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Systemic challenges hindering the flow of sustainable forestry knowledge among smallholder farmers in South Africa

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South African democratic governments instituted several policies aimed at developing the capabilities of smallholder foresters to ensure economic inclusion and rural development. Skills development to build smallholder capabilities was deemed necessary to improve productivity, food security and conserve forestry resources. However, systemic blockages within the South African skills system hinder skills development, knowledge and technological flows to smallholders. This study assessed the systemic blockages hindering forestry skills formation and knowledge flows in the South African provinces of Mpumalanga and KwaZulu-Natal. In-depth interviews were conducted with policy practitioners, skills researchers, forestry organisations, and smallholder foresters. The interviews covered issues about alignment in government departments, extension curricula, linkages and interactions between skills institutions, extension officers and smallholders and other economic agents. Thematic analysis established that systemic blockages within the South African skills systems emanate from the lack of policy implementation resulting from the misalignment in government departments. Weak linkages and interactions between policymakers, researchers, extension officers and smallholders and traditional institutions also limit interactions, sharing and co-generation of skills and knowledge for application by smallholders. This paper recommends monitoring mechanisms to ensure interactive and coordinated implementation of forestry and innovation policies for knowledge to flow to smallholders.

Key words: Knowledge transfer, agroforestry, climate change, smallholders, sustainability.

INTRODUCTION

Millions of smallholder farmers in South Africa still depend on forestry resources for their energy, food, medicines, building needs and as a source of income. The concept of a smallholder is used to refer to 'small-scale', 'resource poor' and 'peasant' farmers (Department

of Agriculture Fisheries and Forestry- DAFF, 2012). Smallholder farmers own small-based plots of land on which they grow subsistence crops, a few cash crops and trees relying mostly on family labour (DAFF, 2012). These farmers have limited resource endowment relative

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to other farmers (Baiyegunhi et al., 2019). In the South African forestry sector, there are about 24,194 smallholders with an average woodlot of two hectares, overall adding up to 45 000 ha (XIV World Forestry Congress, 2015). Most of these smallholders engage in forestry, farming and pastoralist activities (Masekela, 2021; DAFF, 2017a, b; South African Department of Energy, 2016). Nonetheless, there remains a general lack of skills and knowledge among smallholder foresters regarding agroforestry, conservation forestry and community forestry to farming sustainably (Baiyegunhi et al., 2019; DAFF, 2017b). This lack of knowledge and skills for sustainable forestry practices undermines the ability of smallholder foresters to make the most of forestry resources and limits their contribution to South Africa's efforts in combating climate and environmental challenges (National Planning Commission, 2011; DAFF, 2008). The lack of skills and knowledge is partly a legacy of an apartheid skill regime that neglected African agriculture education (Showers, 2010; Grundy and Wynberg, 2001). This is also explained in terms of systemic blockages in South Africa's forestry system of innovation that curtails the flow of knowledge to smallholder foresters (Mushangai, 2020). Although previous research has focused on improving smallholder practices, little has been done to explore systemic blockages that hinder the flow of knowledge among South African smallholder foresters thereby limiting their innovative potential to adapt to climate change (Blignaut, 2015). Through an analysis of related literature and interview data from foresters, farmers, policymakers, and learning institutions, this paper seeks to deepen our understanding of systemic blockages hindering the flow of knowledge to smallholder foresters and to inform forestry policy and strategies required to improve the flow of knowledge and skills to smallholder foresters to improve productivity and contribute to resource sustainability.

IMPORTANCE OF FORESTRY AND CONSERVATION FORESTRY TO SOUTH AFRICAN RURAL COMMUNITIES

Forest resources are critical for the survival of many rural inhabitants in South Africa. About 31% of South Africans live in rural areas (Masekela, 2021). Many rural inhabitants in South Africa depend on forestry resources for timber for housing, kraals and fencing; bark and grass for making ropes, weaving and thatching; wood and grass for local craft industries; and pastures for livestock (DAFF, 2017a, b). Forestry resources are also critical for dietary supplements through the harvesting of caterpillars, mushrooms, edible plants, forest fruits; honey and sap for brewing beer and wine (DAFF, 2017a, b). Forestry harvested food items, nuts and indigenous fruits can greatly reduce vulnerability to hunger and

malnutrition among rural inhabitants. Considering that many rural inhabitants are poor and cannot afford the cost of allopathic medicines, forests are crucial for medicinal products including bark, bulbs, leaves and roots (Akinnifesi et al., 2007; Gqaleni et al., 2007).

Most rural inhabitants in South Africa depend on fuelwood for their energy needs (Masekela, 2021). Shackleton and Shackleton (2004) estimated that households consume an average of 5.3 tonnes of fuelwood per year. The Department of Energy (2016) estimated residential fuelwood consumption in South Africa to be at 7 megatons per year, an amount which it considers unsustainable as harvesting is far beyond the replenishment rate. The high fuelwood consumption levels are likely to remain despite Eskom's rural electrification drive for most rural households cannot afford the exorbitant cost of electricity.

Environmentally, forests and woodland ecosystems provide many benefits to rural inhabitants, such as the protection of soils and catchment areas and water purification in riverine areas (DAFF, 2017a, b; Gomani, 2010). Forests and woodlands therefore economically contribute significantly to rural communities.

The high dependency of rural inhabitants on forestry resources for their varied needs has been behind the overexploitation and ultimately the degradation of forests, woodland ecosystems and the environment in South Africa (DAFF, 2017a, b). This challenge is worsened by unsustainable forms of land uses and forest harvesting activities mainly a result of the lack of sustainability knowledge and skills among many rural inhabitants. This challenge is worsening now as a result of population increases in rural areas (Mushangai, 2020). Consequently, DAFF (2017b) noted the increased depletion of forestry resources and biodiversity, soil erosion and environmental degradation. In the former homelands of South Africa, most woodland environments have been degraded or destroyed through the pressures of the apartheid resettlement programmes and this has been worsened by the current unsustainable agricultural practices (DAFF, 2017a, b; Showers, 2010; Grundy and Wynberg, 2001). Currently, more than 0.7 million ha of land are degraded and have been left bare by sheet and gully erosion (Agriculture Sector Education and Training Authority (AgriSETA), 2016). About 4.61 million ha of natural vegetation, mainly indigenous forests, woodlands, and grasslands, are degraded (AgriSETA, 2016). The degradation of the natural environment and forestry resources compromises traditional agronomic systems and forestry foods, traditional medicines and other ecological services leaving rural inhabitants susceptible to nutrient deficiencies, hunger and diseases (George, 2010). These local challenges, together with international calls for resource efficiency to mitigate environmental disasters and the impact of climate change on local communities resulted in a concerted effort in South Africa by policymakers, researchers and natural resources

professionals, and farmers to appreciate and entrench sustainable forestry practices in the rural areas.

Agroforestry, conservation forestry, and community forestry and their importance in rural development

Agroforestry is, '... a system that includes both traditional and modern land-use systems in which trees are managed together with crops and/or animal production systems in agricultural settings' (DAFF, 2017b). The system is hinged on the deliberate inclusion of woody plants with crops and/or animals within the same land management system. This would encompass a range of tree planting including living fences, hedges, woodlots, fruit trees and food crops interacting on the same piece of land (DAFF, 2017b). The focus is on the interaction of edible flora and fauna on the same piece of land and the advantages entailed concerning improved productivity and environmental outcomes (Lundgren and Raintree, 1982; FAO, 2013; DAFF, 2017a). There exist three socially and scientifically established agroforestry systems. These are, "agrisilvicultural" which is a combination of crops and tree species; "silvopastoral" which is the combination of trees, pastures and animals; and "agrosilvopastoral" which is the combination of crops, trees, pastures and animals. These systems can be applied in different areas considering the area's status quo, that is, biophysical and socio-economic attributes.

Benefits of agroforestry to smallholders

Agroforestry practices are deemed to have many benefits especially on the improvement of rural inhabitants' livelihoods. The diversity of commodities involved in an agroforestry system contributes to food security and income generation for smallholder farmers (Buttoud, 2013). Agroforestry systems would benefit rural communities through the variety of food, medicines, timber for construction, fuelwood, fodder and shade for livestock (DAFF, 2017a, b). The perennial ground cover provided by agroforestry systems improves soil conservation, soil water holding and retention capacity, soil organic matter, soil fertility through humus accumulation, etc (Siriri et al. 2013). The introduction of agroforestry in rural communities can lessen dependency on natural forests for fuelwood and increase the protection of natural resources. Moreover, agroforestry systems have climate change mitigation effects through the maintenance of hydrological cycles and carbon sequestration as trees are considered a superior carbon sinking technology (Mushangai, 2020). If fully implemented agroforestry systems can improve smallholders' climate change resilience through the provision of diverse income sources. This is critical now in South Africa to cushion smallholder farmers,

pastoralists and foresters from the recurring devastating climate change-induced droughts. Agroforestry systems are more relevant to smallholder farmers of South Africa, considering that returns on traditional timber production systems are only seen after 22 to 25 years (XIV World Forestry Congress, 2015 in Mushangai, 2020). Due to limited financing capital, it is difficult for smallholder foresters to rely completely on forestry timber as a source of income. Agroforestry would enable smallholders' access to plantations to produce food and graze livestock and support their livelihoods for the first 3 to 5 years before canopy closure. The implementation of agroforestry is hindered by a shortage of personnel with the required knowledge and skills in the agriculture sector. Bhorat (2020) noted a shortage of Agricultural Scientists, Forest Scientists, Agricultural Engineers, Environmental Education Managers, Environmental Impact and Restoration Analysts, Chief Information Officers, Conflict Resolution Practitioners, Agriculture Mentors, Livestock Inspectors, and Pest Control Supervisors. Further, the professionals available lack the social, communication and conflict management skills required in working with smallholder communities. This is mainly because agronomists and economists mostly inform agriculture and extension programmes without the participation of sociologists and anthropologists who have the knowledge and experience of interacting with disadvantaged communities (Mutizwa, 2010). Linked to agroforestry is conservation forestry.

Conservation forestry

The White Paper on Sustainable Forest Development, 1997 outlines the government's forestry policy focused on wielding 'together the three strains of *conservation forestry*, commercial forestry and community forestry' (Ministry of Water Affairs and Forestry, 1997). Conservation forestry is an important component of the South African forestry policy with a specific focus on conserving and protecting forests (DAFF, 2017b). Conservation forestry is concerned with the preservation or restoration of a forest (Mahon, 2022). Although the South Africa policy defined conservation forestry in relation to all types of forests, emphasis has been placed on the natural capital - natural forests, woodlands and grasslands and not planted forests. This differentiates conservation forestry from commercial forestry, agroforestry and other branches of forestry that give preference to planted forests. Conservation forestry is intrinsically valuable where past deforestation has destroyed much of the natural forestland (Mahon, 2022). Preservation and restoration activities are critical for natural forests to provide habitat and shelter for plants and animals. They help retain topsoil, regulate temperature and act as carbon sinks, protecting the climate (Mahon, 2022).

Regarding rural livelihoods, natural forests, woodlands and grasslands are food, medicines and energy sources. However, many forests, woodlands and grasslands in former homelands are degraded because of unsustainable harvesting practices and erosion rates are five times that of commercial agriculture. Sustainable management of indigenous forests would create income-earning opportunities among smallholders. This is critical now in South Africa considering the growth in the number of smallholder foresters without any prior knowledge of conservation forestry. The land reform as effected by the Restitution of Land Rights Act of 1993 has resulted in smallholders owning some forests, woodlands, and grasslands formerly in the hands of the government and commercial foresters. Whilst the government remains the legal custodian of natural forests responsible for protecting the dwindling resources to benefit future generations, the principle of stewardship stipulates that forest owners must ensure that the entire forest resource is sustainably managed (DAFF, 2017a, b). This requires that the new smallholder owners are equipped with the requisite conservation knowledge and skills. Nevertheless, this is proving difficult partly because of the lack of capacity in extension services to top up managerial and operational capacity among small-scale operators (DAFF, 2015). Moreover, there has not been a conscious and structured effort on the part of Higher Education Institutions to ensure that the challenges concerning conservation forestry, water harvesting, land reform and rural wealth creation are addressed within their curricula (DAFF, 2015). This can be achieved through cooperation between rural people, local governments, provincial and national agencies and skills institutions in instituting relevant curriculum reforms. In addition to agroforestry and conservation forestry as systems of agriculture to improve smallholder foresters' productivity is community forestry.

Community forestry

The White Paper on Sustainable Forest Development (1997) and the National Forest Act (1998) link agroforestry to community forestry and sustainable forestry management. Community forestry is a type of forestry system driven by or implemented with the participation of communities to foster local economic development by addressing communities' social, household, and environmental needs (DAFF, 2017b). According to DAFF (2017a), community forestry includes, 'farm forestry, agroforestry, community or village planting, woodlots and woodland management by rural people, as well as tree planting in urban and peri-urban areas.' This type of forestry production has been neglected in South Africa except in the Eastern Cape where indigenous forests have helped to conserve natural resources (DAFF, 2017b). The lack of adequate community forestry

programmes in South Africa is reflected in shortfalls between the demand and supply of fuelwood, the degradation of woodlands and forests and the lack of tree growing in communities' local development activities (Masekela, 2021).

The neglect of agroforestry, conservation forestry and community forestry activities in South Africa reflects a lack of recognition of the social, economic and environmental value of natural and planted forest resources to smallholder foresters and rural households. Whilst agroforestry systems in South Africa are limited in scale and extent (DALRRD, 2020; Guiney, 2016), these systems are critical in addressing many challenges to rural households concerning, food security, land shortage, environmental degradation and resilience to climate change impact. Considering the outlined benefits of agroforestry, conservation forestry and community forestry to rural economies and environments in South Africa, there is a need to address the institutional, technical, economic, policy and governance and social challenges to create an enabling environment for increased uptake, adoption and out-scaling of these systems for the realisation of these benefits.

Conservation forestry, agroforestry and community forestry have been outlined in various South African policy documents such as the White Paper on Sustainable Forest Development, 1997; Conservation of Agricultural Resources Act, 43 of 1983, which entrenches sustainable use of natural resources; the Agricultural Policy Action Plan (APAP) (DAFF, 2014) advocating for integrated food production and the Climate Smart Agriculture (CSA) of which agroforestry is an aspect; the DAFF Strategic Plan 2015/2016 - 2019/2020, which considers agroforestry policy as a mechanism to ensure food security for small growers; the National Greening Strategy, 1996, which supports agroforestry in urban and informal settlements; the National Research and Development Strategy, 2002 which refers to agriculture and forestry sectors thereby providing an opportunity for integrated research for these systems; the National Development Plan, 2011 which promotes household food security, improved intake of fruits and vegetables in the South African Food Security policy; the Agroforestry Strategy Framework, 2017 which correlates with other programmes such as Conservation Agriculture, Climate Smart Agriculture and Land Care; the Draft Conservation Agriculture Policy, 2017, which links conservation forestry with agroforestry and community forestry and the Economic Reconstruction and Recovery Plan, 2022, which seeks to create 14,000 opportunities in community forestry.

South Africa as a member of the United Nations Framework Convention on Climate change (UNFCCC) ratified the Paris Climate Accord and is committed to implementing the United Nations Sustainable Development Goals (SDGs) which promotes reconciling social, economic and environmental objectives in

mitigating climate change and environmental degradation. The 2011 Durban Conference of the Parties (COP) 17 identified agroforestry as having the potential for climate change adaptation and mitigation. Agroforestry, conservation forestry and community forestry are therefore mechanisms for addressing various challenges to food security, climate change mitigation, and environmental conservation (DAFF, 2017b). Despite the existence of good policies articulating the imperative of these systems of agriculture, these have remained at the level of frameworks with little implementation. There still exist numerous challenges impeding the implementation of these systems.

Challenges to sustainable forestry practices in rural areas of South Africa

In South Africa, there exist various challenges impacting the implementation of sustainable forestry practices among smallholders. Guiney (2016) noted challenges regarding the fragmented nature of information and research on agroforestry practices and the difficulties in accessing agroforestry information by smallholders. Mushangai (2020) noted the lack of improved germplasm as a disincentive for smallholders. Other challenges include a lack of awareness of the benefits of agroforestry, a lack of links between researchers and extension services, hence non-transfer of agroforestry research to extension services or farmers, a lack of information-sharing networks and the exclusion of smallholders from networks of established forestry firms, a lack of markets for agroforestry products such as pigeon pea, moringa, aloe vera and others, and a lack of links between agricultural skills institutions and smallholders (DAFF, 2015, 2017), a lack of forestry financially backed programmes like the Comprehensive Agriculture Support Programme (CASP) to support the smallholder foresters (Mushangai, 2020, DAFF, 2015, 2017a).

Some of these challenges such as the lack of forestry sustainability knowledge, skills, and technologies among smallholders are historically informed. Forestry and agriculture skills development organisations have continued to exclude rural inhabitants as was under apartheid. At least under apartheid, there was a reason which no longer exists now for the colonial administrators then 'thought that there was no need for instruction (black smallholders) because they had learned these skills while working on white farms' (Showers, 2010). As a result of this colonial reasoning, Grundy and Wynberg (2001), noted that 'indigenous forest management in the former homelands came under a conservation regime that was plagued by lack of effective management and ignored the local communities' needs for natural resources to sustain their livelihoods.'

The exclusion of smallholders by the skills system has

continued to this day despite the several policies by the democratic South African governments to reform the skills system to enable the inclusion and participation of the formerly excluded. A recent review of the National Skills Strategy III in 2018 shows that smallholder farmers and businesses are excluded from skills formation processes within the national skills system (National Skills Authority (NSA), 2018). As such, most of them lack the knowledge, skills, and technologies to farm productively and sustainably and require various forms of support, ranging from development finance, managerial skills, and enterprise development to agricultural technical skills for them to be sustainable (AgriSETA, 2016).

Most of the challenges discouraging the implementation of sustainable forestry practices among smallholders relate to the lack of knowledge and skills required to achieve agroforestry, conservation forestry and community forestry, mainly a result of blockages hindering forestry skills formation and knowledge flows within the skills system. It is because of the continued exclusion of smallholders that there is now a growing realisation of the need to foster interaction between the skills organisations, researchers, extension officers and the private sector with rural communities in skills formation, knowledge and technology application, hence the focus of this paper.

Problem statement

Smallholder foresters were previously excluded by the skills system under apartheid governments. Smallholder foresters utilize between 1 and 5 ha each (Lahiff, 2000). There are about 24,194 smallholders in South Africa with an average woodlot of 2 ha, overall adding up to 45000 ha (XIV World Forestry Congress, 2015). Most of the smallholder foresters are located in remote rural areas characterised by poor infrastructure, making it extremely difficult for them to access the essential resources, information, training, technology, capital and assets vital for production (Baiyegunhi et al., 2019). These farmers were neglected by colonial regimes and under apartheid. The colonial administrators 'thought that there was no need for instruction because they had learned these skills while working on white farms' (Showers, 2010). As a result, Grundy and Wynberg (2001), noted that "indigenous forest management in the former "Homelands" came under a conservation regime that was plagued by lack of effective management and ignored the local communities" needs for natural resources to sustain their livelihoods. The exclusion of smallholders by the skills system has continued to this day despite the several policies by the democratic South African governments to reform the skills system to enable inclusion and participation of the formerly excluded. A recent review of the National Skills Strategy III in 2018

shows that smallholder farmers and other small businesses are excluded from skills formation processes within the national skills system (National Skills Authority (NSA), 2018). As such, most of them lack the knowledge, skills, and technologies to farm productively and sustainably. Current studies show that smallholder farmers lack the resources, knowledge, and skills required for agroforestry, conservation forestry and community forestry to farming optimally and sustainably (AgriSETA, 2016; Mushangai, 2020). Smallholders require various forms of support, ranging from development finance, managerial skills, and enterprise development to agricultural technical skills, to be sustainable (AgriSETA, 2016). Worse still, smallholder farmers have limited social capital as they are excluded from the networks of big forestry firms and development financing institutions in South Africa (Mushangai, 2020). This exclusion limits knowledge, skills, and technological transfers from established businesses to smallholder forestry farmers within the agriculture sector. Although previous studies have detailed the lack of financial support, lack of knowledge, technologies and skills as factors undermining smallholders' productivity, much has not been said about systemic challenges and blockages that hinder skills formation processes and the transfer of knowledge to smallholder farmers within and outside the skills system. There is therefore a need for understanding the systemic challenges and blockages if the democratic transformative South African government policies' objectives to boost the productive capabilities of smallholders are to be attained. As a result of the current need to stimulate and enable smallholders' participation within the skills system, a question arises on systemic blockages within the South African skills system that hinders smallholder participation and how they hinder skills formation, knowledge, and technological transfers to smallholder farmers.

Rationale

This paper seeks to provide insights into systemic blockages within South Africa's skills system that hinders skills formation, knowledge and technology transfers to and among smallholder forest farmers. The insights and understanding thereof form the basis for effective strategies for unblocking the blockages thereby enabling smallholders' participation and acquisition of knowledge, skills and technologies within the South African skills system. This is deemed necessary to encourage the application of sustainable forestry practices by smallholders in rural areas. Without these insights to inform strategies, the transformative policy objectives of the democratic South African governments to build smallholder farmers' capabilities, enabling them to farm profitably and sustainably would remain a mirage. The empowerment of smallholder farmers is largely a function of their participation in knowledge, skills formation and

application processes which cannot happen with their current exclusion. The article also sheds light regarding institutions, on how they determine the knowledge flow dynamics, approaches to skills formation, highlighting deficiencies within the skills system and pointing to the need for a different pedagogy, especially when working with formerly disempowered communities.

MATERIALS AND METHODS

To understand the systemic challenges hindering skills formation, knowledge generation and technology transfers regarding agroforestry, and conservation forestry among smallholders and community foresters, in-depth interviews and a critical review of literature on the topic were employed. In-depth interviews were conducted with 4 policy practitioners and researchers from the South African departments of Agriculture and higher education, 4 with researchers and lecturers at South African Colleges of Agriculture and forestry-related departments at South African universities, 3 with researchers from forestry business organisations, and 6 with smallholders' farmers from the provinces of Mpumalanga and KwaZulu-Natal.

Purposive sampling was employed in selecting participants for this study. This type of sampling was crucial because of limited resources, hence reaching a targeted sample quickly. However, important to note is that, with qualitative methods, there are no rules on the size of the sample (Polit and Beck, 2008). The sample size is determined by 'the point to be raised, the purpose of the research, useful things, and things to do with time and resources available (Ahmad et al., 2012). Smith (2004) is of the view that qualitative research samples must be small to allow for detailed investigation.

In the interview, issues about alignment in government departments, accessibility of forestry knowledge, pedagogical issues and smallholder learning capabilities, extension curricula and the practice of forestry extension and technology transfers, linkages between colleges, universities with extension officers and smallholder farmers, and smallholders' networks and connectivity with the big established forestry firms among others were covered.

RESULTS AND DISCUSSION

Issues that emerged from the interviews and the literature review regarding the systemic blockages in the South African skills system in forestry skills formation, and the management and communication of forestry knowledge for application by smallholder foresters were discussed. It discusses misalignment in government departments in their support of smallholders, weaknesses in forestry extension and technology transfers, lack of contextualized forestry curriculums and pedagogies, smallholders limited social capital regarding networks and collaboration, lack of financial support for smallholder forestry activities, and traditional authorities as a hindrance to community forestry, in that order.

Misalignment in government departments

The misalignment of government departments emerged as one of the systemic blockages in the forestry system

of innovation that hinders the flow of forestry sustainability knowledge to smallholders. This misalignment manifests itself in the conflicts between government departments over the control of agriculture and forestry colleges, the lack of post-settlement support to smallholder beneficiaries of the land reform, and the lack of production skills development support for smallholders.

In the field of forest skills development, Fort Cox and other agriculture colleges have been at the centre of developing middle-level technical skills among smallholder foresters in South Africa. Nonetheless, these colleges have been affected by the schism between the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Higher Education and Training (DHET) for their control between 2002 and 2011. This schism resulted in agricultural colleges being neglected during this period. The colleges were poorly funded and this was worsened by their inability to apply for research funding from the National Research Fund as they are not registered under Higher Education. This affected the scope of their operations as to what they could or could not do, thereby limiting outcomes in terms of skilled manpower development. The tenure of the lecturers was also affected as a result of the lack of funding (AgriSETA, 2016). This problem partly explains the current shortage of forestry extension officers in South Africa who are supposed to transfer skills, knowledge and technologies from research organisations to smallholders (Interview-Forestry lecturer).

In some instances, misalignment between government departments caused the production of skills that could not be channelled immediately into production for the benefit of forestry smallholders. A case in point was when the AgriSETA facilitated agroforestry skills among smallholders in Limpopo who later failed to employ the skills because the Department of Agriculture failed to augment this effort by providing the necessary financial and technological support for them to start producing (Interview-Skills Officer, AgriSETA). This is a case of resource wastage as one of the aims of skills production is to enable people to aid in economic development. The failure to provide production finances and technologies hinders skills development as skills are perfected through their application in production activities. Cases like this have also been noted in the downstream activities of the forestry value chain (Mushangai, 2020). These cases highlight that skills development, knowledge generation and application among smallholders are negatively impacted by the misalignment of government departments.

Likewise, the misalignment of government departments in South Africa resulted in government departments neglecting duties assuming that other government departments would perform them. An illustration of this was the misunderstanding between DAFF and the Department of Rural Development and Land Reform (DRDLR) regarding the responsibility for the resettled

farmers. This misunderstanding delayed the provision of post-settlement support for resettled smallholders to start working the land (Mushangai, 2020; Hall, 2007). Many land reform projects in South Africa failed as a result of the lack of post-settlement support (Mushangai, 2020). There is, therefore, a need for alignment of government departments as a solution to blockages within the South African forestry system for the benefit of smallholders.

The lack of alignment between government departments exacerbates transaction costs, which are disincentives for the smallholders wanting to join the forestry sector. Currently, South Africa lacks a centralised system for gathering and collating information on agroforestry, conservation forestry and community forestry. The information on sustainable forestry, water and planting permits is scattered across different government departments and this increase transaction costs concerning the finances and the time spent on visiting different departments if one wants to engage in afforestation (Interview- Small business Development Officer). The lack of alignment and the accompanying transaction costs thereof are systemic challenges hindering the ease of doing business and the development of skills in the forestry sector. This challenge mainly affects the smallholders because of their limited resources. The lack of alignment as a challenge is worsened by the inadequacy of extension officers to link government departments and research organisations with smallholders.

Extension officers, technology transfers and the practice of forestry extension

In most cases, technologies required by smallholders are already there but what is needed is their transfer, adoption and adaptation by smallholder foresters. For example, the CSIR (2011) produces improved germplasm for all sizes of firms in South Africa. Also, the machines needed in harvesting and processing operations are available in South Africa from companies such as Enviro-Chainsaws, Nukor, and Wood-Mizer (Mushangai, 2020). However, technological knowledge is complex and cannot be transferred in its entirety without interacting with the provider of such knowledge (Nelson and Winter, 1977, cited in Joseph, 2009). Technological knowledge is generated by interactive learning and economic agents must interact if it is to be applied successfully (Bergek, 2010). Much of this knowledge is tacit, transferred mainly through experiential learning, observation, demonstrations, and comparing and monitoring the activities of others (Maskell and Malmberg 2002). Even with afforestation, the quality of timber depends on silvicultural skills learnt mostly through demonstrations of silvicultural practices in the fields. The acquisition of this knowledge requires interaction between the producers of the knowledge and the end-

user smallholder foresters. There is a need for extension officers to assist smallholders with 'on-site support and coaching so they can learn practical farming activities, how to do intercropping to increase soil nitrogen, how to measure soil temperature and methods of suppressing weeds using ground covers' (Interview- lecturer). Smallholder farmers expressed the need for extension officers to use demonstration farms to 'impart skills to farmers practically on-site to learn about farming practices such as pollination in their gardens' (Interview-Smallholder). Smallholders may have the knowledge, but the challenge is how to apply it, hence the importance of mentors and demonstrators in the forestry sector.

A major challenge in the upstream tree-growing activities of the South African forestry value chain, has been the shortage of knowledge-transfer officers as 'information intermediaries, knowledge translators, knowledge brokers and innovation brokers' to facilitate interaction between economic agents and smallholder foresters for uptake of innovative practices (Shaxton et al., 2011). Extension officers as intermediaries are also critical in decoding and simplifying the complex knowledge from research institutions for application by smallholder foresters. This challenge was elaborated by an officer responsible for smallholder forestry development in South Africa who noted that:

There are 900 people employed as agriculture extensions by the government and only 8 employed by the government in this province (KZN) as forestry extensions. The 8 people are meant to be servicing 17 000 small-scale timber growers. How is that going to happen? Even if the knowledge is there, the people to transfer this knowledge are not there, the bridges are broken (Interview - Small Business Development Officer).

The shortage of extension officers, especially in state departments, focused on rural development, has prevailed since the 1990s (DLA, 1997). Consequently, the lack of implementation of agroforestry and conservation forestry by smallholders as advocated in many policy documents can be partially attributed to interactional challenges emanating from the shortage of extension officers in providing interfaces between the producers of knowledge and technologies and the end-user smallholders. Without extension officers, the interface between research organisations and smallholders is lost and with it the knowledge and technologies from these organisations to forestry smallholders (Mushangai, 2020). Worthy of note is that the transfer of technologies goes together with the transfer of knowledge and skills to use these technologies, hence the lack of transfers hinders the flow of knowledge and the acquisition of skills by smallholders.

Worse still, it emerged that in some instances where extension officers are available, most of them are not conversant with new knowledge concerning agroforestry,

conservation forestry and community forestry. This has been attributed to limited interaction between researchers and extension officers and the difficulty of aged officers to learn new concepts (Interview-Policy practitioner, Department of Agriculture). Accordingly, the lack of knowledge exchange and sharing platforms between researchers and extension officers is a systemic blockage hindering forestry skills formation and communication and application of sustainable forestry practices among smallholders in South Africa. The practice of forestry extension is partly complicated by uncontextualized forestry curriculums and pedagogies at agriculture colleges.

The lack of contextualized forestry curriculums and pedagogies

Despite policy changes since 1994 to develop a single integrated inclusive extension service for all farmers, most higher education institutions' agricultural programmes are still focused on capital-intensive commercial agriculture (DAFF, 2015). Only a few institutions of higher education have curriculums addressing sustainable smallholder farming, food security and rural livelihoods. This is the case notwithstanding the decline in the number of commercial farmers and the concurrent increase in the number of smallholders emerging mainly as a result of the ongoing land reform processes (DAFF, 2015). The current agriculture curriculum focuses mainly on competence development for conventional methods of commercial agriculture (DAFF, 2015). Such a curriculum excludes the relevance of indigenous knowledge and practices relatable to smallholder farmers. Thus, South Africa has neglected the community and social aspects of forestry resources development (Ministry of Water Affairs and Forestry, 1997). As noted by one researcher, students coming from the colleges, understand very well the natural capital, how to plant a tree, how to trim the branches, and when to cut it down, but they do not understand how to negotiate with the smallholder farmer who does not want to grow trees for paper, but the roof of his house (Interview-Lecturer-Ustainable Forestry Systems).

This points to defects in the forestry system of innovation concerning social and small businesses' development, as the focus is only on businesses that are considered growth-oriented and not-for-profit businesses. This exclusion has unintentionally led to selectivity with forestry curricula focusing only on the development of intensive commercial forestry that is growth-oriented while neglecting the skills and knowledge needs of smallholder foresters whose businesses are mainly not-for-profit. This constrains smallholder capabilities development critical in rural development in South Africa.

There is a conceivable need for a better-integrated forestry education strategy that articulates the skills and knowledge needs of smallholders and caters for

alternative products beyond traditional forestry products. The curriculum has to consider emerging agroforestry products like honey, mushrooms, moringa, aloe vera, pigeon pea, etc. These emerging products are crucial regarding rural income, nutrition, health and food security (Interview-Lecturer-Natural Resources). It is with these products that do not require huge investments, that smallholder participation could be enhanced. These areas could also involve projects for households interested in small-scale plantations to produce timber for their use e.g., fuelwood. This would go a long way in conserving natural forests. The lack of these aspects of agroforestry forestry in the South African forestry curriculum, differentiates South Africa from a country such as China, where the value chain produces a highly differentiated range of products (Mushangai, 2020). South Africa has to explore other products of good commercial value beyond traditional forestry products and promote their quality production, marketing, and trade. This would facilitate the participation of smallholders in the forestry value chain, hence skills and knowledge generation through practice.

Extension officers highlighted the need for periodic reviews of the extension curriculum to incorporate emerging issues on resource sustainability. As stated by one extension officer, the 'curriculum should be reviewed at least after every two years to check if it is still relevant and if not, upgrade it to cater to today's extension needs to include emerging issues of climate change, agroforestry and use of technology' (Interview - Practicing Officer). Currently, '... the challenge they (extension officers) are facing is that they do not know some things about agroecology, and because they are from the college, maybe they never learn anything talking about agroecology. But they do not admit that' (Interview - Farmer). The failure to acknowledge their shortcomings about emerging knowledge is a factor aggravating the dissonance in what extensionists say 'they are doing and what farmers say they do, the process that they perceive to be following and the processes they are following, as well as what they say they will get and the outcome they get' (Interview - Lecturer, Extension Education). Since most agriculture policies enacted by the democratic South African governments call for curriculum recontextualization to cater for emerging smallholder farmers, the lack of implementation may be a result of limited interaction between policy, theory and practice, hence the need for monitoring and evaluation mechanisms to ensure the same. There is therefore a need for close ties between skills and knowledge organisations, policymakers, extension services, and smallholder farmers to ensure that agriculture programmes adjust to changing demands for new knowledge, skills, modernisation and technologies. Worse still, the existing extension education in South Africa follows the traditional approach with a focus on production-related knowledge and skills, technology

transfer and persuasion for behavioural change to enable the adoption and implementation of new technology (Stevens, 2017). This limit approaches focusing on the co-generation of knowledge and skills, in ways that would enable the co-ownership of knowledge-producing processes with smallholders. Nonetheless, some scholars have noted that since the 1990s there has been curriculum recontextualization, away from the domineering interest of commercial forestry to encompass forestry in a holistic way that reflects the needs of community forestry and the participation of the formally disadvantaged communities (Langin and Ackerman, 2008; Underwood et al., 2008). Nonetheless, the argument for competency-based education (CBE) having replaced the traditional agricultural approach focused on the transfer of technologies from researchers to farmers in South Africa (AgriSETA 2014), is not supported by oral evidence from the interviews. It emerged from the interviews that little has been done to foster learning capacity among farmers by working and doing things with them. This is despite the growing recognition of participatory approaches and pedagogies extolling the virtues of working and doing with the smallholders in skills development, knowledge generation and application (Ellis and Biggs, 2001). The continued prominence of the transfer approach is noted in the following assertion:

... you will find that a lot of people have attended programmes, they have certificates, but what have they done with that information? The people who are giving you the information have done their bit. They go through a financing module and give them the templates to use. They go back home and they file them. Whose problem is this? Smallholders need to be responsive; they need to assimilate the knowledge that they are having (Interview - Head of Training institute).

What the head of the institute fails to consider is the effectiveness of the transfer approach, especially when working with disempowered communities of smallholders. Some types of knowledge, especially production and technological knowledge cannot be transferred easily, let alone be comprehended by reading books or notes from a workshop, but require interactions at workplaces between the providers and users of such knowledge (Bergek, 2010). As noted by one researcher:

Knowledge and technology transfer requires face-to-face interaction. Personal contact and practical demonstration are by far the most successful way to do technology transfer. When you go and meet with someone face to face you start to enter into a dialogue, you listen, you look, and if you start listening and looking then you learn.

Moreover, the knowledge coming from universities and research institutes is complicated, produced at certain

levels requiring decoding and simplification by intermediaries to be understood and applied to smallholder growers. This is what the head of the training institute quoted earlier failed to comprehend when she noted that a lot of people have attended training programmes and have certificates but have done nothing to apply the knowledge gained from workshops. The know-how part of knowledge cannot be grasped by attending workshops but through practical demonstrations and interacting with farmers in their fields in applying the knowledge. Working with and doing with as opposed to the transfer approach (jug and mug approach) encourages ownership of the empowerment processes by the farmers themselves (Mushangai, 2015). The absence of recontextualised curricula and pedagogies are therefore some of the systemic blockages hindering sustainable forestry skills formation, and the acquisition and application of forestry sustainability knowledge by smallholders in South Africa.

Smallholders' limited networks and connectivity

Additionally, limited smallholders' social capital also emerged as a factor hindering the implementation of agroforestry and conservation forestry. South African smallholders lack linkages with skills development organisations, financial organisations and established forestry firms. For this reason, most smallholders lack various forms of support in the form of development finance; managerial skills, enterprise development and technical skills for them to operate sustainably (Mushangai, 2020). These problems could be partly addressed by exposing smallholders to activities of the established firms in the sector (AgriSETA, 2016). Thus, linkages with established firms and skills organisations would facilitate skills, knowledge and technology spillovers to smallholders. This, however, requires linkages to be established between smallholders and established firms and with skills institutions and financial organisations. Currently, '... small growers do not have the communication networks like big farmers or the corporates, if I was to put their interaction with established firms on a scale of 1 to 20, I would say the level of interaction is at 3' (Interview-Small Business Development Officer). Limited interaction between smallholders and other economic agents is historically determined - a legacy of the apartheid system of separate development. The current policies have not managed to end apartheid accumulation dynamics to integrate the South African forestry sector. This level of disintegration makes it difficult for smallholders to learn sustainable forestry practices from other advanced actors within the sector. Concerning the interaction between skills-providing organisations with smallholder farmers, it emerged that smallholders' participation is very limited (National Skills Authority, 2018). The smallholder indicated the lack of time to attend lessons at colleges away from their fields

and require instructors to provide training in their fields. This seems to indicate their displeasure with the transfer approach at most colleges, hence the need for working and doing with them in generating knowledge. This situation is worsened by the lack of funding from development institutions, limiting the capacity of smallholders to hire mentors to train them in their fields.

Regarding social capital, it also emerged that forestry smallholders do not constitute a united group. Smallholders are disorganised and this makes it difficult for them to speak collectively and competently with a single voice in lobbying the government to fund their activities. According to the Department of Land and Agriculture (1997), smallholders represent, 'unorganised communities ... not able to express a realistic demand'. This is the case currently, for all smallholders interviewed in this study did not belong to any formal or informal organisation of small growers. This concern was also raised by an officer in the government department of agriculture. It is partly for this reason that the forestry subsector of agriculture does not have a financially backed government programme like the Comprehensive Agriculture Support Programme (CASP) in the agriculture sub-sector to support the smallholder foresters' capabilities development. This is a challenge considering that industrial organisations in the forestry sector such as Forestry South Africa and Sawmilling South Africa mainly speak for the industry as a whole and do not address the specific needs of smallholders. The big firms who fund these organisations prioritise their own needs to the detriment of smallholders. This points to the need for special industrial bodies in the sector to augment the voice of smallholder growers if their productive skills needs are to be prioritised.

Lack of financial support for smallholder forestry activities

Further, pertaining to the limited capital of smallholders Bortagaray and Ordóñez-Matamoros (2012) observed that there are areas in an economy that demand government intervention, for the private sector would not invest in activities considered marginal and of low returns on investment. For example, community forestry related to social aspects of innovation will not succeed without government funding. Whilst banks and development organisations in South Africa have schemes to support small businesses, most smallholders are unable to meet the assessment requirements to secure funding. There is a lack of support for community forestry (Ministry of Water Affairs and Forestry, 1997) which has been worsened by the absence of financially backed programmes for smallholder forestry activities. In the agriculture subsection of agriculture, CASP supports the building of knowledge and capabilities of smallholder farmers. This lack of similar support for smallholder foresters at the level of government programmes poses a

huge challenge to their sustainability. As noted by one researcher:

These people have half a hectare, 1 ha or 20 ha of plants. When a pest or pathogen comes in, it kills their trees or makes them grow half as fast as they should. Who supports these people? From a legislative perspective, if we detect a pathogen or disease, a private company could afford to cut down and lose even 1000 ha to prevent it from spreading, but the private guy cannot afford to lose half a hectare (Interview-Lecturer).

The lack of resources by smallholders for improved germplasm, skills to respond to the threats of fire, pests, and pathogens, coupled with the absence of economies of scale, increase risks, making it impossible for smallholders to secure funding from financial organisations.

This lack of support from the government has led to the neglect of many forestry projects meant to boost smallholders' productive capabilities. For instance,

Fort Cox College started a breeding programme meant to supply smallholder foresters with improved germplasm but failed to maintain it because of the lack of funding (Interview - Lecturer- Forestry).

Thus, the germplasm smallholders still depend on is of the old varieties, not linked to rapid scientific advances in genomics and the production of fast-growing and disease-resistant hybrids. This affects the quantity and quality of their production, hence their income. The lack of funding to enable the adoption and adaptation of existing technologies by small businesses reflects the lack of integration in the South African forestry system.

The government of South Africa is failing to support communities in the management of community forests. Community forests are not open access resources but are managed and accessed for pastures, fruits, poles, and medicines by their responsible members. However, most community forests in South Africa are degraded because of overexploitation and unsustainable land uses emanating from the lack of sustainability skills and knowledge among rural community members (DAFF, 2017b). Some community forestry projects that have been initiated by researchers failed because of the lack of support from the government. One researcher, lamented the lack of government support noting that:

We did a lot of work on the harvesting of bark for traditional medicine. We tried to work with DHET and DAFF, but they are the reason why community participation in forest management does not work in practice. We formed an association with the rural society of Eastern Cape and they were willing to change the way they do things, but DHET and DAFF did nothing. Now they say it is the community's problem when they talk

about participation in forest management but they did nothing to promote it. I wish there was better collaboration between the universities, the government, and companies that deal with it.

The lack of funding for innovative forestry projects in areas considered unviable by the private sector limits the success of sustainable forestry in South Africa. The practice of sustainable community forestry management is further complicated by traditional institutions in rural areas.

Traditional authorities as a hindrance to community forestry

The Traditional Leadership and Governance Framework Act (2003) asserted the important role of traditional authorities in the administration of communally owned rural lands (Ntsebeza, 2006). Most rural South African lands are communally owned under the leadership of traditional authorities. Traditional chiefs have the power to distribute and determine the use of this land. However, communal land tenure under traditional authorities is considered by many as anathema and an antithesis to development, poverty eradication and the development of modern rural economies (De Soto, 1989, 2000). This is because communally owned properties are not legally secure to the people owning them, they cannot be legally burdened as guarantees for shares, investments, and credit, and do not have access to contracts and the formal justice system (De Soto, 1989, 2000). Although these assertions have been disputed (Cousins, 2005), what emerged in this study is that the dictatorial tendencies of traditional authorities curtail the development of community forestry in South Africa. Regarding communal plantations in KwaZulu-Natal, Mr X observed:

Locally most of these people are in chiefdoms led by Inkosi in KZN-Langa. I spoke to some men and said, 'why are you not taking care of the plantation?' It was a community plantation. The men said, 'you do not understand our chief, we work very hard fighting fires and when the plantation gets to maturity, our chief takes over and says this is my plantation, it is in my area (Interview - Small Business Development Officer)

The inviolability of property rights is therefore not guaranteed in former homelands because of the lack of individualised tenure. The lack of tenure clarity and equitable profit-sharing mechanisms in communally owned plantations under traditional authorities are disincentives that have resulted in the neglect and degradation of community plantations. These dictatorial tendencies of traditional authorities to monopolise communal forests, dissuade the private sector from

partnering with rural communities to advance sustainable forestry activities. The dictatorial tendencies make it difficult for private investors to be sure of the possibility to recoup returns on investments should they consider investing in communal plantations. This is one of the blockages that prevent private investors from partnering with rural communities in the development of forestry resources. Such partnerships are critical in facilitating knowledge, skills, and technology transfers from private firms to communities.

Conclusion

This article has alluded to several systemic challenges hindering the flow of sustainable forestry knowledge among smallholder foresters in South Africa. Among these challenges is the misalignment in government departments, limited interaction between smallholders and extension officers limiting the co-generation and ownership, lack of strong linkages between researchers and extension officers for sharing information and application of knowledge, unresponsive agriculture and extension curriculums to needs of smallholders, smallholders' limited networks and connectivity, lack of financial support for smallholder forestry activities, and traditional institutions that disincentives community members from maintaining communally owned forests. Some of the factors such as the need to develop markets for innovative markets agroforestry products such as pigeon pea, moringa, aloe vera and others of medicinal and nutritional value are critical as participation and the development of knowledge and skills can only be advanced if people could see value in the undertaking. However, the issue of markets was not discussed in detail as it was beyond the scope of the paper. Currently, South Africa has good policies that articulate sustainable forestry practices, but the major challenge has been implementation mainly owing to the lack of linkages between policymakers, researchers, extension officers, and farmers and monitoring mechanisms to ensure the same. The forestry sector should build interactive capabilities by establishing platforms allowing for exchange of knowledge and information between practitioners, skills researchers, forestry organisations, and smallholder foresters. Monitoring mechanisms should be devised to ensure interactive and coordinated implementation of forestry and innovation policies for knowledge to flow to smallholders.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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