or negative, but it is certain that the nature of employment and the skills requirements will change dramatically. An interesting observation is that the job categories which may prove to be more difficult for machine learning (e.g. those require empathy and compassion) traditionally were the areas in which females excelled. Or, will humanity, as surveys amongst the next generation suggest, lose its ability to show empathy and compassion?
c) Development: The industrial development path traditionally implies that cheap, but productive, labour would attract capital, knowledge and skills which would enable a country to grow economically. However, will the 4th Industrial Revolution mean the "on-shoring" or "re-shoring" of manufacturing in developed economies and destroy the natural development path of a range of developing countries? On the other side of the coin, an additional 240 million new mobile phone users are expected in Sub-Sahara Africa over the next 5 years. What will be the net effect on global inequality?
d) The nature of work: We are already seeing a movement away from people building a career at one company and more employers are using the "human cloud" to get things done in an environment of "immediacy". In other words, companies are outsourcing specific and well defined tasks to provide an on-demand service. Will this lead to more freedom and flexibility for employees or a more precarious workforce trying to make ends meet without any form of job security?
e) Doing business: The time during which a business remains an industry leader is getting shorter and customers will expect more value added to their purchases (e.g. through data and customisation). To fulfil these expectations, businesses will have to develop partnerships and business models which stretches beyond their comfort zone.
f) New forms of crime: It is estimated that the annual cost of cyber attacks to businesses already amounts to $500 billion (without including consumer and private costs). For this reason the market for cyber security is expected to grow to $170 billion by 2020. Other forms of crime can only be imagined.
g) Governments: One of the potential implications of the 4th Industrial Revolution is that it will be much easier to hold governments accountable whilst, at the same

time, the challenges of creating policies and strategies in a fast changing world will be much more complex. The opposite side of the coin is that governments could use cyber technology to gather and (mis)use the private data of their citizens.

h) Conflict: It is of concern that an increasingly interconnected world, combined with rising inequality, may lead to marginalisation, social unrest and violent extremism. Given the whole range of new technologies, and the ease with which some of it may be developed, the result may be asymmetric warfare (not necessarily waged between nation states) during which the victim may not even known it is being attacked.

4. DISCUSSION: RESPONDING TO THE CHALLENGS, OPPORTUNITIES AND IMPACTS OF THE 4TH INDUSTRIAL REVOLUTION

It is evident that we are standing at the brink of a number of changes which will fundamentally, and irreversible, influence and change economic, social and political systems at macro, meso and micro levels. Indeed, the question companies and industries need to face is no longer "will I be disrupted", but rather "when will my business be disrupted, how will the disruption take place and how will it affect me and my business?" It will probably be those businesses who most effectively succeed in combining the digital, physical and biological worlds that will be the most resilient against disruptive change.

However, it does not mean that we are powerless. Global society still has the opportunity to drive the 4th Industrial Revolution in a desired direction by establishing a common set of values to drive policy choices. For this reason the Western Cape Department of Agriculture has commissioned a study to investigate the trends underpinning the 4th Industrial Revolution, its impacts and, even more importantly, what can be done to ensure the best possible outcome for the people of the Province. To this end the following key research questions will be investigated:

a) Which are the variables influencing multi-facetted change in the global agricultural environment and what are the key elements of each?
b) What new technologies and trends will most likely have an impact (both negative and positive) on the Western Cape Agricultural and Agri processing Sector?

c) What is the nature of the economic, social, technological and political impact of the trends and which of the trends and impacts are the most important?.
d) What should be done (actions) by the Sector to minimise negative impacts and maximise positive opportunities.
e) Who (Government, farmers, agribusiness, etc.) should take responsibility for which actions?

5. CONCLUSION

It is common cause that global society, and farming in particular, is standing at the brink of real and disruptive change. Some of the current drivers of this change, often called "the 4th Industrial Revolution", include autonomous vehicles, 3D printing, advance robotics, new materials, digital as well as biological developments. It is expected that the result of these drivers will have impacts with economic, employment, workplace, business, crime, government and conflict dimensions.

The Agricultural Sector of the Western Cape is not only an important part of the Provincial economy, but it is also an important employment creator, more than 21% of agricultural economy of the Province and totally dependent on the export market. The Provincial Department of Agriculture has developed a logical intervention to support this industry, but is currently asking the question whether this plan of action is sustainable (for itself and the industry) over the medium to longer term. To this end the Department is currently developing a plan of action to maximise the positive and minimise the negative impacts of the 4th Industrial Revolution.

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