Scientific Research Publishing

Open Journal of Social Sciences, 2025, 13(4), 68-83
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Exploration of China-Africa Agricultural Machinery Cooperation

Li Yang[1], Kaili Li[2*], Shaoxuan Dong[3]

[1]School of International Economics, China Foreign Affairs University, Beijing, China
[2]School of International Trade and Economics, University of International Business and Economics, Beijing, China
[3]Beijing Qianhui Brand Consulting Co. Ltd., Beijing, China
Email: gaodengshuxue07@sina.com, *13811102613@163.com, dsxuan67@sina.com

How to cite this paper: Yang, L., Li, K. L., & Dong, S. X. (2025). Exploration of China-Africa Agricultural Machinery Cooperation. *Open Journal of Social Sciences, 13,* 68-83.
https://doi.org/10.4236/jss.2025.134004

Received: March 10, 2025
Accepted: April 7, 2025
Published: April 10, 2025

Abstract

Agriculture is still lagging behind in some African countries. The persistent food shortages and underdeveloped agricultural production in Africa are fundamentally attributed to the low level of agricultural technology, including agricultural mechanization. This paper first analyzes the challenges faced in accelerating agrarian mechanization in Africa. On this basis, it explores comprehensive measures for China-Africa agricultural machinery cooperation and further examines, from a practical perspective, how China can assist and serve Africa at the provincial level.

Keywords

Agricultural Machinery, China-Africa Cooperation, Food Crops

1. Introduction

The experience of the world's agricultural development has shown that mechanization of food crops is the most easily achievable and can lead to total factor productivity improvements. Agricultural mechanization is a core driver of agricultural economic transformation and is important in achieving sustainable food security, reducing rural poverty, and promoting agricultural modernization (Zhu et al., 2022; Li et al., 2021).

Currently, agricultural mechanization has attracted the attention of scholars. They believe that agricultural mechanization has the advantages of saving labor time, reducing labor intensity, improving labor efficiency, and increasing grain yields and total grain production (Wang et al., 2021; Aryal et al., 2021). It can also enhance rural wages and narrow the gap between urban and rural areas (Berhane

et al., 2017). However, not much research has been done on agricultural mechanization in Africa. Among the continents, African agricultural systems are the least mechanized. As a result, agricultural labor productivity, a major determinant of farmers' incomes and, subsequently, food and nutrition security, has stagnated over the years (Pernechele et al., 2021). Data show that 60% of land in sub-Saharan Africa still relies on human labor for cultivation, 25% is animal-driven, and the use of agricultural machinery accounts for only 15%. If South Africa is excluded, the proportion of human farming in the region would be as high as 80%, with agricultural mechanization rates of only about 5% (Daum & Birner, 2020).

Although agricultural mechanization in Africa has been accelerating in recent years, it still faces multiple difficulties in terms of technology, capital, and policy (Fan & Brzeska, 2016). In contrast, China, through a series of policy innovations and technology promotion, has made remarkable achievements in terms of agricultural productivity, production conditions, and farmers' income (Pan et al., 2025). The success of China's agricultural mechanization is mainly reflected in two aspects: first, the government has made significant adjustments to the supply-side structure of agriculture through land and labor policies; and second, it has filled the gap caused by the migration of rural laborers to urban areas through the rapid popularization of agricultural machinery (Pernechele et al., 2021; Daum & Birner, 2020). China's model of agricultural mechanization development is characterized by its systematic, legal, and incentive-based approach, with the full involvement of the central to local governments, a key role played by the domestic agricultural machinery industry, and the promotion of the widespread use of agricultural machinery through legal safeguards and policy subsidies (Fan & Brzeska, 2016). These experiences provide important lessons for Africa.

The objective of this paper is to explore specific measures for Sino-African cooperation in agricultural mechanization from the perspective of coping with the predicament of agricultural mechanization in Africa and to analyze how to enhance the level of agricultural mechanization in Africa through Sino-African cooperation based on China's practical experience of assisting Africa's agricultural development in the form of provinces, to provide a feasible path for solving the problem of food security in Africa and promoting the sustainability of its economic development.

2. Methods and Approaches

The research methods in this paper are documentary analysis, case study and comparative analysis.

This study outlines the dilemmas of agricultural mechanization in Africa, analyzes comprehensive measures for Sino-African cooperation on agricultural machinery, and discusses two case studies in Gansu and Hunan provinces to explore China's efforts to help serve agricultural mechanization in Africa on a province-by-province basis, which provides a sense of direction for policymaking and future research in developing countries at the early stages of agricultural mechani-

zation. The narratives are retrieved from peer-reviewed academic articles from Web of Science, China Knowledge, and Google Scholar. In addition, we use supporting documents from governmental and non-governmental institutional organizations to understand trends related to small-scale agricultural mechanization. We draw conclusions based on a finding analysis of journal articles, other supporting documents, and expert opinions.

The study covers the period from 2018 to 2024, as evidenced by the publication dates of the references. The data utilized in the research, such as the comparison of per capita GDP between the world, China, and African countries, is based on figures from 2023. Key research conclusions are derived from data and information collected between 2021 and 2024. The main keywords for this research are agricultural machinery. The research approach is structured as follows: first, identifying the challenges faced by agricultural mechanization in Africa; second, highlighting the advantages of agricultural mechanization in China; third, recognizing the substantial foundation for China-Africa economic cooperation; and finally, exploring the potential for China-Africa cooperation in agricultural mechanization. The choice of case studies from Gansu and Hunan is based on specific considerations. Gansu, with its challenging natural environment—characterized by large amounts of wind and sand, as well as diverse terrains such as mountains, rivers, plateaus, terraces, valleys, and ridges—provides valuable agricultural mechanization experiences that can be adapted to Africa. Hunan was selected due to its pioneering role in China-Africa economic cooperation, especially in the agricultural sector.

3. Dilemmas in Accelerating Agricultural Mechanization in Africa

Agricultural mechanization in Africa is still in the primary stage of "power substitution", the level of information technology is insufficient, and farmers cannot grasp the market, etc. The yield of agricultural products is less than 1/2 of the world's average, in addition to maize, 80% of rice and 45% of wheat depend on imports (Pan et al., 2025).

3.1. Low Level of Agricultural Mechanization

The level of agricultural mechanization in many African countries has lagged far behind that of Asian and Latin American countries, which used to be inferior to them. The number of agricultural machinery and tools available to African farmers is one-tenth that of farmers in other developing countries and regions, and the pace of development of agricultural mechanization in Africa is lagging far behind that of other regions, so how to provide farmers with access to power machinery and agricultural production equipment remains a major challenge for Africa (Chen & Wen, 2020).

Africa currently has the lowest level of agricultural mechanization in the world. Taking the use of tractors, which is widely recognized as a sign and symbol of

agricultural mechanization, as an example, a survey conducted by Sheahan and Barrett in six African countries, including Nigeria, Ethiopia, Tanzania, Malawi, Niger, and Uganda, showed that only 1% of the surveyed farmers owned their tractors, and only 12% of the respondents had used the services of agricultural machinery (World Bank, 2024).

3.2. Large Tracts of Uncultivated Land

At present, Africa has nearly 200 million hectares of uncultivated arable land, accounting for more than 50% of the world's total uncultivated arable land, and it is the world's richest region in uncultivated arable land resources (World Bank, 2024). However, due to the lack of technology, capital, water conservancy, and other conditions, most of these lands are in a state of barrenness or inefficiency, and they are unable to satisfy the African people's food needs, which leads to the fact that Africa has to import a large amount of food every year, and it even relies on international assistance to be spared from hunger. South Africa, Nigeria, Zimbabwe, Kenya, Zambia, Tanzania, Ethiopia, Sudan, Algeria, Malawi, and countries in the north, such as Egypt, Libya, Tunisia, Morocco, etc., have a large amount of land that has not yet been cultivated (World Bank, 2024). Once this land is cultivated, most Africans will be free from hunger, but the reclamation of large tracts of land will require the mechanization of agriculture.

3.3. Inadequate Technical Service System

Historically, developed countries in Europe and the United States have given assistance to African countries in agricultural mechanization, but when the companies or technologies of these developed countries withdrew at the end of the period, the African countries, relying on their technical strength, were simply unable to maintain the operation and maintenance of these large-scale agricultural machinery (Pernechele et al., 2021). The problems of lagging in the training of agricultural machinery operators, too few maintenance and repair stations, insufficient personnel, lack of staff familiar with agricultural machinery-related professional knowledge in rural agricultural extension centers, or simply no maintenance personnel, and incomplete spare parts for agricultural machinery, such as the weak power of agricultural machinery maintenance and repair and after-sales service in name only, are very common in Africa, which directly lowers the positive willingness of individual farmers with the strength to buy agricultural machinery. There is a lack of adequate State support for manufacturers, dealers, and sellers of agricultural machinery.

3.4. Ineffective Utilization of Large Agricultural Machinery in Africa

Historically, the former colonial sovereigns of Africa, represented by Western countries, made large-scale agricultural machinery the focus of their agricultural assistance to Africa, so that in a considerable number of African countries in the

post-independence period, the level of their agricultural mechanization was much higher than that of China, India, Brazil, and other Asian and Latin American countries, but this large-scale assistance for agricultural machinery ultimately came to a dismal end.

Agricultural machinery is expensive, African farmers have low economic purchasing power, the average household has small arable land, and the terrain is complex. Small family-oriented farmers are the main bearers of food production in most African countries, and the small average household size, small arable land, and steep and complex terrain make it impossible or too costly to use large agricultural machinery (Fan & Brzeska, 2016).

For semi-arid regions such as Saharan Africa, which depend on the weather for food, agricultural machinery sharing is only applicable to some production activities that are not too urgent in terms of farm time requirements, which makes large-scale agricultural machinery still unable to enter the common people's homes.

3.5. Difficulty in Obtaining Bank Loans

For most farmers, the purchase of large agricultural machinery, such as tractors, can lead to an imbalance between income and expenditure. In some cases, even the basic costs of operation, maintenance, and repair are beyond their means. The dispersed rural populations of Saharan Africa and the many tribal languages that characterize them, resulting in poor communication between banks and their customers over long distances, mean that 30 - 60 percent of rural populations cannot obtain the financial support they need to purchase large-scale agricultural machinery. Compared with the contribution of agriculture to GDP and its important role in employment, agricultural loans in Saharan Africa account for less than 1 percent of total bank lending (Daum & Birner, 2020).

4. Comprehensive Measures for Agricultural Machinery Cooperation between China and Africa

The root cause of Africa's chronic food shortages and underdeveloped agricultural production is the low level of agricultural science and technology, including agricultural mechanization. The experience of the world's agricultural development shows that the mechanization of food crops is the easiest to achieve and can lead to the realization of the first reliable area of total factor productivity. In addition to its universal advantages of saving labor time, reducing labor intensity, improving labor efficiency, and increasing food yields and total food production, agricultural mechanization is also a sure way to improve agricultural productivity and food production in Africa and even to achieve agricultural modernization and leapfrog development and is a reliable guarantee for African countries to improve their ability to guarantee food security, raise the nutritional level of their populations and reduce absolute poverty (Fan & Brzeska, 2016; Pan et al., 2025; Chen & Wen, 2020).

After the 2015 Johannesburg Summit, China has been committed to promoting 10 cooperation programs on agricultural mechanization in Africa (Meng et al., 2019). Through agricultural mechanization, part of the labor force, especially the male labor force, which has been stuck in agricultural production for a long time, will be liberated from the heavy and tedious agricultural production, and then get more opportunities to engage in the secondary and tertiary industries to increase their income, thus promoting the development of urbanization (Pan et al., 2025). It can also effectively circumvent the limitation of labor shortage during busy seasons, realize timely cultivation and timely harvesting, and effectively reduce the food production reduction and process loss caused by temporary and severe weather emergencies (Pan et al., 2025; Chen & Wen, 2020).

4.1. Develop Agricultural Machinery Exchanges and Cooperation with Africa

To increase food production and improve the effective supply of agricultural products, African countries need to continue to reclaim a large amount of land to increase the area of arable land but also rely on the use of advanced agricultural science and technology. At present, the awareness of African countries of the importance of agricultural mechanization is becoming clearer and clearer. Agricultural machinery purchase subsidies, agricultural machinery import tariffs value-added tax exemption, and other policy benefits have been introduced, and the future demand for agricultural machinery in African countries will continue to grow.

Agricultural mechanization is recognized by the African Union and the Food and Agriculture Organization of the United Nations (FAO) as an important way to achieve the goal of zero hunger in Africa by 2025. China's agricultural machinery exchanges and cooperation with Africa, and its contribution to the modernization of African agriculture, will make the experience of the vast majority of African citizens, who make up the majority of the population of Africa, of China-Africa friendship more vivid and real, and will be conducive to the formation of a broad public opinion base for the maintenance of China-Africa long-term friendship, and this kind of cooperation is also a vivid practice of building a community of human destiny between China and Africa (Meng et al., 2019).

4.2. Expand Export of Non-Agricultural Machinery

In recent years, the structure of agricultural machinery trade in Africa has shown a strong import trend, African countries have a growing demand for Chinese small and medium-sized agricultural machinery, Chinese agricultural products such as tractors, plows, disc harrows, seeders, sprayers, fertilizers, harvesters and so on are popular in Africa (Aryal et al., 2021), China should vigorously expand the African market. Two-wheeled walking tractors or small four-wheeled tractors can also be used for transportation food processing and agricultural irrigation power sources, more in line with the power shortages in Afri-

can countries and imperfect agricultural leasing market, becoming the first choice of most of the sub-Saharan African countries (Aryal et al., 2021). Chinese enterprises of related products should pay attention to finding markets in African countries.

4.3. Help to Improve the Plight of Africa's Lack of Indigenous Manufacturing Capacity for Agricultural Machinery

The low level and slow progress of agricultural mechanization in African countries is fundamentally due to the insufficient manufacturing capacity of indigenous African agricultural machinery. South Africa, Nigeria, Zimbabwe, Malawi, Kenya, Sudan, Ethiopia, Zambia, Tanzania Egypt, Tunisia, Algeria, Libya, and Morocco in the north need to import agricultural machinery (World Bank, 2024). China should focus on helping these countries to carry out cooperation in the manufacture of agricultural machinery help to improve the localized design and manufacturing capacity of African agricultural machinery enterprises, and effectively improve the plight of Africa's lack of local agricultural machinery manufacturing capacity.

4.4. China Helps African Countries in Their Efforts to Upgrade Agricultural Technology

African countries are striving to upgrade agricultural technology and promote the advancement of agriculture towards scale and modernization to increase income, expand employment, reduce poverty, and promote inclusive growth in related industries. Compared to Africa, China has a higher level of agricultural development (World Bank, 2024; National Bureau of Statistics of China, 2024), so it can explore the mode of China-Africa cooperation in the field of food production and promote the upgrading of the mode and diversification of the content of China-Africa agricultural cooperation by sharing China's experience in the fields of agriculture, infrastructure, park construction, development, and operation. China can help African countries in their efforts to upgrade their agricultural technology in the following ways (Meng et al., 2019; Lin & Cui, 2023):

1) Change Farming Habits of African Farmers

Africa has a large amount of arable land, and China can help to introduce modern mechanized farming techniques and management methods to expand the area under cultivation and increase the density of cultivation, change the farming habits of African farmers, improve crop yields and quality, and increase agricultural production capacity.

2) Help to improve irrigation systems

Africa's climate is mostly hot with little rainfall, and total water resources are abundant, but localized water shortages are severe and water management is more problematic (World Bank, 2024). Parts of the land in some African countries are difficult to cultivate because of drought. By helping to improve irrigation systems and solve water storage problems, it ensures that crops receive sufficient water

even during the dry season.

3) Provide hybrid rice technology

Hybrid rice has been promoted in several countries in Africa. Because of its rapid growth, resistance to pests and diseases, and high yields, it has not only increased farmers' incomes but also provided more food and helped to reduce poverty.

4) Provide a material basis for improving people's livelihoods

In areas that are easy to realize and conducive to poverty eradication, such as mycorrhizal technology, biogas promotion, and greenhouse cultivation, we have been teaching technology and building "small but beautiful" livelihood projects to enhance Africa's capacity for independent and sustainable development, and to help the African people accelerate their poverty eradication and enrichment process.

In these processes, attention should be paid to brand building, to create a brand for agricultural exchanges and exchanges with Africa, so that African countries and people can't help mentioning China as soon as they see these co-operation projects, which will help to enhance the outside world's cognitive understanding of China, and further improve and enhance China's international influence.

4.5. China Helps African Countries Invest in Agriculture

The unstable food import system and low value-added agricultural production have prevented the people of African countries from improving their standard of living. Agricultural productivity and efficiency can be improved and local food demand can be met by increasing investment in agriculture. The relative share of agricultural direct investment in China's direct investment in Africa is relatively low, and preferential policies should be given to encourage Chinese enterprises to invest in agricultural product processing and agricultural development projects in the relevant countries in Africa, to drive the development of local agriculture (Lin & Cui, 2023).

4.6. Focus on the Development of Agricultural Trade with African Countries

China has great potential for trade with 12 countries, including Algeria, Angola, Congo, Gambia, Guinea, Kenya, Mali, Liberia, Libya, Mauritius, Nigeria and Tunisia (World Bank, 2024; United Nations, 2024). The agriculture of these countries is an important part of their national economies, their domestic markets are not saturated, they complement China's structure of agricultural products, and their domestic political and economic environments are relatively stable, so there is obvious room for development. Therefore, the development of agricultural trade with these countries should be focused.

4.7. Upgrade Agricultural Trade Facilitation in African Countries

The vast majority of African countries are small in size, with relatively backward

domestic economic development and backward domestic infrastructure construction. China should accelerate the construction of connectivity in African countries, utilize the China-Africa cooperation platform, give full play to the role of domestic coastal ports as hubs, promote the level of China-Africa trade facilitation, and reduce the cost of agricultural trade. For example, in recent years, China signed loan agreements with Guinea and other countries for projects such as National Highway No. 1 and municipal roads in Conakry, to upgrade the level of infrastructure in African countries (Aza, 2020; Yan et al., 2022).

For example, there is a modern logistics warehouse base covering an area of about 2300 square meters in the park along the highway from Nairobi to Mombasa in Kenya, which is the Hunan Africa (Kenya) public overseas warehouse and typical cooperation between a domestic province and a specific country in Africa. The layout of a public overseas warehouse in Africa is to open up the trade points with Africa, enhance the level of trade facilitation, and serve Hunan and even the national enterprises. The function of this public overseas warehouse, in addition to warehousing, logistics, and other regular services, also has product exhibition and sales, activities, a life office, and other functions, while also providing professional supply chain financial services. In addition, it will also join hands with testing organizations and local financial institutions to provide services such as product pre-screening. And we expect to rely on this overseas warehouse, and actively tap the Kenyan flowers, anchovies exported to China, Chinese hardware, department stores, agricultural machinery, and other materials exported to Africa (Yan et al., 2022).

4.8. Help Africa to Build a "Green Growth Engine"

The development of agriculture in Africa should prevent over-exploitation and take into account ecological environment protection to promote the sustainable development of agriculture. The introduction of scientific and technological elements should be viewed objectively, scientific and technological elements can revitalize the traditional characteristics of the industry, but may also transform the traditional characteristics of the industry into a modern mass industry. How a region protects and develops local specialty agriculture should be based on the bottom line of protection, and there is no need to be too eager to transform specialty agriculture (Zou et al., 2024). China and Africa should work together to promote eco-friendly modernization, deepen African people's understanding of China by strengthening policy and cultural communication with African countries, help Africa build a "Green Growth Engine".

5. China Helps Serve Africa on a Provincial Basis

Africa can introduce capital and technology by strengthening international cooperation to develop its economy and raise the level of agricultural production.

China's local enterprises with mature conditions of agricultural machinery should actively seek support from the relevant state ministries and commissions of the project policy under the guidance of the relevant provincial department (Zou et al., 2024), do a good job of pre-market research of agricultural machinery in African countries, and develop the African market by the export of the whole machine, the transfer of technology patents and other ways.

5.1. Find Similarities between the Two Sides in Terms of Agricultural Production for Cooperation

Many provinces in China have a population or area equivalent to an African country, and it is possible to seek those with a high degree of similarity in the natural environment to cooperate with African countries on a provincial basis in China. Kenya's land area is roughly equivalent to China's Sichuan Province, the Tibet Autonomous Region has an area of 1,202,800 km^2, which is equivalent to South Africa (1,219,090 km^2), and Heilongjiang Province has an area of 473,000 km^2, which is equivalent to Cameroon (475,442 km^2) (World Bank, 2024; United Nations, 2024). Kenya has many highlands, with the equator running through the center, an average altitude of 1500 meters, and a forest cover of about 15% (World Bank, 2024). These natural environmental characteristics have some similarities with the plateau and natural landscape of Sichuan, etc. The Qinghai-Tibet region has similarities with the agricultural sector in Africa (National Bureau of Statistics of China, 2024). The Ali region in Qinghai-Tibet has a harsh natural environment, where fresh fruits and vegetables once depended almost entirely on transshipment from abroad, but nowadays, through the construction of intelligent fruit and vegetable greenhouses, people can eat fresh fruits and vegetables from the local area (National Bureau of Statistics of China, 2024).

Urbanization development is the way to national economic development, and the first stage of urbanization development is the stage of agricultural modernization. As of 2023, there are 12 countries in Africa whose urbanization rate has not reached 30%: Kenya, Lesotho, Comoros, Uganda, Swaziland, Chad, Ethiopia, South Sudan, Malawi, Rwanda, Niger, Burundi (World Bank, 2024). Agricultural development is a priority for these countries, and Gansu, Ningxia, Sichuan, Guizhou, Heilongjiang, Jilin, and Qinghai-Tibetan regions could be selected for cooperation with them (Zhao, 2024).

South Africa, Morocco, Kenya, Uganda, Tanzania, Algeria, and Mauritius have a better climate, mostly located in the plateau area, high altitude, relatively low temperature, influenced by the oceanic climate, moderate precipitation, and no extreme weather (Fang et al., 2024). Especially Kenya, Uganda, and Tanzania, these three countries are located on the East African plateau, and the climate is cool, similar to Kunming, Yunnan Province. Some inland areas are dry but have stable temperatures, making them suitable for living and living. You can also choose one of the safest countries in Africa like Mauritius, which has a cool climate and is suitable for living and traveling.

5.2. Help Small and Medium-Sized Agricultural Machinery Serve Africa

Characteristics of Small and Medium-Sized Agricultural Machinery

China's agricultural machinery is mainly based on large tractors, combine harvesters, and other large agricultural machinery. Subject to the main body of agricultural production mainly by small farmers and the impact of terrain restrictions, small and medium-sized agricultural machinery in the process of agricultural mechanization still has an important role that large agricultural machinery cannot be replaced, more favored by African farmers, the reasons for this (Yan et al., 2022; Tang et al., 2014):

1) Low prices. Most agricultural production machinery is used only a limited number of times a year, and the high price limits the incentive for agricultural producers to buy it.

2) Small size. Small and medium-sized agricultural machinery is small in size, light in weight, occupies little space, easy to store in rooms (sheds).

3) Ease of operation. Small and medium-sized agricultural machinery is easy to operate, making it suitable for meeting the practical needs of African farmers, particularly those with lower levels of education.

Particular attention should be paid to the cooperation of small agricultural machinery. Compared with large-scale agricultural machinery imported from the United States, Italy, and other European and American countries, small agricultural machinery such as two-wheeled walking tractors or small four-wheeled tractors is not only small, simple to operate, adaptable, and inexpensive, but also effective in overcoming the constraints of topography, terrain and the narrowness of the arable land. It can effectively avoid the problems caused by large-scale agricultural machinery, such as deforestation, land erosion, declining fertility of arable land, soil erosion, and destruction of biodiversity. Small agricultural machinery is the strong point of China's private agricultural machinery enterprises, so China should take the initiative to carry out cooperation with African countries in the field of small and medium-sized agricultural machinery.

5.3. Take Gansu as an Example

The topography of Gansu is comparable to that of some African countries. Gansu has a long and narrow topography, with a combination of mountains, rivers, platforms, loess, ditches, beams, and mounts. Because of the small size and inconvenient transportation, some of the hillside areas were mainly cultivated by humans and animals for a long period of history, and the agricultural development was backward. After 1990, Gansu successfully achieved food production and poverty reduction and poverty alleviation through agricultural machinery and other advanced agricultural science and technology. In 2000, Gansu Province, which had needed food relief from other provinces, reached 7.64 million tons of grain production, for the first time to achieve basic self-sufficiency. In 2007, Gansu grain production once again took a new step, the total output exceeded 10 million tons,

in 2020, 2021, and 2022 for three consecutive years to maintain more than 12 million tons. Under the current standard, 5.52 million rural poverty-stricken people have been lifted out of poverty (Du, 2025; Guo, 2025).

In Gansu's rural areas, most young people with a high school education or higher choose to work in the cities. People engaged in agricultural labor, especially in food production, are mostly middle-aged (Du, 2025). They generally have a low level of education, and because of their age, the operation of overly complex agricultural machinery is not welcomed by them. Therefore, Gansu in the use of large-scale agricultural machinery at the same time, adapts to the small special terrain and small farmers' production status quo, with small and medium-sized agricultural machinery to achieve labor-saving, productivity-enhancing agricultural mechanization development path (Guo, 2025). This is a strong reference for African countries. African countries such as Ethiopia, Burundi, Rwanda, and Uganda also have a lot of mountainous terrain, and in Zimbabwe, the average cultivated land of a household is only 3hm, and most of the land is divided into many small plots of less than 0.5hm, which is impossible to be cultivated by large agricultural machinery, so Africa can learn from the experience of Gansu.

5.4. Assist African Countries through the Cultivation of Crops

1) Maize cultivation

Corn is both the first staple food of African countries and the main grain crop of China. At present, domestic corn machinery products have realized the sowing, harvesting, peeling, and threshing. Agricultural machinery enterprises can produce self-propelled, electric or electric walk-behind integrated soybean and corn planters, the product also has rotary tillage, fertilizer, film mulching, and other functions, seed processing machinery to meet the needs of seed cleaning, dusting, drying, processing, coating, metering, warehousing and field breeding and other needs. Nowadays, the planting area of soybean-maize planting in African countries is expanding year by year, which is adapted to this demand (Aza, 2020).

2) Potato cultivation

Because of its adaptation to the arid climate and its high nutritional content and yield, the potato is grown in many African countries and has great potential for future yield increases. Through continuous technological innovation, domestic agricultural machinery manufacturing companies have developed products that provide an effective guarantee for the mechanized production of potatoes from plowing, fertilizing, ridging, mulching, and sowing to digging and harvesting, mitigating the negative impact of climate change and improving soil fertility (Fang et al., 2024).

3) livestock raising

Livestock farming occupies an important share of the African agricultural system. Many agricultural machinery manufacturers (companies) in China can produce livestock machinery such as lawnmowers, guillotine mowers, fodder (grass) grinders, feed mixers, and so on. Livestock farming holds a significant share in the

agricultural systems of African countries. For instance, Botswana, Mauritania, Somalia, and Namibia are primarily focused on livestock production, although their production levels remain relatively low. Many agricultural machinery manufacturing companies in China possess the capability to produce livestock-related machinery, such as mowers, forage choppers, feed (grass) grinders, and feed mixers, which provides opportunities for potential cooperation in this sector (Fang et al., 2024).

4) Take Hunan Province as an example

Located in the East African plateau, Rwanda is known as "the country of a thousand hills", where the quality of high-spiciness chili peppers is very good, but the production capacity is not high and the supply is unstable. Under the China-Africa Economic and Trade Expo, the commerce department of Hunan Province, the Rwandan government, and the Hunan Agricultural Group have joined hands to implement the Rwanda-Hunan Chili Pepper Industry Demonstration Base Project, which is a demonstration of chili pepper planting in the Gabiro area of Rwanda (Pan et al., 2024). The enterprise is mainly responsible for providing capital and technology for chili planting, sending experts to guide production, exporting products to China, selling in China, deep processing, and brand building. The Rwandan partner is responsible for land leveling, seed purchase, daily production, and delivery.

Seeds of agricultural cooperation have also been sown in Tanzania. Longping Development Enterprises and Hunan Cereals and Oils Import and Export Group have joined hands, with the former responsible for planting non-GMO soybeans, corn, sorghum, and other crops, and the latter responsible for trade. In mid-May 2024, the first batch of soybeans was picked and harvested. It is expected that in the following three years, after improving varieties and expanding the area, the trade volume of soybeans exported to China will strive to reach 150 million dollars per year (Pan et al., 2024; Meng, 2024).

5.5. Assist African Countries through Various Types of Agricultural Machinery

Chinese agricultural machinery products have rich varieties and complete functions, laying a solid foundation for the development of China-Africa agricultural machinery cooperation.

Fruit-growing countries, such as Nigeria. It has a favorable climate and fertile soil, which is conducive to the growth of various tropical fruits, and it is one of the countries with the most tropical fruits in Africa (Aza, 2020). We can utilize the products of machinery manufacturers who produce planted fruits for cooperation: grape burying vine machines, fruit tree pruning machines, hops picking machines, fruit grading machines, fruit peeling machines, fruit and vegetable drying machines, and other economic crops production, management, harvesting and finished products deep processing machinery.

The Longping Development Enterprise in Hunan Province and the Hunan Ce-

reals and Oils Import and Export Group are engaged in agricultural cooperation in Tanzania. They grow non-GMO soybeans, corn, sorghum, and other crop grains, which can be processed using Chinese grain harvesting and handling machinery such as sun cutters, threshers, cleaners, grinders, and rice mills.

In addition, grain seeding machinery, such as two-wheeled or four-wheeled tractors, plows, rotary tillers (micro-tillers), deep pine machines, disc harrows, graders, cultivators and other arable land preparation machinery, strip seeders, hole seeders, etc., as well as cotton seeding machines, are inexpensive and quality-assured. For example, the tractor is widely recognized as a representative of agricultural mechanization, and there are models specifically designed for small-scale operations in hilly and mountainous areas. When equipped with the appropriate attachments, tractors can perform a variety of tasks, including plowing, tilling, leveling, seeding, harvesting, spraying, and transportation. In addition, they can serve as a power source for fixed operations commonly found in rural areas, such as threshing, milling, pumping, power generation, rice milling, cotton ginning, and oil pressing. If Chinese enterprises focus on ensuring after-sales service, reducing operational costs, and making tailored designs for local environmental conditions, they would find significant opportunities in the African market.

6. Conclusion

Agricultural mechanization in Africa is still at the primary stage of "power substitution". Agriculture is still relying on God's food, and its investment in agricultural mechanization and related mechanization is at a low level. However, with the rapid growth of population and the acceleration of urbanization, there is an urgent need for the rapid development of agricultural mechanization, so it is of great significance to explore Sino-African cooperation in agricultural machinery to help the development of African agriculture.

The paper first gives the reasons for the dilemma of agricultural mechanization in Africa as follows: the level of agricultural mechanization is low; a large amount of land has not yet been reclaimed; the technical service system is not sound; large-scale agricultural machinery can't be effectively utilized in Africa; and it is difficult to get bank loans, and so on. On this basis, comprehensive measures for China-Africa agricultural machinery cooperation are proposed to carry out China-Africa agricultural machinery exchanges and cooperation, expand the export of agricultural machinery to Africa, help improve the manufacturing capacity of local agricultural machinery in Africa, help with agricultural investment, focus on the development of trade in agricultural products with African countries, and help improve the level of agricultural trade facilitation and agricultural technology. Further, China's efforts to help serve Africa on a province-by-province basis can be further explored, in terms of finding regions where both sides have similarities in agricultural production for cooperation, helping small- and medium-sized agricultural machinery to serve Africa, and assisting African countries using agricultural crop cultivation and various types of agricultural machinery, and discussing

the examples of Gansu and Hunan Provinces (Battersby & Waston, 2018).

Further, Chinese enterprises can be fully encouraged to carry out agricultural machinery cooperation with African countries through online product demonstration, investment, and establishment of factories in Africa, transfer of technology patents, training of local farm machinery technicians, joint research and development, and production, etc., to help African countries to improve food security capacity and realize economic prosperity and social stability (Gong, 2020).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Aryal, J. P., Rahut, D. B., Thapa, G., & Simtowe, F. (2021). Mechanisation of Small-Scale Farms in South Asia: Empirical Evidence Derived from Farm Households Survey. *Technology in Society, 65,* Article 101591. https://doi.org/10.1016/j.techsoc.2021.101591

Aza, L. (2020). *Food System Resilience in Nigeria Farmers Perspective*. University of Nebraska-Lincoln.

Battersby, J., & Watson, V. (2018). Addressing Food Security in African Cities. *Nature Sustainability, 1,* 153-155. https://doi.org/10.1038/s41893-018-0051-y

Berhane, G., Dereje, M., Minten, B., & Tamru, S. (2017). *The Rapid, But from a Low Base, Uptake of Agricultural Mechanization in Ethiopia: Patterns, Implications and Challenges. Ethiopia Strategy Support Program Working Paper 105*. International Food Policy Research Institute.

Chen, H., & Wen, C. H. (2020). Strategic Significance, Environmental Conditions and Policy Support of China-Africa Agricultural Capacity Cooperation. *Journal of Hunan Agricultural University (Social Science Edition), 21,* 15-19.

Daum, T., & Birner, R. (2020). Agricultural Mechanization in Africa: Myths, Realities and an Emerging Research Agenda. *Global Food Security, 26,* Article 100393. https://doi.org/10.1016/j.gfs.2020.100393

Du, M. (2025). Research on the Problems and Measures in the Development of Agricultural Mechanization Modernization in Gansu Region. *Modern Agricultural Science, 2,* 88-90.

Fan, S., & Brzeska, J. (2016). Sustainable Food Security and Nutrition: Demystifying Conventional Beliefs. *Global Food Security, 11,* 11-16. https://doi.org/10.1016/j.gfs.2016.03.005

Fang, D., Chen, J., Wang, S., & Chen, B. (2024). Can Agricultural Mechanization Enhance the Climate Resilience of Food Production? Evidence from China. *Applied Energy, 373,* Article 123928. https://doi.org/10.1016/j.apenergy.2024.123928

Gong, B. (2020). Agricultural Productivity Convergence in China. *China Economic Review, 60,* Article 101423. https://doi.org/10.1016/j.chieco.2020.101423

Guo, X. (2025). Research on the Strategies for the Development of Agricultural Culture in Gansu in the New Stage. *China Agricultural Abstracts—Agricultural Engineering, 1,* 38-42.

Li, F., Feng, S., Lu, H., Qu, F., & D'Haese, M. (2021). How Do Non-Farm Employment and Agricultural Mechanization Impact on Large-Scale Farming? A Spatial Panel Data Analysis from Jiangsu Province, China. *Land Use Policy, 107,* Article 105517. https://doi.org/10.1016/j.landusepol.2021.105517

Lin, D., & Cui, J. (2023) South-South Cooperation and Food Security: Empirical Evidence from China's Agricultural Technology Demonstration Centers in Africa. *Economics (Quarterly), 23,* 1758-1775.

Meng, J. (2024). Accelerating Agricultural Cooperation in Hunan. *Hunan Daily*.

Meng, L., Qi, G., & Yu, H. (2019). Research on China's Agricultural Policy towards Africa and Its Poverty Reduction Path under the "Belt and Road" Initiative. *World Agriculture, 9,* 38-45.

National Bureau of Statistics of China (2024). *The Data on the Areas of Sichuan, Tibet, Heilongjiang, and Other Provinces in China Are Sourced from the National Bureau of Statistics of China*. http://https//www.stats.gov.cn/sj/tjgb/jbdwpcgb/

Pan, R., Gao, M., & Ji, Y. (2025). "Rising Women": Evidence from China's Agricultural Mechanization. *Review of Development Economics*. https://doi.org/10.1111/rode.13193

Pan, X., & Tang, N. (2024). China-Africa "Xiang" See China-Africa Cooperation Focuses on Teaching People How to Fish, Hunan Enterprises Create a New Mode of Agricultural Cooperation with Africa. *Huasheng Online*. https://baijiahao.baidu.com/s?id=1805516587976232093&wfr=spider&for=pc

Pernechele, V., Fontes, F., & Baborska, R. (2021). *Public Expenditure on Food and Agriculture in Sub-Saharan Africa: Trends, Challenges and Priorities*. Food & Agriculture Organization.

Tang, L., Li, X., & Qi, G. (2014). Evolution and Effectiveness of China's Agricultural Aid Management Model in Africa. *International Studies, 6,* 29-40.

United Nations (2024). *The Data on the Areas of African Countries Are Sourced from the United Nations. Department of Economic and Social Affairs, Statistics Division*. https://research.un.org/az.php?s=23211&_gl=1*1kkzu0p*_ga*MTMzMzM0NTY-wMC4xNjkxNTg1MDI1*_ga_TK9BQL5X7Z*MTc0MzYwNjM1MS42LjEuMTc0MzYwNjM5OC4wLjAuMA

Wang, X., Yamauchi, F., Huang, J., & Rozelle, S. (2021). What Constrains Mechanization in Chinese Agriculture? Role of Farm Size and Fragmentation. *China Economic Review, 62,* Article 101221. https://doi.org/10.1016/j.chieco.2018.09.002

World Bank (2024). *World Bank Database*. https://data.worldbank.org/

Yan, S., Zou, S., & Jiang, X. (2022). China-Africa Agricultural Cooperation Promotes Poverty Reduction and Sustainable Agricultural Development. *People's Daily*.

Zhao, X. (2024). An Analysis of the Pathways for Agricultural and Ecological Sustainable Development in Tibet Autonomous Region. *Tibet Agricultural Science and Technology, 4,* 101-106.

Zhu, Y., Zhang, Y., & Piao, H. (2022). Does Agricultural Mechanization Improve the Green Total Factor Productivity of China's Planting Industry? *Energies, 15,* Article 940. https://doi.org/10.3390/en15030940

Zou, B., Chen, Y., Mishra, A. K., & Hirsch, S. (2024). Agricultural Mechanization and the Performance of the Local Chinese Economy. *Food Policy, 125,* Article 102648. https://doi.org/10.1016/j.foodpol.2024.102648