Development Strategy for Food Security and Modern Agriculture in Anhui Province (Post-print)

Authors: Zhang Zhengbin, Duan Ziyuan, Xu Ping, Kun Liu, Li Gui

Date: 2017-10-20T00:00:00+00:00

Abstract

Anhui Province, formerly a disaster-prone impoverished province, has, through over 60 years of arduous efforts, currently achieved a grain production capacity of 35 billion kg, representing 5.5 times the 6.39 billion kg of the early post-liberation period. It has become one of China' s five major grain-exporting provinces, with total grain output expected to reach 40 billion kg by 2020, occupying an important position in China' s agricultural regional development and food security assurance. However, Anhui Province suffers from weak farmland water conservancy construction, with most regions relying on rain-fed agriculture; medium- and low-yield farmland accounts for approximately 60% of the cultivated land area. Agricultural mechanization development is slow, agricultural management is extensive, and per-unit yields are generally low. The province has far from realized the production potential of its natural resource endowment, making it a key region for future medium- and low-yield farmland transformation in China. This paper proposes that Anhui Province' s development strategy for food security and modern agriculture is: under the overall guideline of green quality-improvement, yield-increase, and efficiency-enhancement, in terms of regional governance, to focus on transforming medium- and low-yield farmland areas in Huaibei lime concretion black soil and expand the construction of ton-grain counties and cities in the Huai River Basin; in terms of regional development models, to prioritize the agricultural modernization construction of main functional areas for grain production and deep processing along the Yangtze River and Huai River (rice-wheat) and the Huaibei Plain (wheat-corn), expand the development of economic forest and fruit industry and characteristic aquaculture in the Jianghuai Hills, and accelerate the development of green ecological industries in southern Anhui and the western Dabie mountainous areas; in terms of agricultural infrastructure construction, to highlight farmland water conservancy engineering, accelerate investment in the popularization of large- and medium-scale agricultural mechanization, and

establish a green quality-efficiency disaster prevention and mitigation system; in terms of crop planting structure adjustment, to continue adhering to rice improvement, high-yield wheat, and corn revitalization, while considering the regulation of oil crops (rapeseed, soybean); in terms of optimized crop variety layout, to reduce indica rice and expand japonica rice while stabilizing rapeseed in the Huainan region, reduce winter wheat and expand semi-winter high-quality wheat in the regions along the Huai River and Huaibei, and replace medium-late maturing corn with medium-early maturing varieties featuring fast grain dehydration and high quality. Creating a modern agricultural development path with Anhui characteristics, efficient utilization of hydrothermal resources (800-1000 mm precipitation), low input, rapid transformation of large-area medium- and low-yield farmland, and extension of the green, high-quality, and efficient agricultural product industry chain is the way to ensure food security.

Full Text

1. Anhui Province's Grain Production Capacity and Strategic Importance in China' s Agriculture

Anhui Province, located in China' s north-south transitional zone with diverse ecological environments, was historically a disaster-stricken area frequently devastated by floods from the Yangtze, Yellow, and Huai Rivers. In 1949, the province' s total grain output was only 6.39 billion kg. By 1978, this figure had reached 14.825 billion kg, doubling the initial post-liberation level. In 2008, the province achieved a record-breaking grain output of 30.235 billion kg, doubling again since the reform and opening-up period. In 2014, Anhui' s total grain output reached 34.15 billion kg, ranking sixth nationally and representing a 5.4-fold increase from 1949, marking 11 consecutive years of bumper harvests. The annual grain output growth rate of 4.2% ranked second in the country, placing Anhui at the top among China' s 13 major grain-producing provinces.

In 2015, Anhui' s summer grain achieved 12 consecutive years of increase. The summer grain sown area reached 2.4794 million hectares, a 0.2% increase from 2014, with wheat accounting for 2.457 million hectares (up 0.9%). Summer grain output totaled 14.147 million tons, an increase of 147,000 tons (1.1% growth), with yield reaching 5,706 kg per hectare, an increase of 48 kg per hectare (0.9% growth). According to agricultural department statistics, the autumn grain planting area in 2015 was 3.973 million hectares, an expansion of 44,000 hectares year-on-year, with total autumn grain output expected to exceed 19.5 billion kg, an increase of over 600 million kg. The annual grain output was projected to approach 35 billion kg.

As one of China' s 13 major grain-producing regions, Anhui' s grain planting area accounts for 73% of total crop sown area, approximately 6.5 million hectares annually. The province consistently produces around 10 million tons of commodity grain, making it one of only five provinces capable of sustainably exporting over 5 million tons of commodity grain. In 2013, Anhui sold 11.44

million tons of grain outside the province, ranking fourth nationally. Together with Henan Province, Anhui forms China' s "Central Grain Reserve," playing a crucial strategic role in national grain security.

2. Key Measures for Accelerating Grain Production Development in Anhui

Anhui' s rapid grain production growth offers valuable lessons for provinces in the Huang-Huai-Hai region. Strengthening water conservancy and high-yield farmland construction has been fundamental to ensuring grain production development. Though historically plagued by frequent natural disasters causing significant fluctuations in grain production, Anhui has over the past two decades intensified flood control, drainage, and irrigation infrastructure development in the Yangtze and Huai River basins. Through agricultural comprehensive development projects, high-quality grain industry initiatives, and land consolidation programs, the province has established high-standard farmland that is high-yielding, stable, and resistant to drought and flooding, now accounting for 62% of cultivated land area and significantly enhancing disaster resilience.

Promoting modern agricultural technology has provided internal momentum for grain production development. Key breakthroughs—including dwarf rice breeding in the 1960s, large-scale promotion of hybrid rice and maize in the 1980s, application of dry-raised rice seedlings and sparse planting in the 1990s, improved fertilization levels, agricultural mechanization development, and widespread use of efficient low-toxicity pesticides and herbicides—have all driven quantum leaps in grain output. Over the past decade, Anhui has implemented three major grain production initiatives: the Wheat High-Yield Attack (launched in autumn 2005), Rice Industry Enhancement Action (2006), and Maize Revitalization Plan (2008), vigorously promoting high-yield creation activities. These efforts have forged a successful path of relying on science and technology to increase per-unit yield and achieve both grain and efficiency gains, creating the best development period in Anhui' s grain production history.

Continuously optimizing planting structure has been key to improving quality and efficiency. High-quality rice production began in 1985, followed by high-quality wheat demonstration in 1990. By 2008, the proportion of high-quality major grain crops reached 73.6%. In recent years, accelerated introduction and demonstration of medium-early maturing maize varieties have stabilized maize planting area above 800,000 hectares. In 2014, grain crop planting area reached 6.6289 million hectares, an expansion of 3,600 hectares year-on-year, with high-quality specialized wheat area reaching 2.142 million hectares (an increase of 35,200 hectares).

Strengthening demonstration-driven approaches has proven effective for grain production development. First, the province has focused on advancing high-yield creation across major grain-producing counties, selecting 56 such counties for comprehensive implementation. Special project funds for farmland water

conservancy, agricultural comprehensive development, and modern agricultural development have been integrated to support wheat and maize 500 kg/county creation and high-efficiency 666.67-hectare ton-grain demonstration county activities in three cities and seven counties in northern Anhui. By 2012, Guoyang and Linquan counties had joined the ranks of national 500 kg/county for wheat and maize. Second, large-scale demonstration areas have promoted standardized production. Following the "five haves" (clear demonstration markers, complete technical protocols, administrative and technical responsible persons, supporting measures, and demonstration activity plans) and "five unifications" (unified technical regulations, varieties, formula fertilization, pest control, and order-based sales), the province established 1 million hectares of core demonstration areas for wheat, 1 million hectares for rice, and 400,000 hectares for maize, creating 246 high-yield demonstration plots of 666.67 hectares each that radiate to surrounding areas. Third, large-scale growers have promoted scaled operation. Grain growers with over 6.67 hectares receive increased subsidies, with agricultural machinery purchase subsidies 倾斜 toward them. Annual selection of outstanding grain growers and model growers, coupled with expert and extension personnel guidance, has driven scientific farming among surrounding households.

Executive leadership and primary responsibility have provided organizational guarantees for grain production development. Since implementing the "Governor Responsibility System for Grain" in 1994, Anhui has consistently prioritized the three major grain production actions from 2005 to 2015, continuously optimizing technical protocols. Annual provincial-level commendations of advanced grain-producing cities and counties, individual recognitions by the Socialist New Rural Construction Leading Group, and joint recognitions of grain growers and machinery model households by provincial agricultural, finance, and machinery bureaus have provided strong support for stable grain production development.

Diversified operations have extended industrial chains. Since the 1988 decision by the Anhui Provincial Party Committee and government on "one stable growth (grain production) and two accelerated developments (township enterprises and exploitative agriculture)," agriculture has gradually broken the single grain production structure and embarked on comprehensive development of agriculture, forestry, animal husbandry, fishery, and township enterprises. The province has formed four major development zones: the Huai River basin comprehensive grain-cotton-oil-meat development zone, Jianghuai hilly region high-quality grain-oil-high-efficiency cash crop development zone, Yangtze River large water surface development zone, and southern/western Anhui forest-special product development zone. Ten leading industries have emerged: cattle breeding and processing, fruit production and processing, high-quality rice production and processing, tea-bamboo-economic fruit forests, aquaculture, cocoon and silk, native specialty products, Chinese medicinal materials, and tourism agriculture. Exploitative agriculture has shown trends toward scaling and industrialization, with numerous farmers and enterprises adopting the "company + farmer" industrialized operation model based on household contract management.

Long-term implementation of the Grain Yield Project has promoted sustained production increases. Since the national Grain Yield Project began in 2005, Anhui' s research achievements—including key technologies for hybrid rice mechanical transplanting cultivation, lime concretion black soil improvement and sustained wheat growth, and ultra-high-yield wheat technologies in dryland farming areas—have driven continuous wheat, rice, and maize production increases.

Establishing agricultural service systems constitutes a fundamental measure for grain production development. The province has established monitoring and dissemination systems for seedling, soil moisture, and pest conditions, developing new service organizations such as specialized teams and farmer cooperatives. These have promoted unified seed supply, agricultural input provision, technical guidance, pest control, and mechanized harvesting, providing strong support for stable grain production development.

Strengthening disaster prevention and mitigation is crucial for ensuring grain security. In response to recent extreme climate events including severe floods, rare rain-snow-ice disasters, and major droughts, Anhui has established emergency response mechanisms, promptly allocated disaster relief funds, and strengthened production guidance and services to minimize losses. For pest control, the province focuses on forecasting and unified prevention/control of major diseases and pests including rice blast, rice leaf roller, rice planthopper, wheat scab, corn borer, and armyworm. By expanding semi-winter wheat varieties and controlling early sowing of spring varieties, spring frost damage has been avoided or reduced. Technical measures such as adjusting sowing dates, replacing varieties, and irrigation temperature regulation have mitigated high-temperature impacts on rice seed setting rates. These efforts have continuously improved planting technology levels, particularly for rice, wheat, and maize ultra-high-yield research plots that repeatedly set production records, narrowing the gap with leading grain-producing provinces and driving sustained regional grain production development.

Increasing agricultural subsidies has mobilized farming enthusiasm. In 2013, the province implemented over 1.3 billion yuan in crop variety subsidies, 50 million yuan to support jointing fertilizer application and wheat harvest subsidies in major wheat-producing counties, and 225.7 million yuan in central government funds to support key disaster resistance measures such as wheat "one spray, three preventions."

3. Outlook for Anhui' s Grain Production and Green Yield Increase Model Actions

Strengthening the construction of grain main functional areas in the Huai River basin is essential. Currently, Anhui' s grain production focus and primary task of medium-low yield field improvement (mainly in northern Anhui) lie in the Huai River basin. Constructing grain production main functional areas in this basin will support Anhui's grain production capacity enhancement. The "Anhui

Province 11 Billion kg Grain Production Capacity Increase Construction Plan" states that based on the 2007 provincial grain output of 29 billion kg, production capacity will increase by 6 billion kg to reach 35 billion kg by 2015, and increase by 11 billion kg to reach 40 billion kg by 2020.

Accelerating the construction of the "Second Granary" in the Huang-Huai region is critical. In 2013, Zhang Zhengbin proposed transforming the low-yield wheat-soybean planting system to a high-yield wheat-maize ton-grain model to further promote the Huai River granary construction. Through 2-5 years of effort, promoting green yield increase and quality-efficiency improvement models in the southern Huang-Huai region would build the southern Huang-Huai granary, garnering significant attention from national authorities. In 2014, Vice Minister Zhang Laiwu of the Ministry of Science and Technology proposed during an Anhui investigation to "construct a second granary technology demonstration project in the Huang-Huai-Hai region to fully realize the grain yield potential of medium-low yield fields." By the end of 2014, the Chinese Academy of Sciences launched the "Second Granary" pre-research project with 10 million yuan in funding to implement the "Huai River Basin Technology-Based Grain Increase County-Level Technology Integration and Demonstration" project in Guoyang County and Nongkang Farm. Through joint national and local government efforts, accelerating green quality-improvement yield-increase efficiency-enhancement ton-grain county (city) construction in northern Anhui (with 2.138 million hectares of cultivated land, accounting for 47.8% of Anhui' s total) could add 2.5 billion kg of grain.

Anhui' s grain green yield increase model attack and demonstration action leads the nation. In 2015, the Ministry of Agriculture' s Document No. 1, "Opinions on Vigorously Developing Grain Green Yield Increase Model Attacks," explicitly proposed actions to improve 3.333 million hectares of lime concretion black soil in the Huang-Huai-Hai region (including Henan, Anhui, Jiangsu, and Shandong provinces), aiming to raise the region' s basic soil fertility by one grade, increase fertilizer and irrigation water use efficiency by 10 percentage points, and boost grain per-unit yield by over 15% by 2020. Anhui was the first province nationwide to propose grain green yield increase model attack demonstration actions, targeting a 1% annual increase in provincial grain per-unit yield by 2020; a 6-percentage-point increase in fertilizer and pesticide use efficiency for major crops to achieve zero growth in usage; improvement of farmland irrigation water use coefficient to 0.54; full mechanization of wheat production; and comprehensive mechanization levels of over 90% for rice and maize cultivation, management, and harvesting.

4. Unfavorable Factors Affecting Anhui' s Agricultural Sustainable Development and Food Security

Agricultural farmland is rapidly decreasing, creating a severe farmland protection (quantity and quality) situation. Despite slight expansion under strict balance policies in recent years, the increase has been minimal. Current per

capita farmland is only 0.07 hectares, equivalent to just 72% of the national average. Most counties (districts) in the Yangtze River, southern Anhui, and western Anhui regions have per capita farmland below the 0.05-hectare warning line set by the UN Food and Agriculture Organization. Simultaneously, farmland quality is declining, with insufficient fertility, soil degradation, and water erosion affecting provincial farmland resource quality and severely hindering grain production development.

Farmland water conservancy construction remains a clear weakness. Anhui' s total water resources are less than half the national average, with water shortages exceeding 6 billion cubic meters in moderate drought years. Droughts occur nearly twice every three years, with water scarcity particularly severe in northern Anhui and the Jianghuai watershed areas. In 2013, Anhui' s grain output decreased by 0.3% compared to 2014, with autumn grain production (accounting for 60% of annual output) suffering severe yield losses due to high temperatures and drought, demonstrating that inadequate water conservancy construction affected drought resistance and grain security. The situation of "relying on heaven for harvests" has not fundamentally changed. Most existing sluices, pumping stations, and wells were built in the 1960s-1970s, many now dilapidated and unusable, with effective irrigation area covering only about half of cultivated land. Over the past decade, the "double-to-single" rice planting conversion problem has intensified, with deteriorating water conditions unable to meet rice growth requirements being an undeniable factor.

Agricultural modernization equipment levels need improvement. Anhui' s comprehensive mechanization level for cultivation, management, and harvesting is 59.4%, with grain crop mechanization at 76.4% and some improvement in cash crop mechanization. While progress appears substantial longitudinally, the gap with advanced regions remains large, far from meeting farmers' production demands.

The science and technology service system is relatively lagging, with support capacity needing enhancement. The provincial agricultural science and technology achievement conversion rate is less than 40%, far below advanced regions. Key issues include: weak independent innovation capacity; incomplete agricultural technology extension systems; few self-bred major crop varieties, with rice, wheat, and maize varieties primarily introduced from other provinces, often causing maladaptation and poor disease resistance (e.g., super hybrid rice yield reduction in Anhui in 2014); and insufficient agricultural science and technology talent, with practical experts directly serving agriculture, rural areas, and farmers unable to meet demand.

Disaster resistance capacity is insufficient. Anhui experiences drought every three years and flooding every four years, with more droughts than floods but floods being more severe than droughts. In heavy disaster years, disaster rates reach up to 50%, and 17% in normal years. If Anhui' s annual disaster rate could be reduced by half, average grain per-unit yield could increase by approximately 255 kg per hectare, with total output increasing by nearly 1.5 billion kg. In re-

cent years, Jianghuai regions such as Jiangsu and Anhui have frequently suffered severe wheat scab damage, with maximum losses in 2012. In 2014, wheat in the Huai River-Yangtze River region suffered spring frost during the jointing stage and rainstorms at maturity, causing incomplete grain development, widespread scab, and sprouting, resulting in severe yield reductions and creating significant difficulties for national grain procurement.

Land transfer remains difficult, with grain planting scale and intensification levels still low. In 2014, Anhui transferred 1.39 million hectares of farmland, accounting for about 33.36% of total provincial farmland.

Subsidy amounts are small with too many procedures. Multiple subsidies exist—including variety subsidies, variety-technology matching subsidies, large grower subsidies, and comprehensive agricultural input subsidies—but calculations per unit farmland area are minimal, with insignificant effects on increasing farmers' grain production and income. From farmer application, village-level summary and public notice, township verification, and county-level inspection to card issuance, the numerous procedures and personnel inputs create high administrative costs, occupying substantial county and township agricultural and financial department resources, with corruption occurring in some areas.

Grain production costs are high with low comparative benefits. The situation of "grain production counties with poor finances" remains unchanged. For farmers, rising machinery investment and labor costs make grain production less profitable than migrant work or cash crop cultivation. Farmers' enthusiasm for grain production is low, with insufficient investment in farmland, declining multiple cropping indices, and even farmland abandonment.

Medium-low yield field areas are large, with slow ton-grain county (city) construction. Medium-low yield fields account for about 60% of cultivated land in Anhui, with ton-grain county construction clearly lagging. For example, Huantai County in Shandong became the first "ton-grain county" north of the Yangtze River in 1990. Shandong' s government has established 1.52 million hectares where wheat and maize combined yields exceed 1,100 kg per mu. Five cities including Dezhou have built ton-grain cities, five cities including Liaocheng have basically reached ton-grain city standards, 40 major grain-producing counties (cities, districts) including Shanghe have built ton-grain counties, and 38 major grain-producing counties (cities, districts) including Jiyang have basically reached ton-grain county standards. Henan' s four ton-grain counties are all north of the Yellow River, with plans to achieve 65 billion kg grain production capacity by 2020 by building 4 million hectares of super-ton-grain high-standard farmland within 0.06 billion hectares across 95 counties. Jiangsu Province had 21 recognized "ton-grain counties" in 2015. In Anhui, Mengcheng County in northern Anhui became the province' s first ton-grain county in 2013, Lixin County became the second in 2014, and Guoyang County reached ton-grain county status in 2015, enabling its governing city, Bozhou, to become Anhui' s first ton-grain city. Therefore, Anhui and the southern Huang-Huai region, located at the north-south junction, have few ton-grain counties (cities), and

their climate resource high-yield potential remains unfulfilled.

5. Countermeasures for Promoting Anhui' s Agricultural Sustainable Development and Food Security

Anhui must follow the spirit emphasized at the Fifth Plenary Session of the 18th CPC Central Committee, firmly establishing and earnestly implementing the development concepts of innovation, coordination, green development, openness, and sharing, to accelerate healthy grain security and modern agricultural development during the 13th Five-Year Plan period.

Establishing multi-form national and provincial production area benefit compensation mechanisms will mobilize local government initiative in grain production. To address the awkward situation of "large agricultural provinces (counties), small industrial provinces (counties), poor fiscal provinces (counties)," it is recommended that the state allocate commodity grain distribution compensation funds as special transfer payment funds to grain-exporting main production area local governments. Simultaneously, pilot programs for farmland protection compensation mechanisms should be launched first in grain main production areas, with grain main production counties included in national ecological compensation pilot programs.

Further improving the grain subsidy system will mobilize farmers' grain production enthusiasm. First, direct grain and variety subsidies should be distributed to grain-planting farmers rather than contracted farmland owners. Second, direct subsidies should be linked to grain planting scale and output, shifting from current tax-area-based subsidies to area-yield-market-volume-based subsidies to 倾斜 subsidies toward grain main production areas and large growers, promoting scaled and intensive grain production. Third, agricultural input subsidy methods should be improved through direct subsidies for farmers purchasing fertilizers and pesticides. Fourth, the state should implement macro-control measures to provide price difference subsidies for grain based on domestic and international market demand and prices, directly linking subsidies to grain and farmers.

Increasing investment in agricultural infrastructure in grain main production areas will enhance agricultural development 后劲. It is recommended that the state provide key investment to major grain-producing provinces (counties), integrating forces from agricultural comprehensive development, high-quality grain industry projects, and national large-scale commodity grain base construction. Key projects should include continued construction and matching of the Pi-Shi-Hang and Simashan irrigation districts to address water shortages in the Jianghuai watershed drought-prone areas; completing reinforcement of large and medium reservoirs; actively promoting general dike reinforcement, flood storage area adjustment, and plain depression drainage projects; constructing Yangtze River regime control projects; promoting major tributary management; establishing special subsidy funds for small farmland water conservancy con-

struction; improving field irrigation and drainage facilities; and planned water control, storage, regulation, and comprehensive utilization to improve water resource use efficiency and benefits, maintain water resource ecological balance, and enhance agricultural disaster resistance capacity.

Building new agricultural management systems will improve grain production scaling levels. Vigorously developing specialized service teams for agricultural machinery, plant protection, and formula fertilization, with order-based production as the breakthrough point for high-quality grain industrialization, will promote management models such as "enterprise + base + farmer" and "enterprise + intermediary organization + farmer," integrating pre-production, mid-production, and post-production links to enhance grain production organization levels and improve grain production benefits.

Actively promoting agricultural scientific and technological progress requires continued funding for the Grain Yield Project, high-yield creation, and the three major grain actions to support high-yield technology demonstration zones and leverage model effects. Consolidating "three conditions" (seedling, soil moisture, pest-weed-disease) monitoring points through "four fixed" methods (fixed location, fixed time, fixed expert, regular consultation) will enable timely information release and field management recommendations. Strengthening the close connection between research and extension, and further exploring measures such as expert courtyards, technology special commissioners, and extension personnel serving new agricultural management entities, will deliver improved varieties and methods directly to fields.

Strictly adhering to farmland protection red lines ensures basic farmland is not reduced. Scientific formulation of medium- and long-term rural development plans should utilize barren hills and slopes for urban construction and farmer housing. Including land consolidation-added farmland in agricultural subsidies will enhance farmer participation enthusiasm in land consolidation.

Accelerating full mechanization of grain production requires promoting integration of agricultural machinery and agronomy to substantially upgrade full mechanization levels and apply disaster reduction and avoidance machinery and technical measures. The plan targets provincial agricultural machinery total power reaching 70 million kW by 2017, with 200,000 large and medium tractors, 170,000 combine harvesters, 40,000 rice transplanters, and a machinery-implement matching ratio of 1:2.5.

6. Creating a New Path for Modern Agricultural Development in Anhui

Anhui ranks first among major grain-producing provinces in resource endowment coefficient values, higher than the other five provinces (Jiangsu, Henan, Hebei, Shandong, Hubei), indicating excellent resource conditions for grain production and strong resource competitiveness. Through analysis of Anhui' s main functional area planning and historical development, we recommend that Anhui

localities should, based on their location advantages: learn from Shandong to vigorously develop facility-based high-efficiency modern agriculture and export-oriented agriculture; learn from Henan to vigorously develop agricultural machinery cross-regional harvesting operations and large-scale grain deep processing industries (including breeding industries) and follow the "China' s Kitchen" path; learn from Hebei to develop water-saving high-efficiency modern agriculture and coordinated agriculture-forestry-animal husbandry-side-line-fishery development to provide high-quality agricultural and sideline products to the Beijing-Tianjin-Hebei region; and learn from Jiangsu' s emphasis on technological innovation and coordinated industrial-agricultural development. To achieve central plains rise, Anhui must create a new Huai River basin modern agricultural development path targeting the different industrial and agricultural needs of surrounding major cities such as Shanghai, Nanjing, Wuhan, and Jinan.

References

[1] Agricultural Bureau and Agricultural Committee in Anhui Province. Review grain production in Anhui Province in past sixty years[EB/OL]. (2010-02-03) http://www.ah.xinhuanet.com/zhuanti/2010-02/03/content_{18952091}.htm [2] Qian J. Total grain production of Anhui Province is 34.15 billion kg ranking the sixth in China in 2014[N]. Anhui Daily, 2015-01-20 [3] Su X Q. Total grain production amplification of Anhui Province is 4.2% ranking the second in China in 2014[EB/OL]. (2015-01-13) http://news.hefei.cc/2015/0113/024843846.shtml [4] Feng H. Agricultural production is stable and summer grain crop get a good harvest again[EB/OL]. (2015-07-28) http://www.ahtjj.gov.cn/tjj/web/list.jsp [5] Autumn grain crops plant area is 3.973 million hm^2, total grain production is over 19.5 billion kg[EB/OL]. (2015-09-21) http://www.ahny.gov.cn/xxgk/detail.asp?id=7921 [6] Xinhua News. Grain short in China: Over half province is not self-sufficient[EB/OL]. (2013-07-02) http://news.xinhuanet.com/finance/2013-07/02/c_{124941398}.htm [7] He A X, Su S B. Analysis and prediction of the amount of arable land and grain production in Anhui Province[J]. Academic Journal of Suzhou University, 2014(4): 1-3 [8] China Grain and Oil Network. Anhui Province enables maize plant "Green Mode" [EB/OL]. (2015-07-11) http://www.chinagrain.cn/yumi/2015/7/1/20157113403936263.shtml [9] Yang Y. Anhui Province gives great impetus to grain production and hold bowl safely in himself hands[EB/OL]. (2014-01-26) http://ah.anhuinews.com/system/2014/01/26/006291118.shtml [10] Statistical Bureau of Anhui Province. Statistical bulletin of national economy and social development of Anhui Province in 2014[EB/OL]. (2015-02-26) http://www.ahtjj.gov.cn/tjj/web/info_{view}.jsp?strId=1425024120629028&*{indextow}=1 *[11] Yu X R. Strong boosts three big projects and promotes grain increase production stably[J]. Anhui Agronomy Bulletin, 2012(1): 1-2 [12] Industrialization Office of Agricultural Committee of Anhui Province. Review the industrialization of agriculture in Anhui Province the past sixty years[EB/OL]. (2010-02-05) http://www.caein.com/index.asp?NewsID=51448&xAction=xReadNews [13] Yu H S. Anhui Province launches grain crop harvest project to promote grain yield*

increase[EB/OL]. (2015-10-22) http://www.hljxh.net/zgnx/web/news/?74590.html
[14] Network of Ministry of Finance of the People' s Republic of China. Anhui Province strongly supports main functional area construction plan of grain production to enhance grain increase ability[EB/OL]. (2008-12-02) http://www.mof.gov.cn/pub/caizhengbuzhuzhan/xinwenlianbo/anhuicaizhengxinxilianbo/200812/t20081202{93
[15] Zhang Z B. Granary construction in north of Huai River should be speeded up[N]. Chinese Science News, 2013-06-10 [16] Zhang Z B. Granary construction in south of Huanghuai basin should be speeded up[N]. Chinese Science News, 2014-04-11 [17] Si S. Ministry of Science and Technology came in Anhui Province to investigate and survey the works of grain safeguard by science and technology[EB/OL]. (2014-06-23) http://ah.anhuinews.com/system/2014/06/23/006465554.shtml [18] Sun C. The "Second Granary" pre-research project was startup in Anhui Province[N]. Chinese Science News, 2015-01-22 [19] Ministry of Agriculture of China. In regard to energetically launch tackles key problems of grain green increase mode[EB/OL]. (2015-02-04) http://www.law-lib.com/law/law_{view}.asp?id=486018 [20] General Office of the People's Government of Anhui Province. In regard to energetically launching demonstration action for tackling key problems of grain green increase mode[EB/OL]. (2015-07-24) http://www.agri.cn/V20/ZX/qgxxlb_1/ah/201507/t20150724_{4760255}.htm
[21] People' s Government of Anhui Province. Situation analysis on grain production of Anhui Province[N]. Anhui Daily, 2011-04-19 [22] Dai X C, Liang W. Autumn grain crops meet drought damage, grain reduce yield 95 million kg in Anhui Province in this year[N]. Anhui Commercial News, 2013-12-05 [23] Zhang L. Ministry of Agriculture explains the reasons for super rice yield reduction[EB/OL]. (2015-04-15) http://society.people.com.cn/n/2015/0415/c136657-26845032.html [24] Guangming Net. Anhui Province starts wheat temporary storage at provincial level to solve sale grain difficulty for farmer[EB/OL]. (2015-07-28) http://pic.gmw.cn/channelplay/6200/3260171/0/1.html [25] Shi L. Arable land circulation area over thirty percent in Anhui Province[EB/OL]. (2014-05-15) http://ah.anhuinews.com/system/2014/05/15/006431805.shtml
[26] Zhang H F. Shandong Province gets eleven years of grain good harvest and builds five ton-grain-city in four years[EB/OL]. (2014-05-15) http://sd.dzwww.com/sdnews/201310/t20131022_{9041564}.htm [27] Qiao D. Henan Province will build a batch "1.5 ton grain-village" and "ton-grain-county" [EB/OL]. (2014-05-15) http://finance.china.com.cn/roll/20130322/1344074.shtml
[28] Zou J F. There are 21 "ton-grain-county" was identified in Jiangsu Province[EB/OL]. (2015-05-14) http://news.eastday.com/eastday/13news/auto/news/csj/u7ai3947224_{K4}.
[29] Li T, Ma X X. Guoyang County gets construction goals of "ton-grain-county" [EB/OL]. (2015-05-14) http://www.bozhou.cn/2015/0930/527051.shtml [30] Study China. Xi Jinping and five ideas of development in "13th Five Year Plan" [EB/OL]. (2015-11-01) http://news.ifeng.com/a/20151101/46068411_0.shtml
[31] Kong L C. Countermeasure for Anhui Province grain production under grain security strategy[N]. Anhui Daily, 2014-07-21 [32] Work Seminar of the People' s Congresses of Anhui Province. Analysis and investigate to grain production situation in Anhui Province[N]. Anhui Daily,

2014-07-21 [33] China Industry Research Net. Anhui Province speeds up mechanization in whole journey of grain production[EB/OL]. (2013-12-23) http://www.chinairn.com/news/20131231/16511067.html [34] Li X. Analysis on competitiveness and grain production status of Anhui Province[J]. Anhui Agricultural Sciences, 2014(4): 1220–1222 [35] Anhui Province People's Government. The note of main functional region plan in Anhui Province[EB/OL]. (2013-12-26) http://www.ah.gov.cn/UserData/DocHtml/1/2013/12/26/5120801642263.html

Note: Figure translations are in progress. See original paper for figures.