

Reforming agricultural subsidy policies to facilitate the transformation of agrifood systems: insights from China and Africa

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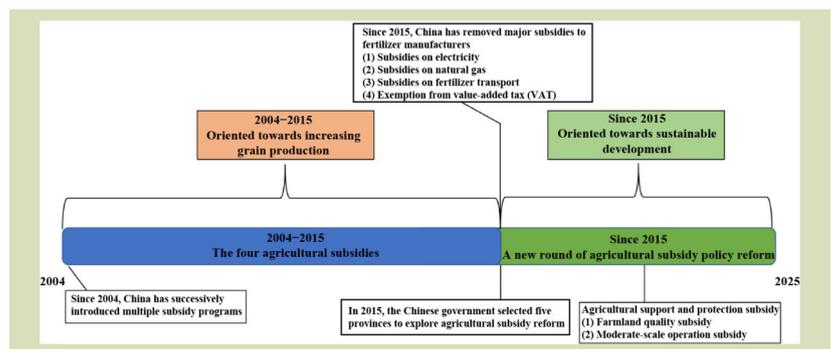
KEYWORDS

Africa, agrifood systems, agricultural subsidies, China

HIGHLIGHTS

- Compares the similarities and differences in agricultural subsidies in China and Africa.
- Summarizes the challenges faced by China and Africa in the transformation of their agrifood systems.
- Provides the path for the transformation of agrifood systems in China and Africa.

GRAPHICAL ABSTRACT



ABSTRACT

Agricultural subsidies have been a vital component of agricultural policies in many Asian and African countries since the 1960s, acting as a key driving factor for facilitating the sustainable transformation of agrifood systems. China and Africa are chosen as case studies because they represent two distinct regions with large population sizes and facing common challenges. This study reviews the evolution, design and implementation of agricultural subsidy policies in China and Africa, highlighting their successes and challenges. The results show that China and Africa aim to enhance agricultural productivity and ensure food security, offering incentives to farmers to increase production and address challenges, such as poverty reduction. However, there are significant differences in the structure and scale of agricultural subsidies. China's policy is comprehensive and oriented toward sustainable development, while African policies tend to be more targeted and often focus on specific areas such as fertilizer subsidies and seed distribution. While both regions have made significant progress in transforming their agrifood systems, they continue to grapple with common, but context-specific, challenges. This study developed recommendations to guide future efforts toward sustainable transformation of agrifood systems in China and Africa. This will involve repurposing agricultural subsidies to promote green sustainability, enhancing support for agrifood

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policies and collaboration between China and African countries, and strengthening investments in agrifood systems in both regions.

1 Introduction

Agricultural subsidy policies are pervasive in both developed and developing countries. It is estimated by OECD that total support toward the agricultural sector reached 842 billion USD per year during 2021–2023 for 54 countries across the world^[1]. Considering the scale of subsidies, the global discussion on agricultural policy reforms in recent years has increasingly emphasized the establishment of new agricultural support systems as a key strategy to facilitate the sustainable transformation of agrifood systems^[2–4]. Some support programs, such as the reformed EU Common Agricultural Policy, condition support on compliance with environment-friendly production processes and land conservation practices^[3]. This trend stems from the recognition that existing subsidy systems, often characterized by distortions and a narrow focus on food security, are insufficient to address the multifaceted challenges posed by climate change and resource degradation^[2]. While developed economies, such as the EU, have made significant strides in reorienting their agricultural subsidies toward sustainability, many developing countries, particularly those in Africa and Asia, continue to grapple with heavily distorted agricultural subsidies, yet well intentioned, primarily due to the imperative of ensuring food security^[5–7]. This approach is not conducive to sustainable agricultural development, presenting a significant challenge in balancing sustainable development with food supply, particularly in developing regions, such as sub-Saharan Africa.

The challenge of balancing sustainable development with food security is particularly acute in developing regions, such as sub-Saharan Africa, where a large share of the population is poor and access to, affordability of, food is a key concern^[8,9]. Thus, many governments in sub-Saharan Africa have re-embraced large-scale agricultural input subsidy programs (ISPs) to raise their agricultural output and reduce poverty among their smallholders^[10]. However, the prevailing approach of prioritizing short-term food production over long-term environmental sustainability, through distorted subsidies, has proven inadequate in fostering resilient and sustainable agrifood systems^[11]. Consequently, there is a pressing need for agricultural subsidy reforms that can reconcile these two objectives, ensuring both food availability and environmental protection^[12,13].

In recent years, significant progress has been made in examining reforms to agricultural subsidy policies with the aim of fostering sustainable development in several developing regions, notably China and select countries in sub-Saharan Africa. China, for example, has taken a series of environment-oriented agricultural subsidy policy reforms since 2015, the most notable of which are the reform of the three agricultural subsidies and the removal of subsidies for fertilizer manufacturers. These measures aim to curb the overuse of nitrogen fertilizers and promote environmentally friendly farming practices, thereby contributing to the sustainable transformation of its agrifood system^[14,15]. Similarly, some African countries have also made attempts to streamline agricultural subsidies, through evaluating efficient input delivery systems (such as electronic vouchers), all aimed at transforming agrifood sector. These reforms, although still in their nascent stages, signal a shift toward more sustainable and environmentally conscious agricultural policies.

Currently, China and African countries are reforming agricultural subsidy policies to move toward a more sustainable agrifood systems, both sides face some common challenges. First, both regions are highly susceptible to climate-related risks. Agrifood systems in these developing regions are profoundly impacted by climate change, exemplified by extreme weather events such as China's great flood in 1998 and 2010–2011 drought^[16].

Second, environmental degradation poses a significant threat^[17,18]. Agrifood systems in China and Africa are at risk as evidenced by the high percentage of global water withdrawals dedicated to irrigation, which varies widely from 21% in Europe to 82% in Africa^[18]. In addition, looming water shortages in China also represent a serious threat to the future food security^[19]. Specifically, water shortages in China are particularly acute, with agriculture accounting for 61.2% of total water consumption, far exceeding the OECD average^[4].

Third, dependence on food imports increases vulnerability to global market fluctuations. Both China and Africa are heavily reliant on international agricultural trade, making them susceptible to food security risks, such as those exacerbated by the Russia-Ukraine crisis, which will disproportionately affect poor developing countries reliant on Russian and Ukrainian

agricultural exports^[20,21]. Between 2018 and 2020, Africa imported significant amounts of wheat from both Russia and Ukraine, highlighting the potential for severe food supply shortages due to such conflicts.

Fourth, both regions are dominated by smallholder agriculture (farming less than 2 ha). Despite significant achievements in agricultural development in China and Africa, agricultural production is still dominated by smallholders. According to a recent International Food Policy Research Institute study, in sub-Saharan Africa and South Asia (excluding India), smallholdings comprise 70%–75% of farm units, but they generate just 35%–40% of the primary production value of the domestic food sector^[22]. Smallholders often face higher poverty risks and hinder agricultural productivity, affecting food security and farm incomes^[23]. Thus, the design and implementation of agricultural subsidy policies in China and Africa necessitates further reforms that effectively balance both economic and environmental objectives.

Therefore, this study aims to contribute to the ongoing discourse on agricultural subsidy policy reform and the transformation of agrifood systems by examining insights from China and Africa. There are two reasons for choosing China and Africa to conduct research on this topic. First, since the 1960s, subsidies for agriculture have been prevalent in Asian and African countries, such as India and in sub-Saharan Africa. Since 2015, in particular, China's agricultural subsidies have undergone a significant transformation. Given China's huge population, any agricultural policy change will have a profound impact on the global agrifood systems. Second, Africa's diverse agricultural challenges, potential for growth, collaborative initiatives with China, environmental concerns, and pressing need for food security and poverty reduction all contribute to making it a compelling and informative case study.

This study contributes to the literature in three ways. First, it contributes to the discussion in the literature on the transformation of agricultural subsidy policies in China and Africa. Specifically, it reviews the evolution, design and implementation of agricultural subsidy policies in China and Africa, highlighting their successes and challenges. Second, it contributes to the literature on specific agricultural implementation strategies. By comparing and contrasting the experiences of China and Africa, this study endeavors to unveil lessons learned, and emerging challenges, thereby informing the development of more effective and sustainable agricultural subsidy policies in the future. In addition, this analysis will provide a reference for other developing and emerging market countries, where similar policies are being considered or

implemented. Finally, this study examines the experience of agricultural subsidies from the perspective of the transformation of agrifood systems in developing countries. In particular, most existing studies on the transformation of agrifood systems have largely been confined to the experiences of developed countries, often overlooking the developing economies. Therefore, this study focused on examining agricultural subsidy reforms within the specific context of agrifood system transformation in developing countries, using China and Africa as illustrative case studies.

2 Agricultural subsidy policy in China and Africa

2.1 China's agricultural subsidy policy

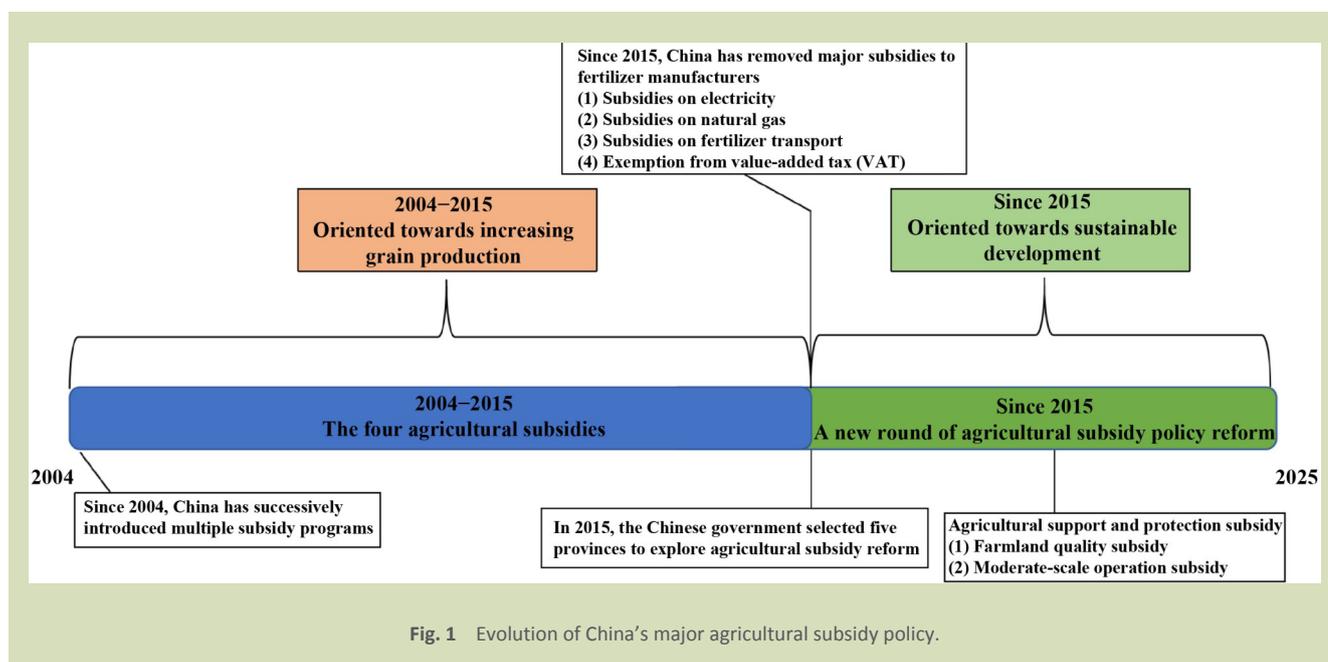
2.1.1 Evolution of the agricultural subsidy in China

The evolution of China's agricultural subsidy policy reflects the changing role of agriculture in economic development across time^[1]. According to policy goals, the reform of China's agricultural subsidy policy can be roughly divided into two phases from 2004 to 2020 (Fig. 1). Since 2004, China has introduced a comprehensive agricultural subsidy system that has helped ensure food security, improve farmer incomes, and end hunger and poverty. Since 2015, China has effected a series of agricultural subsidy policy reforms oriented toward sustainable development to achieve multiple goals of food systems, including food security, nutrition, protection of natural resources and carbon emissions reduction.

It should be noted that agricultural subsidy policies cover a wide range of areas. For the purpose of international comparison, the classification of agricultural subsidy policies in existing literature generally follows the method of the OECD. However, considering the availability of data, the agricultural subsidy policy discussed in this paper is limited to subsidies for agricultural producers (fertilizer manufacturers and farmers). These policies are described below.

(1) Oriented toward increasing grain production: 2004–2015

China's agricultural policy has undergone a fundamental transformation over the four decades since the introduction of market reforms in 1978^[24]. At the beginning of the new century, China has faced the challenges of feeding the growing population and widening income gap between urban and rural areas. Consequently, the pursuit of food security and farm income was the key policy goals over 2000–2015. In 2004,



concerned about rural household incomes and national food self-sufficiency^[25,26], the Chinese government began to successfully introduce multiple subsidy programs, including a minimum purchase price policy for rice and wheat, and a temporary purchasing and stockpiling policy for cotton, maize and soybeans. At the same time, China also implemented direct subsidy program, covering direct grain, quality seed, aggregate input and agricultural machinery subsidies. These policies have effectively incentivized farmers to grow grain and the continuous increase in grain production has, in turn, ensuring food security^[26,27].

Meanwhile, in pursuit of fertilizer supply and reduce farmer's burden, particularly since the 1990s, China has implemented subsidies for fertilizer manufacture at different stages since the 1990s^[28–30]. Parallel to market reform, the subsidy policy for China's fertilizer manufacturers also has evolved over time^[28]. Specifically, from 1998 to 2015, China's major subsidies for fertilizer manufacture included the subsidy for electricity, natural gas, transportation and off-season reserve, as well as an exemption from value-added tax (Tables 1 and 2). It is estimated that the total subsidy to the fertilizer industry reached 0.95 billion USD in 2003, and then jumped to 8 billion USD in 2010, which helped grow the industry and safeguard an adequate supply of affordable fertilizers for farmers^[30].

During this period, subsidies continuously increased, which effectively increased grain production and farm income. However, this has also led to many problems. First, subsidies for the fertilizer industry and general subsidies for agricultural input jointly have stimulated the increase in the use of mineral

fertilizers, which has resulted in serious environmental degradation and high health cost in China^[13,31]. Second, the minimum purchase prices of certain grains and temporary storage price both have also distorted the market price, resulting in new structural challenges^[32].

(2) Oriented toward sustainable development: since 2015

In response to the negative impact of agricultural subsidy policy, China initiated new round of green-oriented agricultural subsidy policy reforms in 2015. A key move within these reforms was the merging of the three direct subsidies. Since then, direct grain, quality seed and aggregate input subsidies, were merged and renamed “agricultural support and protection subsidy” (in Chinese Pinyin - *nongye zhichi baohu butie*)^[25]. The new policy goal was to protect farmland quality while encouraging moderate-scale grain production^[25]. Specifically, 80% of stock funds allocated for the input subsidy, combined with the grain and quality seed subsidies, form the “farmland quality subsidy” (in Chinese Pinyin - *gengdi dili baohu butie*), aimed at preserving farmland quality. Subsidy recipients include farmers with contracted land. The remaining 20% of the input subsidy stock funds, together with pilot subsidy funds for large-scale grain farmers and incremental funds for the three subsidies, form the “moderate-scale operation subsidy” (in Chinese Pinyin - *shidu guimo jingying butie*), which supports large-scale farming operations.

Also, starting in 2014, China has gradually abolished temporary policies for purchasing and stockpiling agricultural

Table 1 Evolution of subsidies to fertilizer manufacturers in China from 1990 to 2015

Subsidy programs	1998–2000	2001–2003	2004–2007	2008–2012	2013–2015
(1) Electricity	Preferential price and exemption of electricity construction funds policy started in the planned economy period and stopped in 2012			Removed the preferential price policy in 2015	
(2) Natural gas	Preferential price policy started in the planned economy period and stopped in 2012			Removed the preferential price policy in 2015	
(3) Rail transport	Preferential price and the exemption of railway construction funds since 1998 and it was adjusted to No. 4 freight rate in 2015				
(4) Off-season reserve	Subsidized loans for fertilizer reserve implemented since 2004				
(5) Value-added tax (13%)	All exemptions removed September 2015				
Urea		Full rebate in 2001 Half rebate in 2002 No rebate in 2003	Half rebate after paid tax in 2004 and then full exemption since 2005		
Diammonium phosphate			Half rebate after paid tax in 2004 and then full exemption since 2005		
Monoammonium phosphate			Full exemption since 1998		
Potash fertilizer	The value-added tax full rebated since 1995 except for 2001–2002 when value-added tax was fully exempted				
NPK compound	Full exemption since 1994				

Note: Adapted from Huang et al.^[28].

Table 2 Major subsidies to fertilizer manufacturers in China from 2004 to 2010 (unit: million USD)

Year	Electricity	Rail transport	Value-added tax	Reserve
2004	209	855	871	50
2005	265	1012	1192	58
2006	313	1131	2947	63
2007	365	1281	3786	101
2008	417	1370	5301	225
2009	444	1145	5308	140
2010	433	897	6762	163

Note: Source from Li et al.^[30].

products including cotton, maize, rapeseed and soybeans. These policies have been reformed into income transfer, target price, producer and agricultural insurance subsidies. Only the minimum purchase price policies for rice and wheat have been retained but the amount of these commodities being purchased has declined.

With mounting concerns about the negative impact of excessive nitrogen fertilizer use on the environment, China has abolished subsidies for fertilizer manufacture since 2015^[15,33]. More specifically, the subsidy to fertilizer manufacturers averaged 7 billion USD per year from 2008 to 2010, contributing to extensive over application of nitrogen fertilizers. From 2015, China took steps to phase out the

subsidies for fertilizer manufacture and these were almost fully eliminated by 2017^[33].

2.1.2 Scale and structure of China's agricultural subsidy policy

Globally, China's agricultural support intensity was at a medium level. According to OECD figures, China's total support estimate accounted for 22% of agricultural gross domestic product (GDP) in 2018–2020^[34]. This was close to the world average (23%), higher than the 12 emerging economies (15%) but lower than the percent average of OECD countries (42%). In the same period, the USA and Japan were at 54% and 78%, respectively^[34] (Fig. 2).

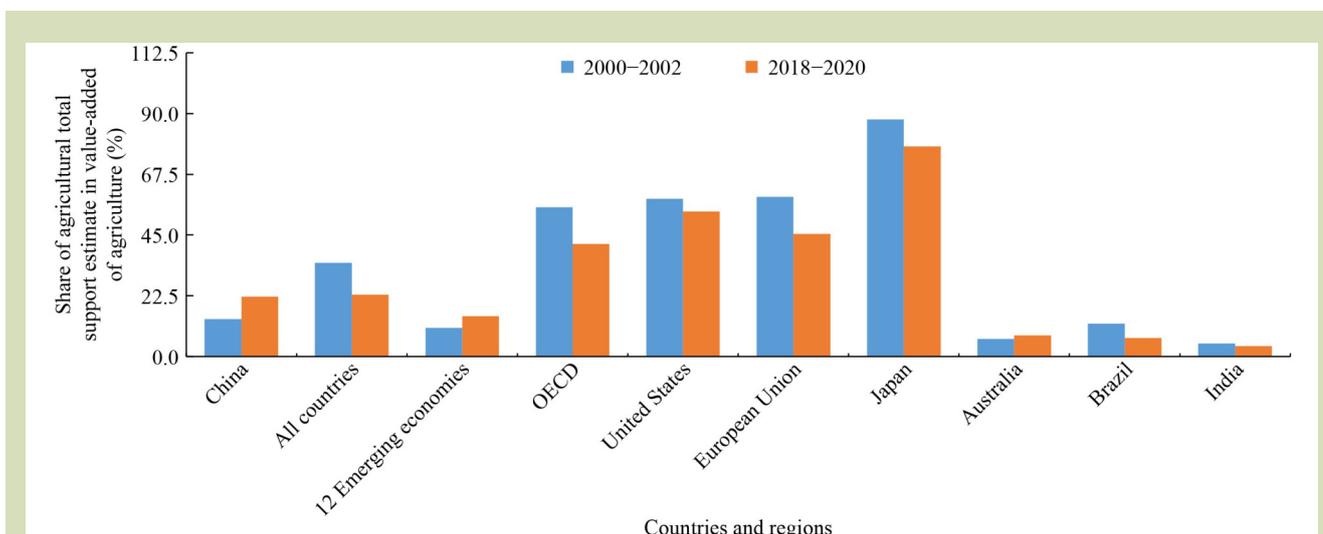


Fig. 2 Comparison of agricultural support intensity in China and other countries for 2000–2002 and 2018–2020. Source from AGFEP^[34]. “All countries” refers to the 54 countries (including OECD countries, EU non-OECD countries and 12 emerging economies) that are reported in OECD (2021); EU 2000–2002 reports EU15 countries; EU 2018–2020 report EU27 countries plus the UK.

Given that this study mainly focuses on producer subsidies, the analysis below focuses on the five major agricultural subsidies in China. Table 3 presents an overview of the five major agricultural subsidies in China, namely direct grain, quality seed, aggregate input, machinery and farmland quality subsidies spanning 2004–2022.

The direct grain subsidy has remained relatively stable over the years, with only minor changes. It started at 11.6 billion yuan in 2004 and gradually increased to 15.1 billion yuan by 2007. However, there has been no significant increase since then, with the subsidy remaining around 15.1 billion yuan until 2015, when it slightly decreased to 14.1 billion yuan. The quality seed subsidy has had a steady increase. Starting from 2.9 billion yuan in 2004, it gradually rose to 22.6 billion yuan in 2013, remaining relatively stable thereafter. The aggregate input subsidy has experienced the most dramatic increase among the five subsidies. It started at a negligible amount of 12 billion yuan in 2006 and surged to 107 billion yuan in 2015. This substantial increase indicates a significant shift in agricultural policy toward supporting overall farm input costs, including seed, fertilizer, pesticides and other agricultural supplies. The machinery subsidy has also seen a significant increase over the years. Starting from 0.07 billion yuan in 2004, it gradually increased to 23.8 billion yuan in 2015 and has remained at a relatively high level since. In 2016, China merged three agricultural subsidies to form the farmland quality subsidy, which remained constant at 120.5 billion yuan from 2016 to 2022. This indicates a consistent investment by the government in improving the quality of farming and promoting sustainable agricultural practices.

2.2 African agricultural subsidy policy

2.2.1 Evolution of the agricultural subsidy in Africa

Africa is a continent with diverse agricultural systems and challenges. According to the World Bank, agriculture accounts for about 23% of gross GDP in Africa and employs about 60% of its labor force. However, Africa also faces low productivity, high vulnerability to climate change, and limited access to markets and finance. Therefore, many African governments have adopted different types of agricultural subsidies to support their farmers and achieve their development goals. In Africa, agricultural subsidies have a long and complex history, shaped by colonialism, independence, structural adjustment and globalization. The following is a brief overview of some of the main trends and issues in African agricultural subsidy policies, based on the literature review of Jayne and Rashid^[6].

(1) Oriented toward export (the 1940s to the 1960s): colonial period

Before most countries gained independence, agricultural subsidy policies were mainly used to support production and export of cash crops, such as cotton, coffee, cocoa, tea and rubber, while food crops were neglected or taxed^[36,37]. Subsidies were also used to promote the use of imported inputs, such as seed, fertilizer and pesticides, which increased the dependency of African farmers on foreign markets and technologies^[38,39]. Subsidies were often accompanied by coercive measures, such as forced labor, land expropriation and

Table 3 The five major agricultural subsidies in China, 2004–2022 (unit: billion yuan)

Year	Agricultural subsidies			Agricultural machinery subsidy	Farmland quality subsidy
	Direct grain subsidy	Quality seed subsidy	Aggregate input subsidy		
2004	11.6	2.9	–	0.07	–
2005	13.2	3.9	–	0.3	–
2006	15.1	4.2	12.0	0.6	–
2007	15.1	6.7	27.6	2.0	–
2008	15.1	12.1	63.8	4.5	–
2009	15.1	15.5	71.6	12.9	–
2010	15.1	20.0	83.5	15.5	–
2011	15.1	22.0	86.0	17.5	–
2012	15.1	22.4	107.8	21.5	–
2013	15.1	22.6	107.1	21.8	–
2014	15.1	21.5	107.8	23.7	–
2015	14.1	20.4	107.1	23.8	–
2016				22.8	120.5
2017				18.6	120.5
2018				17.4	120.5
2019				18.4	120.5
2020				27.7	120.5
2021				19.0	120.5
2022				21.2	120.5

Note: Source from Han^[35]. Since 2015, in addition to agricultural machinery subsidies, the three agricultural subsidies were merged into the farmland quality subsidy.

price controls, that undermined the autonomy and livelihoods of African farmers^[40,41].

Table 4 details the evolution of fertilizer application in selected African countries from 1961 to 2018, as an indicator of the level of input subsidy. The Table 4 shows that fertilizer application was generally low and stagnant in most countries, except for a few outliers, such as Malawi, Zambia and Zimbabwe, that experienced some periods of high fertilizer use, often associated with subsidy programs.

(2) Oriented toward import substitution (the 1960s to the 1970s): post-independence

After gaining independence, many African countries adopted policies that aimed to increase the role of the state in the agricultural sector as part of a broader strategy of import substitution industrialization. Subsidies were used to support the development of domestic industries, such as agro-processing, irrigation and mechanization, as well as to provide affordable food and inputs to urban consumers and industrial

workers^[45,46]. Subsidies were also used to establish and maintain state-owned enterprises, such as marketing boards, cooperatives and parastatals, that controlled the procurement, distribution and pricing of agricultural products^[36,47]. Subsidies were often financed by taxing the export earnings of cash crops, creating a gap between the domestic and world prices of agricultural commodities^[48,49].

(3) Oriented toward response to pressures of structural adjustment (the 1980s to the 1990s)

In the 1980s and the 1990s, many African countries faced severe economic crises, characterized by high inflation, fiscal deficits, external debt and balance of payments problems. Under the pressure of international financial institutions, such as the World Bank and the International Monetary Fund, many African countries adopted structural adjustment programs, which involved a series of reforms that aimed to liberalize and deregulate the economy, reduce the role of the state and promote market forces^[46,50]. Subsidies were drastically reduced or eliminated, as part of the measures to cut public spending,

Table 4 Fertilizer application of arable land (unit: kg-ha⁻¹)

Country	1961	1971	1981	1991	2001	2011	2018
Benin	0.7	1.4	2.7	4.2	5.4	9.9	13.6
Burkina Faso	0.3	0.8	2.5	3.8	7.8	13.7	18.1
Cote d'Ivoire	3.5	6.8	7.9	8.6	8.9	12.2	14.7
Ethiopia	0.4	0.7	1.7	2.0	3.8	7.8	14.3
Ghana	2.5	3.4	6.6	8.2	7.9	11.5	15.4
Kenya	9.4	20.7	29.3	28.3	23.4	32.7	35.6
Madagascar	0.9	2.7	3.6	4.2	1.5	2.0	2.9
Malawi	1.5	3.2	7.2	13.0	23.1	67.6	41.2
Mali	0.5	1.7	3.6	6.0	9.7	14.8	15.0
Nigeria	1.3	2.5	3.8	5.2	8.1	10.8	10.0
Rwanda	0.1	0.2	0.7	1.0	1.9	5.8	8.7
Senegal	0.6	2.3	5.1	9.1	11.7	17.9	18.9
Tanzania	0.5	1.8	3.0	3.4	3.3	6.5	9.3
Uganda	0.4	0.9	1.7	2.1	1.5	1.8	2.1
Zambia	2.9	8.1	20.8	28.6	25.8	39.7	32.3
Zimbabwe	4.4	9.3	24.0	33.9	23.7	25.3	24.2

Note: Source from FAO^[42], World Bank^[43], and IFA^[44].

rationalize public enterprises and remove price distortions^[6,51]. Subsidies were also seen as inefficient, ineffective, and prone to corruption and rent-seeking^[52]. The removal of subsidies had significant impacts on the agricultural sector, such as reduced access to inputs, credit and extension services, increased exposure to price volatility and competition, and decreased productivity and profitability^[53,54].

Table 5 details the evolution of public expenditure on agriculture as a percentage of total public expenditure in selected African countries from 1980 to 2017, as an indicator of the level of budgetary subsidy. These data show that public expenditure on agriculture declined sharply in most countries in the 1980s and the 1990s, as a result of the structural adjustment programs, and recovered slightly in the 2000s and the 2010s, as a result of the renewed interest and investment in the agricultural sector.

(4) Responding to global food crisis and incentive to ensure food security (the 2000s to the 2010s)

In the 2000s and the 2010s, many African countries experienced a resurgence of interest and investment in the agricultural sector, driven by various factors, such as the global food crisis, the rise of China and other emerging economies, the emergence of new donors and partners, and the recognition

of the potential of agriculture for poverty reduction and economic growth^[56,57]. Subsidies were reintroduced or expanded, as part of the policies to address the challenges and opportunities of the agricultural sector, such as food insecurity, climate change, rural development and regional integration^[6,58]. Subsidies were also influenced by the experiences and practices of other countries, such as Brazil, China, and India, that have used subsidies to support their agricultural development^[59,60]. Subsidies were often targeted to specific groups, such as smallholders women, and youth, or specific crops, such as cassava, maize and rice^[61–63]. Subsidies were also designed to be more market-oriented, participatory, and transparent, involving the use of vouchers, coupons, smart cards and mobile phones, as well as the engagement of the private sector, civil society and farmer organizations^[6,64].

Table 6 shows the evolution of the number of beneficiaries of ISPs in selected African countries from 2000 to 2017, as an indicator of the scale and coverage of input subsidy. These data show that ISPs reached millions of farmers in many countries, especially in Ethiopia, Malawi, Nigeria and Zambia, where the programs were implemented on a national scale.

2.2.2 Scale and structure of African agricultural subsidy policy

The scale and structure of African agricultural subsidy policy

Table 5 Evolution of public expenditure on agriculture as a percentage of total public expenditure in selected African countries from 1980 to 2017

Country	1980	1990	2000	2010	2017
Benin	3.5	2.4	2.9	4.3	4.9
Burkina Faso	7.9	5.6	7.2	11.1	10.8
Cote d'Ivoire	5.7	3.4	3.3	5.0	3.7
Ethiopia	8.2	3.6	8.8	13.9	12.8
Ghana	5.4	2.6	3.1	6.4	6.2
Kenya	7.3	4.9	4.3	5.0	3.5
Madagascar	6.6	4.7	3.6	3.5	3.6
Malawi	4.6	3.1	6.1	12.0	10.6
Mali	6.3	4.5	5.9	8.3	9.1
Nigeria	3.0	2.3	1.8	2.1	1.6
Rwanda	6.1	4.3	4.9	6.4	6.8
Senegal	4.4	3.1	4.5	6.4	6.5
Tanzania	5.1	4.2	3.5	4.6	4.2
Uganda	4.9	2.9	3.3	3.8	3.5
Zambia	7.0	3.9	3.3	4.7	2.4
Zimbabwe	5.5	2.9	1.8	1.7	1.5

Note: Source from World Bank^[65].

Table 6 Number (in millions) of beneficiaries of input subsidy programs in selected African countries

Country	2000	2005	2010	2015	2017
Benin	0.1	0.2	0.3	0.4	0.4
Burkina Faso	0.1	0.2	0.4	0.5	0.6
Ethiopia	1.5	2.5	4.5	6.5	7.1
Ghana	0.1	0.2	0.3	0.5	0.5
Kenya	0.5	0.6	0.8	1.0	1.1
Madagascar	0.1	0.1	0.2	0.3	0.3
Malawi	1.7	1.4	1.6	1.5	1.5
Mali	0.1	0.2	0.3	0.4	0.4
Nigeria	0.5	0.6	0.8	4.2	5.0
Rwanda	0.1	0.2	0.3	0.4	0.4
Senegal	0.1	0.1	0.2	0.3	0.3
Tanzania	0.3	0.4	0.5	0.6	0.7
Uganda	0.1	0.2	0.2	0.3	0.3
Zambia	0.5	0.6	0.9	1.0	1.1
Zimbabwe	0.3	0.4	0.6	0.7	0.8

Note: Source from AGRA^[65].

vary widely across countries and regions. According to a report by the International Food Policy Research Institute^[66], the total

amount of agricultural subsidies in Africa increased from about 2.8 billion USD in 2000 to about 13.2 billion USD in 2015,

representing an average annual growth rate of 11.4%. However, the share of agricultural subsidies in total public spending on agriculture declined from 28.6% in 2000 to 19.6% in 2015, indicating a shift toward more public investments in agriculture.

The structure of African agricultural subsidy policy also differs across countries and regions. According to the same report by the International Food Policy Research Institute^[66], the most common types of subsidies in Africa are input subsidies, which accounted for about 77% of the total subsidies in 2015. Input subsidies are mainly used to provide fertilizers, seed and other inputs to farmers at subsidized prices or for free. The second most common type of subsidies are output subsidies, which accounted for about 12% of the total subsidies in 2015. Output subsidies are mainly used to provide guaranteed prices, price support or direct payments to farmers based on their production or sales. The third most common type of subsidies are consumer subsidies, which accounted for about 7% of the total subsidies in 2015. Consumer subsidies are mainly used to provide food or other products to consumers at subsidized prices or for free. The remaining types of subsidies are trade subsidies, which accounted for about 3% of the total subsidies in 2015, and environmental subsidies, which accounted for less than 1% of the total subsidies in 2015.

Most African countries adopted input targeted subsidies learning from a prior successes. [Table 7](#) summarizes the timelines of ISPs in Africa.

A notable example is the Malawi Fertilizer Subsidy Program launched in 2005 that subsidized fertilizer and seed for smallholder farmers to increase maize production and food security. The program was credited with boosting maize yields and reducing poverty, but it has also been criticized for its high

fiscal cost, crowding out of private sector and environmental impacts^[67]. Similarly, the Nigerian Growth Enhancement Support Scheme launched in 2012 provides subsidized inputs to farmers through electronic vouchers and mobile phones. This scheme aims to improve the efficiency and transparency of input delivery, increase farmer access to finance and markets, and promote the adoption of improved technologies. While praised for its innovative design and productivity gains, it has encountered challenges with corruption, fraud and implementation. The Ethiopian Productive Safety Net Program launched in 2005 provides cash or food transfers to chronically food-insecure households in exchange for their participation in public works or other activities.

Input subsidies, particularly fertilizer subsidies, are favored by politicians and rural populations in many developing countries, especially in sub-Saharan Africa^[68]. Since the 1970s, many African governments have adopted different types of agricultural subsidies to support their farmers and achieve their development goals. However, these programs were expensive and fiscally unsustainable, governments lacked the capacity to implement them effectively. As a result, many African countries eliminated their subsidy programs in the 1990s. Interest in subsidies was revived following the 2006 Abuja Declaration on Fertilizers^[69]. In 2011, about 10 African countries spent roughly USD 1.05 billion on ISPs, amounting to 28.6% of their public expenditure on agriculture^[6]. [Table 8](#) summarizes the fertilizer subsidies and public agricultural expenditures in selected African countries.

2.2.3 Rethinking African agricultural subsidies

Over time in response to experiences, proposals have been made on how to strengthen and streamline subsidies for effective and efficient means of their delivery. In 2016 and 2017, Africa Green Revolution in Africa (AGRA)^[70] undertook

Table 7 Timeline of input subsidy programs (ISPs) in Africa

Year	Program
1960–1970	Donors fund input subsidy programs (ISPs) to help developing countries overcome market failures
1980–1990	Donors turn against ISPs and pressure many (but not all) governments to shut them down due to their high fiscal costs, program mismanagement and limited impact on food production and security
The early 2000s	Stagnant agricultural growth during the 1990s leads governments to question the structural adjustment programs that did away with ISPs and a new call for direct government intervention is once again championed
2006	African governments, through the Abuja Declaration, reaffirm their intention to dramatically raise and subsidize fertilizer use in the region while donors begin to support a new wave of improved or “smart” subsidy programs
2007	The “Malawi Miracle”, featuring a large-scale input subsidy program, is praised by the <i>New York Times</i>
2010	Nine African governments follow suit and reinstitute their subsidy program

Note: Source from IFPRI^[66].

Table 8 Fertilizer subsidy and public agricultural expenditures in selected African countries

Country	Year	Program cost (million USD)	Public expenditure on agriculture (million USD)	Input subsidy programs as % share of public agricultural spending
Mali	2011	38.6	213	18.1
Burkina Faso	2010	21.7	259	8.4
Ghana	2011	111.7	374	29.9
Senegal	2010	42.4	163	26.1
Nigeria	2010	190	729	26.0
Kenya	2011	61.1	318	25.7
Malawi	2011	179.2	308	58.3
Tanzania	2011	134.1	291	46.0
Zambia	2011	134.8	438	39.9
Ethiopia*	2011	55.0	530	10.4

Note: Source from Jayne and Rashid^[6]. *The Ethiopian Government does not refer to its subsidization of retail fertilizer prices as a subsidy program.

an assessment in 11 countries (Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Rwanda, Tanzania, and Uganda) in Africa on the functioning of input distribution systems especially focusing on the marketing and distribution efficiencies with a view to understand how farmers are accessing these inputs. The lessons from that assessment showed that input subsidies can be effective in increasing farm productivity, but only when the management and distribution systems are transparent and efficient.

The initial AGRA^[70] and as updated in 2024^[65], complemented by what other studies, such as Tegemeo^[71] show input subsidy implementation contexts differ significantly across the 11 AGRA countries. In trying to observe the various impacts of the input subsidies, AGRA assessment review^[65] noted that the economic efficiency of any inputs use such as seed or fertilizer should be the overarching goal of any subsidy support program, but objectives such as poverty reduction or food security may be relevant where input subsidies cost-effectively address these problems.

Generally, agricultural subsidies have been a cornerstone of agricultural policy in many African countries. As noted above, these policies are designed to lower the cost of farming inputs, such as seed, fertilizer and pesticides, thereby improving farm productivity and ensuring food security. However, subsidy policies have also faced several challenges and criticisms. One major issue is the sustainability of such programs. Critics argue that subsidies often lead to dependency, and once the support is withdrawn, productivity levels can plummet. For example, in Tanzania, the National Agricultural Input Voucher Scheme initially boosted maize and rice yields but showed dwindling

impacts once subsidies were reduced. In addition, there are concerns about the equitable distribution of subsidies. In some cases, larger and more influential farmers have been the primary beneficiaries, while smallholders, who are often the most in need, receive less support.

Environmental sustainability has been given as another critical concern. The overuse of subsidized fertilizer and pesticides can lead to soil degradation and water pollution. A study by the FAO^[72] warned that “while subsidies can boost short-term productivity, they may also encourage practices that are harmful to long-term soil health.”

To maximize the benefits and mitigate the detriments of subsidy policies, a balanced and well-targeted approach is essential. Policymakers need to ensure that subsidies reach the most vulnerable farmers and are part of a broader strategy that includes training and support for sustainable farming practices. Integrating technology, such as mobile platforms for distributing subsidies and providing agricultural advice, can also enhance the effectiveness of these programs.

2.3 Comparative analysis

Based on the above analysis, here we compare and analyze the similarities and differences in agricultural subsidy policies between China and Africa.

China and African countries share numerous similarities in their agricultural subsidy policies, reflecting common goals and strategies. First, China and African countries have

implemented agricultural subsidy policies aimed at enhancing agricultural productivity and ensuring food security. Second, China and Africa offer incentives to farmers to encourage increased production. These incentives may include financial rewards, technical support or access to better resources, all aimed at motivating farmers to expand cultivation and enhance yields. Third, China and Africa face challenges such as increasing farm income and reducing poverty. Agricultural subsidy policies are crafted to directly address these issues, aiming to uplift rural economies and improve the livelihoods of farmers.

Despite these similarities, China and Africa have notable differences in the orientation of their agricultural subsidy policies. First, in addition to environmental target, the goal of China's agricultural subsidy reform has also shifted toward moderate-scale operation. Currently, large-scale farms account for less than 2% of China's total cropped area^[31]. Consequently, for a long time, small farm size and the smallholder management have been regarded as key factors contributing to issues such as low agricultural productivity, environmental degradation and food security concerns in China^[31,73]. To address this challenge, drawing on the experiences of the EU and the USA, the Chinese government initiated reforms to agricultural subsidies in 2015 by implementing a moderate-scale operation subsidy, shifting some of the previous subsidies to large-scale producers in order to promote such operations. Overall, this new subsidy is crucial for improving the agricultural development model dominated by smallholders and promoting sustainable agricultural development. In contrast, although African countries have also implemented agricultural subsidy reforms in recent years, their practice still emphasis on targeted subsidies aimed at smallholders. Specifically, many African countries focus their subsidies on specific areas, including seed and fertilizer. While these targeted subsidies may address immediate needs and promote productivity in specific crops, they may not fully support the broader transformation of agrifood systems required for sustainable development, such as facilitating the transformation of smallholders.

Second, in terms of promoting sustainable development, China and Africa have different agricultural subsidy policy designs. However, since 2016, China has implemented a subsidy for soil protection. As the most representative green-box policy in China, the farmland quality subsidy is a decoupled subsidy, which is equivalent to a transfer payment to farmers. As it is an income subsidy, there is still controversy over whether this subsidy can help motivate farmers to protect farmland quality. Likewise, some African countries have also implemented some

sustainability subsidies, such as subsidies for organic agriculture and sustainable irrigation. In practice, these subsidies are linked to specific inputs, such as mineral fertilizer. In the context of policies emphasizing food security, it remains to be further considered whether farmers are willing to engage in green practices. In addition, research shows that the costs of the ISPs generally outweigh their benefits^[6].

3 Future challenges for agrifood systems in China and Africa

Although China and Africa have made remarkable achievements in their agrifood systems, they also face different challenges due to their different stages of development, which set higher requirements for agricultural support policies.

3.1 China

First, China is facing the two problems of increasingly people being overweight to obese and having micronutrient deficiencies. With rapid improvements in agricultural productivity and resident income, China has made remarkable advances in reducing hunger and malnutrition. In 2020, as an example, the prevalence of undernourishment dropped below 2.5%^[8]. However, people being overweight and obese are new challenges for malnutrition in China. The prevalence of overweight children in China (under 5 years of age) rose from 7.2% in 2012 to 8.3% in 2020. Similarly, the estimated prevalence of obesity among the adult population increased from 5.0% to 6.2% between 2012 and 2016^[8]. In addition, the problem of people being overweight and obese in China is more common among males. Specifically, the rates of being overweight and obese for male adults were 37.6% and 16.1% in 2018, an increase of 13.2% and 10.1%, respectively, compared with their rates in 2000^[74]. Evidence shows that obesity and obesity-related dietary and physical activity patterns cost about 9% of its GNP by 2025. The growth in the costs attributable to people being overweight or obese in China rose from about 49 billion USD in 2000 to about 112 billion USD in 2025^[75].

Also, urban and rural populations both have unbalanced diets. There is an excessive intake of cereals and tubers, edible oil and red meat. The overconsumption of red meat by urban residents is more serious than in rural areas, and in 2020, it exceeded the values recommended in the dietary guidelines by 58.3%. Additionally, the intake of vegetables, fruit, aquatic products, eggs and dairy products has been insufficient for a long time and the rate of increase is small^[76]. Also, there has been long-term insufficient intake of vitamin A, vitamin C, calcium and

selenium among urban and rural populations, with intake less than 50% of the recommended dietary guidelines, a serious insufficiency^[76].

Second, China is facing the urgent challenge of rural-urban and regional inequality. While China has built a moderately prosperous society in most respects, the rural-urban development disparity remains significant^[77,78]. In particular, even if rural incomes are growing at high rates, they remain at around one-third of those in urban areas^[4]. In the new development stage, narrowing the income gap is a major challenge for China to achieve common prosperity. Since entering the 21st century, the income gap of Chinese residents

has fluctuated. From 2003 to 2008, the Gini coefficient of China's income gap continued to rise, reaching a peak of 0.491 in 2008. In the following years, the Gini coefficient declined somewhat, but in recent years, it has fluctuated to a greater degree^[79] (Fig. 3). More specifically, the urban to rural per capita income ratio has narrowed for 13 consecutive years after reaching the peak of 3.14 in 2007. However, it was still as high as 2.56 in 2020^[78] (Fig. 4). Although it has declined to 2.39 by 2022, the ratio still remains above 2. Also, the average annual economic growth rate of the northern and southern China was 8.5% and 6.9%, respectively, during 2013–2017, and the gap continued to expand^[79].

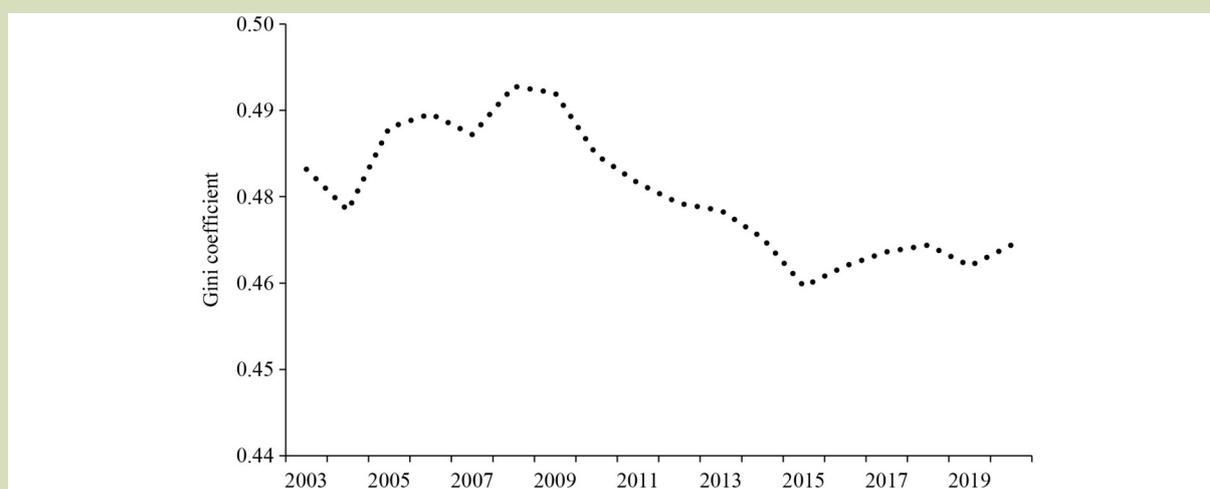


Fig. 3 China's Gini coefficient from 2003 to 2020. Source from National Bureau of Statistics of China^[80].

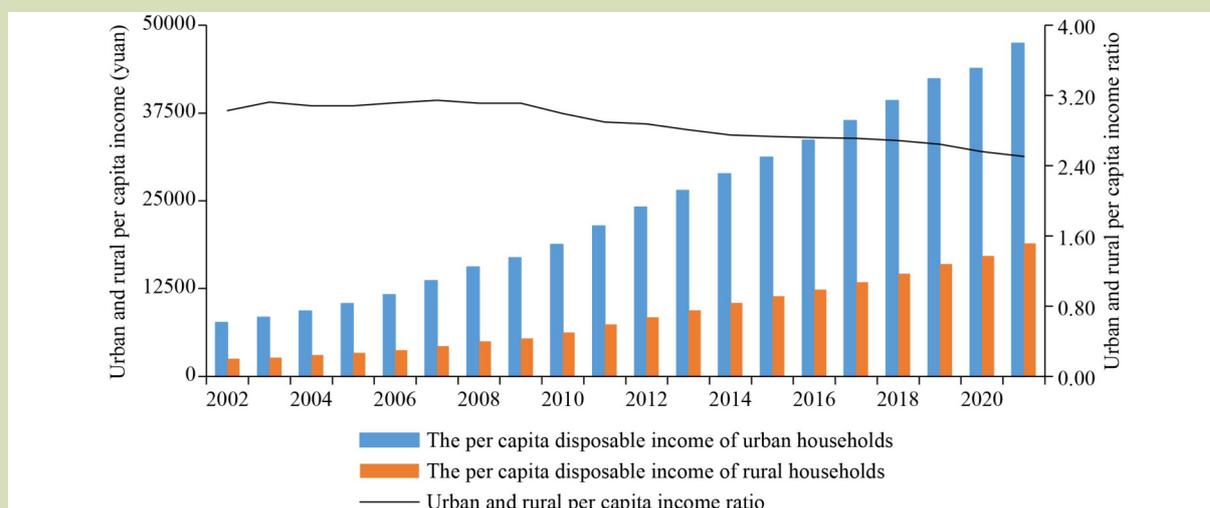


Fig. 4 Urban and rural per capita income and their ratio. Source from National Bureau of Statistics of China^[80].

Third, the slowdown in agricultural productivity growth in China is detrimental to enhancing agricultural competitiveness. China's agricultural output growth averaged 2%, which has been driven by growth in total factor productivity of 1.7% per year during 2010–2019, higher than the global average^[4]. While increasing quickly in the past, agricultural total factor productivity has slowed in recent years^[81,82]. In 2020, China's agriculture accounted for 24.7% of employment, but its 8% share of GDP indicates that labor productivity is significantly lower than in the rest of the economy^[4]. Also, labor wages are increasing annually by about 8%, and the labor opportunity cost of agricultural production has increased significantly. Meanwhile, Agricultural production costs, especially labor wages, are rising rapidly, accompanied by labor shortages (Fig. 5), which is not conducive to agricultural competitiveness.

3.2 Africa

First, Africa is facing challenges such as political conflicts and instability. Since the 1960s, due to natural, historical and ethnic reasons, most African countries have experienced various forms and intensities of conflicts after independence. For example, countries such as Ethiopia, Sudan, Nigeria and the Democratic Republic of the Congo, have experienced significant instability due to armed conflicts and political unrest. These conflicts not only disrupt economic growth and development, but also hinder the modernization of agriculture, further exacerbating poverty and inequality.

Second, infrastructure in African agricultural sectors is weak. African agricultural sector infrastructure (irrigation, roads, storage, processing and marketing) have significant problems, which significantly hinder the agricultural development and food security. African agriculture is largely rainfed, with only a

small fraction of farmland under irrigation. For example, the proportion of irrigated farmland in sub-Saharan Africa is estimated to be around 5% of the total farmland^[84]. In addition, poor rural infrastructure, especially storage and processing facilities, remains a major challenge for most farmers in Africa. Estimates suggest that postharvest losses in Africa can be as high as 20% for grains and 40% for fruits and vegetables^[85].

Third, hunger is still on the rise in Africa. In Africa, hunger has been rising steadily since 2015, and it remains the region with the largest estimated proportion of the population facing hunger. According to FAO^[86], in 2023 in Africa, 58% of the population was moderately or severely food insecure, and 21.6% faced severe food insecurity. Regionally, central Africa had the highest prevalence of moderate or severe food insecurity (77.7% or 157 million people), making it the subregion with the highest level in the world. This is followed by eastern Africa (64.5% or 313 million people) and western Africa (61.4%, or 270 million people). It is projected that 582 million people will be chronically undernourished by the end of the decade, more than half of them in Africa. This means that if measures are not taken in a timely manner, the world is highly likely to fail to achieve the UN Sustainable Development Goal 2, Zero Hunger.

Despite the challenges, both China and Africa are setting ambitious agendas for their agrifood systems transformation. Africa is designing a new Comprehensive Africa Agriculture Development Program (CAADP), a policy direction that will succeed the one that was agreed by African heads of state and governments in 2014 in Malabo, Equatorial Guinea. This new policy direction has underscored the challenges mentioned above but is drawing from a myriad of lessons learned from the implementation of the previous CAADP. The new policy

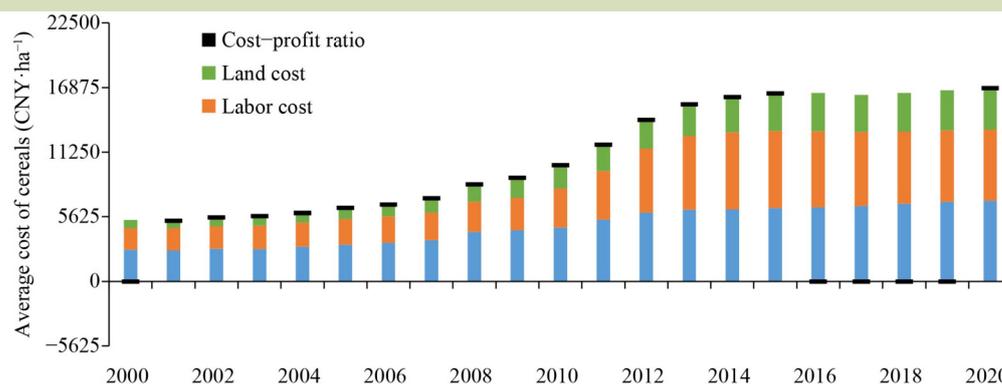


Fig. 5 Average cost and cost-profit ratio of cereals in China from 2000 to 2020. Source from China Statistical Yearbook^[83].

direction envisages focus on six broader but strategically intentional goals: (1) intensifying sustainable food production, agro-industrialization, and trade; (2) boosting investment and financing for accelerated agrifood systems transformation; (3) ensuring food and nutrition security; (4) advancing inclusivity and equitable livelihoods; and (5) building resilient agrifood systems; (6) strengthening agrifood systems governance.

4 Policy recommendations for China and Africa

The agrifood systems in China and Africa have significant challenges, including climate change, environmental degradation and dominance of smallholder. To address these issues and foster sustainable development, it is imperative to promote the transformation of agrifood systems through collaborative efforts and strategic initiatives. Three specific policy recommendations are given here.

The first is repurposing agricultural subsidies and moving toward green sustainability. The key goal of agricultural subsidy policies in China and Africa is to ensure food security. However, given the significant differences in agricultural development stages between the two regions, their respective policy priorities also differ significantly. Specifically, since 2015, China has undergone profound changes to its agricultural subsidy system, aimed at promoting sustainable development through subsidy mechanisms without compromising the solid guarantee of food security. In contrast, African agricultural subsidy policies, although placing food security at the forefront, still focus on the traditional path of directly supporting and ensuring food production in their implementation strategies. This difference reflects the targeted policy considerations formulated by countries based on their own national conditions at different stages of development. It is particularly worth mentioning that China's fertilizer policy reform is a successful case study for meeting environmental targets while safeguarding food security. This reform also provides important policy insights for Africa's sustainable

development in agriculture, namely, greening the subsidy incentivizing the adoption of more efficient fertilizer and green practices^[15].

The second is enhance agrifood policy support and collaboration between China and Africa. China and African countries should jointly develop a long-term vision and strategic goals for the transformation of agrifood systems. This could be achieved through high-level dialogs and summits, such as the Forum on China–Africa Cooperation, the Africa Food Systems Forum where both sides can discuss and agree to shared priorities and objectives. Additionally, it is important to strengthen agrifood policy coordination is crucial to ensure that national policies and programs in both regions are complementary and mutually reinforcing. Regular exchanges of policy frameworks, best practices and lessons learned can facilitate sustainable development of agriculture. For example, climate change poses a significant threat to agriculture in both China and Africa. Therefore, China and Africa can collaborate on initiatives to promote sustainable farming practices, such as climate-smart crops, climate-smart livestock production and climate information services, can help smallholders to mitigate the effects of climate change.

The third is enhance investments in agrifood systems between China and Africa. Given China's abundant capital flow, it should strengthen Chinese investments agrifood systems. Since 2000, China has emerged as largest trading partner for most African countries. However, most recent investments in China have been focused on specific areas such as infrastructure, construction and mining, with less interest in the agricultural sector. Thus, China should strengthen its investment in the transformation of African agrifood systems to achieve a win-win benefits for both parties. Additionally, it is important to strengthen investment in agricultural research and innovation. Specifically, China and Africa can establish joint research programs to address regional-specific challenges in agrifood systems. These programs can focus on areas, such as drought and flood-tolerant cereals, pulses and vegetables, and postharvest handling and storage, which should help in climate adaptation while concurrently enhancing productivity^[15].

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Compliance with ethics guidelines

Zongyi Wu, Boaz Blackie Keizire, Shenggen Fan, and Xiaolong Feng declare that they have no conflicts of interest or financial conflicts to disclose. This article does not contain any studies with human or animal subjects performed by any of the authors.

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