TECHNOLOGY, INNOVATION AND MODERNISATION: IMPLICATIONS ON CROP PRODUCTIVITY

AGRICULTURE remains the basis of the Zimbabwean economy. If we get agriculture right, then we are on the right track to get everything else right: food security and surplus, industrialisation, exports growth, job creation, value creation, growth of the rural economy and growth of the overall economy. The sector contributes significantly to the National Gross Domestic Product, exports, raw material supply base to the manufacturing industry, employment and livelihoods, so it is clear that we need to fundamentally get it right.

The World Bank toolkit on the Health of Agriculture comprise of 8 tools or touch points and according to a 2017 World Bank report, Zimbabwe still needs to improve on 7 of the 8 touch points as illustrated in the dashboard below:

*Green=good
Source: World Bank Presentation on Vision 2030 for Zimbabwe’s Agri-Food System

But, we can still put some important add-ons, such as knowledge through sound agricultural Extension, Communication and Farmer Education, which is a key enabler in improving crop productivity.

Technology adoption, innovation and modernisation are critical tools in the Agriculture development toolkit. These tools help in improving; output/time, output/investment, output/labour and output/cultivated area. Improving efficiencies, productivity and profitability ensure sustainability and competitiveness of the agriculture value chain. Surely, for us to be able to sustainably feed our growing population (growing at the rate of 2.4 % p.a) and supply our industry with raw materials, yields must grow, Productivity, Productivity, Productivity! Technology and innovation adoption optimise Agriculture productivity.

Further, the trio (technology, innovation and modernisation), is an important ingredient in our efforts to commercialise farming in Zimbabwe, which is still largely subsistence and semi subsistence and to transform it to semi-commercial and commercial. We have over 1.2 million smallholder farmers in Zimbabwe, if we can successfully turn these to smallholder farming businesses? The implications will be positively significant in terms of rural employment, value creation, rural economy, competitiveness, rural livelihoods, agriculture value chain upgrading and overall the national economy. Over 67 % of our population live in the rural areas, and as such we cannot talk of inclusive economic growth, without the inclusion of this demography. We need to promote adoption of appropriate technologies and innovations among farmers in order to upgrade our Agriculture Value Chain.

Technologies with potential impact on Cropping Systems in Zimbabwe

Crop protection technologies
Generally, failure to control weeds during the first five weeks of a crop cycle leads to a 50% yield reduction. A painful example in maize is, failure to control Shamva grass throughout the growing season, can result 57-80% yield loss. The correct use of herbicide technologies (pre-emergence and post-emergence) can help keep fields weed free. Fall Armyworm pest is proving to be a menacing pest, and a real threat to farmer productivity and food security in Africa, but the use of registered pesticides technologies can help avert yield losses from this and other pests. The same applies for fungal diseases and fungicide technologies in crop production systems. Annually, 25 to 30 % of yield is lost due to poor Post Harvest Handling (PHH) of agricultural produce. PHH technologies including metal silos, grain protectants, grain bags, refrigerated trucks/containers, modern granaries and fumigants etc., must be promoted to avert PHLs.

Mechanisation

Appropriate mechanisation optimise efficiencies, productivity and production, which in turn and ultimately increases agricultural value chain competitiveness. Tillage implements, planting units, spraying equipment, detasseling machines, harvesting equipment and drying equipment are good examples of mechanisation which need to be embraced and promoted in our farming systems.

Soil and Crop Sensors

A number of farmers in Zimbabwe are beginning to use device sensors to monitor conditions such as soil moisture, pH, nutrient status and soil temperature. These devices regularly provide farmers with
valuable information about the condition of their soil and crops. This helps them make essential operational choices to maximize crop yield.

**Drones**

In modern cropping systems, the use of sustainable information and communication technology is not an option, but actually a necessity. Drones are remote controlled aircraft with no human pilot on-board. These have a huge potential in cropping systems in supporting evidence-based planning and in spatial field data collection.

**Drone uses in cropping systems**

- Declining insect populations call for innovations that support pollination and drones can be used to supplement insect pollination
- Aerial drone photography provides a quick look and detection of diseases, weeds, pests and localised nutrient deficiencies in the fields
- A drone enables automated crop harvest
- Drones can be used to direct detasseling in maize seed production
- Drones can be used for pesticide, fungicide and herbicide application

**Management Systems and apps**

Many factors impact the success of a farm. A farmer needs to monitor crop conditions, schedule planting and harvesting, prioritize daily and long-term tasks, and more. Smartphones/gadgets are now more useful in farm management as farmers can now actively use apps to monitor their crops via GPS, calculate feed, disease and pest diagnosis, save water, accessing financial services, shopping, procurement, inventory management, get access to networks and markets, etc.
Smart Platforms: Interaction and business in real time

**Precision Farming**
Precision farming is emerging as an innovation driven solution which is based on the optimised management of inputs in a field according to actual crop needs. It involves data-based technologies, including satellite positioning systems like GPS, remote sensing and the Internet, to manage crops and reduce the use of fertilizers, pesticides and water. This innovation maximise resources use efficiencies, yields and profits.

**Solar farms on the farms**
Significant amounts of electricity and energy go to the farming sector. Investing in renewable energy at farm level, apart from helping reduce the burden on national grid, it can also help reduce production costs, in the long run, ensuring widened value wedges/margins.

**Varietal technology**
Researchers have developed various forms of hybrid crops which offer benefits at two levels from the heterosis phenomenon; genetic yield potential and defensive agronomic traits-necessary for yield protection. Hybrid technology has proven to out-yield other planting materials significantly. Farmers who use hybrid seed material can produce more food without the need for more land. In fact, with a carefully chosen hybrid seed material, a farmer can produce more for less and produce more on less land and less other resources. Record yields have been realised by employing hybrids in vegetables, maize and sorghum, and high breeds of self-pollinated crops, such as soybean, sorghum and wheat.

**Molecular Technology**
Investments in molecular laboratory technology would improve genetic purity of seed crops, increase yield and enhance resistance to key diseases that compromise yield. Application of this technology would also speed up the breeding process and enhance speed to market in real time. This is essential in managing the effects of climate change by churning out new varieties every 3 – 5 years. Conventionally, without the molecular technology, it would take a researcher 8-15 years to release a maize variety.

**Vertical farming**
This modern form of farming used to produce food in a smaller controlled environment through vertically stacked layers to save on water and fertilizer – is no longer just a ‘buzz word’, but a reality. A number
of farmers in South Africa are already successfully using this technology as part of their farming practices.

**Vertical farms, stacked production beds** - Innovative utilisation of space: Producing more on less-suitable for urban backyard farming

**The fertilizer technology**
Achieving higher productivity levels require an excellent soil fertility management program which is centered on adequate timing and placement of Nitrogen, Phosphorus, Potassium and other micro-/macro-nutrients. The 5 Rs: Right fertilizer, Right soil condition (pH), Right time, Right placement, Right amount; must be adhered to, to get maximum returns from the fertilizer technology.

**Irrigation development and climate change adaptation**
Climate change is a reality and affecting farmer productivity and the economy in general. Climate change has brought in severe extreme weather scenarios; flash floods, false starts to seasons, high frequencies of mid-season dry spells, high frequencies of terminal droughts, heat waves, all negatively affecting agriculture production and productivity and the overall economy in general.

**Agriculture vulnerability to Climate Change effects:**

**Source:** World Bank Presentation on Vision 2030 for Zimbabwe’s Agri-Food System
Deliberate efforts and investments should go towards irrigation development, if we are to adapt to climate change effects. We have over 10700 water bodies with potential to irrigate over 2 million Ha of land in Zimbabwe, but it is unfortunate that we don’t “eat” potential, we need appropriate investments to harness this comparative potential into capacity. Irrigation development is essentially part of agriculture modernisation agenda and our agriculture desperately needs that.

**Benefits of technological innovations**
In summary the following can be realised by using technological innovations:
• Higher crop productivity and profitability - produce more for less and more from less.
• Increased water, land, fertilizer, pesticides, fungicides, herbicides use efficiencies i.e. Resources Use Efficiencies
• Reduced impact on natural ecosystems
• Reduced pollution of surface and groundwater
• Increased worker productivity and safety
• Enhanced genetic gains
• Managing climate change effects
• Push food prices down – crop productivity would sustainably drive down the costs of food. Imagine the impact of obtaining mountains of grain on the whole feed, food and fuel chain!

Key enablers to improve adoption of innovative technology in agriculture
In order to get the benefits of technological innovations, the country needs to invest and sustain the key enablers such as:
• Improved access to electricity and other utilities
• Increased internet connectivity, mobile devices and platforms to access information
• Geospatial analysis to help producers make informed decisions
• Implementation of a sound Intellectual Property protection & End Point Royalty System
• Access to extension and farmer education
• Access to output markets
• Access to appropriate credit and other financial services
• Value addition across the chain to increase the value of exports and further creation of jobs.

Parting shots
Technologies, Innovation and Modernisation is a formidable trio towards enhancing land utilisation as well as increased productivity, competitiveness, sustainable food security and attainment of agriculture led industrial revolution in Zimbabwe. Let us embrace and adopt technologies and innovations and modernise our agriculture. This will put us on a good space to attain another Green Revolution and to leapfrog.