
Curriculum reform in agricultural vocational education and training in Zimbabwe: Implementation challenges and possibilities

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ABSTRACT

There is a need for the agricultural technical vocational education and training curriculum in Zimbabwe to be reformed so that it can respond to changes in farmer demographics, the expanding roles of agricultural extension officers (AEOs), changes in technology and climate change. The current agriculture curriculum was developed for a different context altogether; therefore, it now lacks relevance to the prevailing socio-economic, political and environmental changes. There is a need for the curriculum to respond to the evolving needs of farmers, AEOs and institutions providing agricultural extension, and to match the changes in AEOs' occupation role profiles. This article draws on curricular documents from five institutions involved in the agricultural extension curriculum and policy, together with 22 respondents, with the aim of exposing gaps in the agricultural extension curriculum. In addition, the article explores the ways in which the curriculum can be reimagined to meet the needs of small-scale farmers, AEOs and emerging agricultural developments and digital technologies. The authors advance what might be the processes of change in the curriculum, highlighting the weaknesses of the current curriculum as well as what a more responsive curriculum for Zimbabwe should look like in the light of both local and international expectations. In so doing, it contributes to a wider international debate about agricultural education reform.

KEYWORDS

Agricultural education and training (AET), curriculum reform, conservation agriculture, agricultural extension, vocational education and training (VET)

Introduction

Internationally, the reform of agricultural vocational education and training (VET) curricula has gained prominence among policy-makers and academics. Agriculture is recognised as still being central both to economic development and to meeting the continuing challenges of poverty and hunger (Csete, 2018). Increasingly, too, it is seen as an important element of the responses to climate change. In this light, the problem of curricular misalignment has become widely recognised. This is the case in Zimbabwe, where important domestic contexts have also exacerbated the issue. There is general consensus that the current curriculum was conceptualised and designed for a different Zimbabwe which placed more attention on commercial farming and had few smallholder farming communities. Since the attainment of political independence in Zimbabwe in 1980, significant changes have taken place in the agricultural sector. Some have been due to land reform that opened up farming to new categories of farmer as part of wider changes in the political economy. Moreover, Zimbabwe has not been spared the changes in technology or climate change, both of which also significantly influence curriculum reform. The current agricultural extension curriculum was developed to meet the needs of a different Zimbabwe which had evolved since independence and the ensuing land reform. The need exists, therefore, for a more relevant and responsive curriculum which addresses the current and future needs of farmers. Agricultural education and training (AET) has struggled to maintain relevance in the face of major changes, and the Zimbabwean context has exacerbated such challenges. Zimbabwean colonialism took a particular form because the climate made it possible for a large white settler population to develop. As a result, both vocational and higher education, and access to professional and technical roles, were strongly shaped by the interests of the white population (Thondhlana, Abdulrahman, Chiyevo Garwe & McGrath, 2021).

Then, land ownership was highly unjust and unequal, with the most productive land being reserved for white-owned commercial farming and most of the black population being confined to small-scale production in ‘communal areas’ (Muzvidziwa, 2019). Inevitably, AET reflected these dynamics. During independence in 1980, there was an attempt to continue the presence of large-scale white-owned commercial farming while supporting the growth of small-scale black production for the market (Palmer, 1990).

For the purposes of this article, we sought to investigate whether the existing AET curriculum responds to the changing needs of stakeholders, the changing role profiles of AEOs, farmer populations, climate change and current developments in technology. The researchers sought to identify weaknesses and gaps in the curriculum and to suggest future directions for curriculum reform in Zimbabwe.

This article has three sections. In the first, we briefly discuss the international context of AET reform. Internationally, curriculum reform in AET is a topical issue, given the changing needs of stakeholders in agriculture that are driven mainly by climate change. The second section focuses on the methodology of the study. The final section presents the results and discussion. These are presented based on emerging themes, institutions offering AET, policy implementation capacity, finance and the economy, and developments in technology.

International context of agricultural education and training curriculum reform

The agricultural sector remains central to Africa's economic growth even though it faces challenges of productivity (Afeti, 2018; Jjuuko, Tukundane & Zeelen, 2019). Low productivity among small-scale farmers is a result of rainfall variability due to climate change, unresponsive soils, low levels of fertiliser use and the limited use of hybrid seeds. Climate change and environmental degradation pose a risk to agricultural production; therefore, farmers ought to be able to respond to these changes by adopting more 'climate smart' approaches, such as growing more drought-tolerant crop varieties. What makes these challenges worse is the skills deficit among small-scale farmers and agricultural extension officers (AEOs) linked to the poor responsiveness of the agriculture curriculum, among other factors.

Building and strengthening skills for boosting agricultural production and value addition in the agricultural value chain is a policy imperative for the developing world (Afeti, 2018). Therefore, internationally, curriculum review in agricultural extension has been topical, dealing as it does with current developments and with responsiveness and relevance (Raidimi & Kabiti, 2019). The landscape of agricultural production in the global south has changed over the past several years (Vicol, Fold, Pritchard & Neilson, 2019; Brown & Majumdar, 2020). Agriculture has become more complex and diverse in modern times than it was previously. The changing nature of agriculture now calls for curriculum reform in agricultural and vocational education and training to provide it with relevance, responsiveness and sustainability (Jones, 2013; Terblanche & Bitzer, 2018; Magomedov, Khaliev & Ibragimova, 2020).

At the global level, vocational education programmes in agriculture have been criticised for being narrow in scope and misaligned to the needs of the labour market while those programmes at universities and colleges of agriculture at undergraduate level are too theoretical and not aligned to the needs of small-scale farmers and employers (Vandenbosch, 2006; Wedekind & Mutereko, 2016). Curriculum challenges in AET have also been noted at the global level. Freer (2015) argues that there is a need for curricular and pedagogical updates for AET systems to produce graduates with the knowledge, skills and attitudes that enable sustainable food security, improve livelihoods and facilitate the conservation of natural resources. Generally, the AET curriculum and pedagogy have been criticised as being outdated and unable to serve the needs of learners of agriculture and the labour market.

More broadly, the call for a responsive VET curriculum has caught the attention of a number of researchers in southern Africa (Gamble, 2003; Wedekind & Mutereko, 2016; Muwaniki,

2021). A responsive curriculum requires a rethinking of the nature of the curriculum, particularly of the relationship between the curriculum, everyday life and the world of work. For responsiveness to be achieved there is a requirement to consider the needs of learners, institutions, the labour market and also policy-makers (Wedekind & Mutereko, 2016; Muwaniki, 2021).

For instance, a study in South Africa by the Academy of Science revealed that there is an urgent need to improve the relevance and responsiveness of the agriculture curricula (ASSAF, 2017). According to Muwaniki and Wedekind (2018), the curriculum and teaching methods in AET emphasise theory at the expense of (minimal) practical training – because most lecturers in the sector do not have the relevant practical skills themselves. AET providers in sub-Saharan Africa often face challenges regarding the curriculum, poor institutional linkages, new technologies and dilapidated infrastructure and equipment (Freer, 2015; Minde, Terblanche, Bashaasha, Madakadze, Snyder & Mugisha, 2015). There is therefore an urgent need to align AET curricula at all levels in the education sector to the key challenges facing the agricultural sector, with a particular focus on the needs and requirements of emerging farmers and national priorities. These priorities include food security, rural wealth creation and sustainable development (Raidimi & Kabit, 2019). Achieving this goal will entail broadening the curriculum to include emerging issues such as climate change and entrepreneurship, especially to support emerging smallholder farmers.

Institutions offering agriculture studies and other training providers have come to realise the need for curriculum review in line with market demands. However, there is limited knowledge about the implementation of successful curriculum development programmes, especially in the area of agricultural extension (Ngwenya & Akeredolu, 2017). Moreover, the demographics of farmers in the global south have changed, in particular with the emergence of more young farmers. Brown and Majumdar (2020) note that young farmers face unique sets of challenges and opportunities not present in previous generations. Some of these are indicated below.

In the first instance, recruitment into AET institutions in sub-Saharan Africa has shown an urban bias. This is because urban dwellers have easier access to the media and therefore obtain information on educational and training programmes more easily and faster than their rural counterparts. But even if urban and rural dwellers had an equal chance of applying for admission to programmes, often the urbanites are more likely to meet the admission requirements. This misalignment in recruitment also means that graduates from the urban areas are likely to return to the cities and towns after graduating to obtain employment rather than working in the rural areas as AEOs (Mudege, Mdege, Abidin & Bhatasara, 2017). The participation of youths in agriculture in sub-Saharan Africa is also affected by institutional and structural barriers, including primarily a lack of access to productive resources – in particular, land (Jjuuko et al., 2019) – and the fact that some young farmers also lack the necessary knowledge and skills even if they may have access to productive resources.

Methods

The article draws on evidence gathered from a study on Reimagining Agricultural Extension through a Learning Lens (RAELL) conducted from January to July 2021. The RAELL project was conducted in South Africa, Uganda and Zimbabwe. This article reports on the Zimbabwean case study. Although the RAELL study was more extensive and comprehensive, this article emanates from the section on curriculum reform in AET.

Although Zimbabwe has 24 (14 public and 10 private) universities and more than 100 degree-awarding public and private institutions (Garwe & Thondhlana, 2019), the data which informed this study were drawn from an analysis of the curriculum of only five selected providers of AET: two universities, two colleges of agriculture and one vocational training centre.

Stakeholder interviews were conducted with 22 participants: eight farmers, four AEOs, six lecturers in Agriculture and four policy experts from the Division of Extension and the Division of Research of the Ministry of Agriculture. The majority of the interviews were conducted face-to-face, with only two interviews with senior officials in the Ministry of Agriculture being virtual (on the Zoom platform) in compliance with the COVID-19 protocols. The other two interviewees on policy matters were retired provincial AEOs. Of the eight farmers interviewed, five were female and three were male. The distribution of the farmers ensured that all the categories of farmer were represented (A1, A2 and large-scale commercial farmers). Four AEOs were interviewed. Of these, three were females who worked in government service while the only male AEO worked in private extension services. For the purposes of data analysis, on the one hand, the authors used content analysis to analyse the curriculum documents from the institutions under study, and on the other, the interviews were analysed using thematic analysis (Vaismoradi & Snelgrove, 2019; Anderson & Gagliardi, 2021).

Results and discussion

This section presents and discusses the findings of the study, grouped under these main topics: a lack of institutional capacity to implement the curriculum; the inadequacies of policy and implementation capacities; financial and economic barriers to curriculum reform; technological barriers; the inability of the curriculum to meet the needs of small-scale farmers; and the negative impacts of climate change.

Lack of institutional capacity to implement the curriculum

This section is based on the findings derived from curriculum review documents for the six institutions offering AET in Zimbabwe: three universities, Bindura University of Science Education (BUSE), Zimbabwe Open University and Lupane State University; two agricultural colleges, Gwebi College of Agriculture and Mlezu College of Agriculture, which offer training

leading to the awarding of certificates and diplomas in Agriculture; and Mwenezi Development Training Centre, which awards certificates after the successful completion of short courses in Agriculture (see Table 1). Independent training centres such as the Mwenezi Development Training Centre offer training and partner with a number of international organisations and non-governmental organisations (NGOs), such as the World Food Programme, Plan International and the Norwegian Agency for Development Cooperation. Research organisations such as the Agricultural Research Trust also offer training to AEOs, mainly through farm visits, field days and practical demonstrations of the research trials that are used to showcase the latest technologies.

The duration of training for the certificate level at Mwenezi Development Training Centre and at the other two colleges of agriculture is two years, whereas for the diploma courses the duration is three years. The colleges offer both theoretical and practical training and aim to produce graduates in Agriculture capable of delivering agricultural support services, practical farming, research, extension and farmer training.

Most of the colleges offer diplomas and certificates in conjunction with state universities. For example, Gwebi offers diplomas in Agriculture together with the University of Zimbabwe. There are also several private agricultural colleges, such as Blackfordby Agricultural College. These offer diploma courses in addition to tailor-made short courses, after which trainees are awarded a certificate of attendance. Private colleges also offer the integration of information and communication technologies in agricultural market intelligence modules.

Mlezu College offers four certificate programmes in Agriculture, namely: Crop Production, Animal Production, Agricultural Production, and Farm and Agri-Business Management. Of these four programmes, Agricultural Extension is offered in the Certificate in Farm and Agri-Business (as one of the ten modules, contributing 10% of the total credits).

The example of Gwebi College of Agriculture will be used to illustrate the Diploma in Agriculture. Gwebi offers four diploma programmes in Agriculture: Crop Production, Animal Production, Agricultural Engineering, and Farm and Agri-Business Management. After completing any of these diploma programmes, graduates qualify to work as an AEO. Regarding the curriculum breakdown, of the four programmes, only the Diploma in Agriculture, Farm and Agri-Business Management has a module on Agricultural Extension. Coincidentally, this is the final module. For the other three diplomas, there is no specific module on Agricultural Extension.

Students who graduate with the Diploma in Agriculture qualify for the BSc in Agriculture. Although the Diploma in Agriculture is an acceptable qualification for graduates to practise as AEOs, it has become common for graduates to pursue higher qualifications – the pursuit of professional development programmes has intensified in Zimbabwe (Muwaniki & Wedekind, 2018). The BSc Agriculture degrees offered in these institutions have a duration of four years.

TABLE 1: Higher institutions' Agriculture-related programmes

INSTITUTION	DEGREE OR DIPLOMA	CERTIFICATE PROGRAMMES/ MODULES	WEIGHTINGS OR CREDITS (%)	NOTES
Gwebi College of Agriculture	Diploma in Agriculture (3 years)	Crop Production Animal Production Agricultural Engineering Farm and Agri-Business Management	Agricultural Extension offered only in Certificate in Farm and Agri-Business Management	Students who graduate with the Diploma in Agriculture qualify for the BSc in Agriculture
Mlezu College of Agriculture	Diploma in Agriculture (3 years)	Crop Production Animal Production Agricultural Production Farm and Agri-Business Management	Agricultural Extension only 10% of Certificate in Farm and Agri-Business Management	Students who complete qualify for work as AEOs as well as for further studies
Mwenezi Development Training Centre	Certificate in Agriculture	Crop Production Animal Production Farm Machinery and Engineering Agri-Business and Entrepreneurship	Agricultural Extension approximately 5% of the Agri-Business and Entrepreneurship module	Students who complete the Certificate in Agriculture qualify to be skilled workers after trade tests
Bindura University of Science Education (BUSE)	BSc degree in Agricultural Economics, Education and Extension (4 years)	40 modules Science-related Agricultural Application Socio-economics Agricultural Extension	± 26% 42% 22% 10%	Students who complete qualify for work as extension officers, scientists, financial services and for further studies
Zimbabwe Open University	BSc Agricultural Management	34 modules and a minimum of 136 credits 60 credits Science-related 72 credits Applied Agriculture 4 credits Agricultural Extension	44% 53% 3%	Students who complete work in extension, as scientists and qualify for further studies
Lupane State University	BSc Crop Science (4 years)	36 modules Science-related Applied Agriculture Agricultural Extension	50% 38% 10%	Industrial Attachment in the third year

BUSE offers a BSc degree in Agricultural Economics, Education and Extension. The majority of the universities, however, offer agricultural extension only as part of the BSc Agriculture programmes, with an emphasis on Agricultural Economics. These programmes are responsible for further developing the knowledge and skills of AEOs who would have graduated from diploma-awarding colleges. The universities also recruit students directly from the advanced diploma levels who possess passes in science subjects.

The distribution of modules in the BSc Agricultural Economics, Education and Extension offered at BUSE is as follows: out of a total of 40 modules, the science-related modules constitute about 26% of the total credits; Agricultural Application constitutes 42%; socio-economic modules 22%; and Agricultural Extension 10%. At the Zimbabwe Open University, over the four years, a student will have completed a total of 34 modules and must acquire a minimum of 136 credits to graduate. Of these, 60 credits are for science-related modules; 72 credits for Applied Agriculture and only four credits are for Agricultural Extension.

The distribution of credits is not too different at Lupane State University. For example, to complete the BSc in Crop Science programme, a student has to pass 36 modules, including Industrial Attachment in the third year. The credits for this programme are not spelt out; however, one can assess the distribution of the modules, which is as follows: 50% of the modules are science-related; 38% are linked to Applied Agriculture; and 10% to Agricultural Extension.

In some universities, Agricultural Extension is offered only as an elective module. The distribution in other universities in Zimbabwe also reveals that Agricultural Extension is given little attention in BSc Agriculture degree programmes. This is also the case for the certificate- and diploma-awarding institutions. In the case of the universities, another cause of concern is that there are still very few higher degrees in Agricultural Extension in Zimbabwe. On paper, many institutions indicate that they offer these programmes, but the situation is different on the ground. The underlying reason is that the majority of these institutions lack the capacity to offer higher degrees, which, as a consequence, affects the supply of high-level agricultural scientists in the market.

Inadequacies of policy and implementation capacities

The (non-)availability of a policy for Agriculture education and training is both an enabler and a barrier to curriculum reform. The presence of a policy on agricultural extension for the country is a key enabler of the reform of the Agriculture curriculum in Zimbabwe. Internationally, poor policy implementation is a barrier to effective curriculum reform in the sphere of agriculture. Although the ministry has a policy framework to guide AET in Zimbabwe, as outlined above, the main challenge is the implementation of the policy.

There are several dimensions to this. First, although the policy framework acknowledges the need for a responsive AET curriculum, the challenge is to have a well-adapted curriculum in place to suit the level at which the training takes place. For example, training takes place in

private agricultural colleges, such as Blackfordby, and in public agricultural colleges, such as Chibero, but the context of the training is not the same in these colleges. Secondly, the curricular reform in AET has to deal with the challenge of the misalignment of skills needed by smallholder farmers. For example, smallholder farmers require extension services in the use of appropriate technologies, yet for training in the agricultural colleges the emphasis is on the technology suitable for large-scale commercial farms. Thirdly, the reconceptualisation of the AET policy is not the same in all the training colleges. This is because the national AET policy at central government level in Zimbabwe is reconceptualised at a particular agricultural training college, reproduced in the classroom during teaching and learning and then applied by extension officers as they pass it on to farmers. This process of reconceptualisation is influenced by both discipline-specific requirements (internal dynamics) and external requirements and this therefore leads to variations. Interviews with lecturers in Agriculture at Great Zimbabwe University revealed that the introduction of the Certificate and Diploma in Sugarcane Agriculture, for example, has been in response to the requirements of already practising farmers in the sugarcane-dominated Lowveld area of Zimbabwe. The courses include those specific to Agricultural Science and Social Science courses related to culture and heritage.

Apart from the usual technical and scientific knowledge of agriculture, farmers and agricultural practitioners in the global south require entrepreneurial skills and competencies to enable them to be able to adapt to the current uncertainties (Brown & Majumdar, 2020). Entrepreneurship training is expected to include modules on social, civic and economic competencies – all of them not only important in the labour market generally but also in supporting their personal development and promoting active citizenship.

The Ministry of Higher and Tertiary Education, Science and Technology Development introduced Education 5.0 in 2018, moving away from what it terms ‘Education 3.0’, which characterised colonial and postcolonial education. The process was spearheaded by the Zimbabwe Council for Higher Education (ZIMCHE). The shift from Education 3.0 to 5.0 was necessitated by the need to prepare higher and tertiary students for entrepreneurship and job creation and also to meet the country’s developmental needs (Muzira & Bondai, 2020). Education 3.0 failed to drive industrialisation because it focused mostly on theory. At university level, for example, Education 3.0 had only three pillars: Teaching, Research and Community Engagement. Education 5.0 added Innovation and Industrialisation to make five pillars.

The success of Education 5.0 is dependent on a number of factors, including programme, promotion, physical and financing infrastructure (Muzira & Bondai, 2020). The reform of programme infrastructure meant that wide-ranging stakeholder consultations had to take place across the institutions of higher education and include curriculum specialists, industry and commerce. The process of programme reform led to the development of a Minimum Board of Knowledge (MBK) for all disciplines, including Agriculture. Subjects such as Entrepreneurship Agriculture, Innovation in Agriculture and Smart Agriculture

were incorporated into the Agriculture programmes across the higher and tertiary institutions. The other aspect which the reform process managed was to achieve uniformity of the MBKs across the universities. However, in order to maintain institutional ‘autonomy’ and programme uniqueness, each institution was left to introduce a few subjects that are appropriate to their niche area. The new curricula under Education 5.0 require problem-solving and value-creation to be integrated into the learning process in Zimbabwe’s higher education system. The teaching methods and delivery strategies envisaged in line with Education 5.0 include students’ involvement with productive farms in order for them to acquire hands-on skills, increased in-the-field exposure to the practicals included in the curricula, improving the condition of laboratory equipment, exposing the students to new technologies, and arranging and implementing exchange visits of students both nationally and regionally in order for them to acquire innovation skills and exposure to modern technology. Some of the support required to implement the new curriculum successfully includes introducing or upgrading staff training and refresher courses, offering teaching staff training in the latest teaching and delivery methods, facilitating train-the-trainer courses, and providing greater access to resources and facilities for the internet and connectivity.

According to the Ministry of Agriculture’s (2012) Comprehensive Agricultural Policy Framework (2012–2032), the policy-related objective would be to promote a responsive AET system. In this regard, the government envisages implementing the following policy statements:

- promote an active and demand-driven agricultural education and farmer training system to produce knowledgeable and skilled practitioners;
- promote the adaptation of the curricula to meet the knowledge and skills requirements of players in the agricultural sector;
- promote the upgrading of modern teaching and training technologies that serve to redress the challenge of gaps in current agricultural knowledge and skills; and
- promote the enrolment of women in training to levels commensurate with their role in the sector.

Regarding the policy issue of resourcing the education and training, the policy objective is to have in place adequately resourced AET services. The main policy statements to be implemented under this policy objective include:

- providing communication infrastructure and information and communication technologies (ICT) at agricultural institutions;
- building institutional and human capacity; and
- promoting private-sector participation in AET.

The ICT infrastructure still needs to be developed adequately across institutions. For instance, the implementation of e-learning programmes is still problematic, even in long-

established universities. In addition, agricultural colleges are often located in remote areas where the physical ICT infrastructure is expensive to instal. This hinders the effective use of digital technology in these institutions (Brown & Majumdar, 2020). According to the policy on responsive education, training and curricula, the policy objective would be to devise a curriculum that constantly meets the requirements of the sector. The government is expected to establish a system that reviews the curricula and practice regularly, and which regularly streamlines existing agricultural training courses so that they remain relevant and promote the participation of working agricultural professionals in the training process while also promoting linkages with local and regional colleges.

Although the policy appears to be commendable, the successful implementation of the required financial support for its rollout remains an ongoing challenge. Even though Zimbabwe has some universities with rich histories and infrastructure, such as the University of Zimbabwe, and well-established agricultural colleges, such as Gwebi and Chibero, the institutional capacity of these universities and colleges has been hamstrung by the country's poor economic performance over the past two decades.

The conclusions to be drawn from the findings established by Brown and Majumdar (2020) indicate that the Zimbabwean case is unique in that all the institutions providing agricultural technical and vocational education and training (TVET) have demonstration farms at their disposal on which practical training is offered to students. However, funding these demonstration centres remains problematic.

In line with these policies, a new curriculum for AET has been launched by the MLAFWRD as part of the response to these policy issues and challenges. The reform of the curricula is also partly driven by the challenges identified under the National Agriculture Policy Framework (2019–2030) (Ministry of Lands, 2018). Some of the challenges identified under Pillar II on agriculture, knowledge, technology and innovation systems are the inadequacy of the country's skilled manpower, the sub-optimal provision of practical agricultural training and the lack of coherence between the Agriculture curricula and industry needs. Regarding practical agriculture training, the major criticism has been the lack of hands-on training, with college students having limited practical exposure in the field due to the lack of facilities and resources. The training has also been criticised for being largely theory-based and for lacking access to modern technologies and adequately equipped laboratory facilities. These deficiencies seriously disadvantage the Agriculture students, making it difficult for them to bridge the gap between their studies and the workplace – the one not reflecting the other at all closely. In the global south, it has been noted that the lack of industry experience and knowledge of vocational pedagogies among the facilitators of AET contributes to the weak and inadequate implementation of the curricula (Brown & Majumdar, 2020).

The new curriculum launched by the ministry is consequently expected to close the gaps identified in order to improve the curricula and adapt them to meet the contemporary needs

of the industry. The new curricula are also expected to benefit society and the economy as they aim to redress the skills shortage identified in the National Critical Skills Audit of 2018 (Ministry of Higher and Tertiary Education, 2018) – the Critical Skills Audit report indicated a skills deficit of 88% in the Agriculture cluster.

In addition, the new curriculum will also contribute to resolving some of the policy gaps in AET that are identified in the various policy initiatives of the ministry, such as the Agriculture and Food Systems Transformation Strategy (2019), the national climate policy and the gender policy relating to Agriculture.

Financial and economic barriers to curriculum reform

Financial barriers at the government level usually cascade down to institutions offering AET, with concomitant negative impacts on curriculum reform (Davis, 2020). The instability in agricultural produce markets induced by economic liberalisation in the global south affects the national fiscus (Sundaram & Von Arnim, 2008). This same instability also limits the ability of individuals to invest in their education in Agriculture or to access some AEO services. As a consequence, the agriculture sector is weakened.

Financial challenges in AET institutions were exacerbated by the exceptionally poor performance of the Zimbabwean economy after the relatively prosperous first decade of independence. By the early 1990s, Zimbabwe was experiencing a severe economic downturn, increasing political contestation and large-scale emigration. Among the most contentious issues of the period was land reform (Muwaniki, 2019). In addition, the Zimbabwean AET curriculum contains weaknesses influenced by a number of factors highlighted in the section below. Some of the weaknesses are located more broadly in the wider community whereas others are unique to the tertiary and higher institutions; others arise from discipline-specific challenges.

The economic liberalisation policy adopted by Zimbabwe in 1991 had unintended negative consequences for the economic performance of the country as a result of the imposition of substantial cuts in subsidies (Kanyenze, Kondo, Chitambara & Martens, 2011). At the macro level, the poor performance of the Zimbabwean economy over the past three decades has had negative consequences for the provision of AET. These challenges have been particularly severe for the government-run universities and colleges and they have resulted in shortages of qualified personnel. Moreover, the late 2000s were characterised by a politico-economic crisis that culminated in unprecedented hyperinflation, which led to the decline in the country's gross domestic product by 50% in 2008 (Gukurume, 2018). The political impasse that arose soon after the highly volatile Zimbabwean elections of 2008 had a further severe effect on the economy. The economy was even further affected by the international sanctions imposed on Zimbabwe as a consequence of the violent land reform programme. The poor performance meant that the sources of funding for non-state providers of AET were also adversely affected.

At the micro level, the financial challenges faced by the state universities have adversely affected their investment in facilities, equipment and training materials. The lack of proper investment in agricultural research and education and the remuneration of staff has in turn affected the retention of highly skilled scientists (Masere & Worth, 2021). One female AEO noted that

when resources are scarce, male AEOs are prioritised in the allocation of motorbikes. This compromises the work and morale of female AEOs.

She went on to note that one ends up thinking that they don't belong.

It is important to note that the curriculum reform processes under way are financed largely by donors, with the implementation support channelled through NGOs. The funding has facilitated stakeholder consultations and contributions to the curriculum reform process. In particular, private-sector support of AET has become critical to supporting agricultural education programmes. In Zimbabwe, this support is quite notable, especially that from seed companies such as Pannar Seeds, Cargill and SEEDCO. Under normal circumstances, AET is mainly provided through publicly funded agricultural colleges, complemented by a few privately funded agricultural colleges. This means that the sustained implementation of the reforms requires sustainable funding from the fiscus. However, the funding from that source has been limited due to the subdued overall performance of the economy, which has limited financial support to all sectors.

Technological barriers

While there is often excessive hype regarding the 'fourth industrial revolution' (4IR) (Avis, 2020), clearly, new technologies are being applied to agriculture globally in connection with such notions as 'precision agriculture' (Gebbers & Adamchuk, 2010). The main three mechanisms that are required for further progress towards the digitisation of and further progress in agriculture are the Internet of Things, nanotechnology and digital education (Magomedov et al., 2020). The Internet of Things is an interrelated or integrated system that entails a computing device, a mechanical device, and a digital component or objects that together are used, for instance, to inform farmers about unexpected adverse weather conditions and the need to protect plants (Mishra, Kumar & Patel, 2021). Precision agriculture is used to improve farming through digitalisation (Fausti, Erickson, Clay, Schumacher, Clay & Skouby, 2018). However, the pace of introducing and implementing digitally enabled agriculture is much slower in countries in sub-Saharan Africa than in other regions (Porciello, Coggins, Mabaya & Otunba-Payne, 2022). But that is not to say that it should not be introduced.

As noted above, new technologies are being introduced into agriculture globally. Yet a curricular or an institutional response to embracing them is made more difficult by many of the challenges noted above. Curricula have been slow to respond to new trends such as

precision agriculture, to the adoption of remote sensing and also to the use of geographic information systems (GIS) (Lele & Goswami, 2017). In fact, the adoption of technology has become a key enabler in the dissemination of agricultural knowledge and practices by farmers and extension officers (Ismoilov, 2021; Masere & Worth, 2021); this means that their inclusion in Agriculture degree and diploma programmes has become essential. Besides, recent studies have revealed that technology is an important tool with which to encourage engagement among the current generation of students, including motivating learners to enrol in programmes and to encourage student retention (Bond & Bedenlier, 2019). The importance of technologies in and to learning has been intensified further during the COVID-19 pandemic, having created a number of new challenges in AET. One example of the challenges facing AET was the impossibility of engaging in practical and hands-on experiences during lockdowns and enforced social distancing, despite their importance to learning, especially in the area of Agriculture (Davis, 2020). However, these radical changes have presented challenges that have included poor access to digital technology and a consequent lack of skills required to use digital technology (Mukute, Burt, Francis & De Souza, 2020). The digital divide between rural and urban Zimbabwe is therefore a barrier that we cannot ignore and it must be an important priority to break it down.

As a result, an infusion of agricultural technologies could be the key to a responsive and relevant AET curriculum in the context of climate change. One AEO recommended that more resources be allocated to the inclusion of technologies in digital agriculture in the form of projectors and smart phones with internet capabilities:

Farmers are practical people hence without projectors it is difficult for an AEO to teach some concepts and practices. Farmers would understand more when there is that practical interaction with technology. Another challenge facing AEOs is the inability to use technology. In that regard, there is need for some refresher courses, especially among older AEOs.

But with new technologies come pedagogical challenges. According to Davis (2020), graduates of AET programmes at all levels also need training in soft skills that make use of modern technologies to manage extension approaches. These would include managing groups and participatory extension. In addition, the need for training in climate change mitigation needs to be emphasised because it is one of the most important emerging issues affecting agriculture.

Inability of curriculum to meet needs of small-scale farmers

While some land reforms took place after independence, the most significant programme (regarding coverage, beneficiaries and impact) was the Fast Track Land Reform Programme (FTLRP), which began in 2000 (Scoones, Marongwe, Mavedzenge, Murimbarimba, Mahenehene & Sukume, 2011; Mkodzongi, 2013). This programme introduced new categories of farmer, namely, the A1 and A2 farmers.

A1 farmers are typically newly resettled smallholder farmers who were removed from the overcrowded communal areas. Largely socially and economically excluded, they engaged in smallholder production either on small farms or in villagised arrangements with shared grazing and clustered homes (Njaya & Mazuru, 2014).

A2 farmers are those who were able to take over previously white-owned large commercial farms. They were typically well educated and economically and politically privileged (Zamchiya, 2011; Muwaniki, 2019). Along with the remaining white commercial farmers, the A2 farmers had the capacity to employ qualified farm managers and had unlimited access to agricultural extension services.

By 2010, the formal land reallocation had resulted in the transfer of land to nearly 170 000 households; moreover, 40% of these beneficiaries were supposed to be women (Scoones et al., 2011; Mutambara, Jiri, Jiri & Makiwa, 2013). This led to a massive need for training and for radically different approaches than had been followed previously (Zamchiya, 2011; Mutambara et al., 2013).

Because of this, the need arose to examine learning platforms that offer, for example, education and mentoring in farming skills development and in agriculture extension and information in order to induce desirable outcomes in the economy (Matondi, 2012). According to Mutambara et al. (2013), there was a resultant increased demand for AEOs, who were now expected to extend their services to the rural communal sectors which had previously been sidelined by the colonial agricultural policy. Agricultural training colleges, universities and vocational colleges all expanded their agricultural programmes after the year 2000 to respond to this demand. However, the training curricula in AET have been criticised for not developing the appropriate competencies in AEOs. And, furthermore, the curricula and teaching methods have been criticised for emphasising theory at the expense of practical training, which remained inadequate, because most of the lecturers do not have the relevant practical skills themselves. When he launched the new curricula, the Minister of Lands, Agriculture, Fisheries, Water and Rural Development indicated that the current rigid agricultural education system has not been responding to the requirements of farmers resettled under the land reform programme, which has led to agricultural production and productivity being negatively affected (The Herald, 2020).

In the light of these developments, agriculture colleges ought to offer curricula that are practical, relevant and inclusive – and both farmer-centred and market-oriented. Furthermore, challenges are also faced at the institutional level because most institutions have poor institutional linkages, poor access to technology, and dilapidated or outdated infrastructure and equipment. In Zimbabwe, therefore, one of the main challenges facing agriculture is to align the curricula to the key requirements and needs of emerging farmers resettled under the FTLRP. Accordingly, curricula need to take into account both the particular needs of the A1 and A2 farmers, on the one hand, and national priorities such as food and nutrition security, on the other. Real cases help to put these problems into perspective: one farmer who specialises

in market gardening revealed that he faces challenges in conducting his enterprise. His biggest challenge is in relation to accessing the markets for his produce. He noted that new farmers like him lack the knowledge or expertise to deal with markets, even when he has a good crop. Another farmer, who specialises in horticulture, had this to say:

As a farmer, do not venture into market gardening without knowledge of markets, pests and diseases that affect horticultural crops. I made that mistake and would not want any new farmers to fall into that pit.

Yet another cause for concern revealed by studies on AET is the challenge of the misalignment between the gender of AET graduates and the smallholder farmer population. Smallholder production in sub-Saharan Africa is dominated by female farmers. Despite this, most graduates in AET are men (William, Mboya & Wainaina, 2019; Mutambisi, Mavesera, Madondo & Dube, 2021). As a result, women are significantly underrepresented in AET in proportion to their broad responsibilities in farming. An interview with one female AEO revealed these challenges of gender bias in agricultural extension:

Agricultural extension is traditionally a male domain, farmers are sceptical to engage your services as a female AEO ... they will wait for you to prove yourself that you can do the job just as your male counterparts.

A study by Mutambisi et al. (2021) revealed that gender has not been adequately mainstreamed in the AET curriculum in colleges. There is a need, therefore, for gender-sensitive recruitment and gender mainstreaming in AET that targets mostly women (Mutambisi et al., 2021). Another aspect is the training of female farmers as trainers of other women, as this provides them with an opportunity to share their experience and knowledge. A further weakness is that training and micro-credit programmes are not interlinked so as to transfer agricultural technology effectively to women farmers. Yet another criticism of the system is that in extension too little emphasis is placed on areas such as marketing, food processing and post-harvest sciences, where women have tended to be best represented.

Negative impacts of climate change

In Zimbabwe, the negative impacts of climate change are being felt in the form of increasing temperatures, increasing diseases, alternating floods and droughts, and shifting agro-ecosystem boundaries. There is therefore a great and urgent need for agricultural practices to adapt to these changes. Conservation farming practices are a good example, and these target mostly smallholder farmers in communal and resettlement areas. Locally known as *Pfumvudza/Intwasa*, conservation agriculture is a major government response to climate change and is taught to farmers mostly in communal and resettlement areas (Mucheri, 2021; Mujere, 2021). Conservation agriculture aims at conserving moisture and soils in rain-fed smallholder farming systems.

One AEO has implemented conservation agriculture by using raised gardens. This method uses plant residues to trap moisture in the ground. This works well in situations with low levels of water. However, knowledge of climate-smart agriculture is not the same for all AEOs: there are some who lack this knowledge entirely, which means there is a need to implement capacity-building programmes to promote climate-smart agriculture more widely. This point was noted by one retired AEO:

Because of differences in agro-ecological zones as well as climate change the extension officer should have solid knowledge in a variety of crops, especially small grains which are drought resistant. Again, these days conserving moisture is quite topical hence there is need for extension officers to possess such knowledge.

A recent study by Mbanyele, Mtambanengwe, Nezomba, Groot and Mapfumo (2021) showed that crop yields and water-use efficiency were improved in fields tilled employing conservation agriculture and that the yields were larger than on conventionally tilled fields. Conservation agriculture has the potential to increase crop productivity even under wetter conditions because it enables excess water to be shed from fields (Mbanyele et al., 2021). However, further research is still required on the way conservation agriculture can be applied to other crops that smallholders typically grow in addition to maize – for instance, sweet potatoes, sorghum and pearl-millet.

Poor soil fertility is another barrier to crop productivity and farmers' adapting to climate change. Soil fertility is an underlying production challenge in Zimbabwe, particularly for smallholder communal farmers who depend on producing crops in soils that are intrinsically low in levels of essential nutrients (Mtambanengwe & Mapfumo, 2005; Mtali-Chifadza, Manzungu & Mugabe, 2020). And even though extension officers are generally aware of the problem, they are limited in their responses to finding solutions to the specific fertility problems in farmers' fields. One AEO argued that sometimes farmers are resistant to adopt the information and knowledge they receive from extension officers. She pointed out that farmers are adults and have their own ways of solving their own challenges. It is also difficult for most smallholder farmers to test their soils because of their limited access to research stations, the limited number of laboratories and the high costs of testing in the country. The implementation of *Pfumvudza* has great potential to enhance soil fertility and household food security, in addition to reducing carbon emissions (Mujere, 2021).

Conclusion

AET continues to be of enormous importance globally, with the climate crisis making it even more pressing. In the case of Zimbabwe, as this study reveals, attempts currently under way at reforming the AET curriculum are faced with challenges such as the lack of institutional capacity, inadequacies in policy, financial and economic barriers, technological barriers, and the inability of the curriculum to meet the needs of small-scale farmers. While the education

of agricultural scientists and managers or owners of large farms cannot be neglected, there is a particularly pressing need to train AEOs to work with the vast majority of farmers who remain small-scale producers. For these reasons, the AET curriculum ought to respond to the changing needs of stakeholders, the changing role profiles of AEOs, the demographics and specific needs of farmer populations, climate change and recent developments in technology. In addition, the AET curriculum must move away from the influence of big agriculture and big science on the Agriculture curriculum that is currently the case. However, through an analysis of recent curricular documents and the transcripts of interviews with key stakeholders, the limitations of some aspects of the current reforms have been highlighted in this article, as has the over-ambitious nature of other aspects, given the current resource context. In outlining the challenges but also the possibilities of the case, this article contributes to a wider international debate about education reform in the field of agriculture.

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