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SCIENTIFIC CORRESPONDENCE

Promoting Adoption of Soil Health Related Regenerative Agriculture Practices Amongst Small-Scale Sugarcane Grower Communities in South Africa

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Abstract

The term 'regenerative agriculture' describes a rehabilitation and conservation approach to farming, which aims to enhance the sustainability of production. The approach consists of an array of practices that focus on the maintenance and rehabilitation of soil health. In the South African sugar industry, major soil related problems include: (a) soil erosion; (b) compaction; (c) acidification; and (d) soil salinity/sodicity. While regenerative practices to guide growers have been developed at the South African Sugarcane Research Institute (SASRI), the remediation of poor soil health in the industry has generally been hampered by low levels of adoption of these practices. The importance of the small-scale grower (SSG) sector to economic development has been recognised as a key element of the South African Sugarcane Value Chain Master Plan to 2030, which aims to ensure the long-term sustainability of the industry. To understand the barriers to adoption, SASRI conducted a survey of a small-scale grower community. This revealed that conventional knowledge exchange methods were ineffective with SSGs. Consequently, SASRI is developing and implementing knowledge exchange approaches which are founded on: (a) networks of demonstration plots where regenerative practices can be showcased and (b) participative research methodologies which aim to empower SSGs in discovering their own practical solutions to production challenges. Complementing these is an initiative to upskill extension specialists and agricultural advisors in soil health regenerative practices supported by regular radio broadcasts and newsletters. In the short term, the impact of these knowledge exchange tactics is being monitored through analysis of SSG production and economic data by SASRI, in collaboration with stakeholders from the local grower associations and mills. To date, data from the small-scale grower community study indicated that the implementation of the demonstration plot methodology focused on matching variety to soil type has had a positive impact on SSG livelihoods.

Keywords Adoption · Management · Regenerative agriculture · Small-scale growers · Soil health

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Overview of Industry Governance and Service Provision Entities

The South African sugarcane production sector comprises 23,705 registered sugarcane farmers, the interests of whom are represented on the sugar industry governing body, the Council of the South African Sugar Association (SASA), by representatives from either the South African Farmers' Development Association (SAFDA) or the South African Canegrowers' Association (SACGA). These grower associations serve the interests of their constituents through the provision a range of business- and finance-focused services and support. In the 2021/2022 season, the approximately 16,898,639 tonnes of cane milled in South Africa was delivered by 1115 large-scale growers and 13,654 small-scale

growers (SSG), with the latter sector accounting for 11.6% of the crush (SACGA 2021/2022).

The sugar industry, through SASA, operates and funds the South African Sugarcane Research Institute (SASRI), which provides agro-technical resources and services for cane production, including sugarcane varieties, a biosecurity inspectorate, extension services and research, technology development and knowledge exchange activities that aim to: (a) enhance the efficiency and scope of sugarcane variety improvement through classical breeding approaches and the application of state-of-the-art biotechnologies; (b) provide information, resources and services that advance nutritional, agronomic and engineering practices and pest and disease control measures; (c) transform research outputs into practical knowledge and technology products; (d) facilitate the adoption of technology and best management practices that encourage responsible and sustainable land use and deliver optimal productivity and profitability; and (e) generate new ideas with the potential to enlarge the scope of sugarcane agriculture and sustain the industry into the future.

Industry Transformation Imperatives

The South African sugar industry is in an exponential phase of ongoing transformation processes that aim to ensure that remaining socio-economic imbalances within the industry that have arisen from the historical disenfranchisement of the majority of South Africans do not persist. Commitment exists to ensure that this transformation process is reflected explicitly in the SASRI research and extension programmes, particularly in terms of the development and diffusion of technologies customised to the needs of SSG communities.

The importance of the SSG sector to economic development has been recognised as a key element of the South African Sugarcane Value Chain Master Plan to 2030 that has been implemented by the national Department of Trade, Industry and Competition in partnership with the sugar industry to ensure the long-term sustainability of the industry, with emphasis on rural development and SSG livelihoods.

Empowering Participatory Research and Extension Services for Small-Scale Growers

Over the past few years, SASRI has been working with sugar industry stakeholders to develop participatory research and extension methodologies (Hellin et al. 2008) that will ultimately empower SSGs to discover their own solutions to problems that they have identified for themselves and to initiate communication with specialists when needed. The goal is to move away from the natural inclination of researchers and extension specialists to tell growers what the solutions are to problems that have been identified by specialists. This empowerment paradigm is necessarily framed by the resource constrained environments in which SSGs operate. In illustration, the developed approaches are being applied to variety choice and husbandry and cane quality management in a SSG context. The purpose of this section is to give examples of participative methodologies have been developed/refined in the small-scale grower sector. The methods and lessons learned will be implemented to encourage the adoption of regenerative agriculture practices amongst SSGs.

Variety Choice and Management

The SSG cane supply area to the Illovo Sugar Limited Noodsberg Mill is located near Wartburg in the Midlands North region of KwaZulu-Natal (KZN), occupying 12,500 ha with about 1650 SSG houses and homesteads. The soil in this region has a high production potential, although SSGs were initially unaware of this, and crop production activities were not maximising the potential. Consequently, the SASRI SSG extension specialist operating in the region was assigned to the Noodsberg SSG Cane Supply Area in 2001 to assist SSGs in unlocking the potential. In collaboration with a soil scientist from the provincial KwaZulu-Natal Department of Agriculture and Rural Development (DARD), the extension specialist developed a system to demonstrate to SSGs the potential of the soil and methods and procedures to unlock it (Gillespie et al. 2017). The approach focuses on the identification of an individual grower, site selection and soil identification, variety choice, planting and fertilisation, weeding, scouting for pests and diseases, and harvesting of demonstration plots. The grower is also assisted in ratoon management. During the crop growth cycle, care of the demonstration plot is the responsibility of the SSG as they derive income from the plot. The demonstration plots also served as a learning opportunity for neighbouring SSGs, who are invited to each meeting with the SSG hosting the demonstration plot.

The first demonstration plot was established in 2001 with strong collaboration from the milling company, Illovo Sugar Limited (Noodsberg Mill) and an Extension Venture Agreement (EVA) between SASRI and the DARD. By 2021, a total of 71 demonstration plots had been established in the region. Good yield responses resulting from sound agronomic practices encouraged others SSGs to get involved by growing their own plots of sugarcane. The number of growers increased from 264 in 2005 to 833 in 2021 – an average increase in 38 new SSGs per year (Table 1 and Fig. 1). Besides the increase in number of SSGs, area harvested per

Table 1 Increase in six production parameters in the Noodsberg SSG Cane Supply Area from 2005 to 2021

Parameters	2005	2021
Number of SSGs	264	833
Total area harvested (ha)	323	741
Stalk yield (t ha^{-1})	60	76
Cane delivered to the mill (t yr^{-1})	19,252	56,112
Area income (ZAR million yr^{-1})	3.70	34.49
Area income (USD million yr^{-1})	0.25	2.38

year and income for the region, was the improvement in stalk yield of 16 tonnes ha^{-1}, which is an indication of their skills growth in the production of sugarcane. In this period (2005–2021), the cumulative income for the region was ZAR 272.6 million (USD 18.8 million).

In addition to empowering producers, the methodology also serves as a resource for the training of DARD Agricultural Advisors in sugarcane husbandry within the SASRI mentorship programme. The success of the participatory observation trial methodology developed by Gillespie and Mitchell (2017) has inspired the implementation of further studies based on the empowering participative research methodology.

A further major outcome of this participative approach is the increased access that SSGs in the Noodsberg SSG Cane Supply Area have to high quality seed cane from the demonstration plots.

Cane Quality Management

In the South African sugarcane industry, chemical ripening has been an effective strategy for increasing cane quality of immature crops and enhancing grower revenue. Unfortunately, SSGs have been unable to take full advantage of chemical ripening due to the nature of their farming, which features small, irregularly shaped sugarcane fields that are spatially fragmented and often surrounded by other forms of land use, such as livestock and vegetable farming. However, the recent deployment of crop spraying unmanned aerial vehicles (UAVs) within the South African sugarcane industry has brought exciting chemical ripening opportunities to the SSG sector due to the ability of UAVs to operate effectively within a fragmented and diverse small-field environment.

SASRI has established regional partnerships for pilot studies amongst all relevant stakeholders, including the SASRI SSG extension specialists, KZN DARD agricultural advisors, SAFDA, SACGA, regional mill representatives, crop spraying UAV operators, harvesting and transport contractors and relevant government departments, to advance cane quality management in the SSG sector. Through this collaboration and mutual agreement amongst all stakeholders, a network of participatory demonstration trials on SSG farms has been established and used to quantify and demonstrate the economic benefit that SSGs can derive through effective cane quality management.

Numerous field days with SSGs and participating stakeholders have been held at eleven rural and deep rural locations, and have included the initial community engagements, trial establishment, UAV-mediated spraying of the field with ripeners, crop harvesting, and report back on the trial results and economic benefits of crop ripening. The impact of the pilot programme is steadily increasing as awareness develops amongst SSGs and regional stakeholders of the economic benefits of chemical ripening.

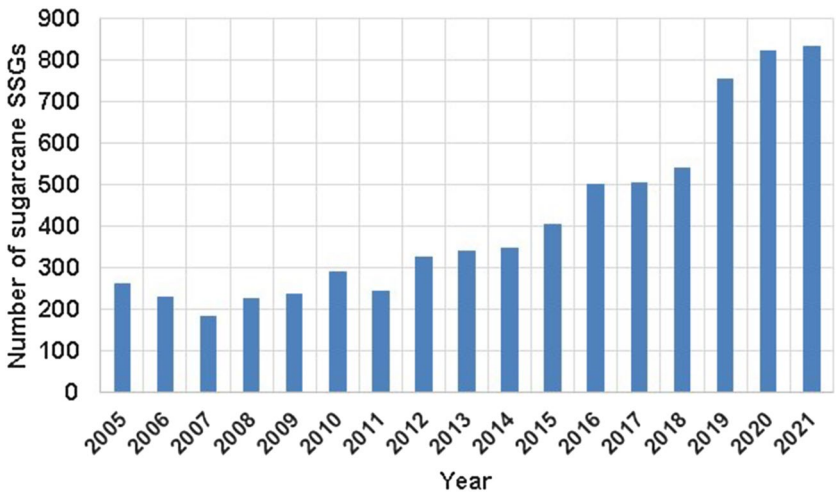

Fig. 1 Change in the number of SSGs farming with sugarcane in the Noodsberg SSG Cane Supply Area between 2005 and 2021

Encouraging Regenerative Agriculture Practices Through Participative Research and Extension Methodologies

The term 'regenerative agriculture' describes a rehabilitation and conservation approach to farming, which aims to enhance the sustainability of production. The approach consists of an array of practices that focus on the maintenance and rehabilitation of soil health. In the South African sugar industry, major soil-related problems include: (a) soil erosion; (b) compaction; (c) acidification; and (d) soil salinity/sodicity. While regenerative practices to guide growers have been developed at SASRI, the remediation of poor soil health in the industry has generally been hampered by low levels of adoption of these practices.

Of major concern is the low adoption level of better management practices (BMPs) relating to soil health by the many SSGs farming sugarcane in rural and deep rural areas of eastern sub-tropical South Africa whose livelihoods depend on sugarcane cultivation and who are likely to be particularly vulnerable to the predicted effects of a changing climate. To understand influences on BMP adoption, SASRI, in collaboration with the KZN DARD conducted a survey amongst SSGs cultivating cane in Gcumisa, an inland rural area in the KwaZulu-Natal province of South Africa. The survey revealed that conventional methods of knowledge exchange with SSGs are not effective, and that communication methods need to be tailored accordingly. Consequently, SASRI is developing and implementing knowledge exchange strategies which are founded on: (a) networks of sugarcane plots in which the implementation and benefits soil health BMPs can be demonstrated at a local level; and (b) participative research methodologies which aim to empower SSGs in discovering their own practical solutions to soil health-related production challenges. Complementing these core approaches is an important initiative to upskill SASRI SSG extension specialists and KZN DARD agricultural advisors in soil health BMPs to enable them to more effectively support SSGs, particularly in the implementation of soil health BMPs aligned with regenerative agriculture principles. Regular broadcasts in the vernacular on local radio stations, in addition to frequent newsletters, are also used to communicate soil health BMPs to SSGs.

In the short term, the impact of these knowledge exchange tactics is being monitored through analysis of SSG production and economic data by SASRI, in collaboration with stakeholders from the local grower associations and mills. To date, data from the small-scale grower community study indicated that the implementation of the demonstration plot methodology focused on matching variety to soil type has had a positive impact on SSG livelihoods and has led to renewed interest by the younger generation to earn a living from agriculture.

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