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POVERTY ALLEVIATION IN SOUTH AFRICA: THE ROLE OF AGRICULTURE EDUCATION AND MECHANIZATION

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ABSTRACT

The need to reduce poverty and increase agricultural production has been the priority of emerging economies. Poverty is one of the significant developmental challenges affecting the development of South Africa after the 1994 apartheid. Recent statistics indicated that about 49.2% of citizens aged 18 falls below the upper-bound poverty line in South Africa. Therefore, various mechanisms are being implemented to alleviate poverty in South Africa. Sustainable agricultural mechanization is a pivotal contributor to the development of agricultural productivity.

The study employed a content analysis technique to approach the significant objective of the research. Discussion from the study shows that poverty can be alleviated through agriculture mechanization when; there is a reduction in food prices, improved farm income, created jobs through agriculture, and increased farm productivity. The study also indicated that effective agricultural mechanization implementation could be achieved by including agriculture mechanization modules in the South African educational system, enhancing the agricultural sector's innovation and profitability, and establishing a training base for enterprises.

Government must therefore create an enabling environment for the development of agriculture mechanization in South Africa. Agricultural mechanization can be promoted by providing local farmers subsidies and credit loan facilities, capacity building and training, and research and development.

Keywords: Agriculture; mechanization; poverty alleviation; education; South Africa.

1. INTRODUCTION

South Africa (SA) is located at the southernmost part of the African continent, and the country is well recognized in terms of its cultural diversity, serene environment, and different topography. The country is also well known for its natural mineral, including silver, manganese, gold, etc. [1]. South Africa is a historically and culturally prosperous nation positioned at the African continent's southern tip, bordering the Indian and South Atlantic Oceans. With a population of 56.5 million citizens, the region is a

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one-of-a-kind example of economic development, with several new advances that are more relevant than one might expect. Since the end of apartheid in the 1980s, South Africa has made real progress. Nonetheless, poverty remains a significant issue in South Africa [2].

The government of SA measures poverty in three threshold areas. First is those categorized under the upper-bound poverty line (UBPL). Those in the UBPL category can afford an income of ($70.90) a month. The second category is the lower-bound poverty line (LBPL). Citizens who can afford an income of ($47.04) per month are classified under the LBPL. The third group is the poverty line (PL), which refers to those whose monthly income is within ($32,78) [2]. The Department of Statistics in South Africa report also indicated that about 49.2% of citizens aged 18 falls below the UBPL. Therefore, various mechanisms are being implemented to alleviate poverty in SA [2].

Mkhabela [3] indicated that agriculture is a critical industry that contributes to the economic development of South Africa. Agriculture contributes 4% annually to the gross domestic product (GDP) of the country's economy. Some farm products in South Africa include maize, sorghum, groundnut, wheat, etc. The country is known for poultry farming, pig farming, sheep, cattle, and goat in animal rearing. SA produces a lot of timber because of its large forestry reservoirs. [1]. [4] argued that the agricultural industry is helping many people cope with hunger and food security. For the past decades, the agricultural sector in SA has evolved from the workforce to mechanization. There has been a lot of progress in agricultural mechanization in SA.

Agriculture mechanization (AM) is critical in boosting crop production and improving food production in developing nations. Implementing mechanization in agricultural production has numerous advantages. These benefits include increased output, labour and yield efficiency, reduced unit costs, and enhanced farming technique. It might lead to agriculture production, which could improve land utilization and, as a result, farm income [5]. While also acknowledging the role of agricultural development in addressing poverty and inequalities, it is evident that effective agricultural production and reform can reduce poverty. Long-term poverty reduction requires involving a more significant proportion of the rural poor in economic activities that generate sufficient income [6].

Despite the impact of AM on the agricultural production process, there have always been differences of opinion and doubts about the role of mechanization in the farming sector [7]. This has hampered the stabilization and improvement of agricultural mechanization in developing countries' agricultural sectors, industries, and services. The FAO report on the state of mechanization in African countries shows, for example, that most African countries have not made serious plans for long-term sustainability [7].

Agriculture employs a large portion of the SA population and accounts for a significant amount of the country's GDP. Despite its importance to the regional economy, agriculture remains underdeveloped in SA. One of the tremendous constraints to agricultural development and food security has been identified as the limited use of mechanization in SA [8]. Youth in Africa are impacted by high unemployment and working poverty. Increased adoption of agricultural mechanization, particularly small, affordable, and easy-to-maintain machines like two-wheel tractors, is boosting African youth's job opportunities and entrepreneurial opportunities [9]. In the coming decades, [10] believe that technology will play a significant role in agriculture, with farmers becoming more informed and productive due to smart farming and automated operations.

Therefore, this research aims to investigate agricultural mechanization's role in reducing poverty in South Africa. This presents research seeks to answer the following questions:

1. What is the current status of agricultural mechanization in South Africa?
2. What is the higher educational status quo of agricultural mechanization in South Africa?
3. What is the role of agricultural mechanization in poverty alleviation in South Africa?
4. Is there any international collaboration in agricultural machinery between China and South Africa?

The contribution of the present studies is as follows: This paper aims to close this knowledge gap by presenting an analysis of how agricultural mechanization can lead to poverty in South Africa. Moreover, this study will provide an overview of the current agricultural mechanization in South African farmers. The present research will provide timely information to educationalists and the government of SA on the need to incorporate AM in students' curricula. The current analysis will contribute to agriculture mechanization and international competency training to help SA to alleviate poverty. Fig. 1 depicts the research framework on how AM contributes to poverty reduction in SA.

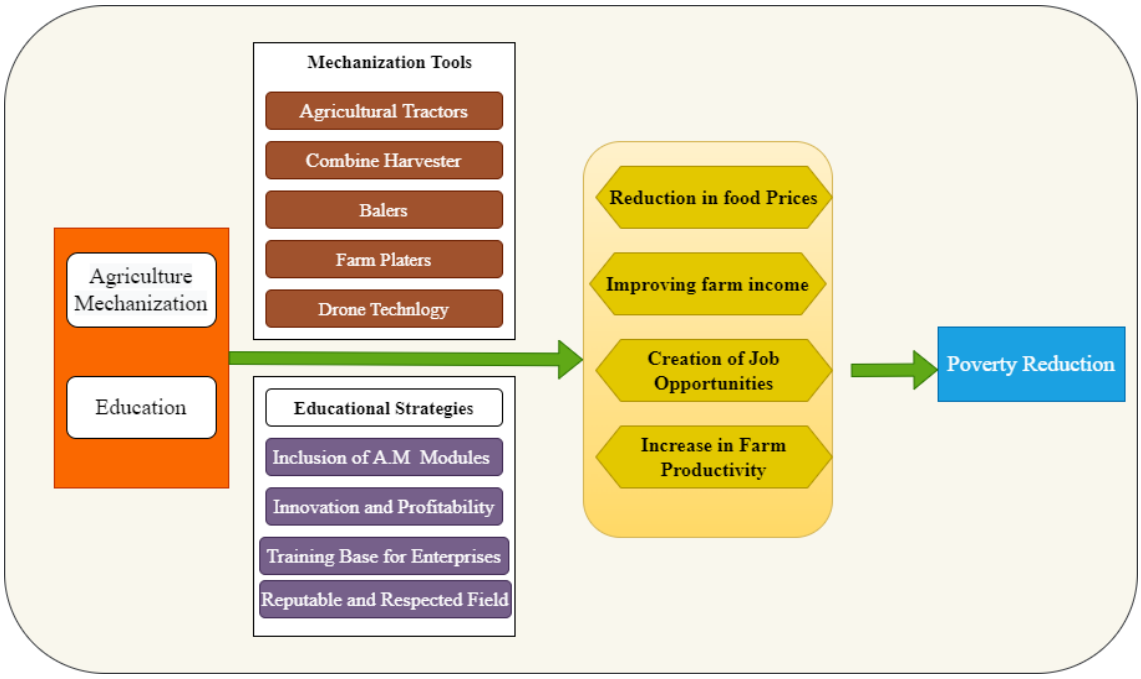

Fig. 1. Research framework

This study is organized as follows: Section 1 focuses on a brief background about South Africa. Section 2 focuses on the current status of agricultural mechanization in South Africa. Section 3 will delve into education and agricultural mechanization in poverty alleviation in South Africa. Section 4 focuses on the higher educational status quo of agricultural mechanization in South Africa. Section 5 will expound on the international collaboration in agricultural machinery between China and South Africa. Section 6 outline some recommendations and prospects.

2. CURRENT STATUS OF AGRICULTURAL MECHANIZATION IN SOUTH AFRICA

Khumbulani et al. [11] defined AM as a mechanism of improving higher productivity by using agriculturally based machinery and tools. Kirui [12] reported that AM includes all tools, implements, and machinery powered by humans, animals, or motorized sources. Mechanization facilitates and reduces hard labour, alleviates labour shortages, increases farm labour productivity, increases the productivity and timeliness of agricultural operations, improves resource efficiency, improves market access, and contributes to mitigating climate-related hazards.

Similarly, [13] defined AM as using hand tools and motorized equipment to reduce human effort, i.e., a method of improving human inputs for performing production-related operations. Mechanization is defined as a set of technological skills used to increase productivity by introducing timely field operations and grain quality [13].

AM is defined by the Food and Agriculture Organization of the United Nations (FAO) as the use of all basic hand-tools, equipment, machines, and implements for farming, ranging from simple essential tools to much more complicated and automated equipment [14-16]. According to [15], AM strategies have mainly been around heavy equipment (four-wheeler farm equipment) and related equipment such as planters, combine harvester, balers tiller, etc. Agricultural mechanization refers to using hand tools, animal-drawn implements, and motorized equipment to reduce human effort, perform certain farming operations that cannot be achieved by other means or in the time available, and improve the quality of others. i.e., a method of improving human inputs for performing production-related operations.

A recent report by Business Wire [17] indicated that the agricultural sector of South Africa is at a crossroads, with numerous challenges such as depleted soils and over-extracted and polluted water reserves. Water scarcity due to prolonged drought and declining rainfall is driving agricultural mechanization. Global market pressure for low-carbon, environmentally friendly agricultural products is becoming increasingly crucial in mechanization adoption.

Since the pre-industrial era, hand tools and simple equipment have been used for production. Nevertheless, the eighteenth-century industrial revolution saw the emergence of power-operated machinery, special-purpose industrial equipment, factories, and increased manufacturing. Farm mechanization has seen the rapid development and use of power-operated machines in many industrialized countries [18]. As demonstrated by the history of AM has evolved, and there is a replacement of manual labour and animal manoeuvrability with mechanical power that would alter the face of African agriculture. As indicated in Fig. 2, AM has evolved over the past centuries. Thus, AM started with improved hand tool technology, and recently there has been an automation of agricultural production. Many people believe that mechanization has mostly positive consequences, such as relieving farmers of heavy physical work and allowing higher yields.

[16] pointed out that AM in the 21st century should be eco-friendly, economic viability, affordability, adaptable to local conditions, and climate-smart, given recent changes in weather patterns. Therefore, today's AM should focus on these critical parameters:

- Increasing agricultural productivity while improving natural wealth and natural environment services is a goal.
- Managed and natural biodiversity is used to strengthen system resilience to abiotic, biotic, and financial stresses.
- Increased AM result in more effective, efficient, and eco-friendly food production [16].

Following the 2008 economic recession, South Africa's agriculture equipment market gained prominence in its market share value. The government aided the South African agriculture equipment market, which helped overall market growth. In recent years, the need for increased productivity and efficiency in agricultural fields has resulted in a surge in demand for more extensive four-wheel tractors [19]. The government in SA and local farmers are concentrating their efforts on overcoming market constraints by making agricultural equipment more accessible to credit.

South Africa's agricultural economy is the most contemporary style, efficient, and diverse in Africa. South Africa has a well-developed agricultural industry, which will benefit the country as economic and weather uncertainty persists. A downgrade in credit ratings, concerns about land reform, a fluctuation of the exchange rate, continuing weather issues, and the latest Covid-19 pandemic are all affecting the industry. The current mechanization status of South Africa includes the use of the following tools equipment that helps farmers to achieve higher productivity [20]. Some agriculture mechanization tools currently applied by farmers in South Africa include.

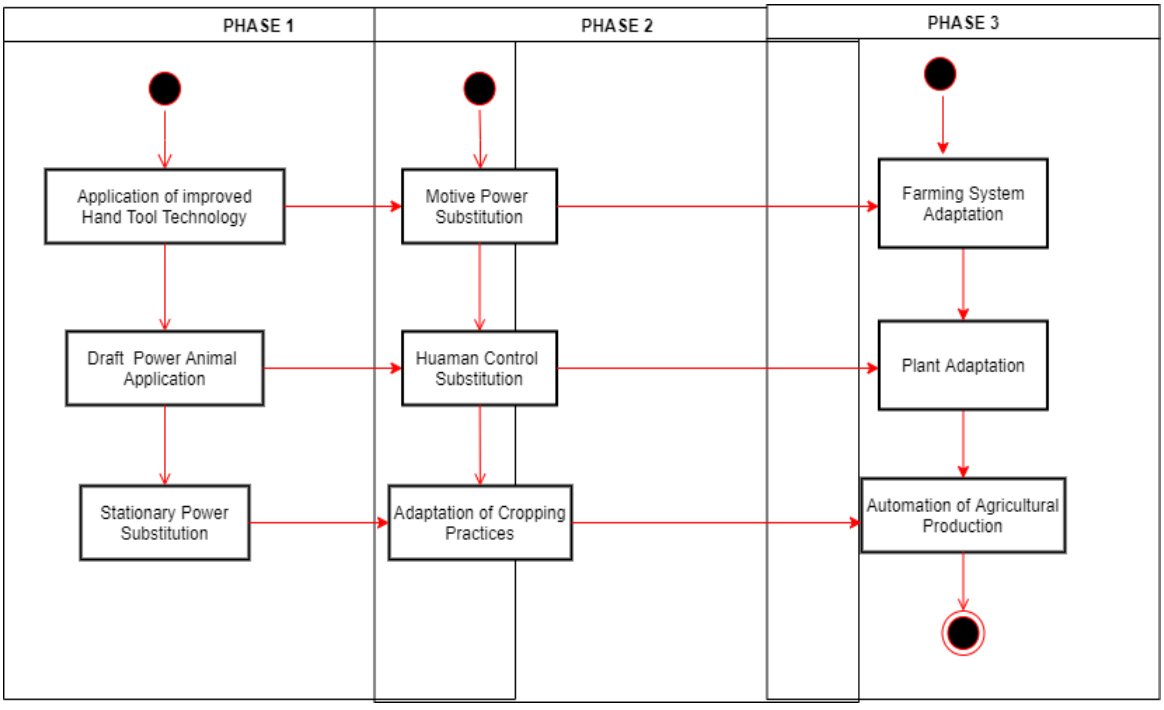

Fig. 2. Agriculture mechanization adoption process flow diagram

2.1 Agricultural Tractors

A tractor is an agricultural machine used to mechanize agricultural tasks such as ploughing. Nevertheless, the tractor has made great strides since its early roots as a steam engine on wheels in the 19th century. Tractors for farming are now used for ploughing, cultivating soil, and planting crops. Today's tractors can be used for various tasks such as shrubs, gardening, moving or spreading fertilizer, and lawn maintenance. As a result of precision farming technology and advanced equipment, the range of tasks and capabilities of advanced farm machinery has expanded even further.

A tractor, in general, is a vehicle that is explicitly expected to produce high, slightly inclined, or engine power at reasonable speeds for a variety of uses, such as towing a trailer or other agricultural or industrial development equipment. Nowadays, a "tractor" is a farm vehicle that provides power and traction to mechanize agricultural tasks, particularly tilling, etc. Because of its numerous applications, the tractor is handy in a farm setting. The tractor makes farm work activities accessible and faster [21].

Tractors and combine harvesters were discovered to be the most popular types of agricultural machinery, with a well-developed ecological system of production and sales by several various producers. The entry of new players into the market, growing demand for mechanization, and significant export demand were the South African agricultural equipment market [19].

Since 2000, South Africa's tractor sales have increased from 75 276 units to 93 020 units by 2020. Fig. 3 indicates the agricultural sales from 2001 to 2020, which shows a rise in the increase of tractors for farming activities in South Africa [22]. According to Folaranmi et al. [23] study, South Africa has over 325 000 tractors, with over 80% owned by commercial farmers.

2.2 Combine Harvester

A combined harvester has the advantage of completing reaping, threshing and winnowing all in one process. It can harvest various crops, including barley, sorghum, and flax. It is also helpful for harvesting wheat and oats. Having a combined harvester saves time by reducing the labour required for harvesting. It increases farmer profits by providing a low-cost harvesting method. Combine harvesters have detachable heads that can be swapped out depending on the crop being harvested [24].

2.3 Balers

Balers of various types are used in agricultural mechanization to assist farmers in moving and processing everything from vegetation to recyclable waste [25]. A baler compresses and binds this cut and raked plant material with twine, wire, or netting. Using a mechanical baler instead of doing this laborious work by hand is more efficient. It enables the machine operator to harvest large land areas quickly. The binding process also allows the harvested crop to be transported over long distances, which was previously impossible with traditional haystacks [26].

2.4 Farm Planters

A planter is a farm tool usually towed behind an agriculture tractor. It can be discovered on farms where grains and forage crops are grown. Its purpose is to sow seeds with the proper row width into the soil, resulting in crop rows that are evenly spaced and seed holes that are metered. The farm machine is equipped with a fan system that generates air and vacuum pressure. The number of seeds planted per acre is the plant population. A planter machine is used to open the harrow and meter the seed. It deposits the seeds in the furrow and covers them with soil.

A seed has the best chance in a well-kept planter. Planter maintenance is essential for no-till and reduced-tillage farmers. The planter bears the brunt of the physical labour involved in manipulating soil, planting seed, and getting the seed off to a good start. The planter is the most crucial piece of equipment on a no-farm. Tiller's opens a slit in the soil, drops in seed, and closes the seed trench, all while efficiently managing residue in the field. Planters available on the market when no-tilling first gained traction in the 1970s were primarily designed for conventional farming with drier soils and far less residue on the ground. In contrast, no-tillers dealt with higher soil moisture [27].

3. HIGHER EDUCATIONAL STATUS QUO OF AGRICULTURAL MECHANIZATION IN SOUTH AFRICA

Education is among the necessities of human beings, and it is critical for both advanced and emerging countries' human capital growth and development. Education and training both induce learning, which is a process that alters skills and behaviours through knowledge and experience [28]. Training is a type of communication that aims to improve skills, change behaviour, and increase competence. It is aimed at a specific group of people and focused exclusively on what must be understood. Education seeks to gain knowledge and develop intelligence in a broad sense while also focusing on specific skill transfer [28]. Melembe, Senyolo, and Mmbengwa [29] argue that

cognitive skills such as farmer history, education level, previous market experience, and agricultural training may impact value addition.

In South Africa, the current status-quo of agriculture mechanization in the higher institution is embedded in the National Agricultural Education and Training Forum (NAETF), conducted under the auspices of Agricultural Education and Training (AET). ATE is critical in preparing local farmers, educational researchers, agriculture extension officers, and essential stakeholders. According to [30], one key issue is how AET can make a meaningful contribution to improved food security and improve farm yields through agriculture mechanization, which can promote rural advancement in SA. This objective can be achieved through agricultural mechanization education in higher education.

Agricultural Education and Training in Sub-Saharan Africa shows that many agricultural education curricula are insufficient because they are non - responsive to socio-economic status, innovation, physiological, and ecological issues. Besides that, many formal and non-formal AET education systems demonstrate a lack of structured training needs and frequently employ delivery modes and mechanisms that do not reflect the reality of people's situations in their community context [30]. Here the researcher suggests that for proper and effective implementation of agricultural mechanization in South Africa, higher institutions can adopt the following measures.

3.1 Inclusion of Agriculture Mechanization Modules in Schools

The government of South Africa should make an effort to include AM as a course in the curriculum at all educational levels, from primary school to university. This may encourage students to consider a career in agriculture as a viable option. Because the government does not promote agriculture to today's youth, they regard agriculture as an old-fashioned industry. The more agriculture mechanization becomes attractive to students, the more they engage in agriculture activities.

Swanepoel et al. (2017) reported that agricultural curricula in schools must be an integral part of the education system. There is no legal framework to encourage or require systemic relationships between universities and agricultural colleges. This lack of clarity and progress regarding agricultural colleges and their positioning has significant ramifications for educational provision quality and the potential for enhanced articulation. To reduce poverty, higher education in South Africa should include agriculture mechanization modules into their curricula. The researchers advocate that to improve agricultural mechanization; higher education institutions need to employ professionals to help integrate this new feature in the curriculum of learners in SA [31].

3.2 Enhance the Agricultural Sector's Innovation and Profitability

Making agriculture and farming more innovative will appeal to many young people, mainly if it is linked to technology and digital skills that can be used to increase agricultural profits. This initiative, however, will necessitate the government's commitment to invest more in the sector. For example, investing in cutting-edge technology tools, skill training, research, and agriculture mechanization will arise people interested in agricultural activities in the long run. The agriculture sector's image will improve due to the government's efforts, attracting an increasing number of young people.

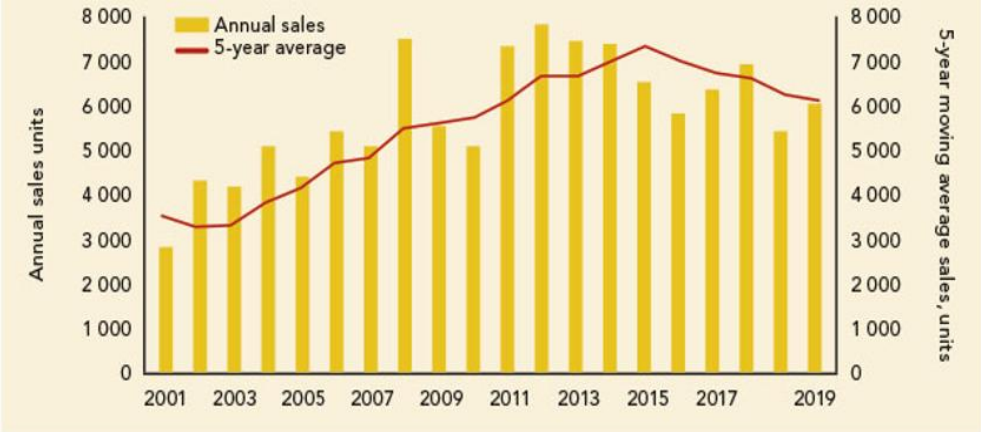

Fig. 3. South Africa agricultural tractor sales to 2000 to 2020
Source: [22]

A transparent government reform entails investing in public science and development institutions, as well as supporting the private sector through tax breaks and financial support for public-private partnerships, as well as promoting the development of information and communication technologies, infrastructure for biological sciences and information systems, and intellectual property rights [32].

3.3 Establishment of a Training Base for Enterprises

To better implement AM in South Africa, higher institutions should build a rapport between businesses and entrepreneurs (farmers) to help students understand how to use the modern equipment and tools used in agricultural production. Through collaboration between higher institutions and enterprises, the school can help train students interested in AM. Accordingly, higher institutions can establish enterprise training bases, such as crop and animal product lines machinery, farm equipment training base, etc [32]. The establishment of training base centres in the various higher institutions can allow students to learn how to use modern AM equipment. Also, agricultural entrepreneurs can be called upon to mentor students who want to venture into farming after graduation from a higher institution in SA. This can go a long way in promoting AM mechanization intention among students.

3.4 Present Agriculture as a Reputable and Respected Field

African governments should collaborate with national and international publications to regularly feature successful agripreneurs to increase agriculture's appeal. Farmers and others involved in agriculture should have their success stories featured in reputable magazines and media outlets. Additionally, governments should recognize individuals who work across the agriculture value chain to promote the narrative that agriculture is a thriving field on a national and regional level. Governments should assist smallholder farmers in helping them increase their output and profits. These actions will demonstrate to young people that agriculture is a financially secure and respected profession [33].

If policymakers want to make agriculture more appealing to the younger generation, it needs to change its narrative. Governments must encourage more young people to become agri-preneurs as early as secondary school to change people's perceptions of agriculture as a path to success. Governments should provide well-trained career counsellors to schools and universities to encourage students to consider agribusiness a viable career path. From growing to selling crops, farming details should be included in primary and secondary school education. Actions like these may encourage young people to consider a career in agribusiness [34].

4. INTERNATIONAL COLLABORATION IN THE FIELD OF AGRICULTURAL MACHINERY BETWEEN CHINA AND SOUTH AFRICA

There are a lot of potentials that China can offer to promote AM in South Africa. Over the years, China has played a crucial role in agriculture development through education. Thus, China provides scholarship opportunities to students to learn agriculture programs for which students can transform their ideas to help the development of agriculture mechanization in South Africa. Although enough opportunity has been provided by the China and Chinese government in the development of AM in South Africa, there are still some potentials that can be explored in the future. [35] reported that Chinese agricultural aid in Africa dates back to the late 1950s and is still an essential component of China's current assistance to the continent. The Chinese government has always prioritized agriculture in its aid pledges due to its importance to economic development and social upliftment.

At the 2015 Johannesburg Summit of the Forum on China-Africa Cooperation (FOCAC), President Xi Jinping announced 10 major collaboration strategies, including farm mechanization, and promised $60 billion in financial assistance. At the 2018 Beijing FOCAC Summit, Xi pledged another $60 billion to support eight significant initiatives in China-Africa cooperation, along with a proposal to collaborate with the African Union and International Food Policy Research Institute (IFPRI) to devise and execute an action plan to foster Africa's agricultural mechanization [36].

Shang and Zhang [36] reported that the Belt and Road Initiative, in which African countries play an essential role, emphasizes international agricultural cooperation as critical for establishing a community of shared future for humanity. China can help improve the potential of agriculture mechanization in South Africa through the following ways, as suggested by Shang and Zhang [36]:

i. There is the need for strategic planning and policy research guidelines that are focused on the education of local framers on agriculture mechanization in South Africa

ii. Investment in agricultural mechanization should be based on the needs of local farmers
iii. Knowledge sharing is vital: Thus, China can collaborate with local farmers and share China's story on mechanization. This will provide an opportunity for the farmer to learn how mechanization can transform the agriculture industry in South Africa
iv. Enhance commercial crop operations through increased private sector participation for long-term sustainability.
v. Actively encourage assessments of China-Africa agricultural sectors, and collaborate with the media to share evidence-based stories.
vi. Increase three-way cooperation among Africa, China, and partners such as international organizations, bilateral development agencies, civil society, and the private sector.

5. POVERTY ALLEVIATION IN SOUTH AFRICA: THE ROLE OF AGRICULTURAL MECHANIZATION

Statista [37] report indicated that approximately 16.31 million South Africans were living below the poverty line as of 2020, with the poverty line set at $1.90 per day. In addition, over a million of these people fell into economic hardship in 2019 than in 2018. As shown in Fig. 4, approximately 16.71 million South Africans are expected to live on an optimum of $1.90 per day by 2025. Furthermore, individuals with a monthly food budget of 624 rands (approximately 44 US dollars) were considered poor by South African national standards. Changes in household consumption patterns and fluctuations in the prices of services and goods impact national poverty lines. In South Africa, for example, 16.3 million people were homeless [38].

South Africa's economic growth will remain under pressure as citizens tighten their belts due to a contracted economy and higher inflation in recent years. Agriculture investment is widely recognized as a critical prerequisite for achieving goals related to improving food security, creating jobs, creating wealth, and thus reducing poverty. Growth in agricultural productivity is a worthwhile goal, as it results in significant leverage for hunger relief, poverty reduction, and an improved labour market [20]. This is particularly important in countries with low agricultural productivity, such as SA. As a result, facilitating farm development and improving agricultural productivity should be regarded as crucial in increasing AM in South Africa [39]. The South African government has placed agriculture at the heart of rural development due to its role in food security, rural income, and job creation [11]. In SA, agriculture is an essential part of the economic development progress and can help ensure household food security and poverty reduction. By 2030, the National Development Plan (NDP) aims to eliminate poverty and reduce inequality in SA [40]. Poverty and hunger remain the far more pressing development issues of our time. Food insecurity and malnutrition are still problems in the world's less developed states [41]. [42] reported that many initiatives have been implemented in South Africa to improve the livelihoods of the rural population, with varying degrees of success. The critical issue that needs to be addressed is what role education and agricultural mechanization play in poverty alleviation in SA. Furthermore, as shown in Figure (please re-arrange the figure numbers), AM and education have a causal impact in alleviating SA farmers.

The authors in this section provide ways to help eradicate poverty in SA through education and AM.

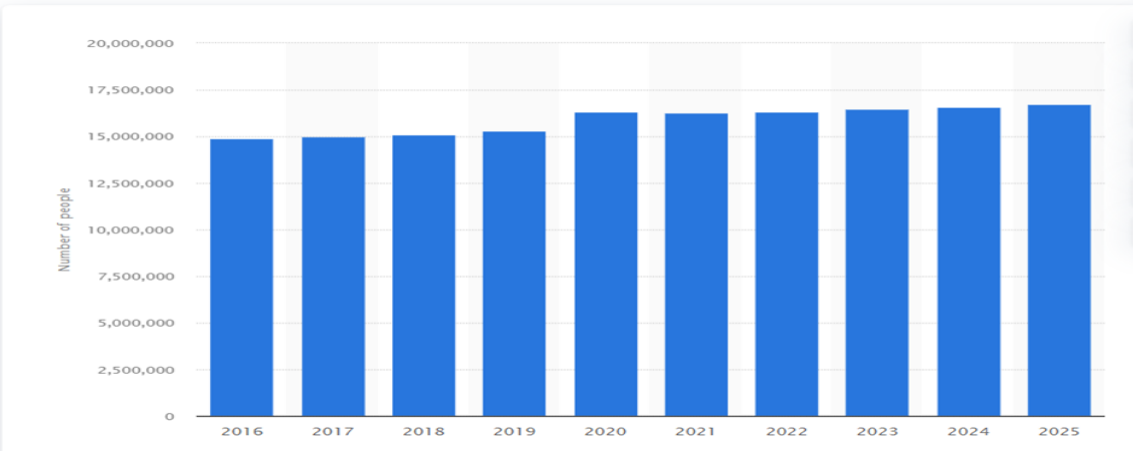

Fig. 4. Citizens below the poverty line in South Africa from 2016 to 2025
Source: [37]

5.1 Reduction in Food Prices

According to [43], rising food prices affect economic stabilization and the welfare of consumers. Relatively poor households, who spend a more significant percentage of their income on food, are particularly affected. In South Africa, rising living costs force families to spend rather than save their earnings, as shown in Fig. 5. High food prices raise the risk that lower-income residents encounter, and as a result, lower-income consumers lose real income. Given South Africa's high levels of inequality and poverty, food price inflation is an important economic indicator because of its contribution and influence on the general Consumer Price Index (CPI) and its potential impact on food security : [44]. Because poor households spend most of their income on food, food prices are significant in their well-being [43].

There is clear evidence that AM leads to higher agriculture production. For instance [7] indicated that yields in mechanized agricultural areas were significantly higher than yields in non-mechanized agricultural regions. Pesticides applications were also more effective, and the land and fertilizers were used to their full potential. The world's current need is to achieve food security while preserving natural resources for future generations. Therefore, higher yields can lead to a drastic in food prices, affecting the living standard of people in the long run. This can lead to poverty alleviation in SA.

5.2 Improving Farm Income

Improvements in farm income can help people get out of poverty. According to Department for International Development (DFID), agriculture can reduce poverty in ways that directly affect farmer income. Increased agricultural productivity boosts farm income, expands food supply, lowers food prices, and creates more jobs in rural and urban areas [45]. As income levels rise, enterprises' and citizens' consumer demand for goods and services may increase. Such links, the "multiplier effect" among agricultural and broader economic growth, have enabled developing countries to diversify into higher-growth, higher-wage sectors [45]. Machethe [46] cited that agriculture plays a critical role in poverty alleviation in SA, with 1031 households. According to the findings, families involved in agricultural production are less poor than those not. Furthermore, the study finds that farm income rises in tandem with total household income, implying that agriculture continues to be a significant source of income for households.

According to Melembe et al. [29], the primary motivation for smallholder farmers to use value addition is to increase sales and profits. Sales must be increased to avoid post-harvest losses due to perishability. Farmers in SA lack modern storage facilities, making them vulnerable to failures due to perishability during low demand periods. South Africa's manufacturing and tertiary sectors have strong links with agriculture and agro-processing. The expansion of the agro-processing industry stimulates agricultural growth by creating new output markets and increasing farmer incomes, allowing farmers to invest in land and inputs to increase productivity [29]. The researchers are optimistic that government and policymakers should channel more resources to develop agricultural mechanization to reduce poverty in SA. This can assist farmers in producing high yields, leading to an increase in farm income. An increase in farm income can help in addressing poverty in SA.

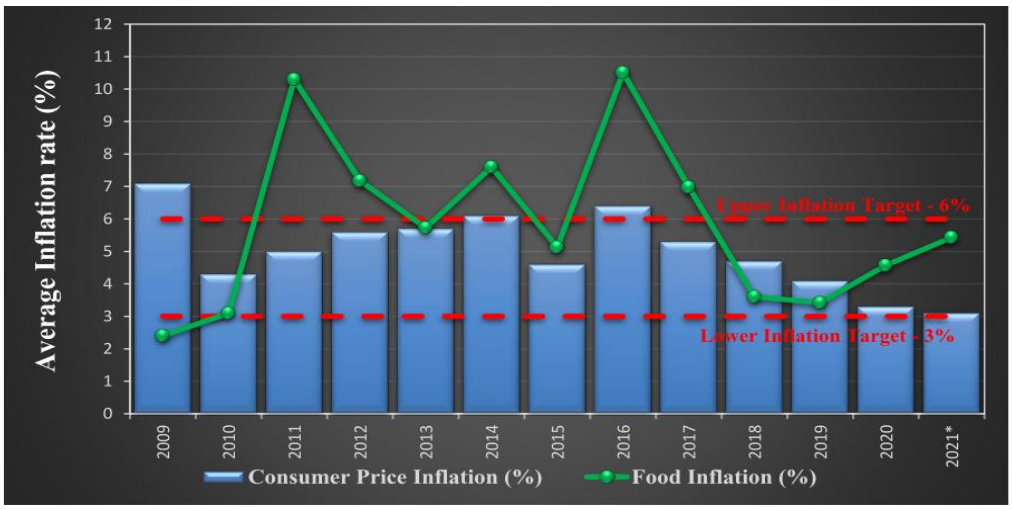

Fig. 5. South African food inflation and consumer price index (CPI)
Source: [44]

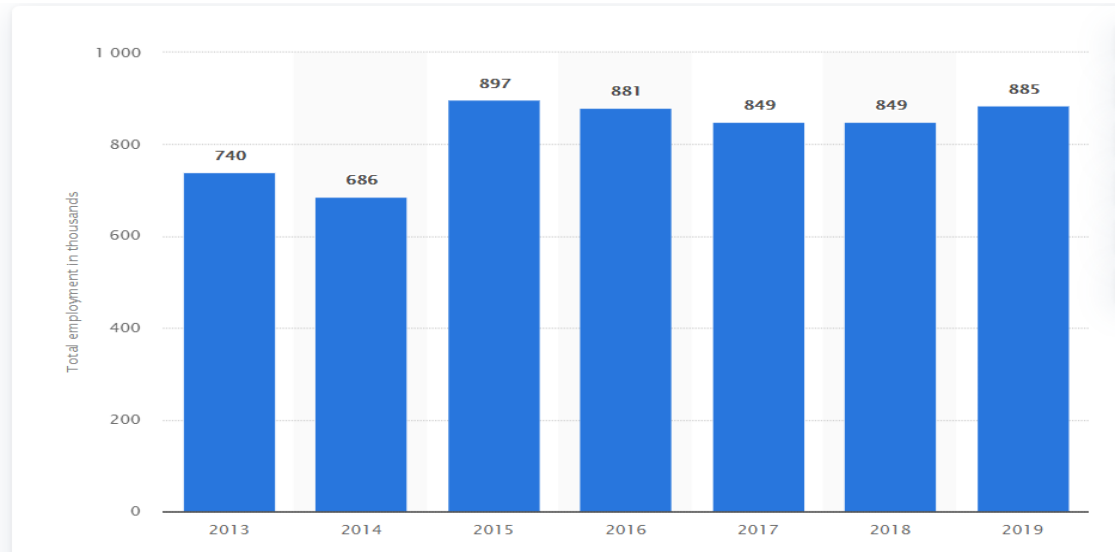

Fig. 6. Employment in agriculture in South Africa between 2013 and 2019 (estimated in 1,000s)
Source: [47]

5.3 Creation of Job Opportunities

In 2019, approximately 885 thousand people were employed in agriculture, hunting, forestry, and fishing. This represents a 19.6% increase over 2013. Furthermore, the employment rate fluctuated between 2013 and 2019, falling by roughly 7.3% in 2014 before rebounding to 897 thousand in 2015, as indicated in Fig. 6 [47]. This could be attributed to the government's National Development Plan (NDP), which addresses inequity, unemployment, and social exclusion. The plan of NDP was introduced in 2012, and it is expected to support commercial agricultural industries by 2030, allowing for high potential growth and job creation.

Folaranmi et al. [23] asserted that South Africa has a diverse agricultural sector in which commercial farmers thrive. Farmers in SA are still developing and growing to run sustainable farming businesses. Agriculture is essential to the South African economy because it creates jobs, promotes land reform and rural development, reduces poverty, and increases food security. [48] opined that agriculture is at the heart of emerging economies. As one of these economies, South Africa should create a healthy agricultural sector that contributes to the nation's GDP, food production, welfare programs, creation of jobs, and environmental conservation while still introducing additional value to raw materials. The agricultural sector's health, on the other hand, is dependent on the long-term suitability of farming techniques. Agricultural mechanization must thus ensure the land's long-term productivity, profitable yields, and the well-being of agricultural producers. An increase in job creation will reduce poverty in SA.

5.4 Increase in Farm Productivity

Farm power and mechanization are agricultural production inputs needed to increase labour and land productivity to meet SDGs 1 and 2 (ending poverty and hunger). To stimulate the product value chain and activate input supply, the demand for mechanization in the smallholder farm sector must be increased. Conservation agriculture principles are used to discuss the sustainability of mechanization from natural resource conservation [49].

Mechanization has the potential to increase farm productivity, resulting in poverty reduction. Increased productivity means more money in the bank, which means more demand for productivity. As a result, productivity will rise, and the self-reinforcing cycle will continue. On the other hand, the increased need for automation leads to increased supply, which allows for lower per-unit costs for services and thus increases demand—a second self-reinforcing virtuous cycle. The challenge is to provide farmers with long-term mechanization to break the poverty cycle and improve living conditions [49].

6. CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Conclusion

Agriculture Mechanization needs to be given greater attention in South Africa by policymakers because it benefits agricultural production. This study has discussed the mechanization roots in SA and how they can contribute to poverty reduction. The discussion discovered higher institutions' role in promoting

agriculture mechanization in South Africa. The need to reduce poverty and increase agricultural production has been the government's priority. Government must therefore create an enabling environment for the development of AM in SA. AM can be promoted by providing local farmers subsidies and credit loan facilities, capacity building and training, and research and development. Future research will focus on how high-capacity equipment such as ploughs, laser levellers, threshers will be investigated to analyze their impact on agriculture in South Africa.

6.2 Policy Recommendations

The following recommendations can lead to sustainable agricultural mechanization development in South Africa. When adopted by policymakers, the government of South Africa and various stakeholders can go a long way to help enhance agriculture mechanization, leading to poverty alleviation.

6.2.1 Support from local government

Local governments can assist farm equipment owners in connecting with clients in other parts of the country by facilitating a better relationship or coordination between agriculture mechanization equipment and supply of it. Governments can fund research and development to produce smaller equipment better suited to the local situation and illustrate its benefits through skills training. Governments can also trade tariffs on parts and accessories imports and encourage appropriate agriculture mechanization equipment. Governments should take action in several areas, including knowledge and skills development. However, this area is underserved, possibly because it is less politically appealing than importing machinery [50].

Policymakers must devise novel initiatives and foster conducive conditions to encourage adapted mechanization pathways. Subsidies to increase private-sector cooperation and coordination, youth skill education and training, and assistance for employment generation in the mechanization industry are just a few illustrations of how nations could perhaps make substantial progress. Agriculture transformation in Africa is not only feasible but also taking place. To avoid potentially disastrous consequences, Africa must devise novel and innovative approaches to integrating conservation agriculture and mechanization methods while considering the diversity of contexts [51].

6.2.2 Creating pathways for the adoption of Agriculture Mechanization

The success of mechanization entails more than simply implementing available appropriate technology. Increasing agricultural mechanization adoption across the entire value chain, on the other hand, necessitates investment in a technical capacity to build and operate machines, and resilience to local needs as well as different ecological and sustainability conditions, among other things. A detailed, systematic approach is required to achieve effective and sustainable agricultural mechanization and to promote conservation agriculture principles in South Africa.

6.2.3 Research and development

In most countries, government sector investigations on agricultural machinery and integration are typically handled by several state agencies, with little collaboration. For instance, enough research should be conducted in farm mechanization and irrigation projects. Higher educational institutions can carry out this research, and development centres in South Africa serve as an essential country connection point for any regional agricultural mechanization networking. The research team's principal task should be to facilitate the collaboration of national centre efforts to work together in a structured regional network to achieve economies of scale and scope [52].

6.2.4 Capacity building and training

Small-scale farmers lack the requisite capital, either through investments or provision of financial credit, to invest in the costly farm power and machinery needed to increase labour and land efficiency. Furthermore, poorly chosen or misappropriated agricultural machinery can degrade, rather than improve, the quality of the environment, particularly soils. Longer-term and broader training programs are required to implement short and long-term training for mechanization service providers, farm owners, technicians, and agricultural extension. Therefore, existing agricultural mechanization and engineering centres must provide such programs [14, 52].

6.2.5 Availability of credit facilities to farmers

One of the issues with farm mechanization in SA is that farmers cannot afford to buy farm machines due to their low income. Most of these farm machines and implements are exorbitantly expensive to buy and maintain for the average farmer. [53] indicated that market failure in agricultural finance has been identified as a significant impediment to mechanization, affecting tractor investments and tractor service financing. Their research revealed that private bank loans are, as expected, difficult to obtain. Farmers and tractor owners reported that applying for a loan from a private bank is time-consuming and that

the repayment schedule is strict and not tailored to the needs of farmers. To address this issue, governments and various banking institutions must establish credit facilities to disburse loans to farmers to purchase some of this equipment.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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