

Roles of agricultural Universities in extension of S&T achievements and transformation of agricultural development patterns: A case study in Henan, China

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Abstract

Taking Henan Agricultural University (HAU) as an example, the paper discusses roles of Chinese agricultural universities in extension of S&T achievements and transformation of agricultural development patterns in China. In the first half common acts that HAU takes are emphasized for the production-teaching-research combination: (1) accelerating industrialisation process of agricultural S&T achievements by means of HAU-based national and provincial research platforms, (2) innovating the production-teaching-research combination model of “321” and establishing cooperation base to promote development of local economy, (3) innovatively designing “9:1” model to explore the brand-new agricultural development pattern, (4) advancing cooperation to achieve a win-win situation between HAU and local governmental institutions or enterprises, and (5) extending and applying advanced S&T achievements by popularisation activities in rural areas. And in the latter half, major effects of and experience in the production-teaching-research combination are introduced: (1) rapid and sound development of agricultural production has been pushed forward and the pace of agricultural modernisation has been quickened up, (2) independent innovation ability and core competition ability of enterprises have been enhanced, (3) large numbers of high-quality S&T personnel have been well educated for the society, and (4) educational quality of HAU has been improved and its S&T innovation ability enhanced. Finally, forms of cooperation between Chinese people and African people are also discussed.

Key words: China, Henan Agricultural University, production-teaching-research combination

Résumé

En Prenant «Henan Agricultural University (HAU) » (Université Agricole de Henan) à titre d'exemple, le document examine les rôles des extensions d'universités agricoles chinoises de S & T, la réalisation et la transformation des

structures de développement agricole en Chine. Dans les programmes communs du premier semestre communes que HAU offre, on met l'accent sur la combinaison : production-enseignement-recherche: (1) en accélérant le processus d'industrialisation de l'agriculture S & T, la réalisation au moyen des plates-formes de recherche nationaux et provinciaux de HAU, (2) l'innovation de modèle de combinaison de « 321 » production-enseignement-recherche et l'établissement de base de coopération pour promouvoir le développement de l'économie locale, (3) le modèle de conception innovante « 9:1 » pour explorer le tout nouveau modèle de développement agricole, (4) faire progresser la coopération pour réaliser une situation gagnant- gagnant entre HAU et les institutions gouvernementales locales ou des entreprises, et (5) l'extension et l'application des productions scientifiques et technologiques avancées acquis par des activités de vulgarisation dans les zones rurales. Et dans la seconde moitié, les effets majeurs de l'expérience et de la combinaison production-enseignement-recherche sont mis en place: (1) le développement rapide et accentué de la production agricole a été poussé vers l'avant et le rythme de la modernisation de l'agriculture a été accéléré d'une manière avancée, (2) l'aptitude d'innovation indépendante et l'habileté de concurrence des entreprises de base ont été améliorées, (3) un grand nombre du personnel qualifié en S & T ont été bien éduqués pour la société, et (4) la qualité pédagogique de HAU a été améliorée et son aptitude d'innovation scientifique et technologique renforcée. Enfin, les formes de coopération entre le peuple chinois et des peuples africains sont également discutés.

Mots clés: Chine, Université Agricole de, Combinaison: production-enseignement-recherche

Background

Henan Province (31°23' N~36°22' N, 110°21' E~116°39' E), located in mid-eastern China, is one of the important birthplaces of the Chinese nation and the cradle of Chinese civilisation. It covers an area of 167,000 km² and has a population of 94 million (2012), 60%~70% of which live in rural areas with a net income per capita of about ¥5500 CNY (ca. \$870 USD).

The north, west, and south of Henan are occupied by mountains and hills accounting for 44.3% of the total land area, and the remaining is plains accounting for 55.7%. Henan is situated on a transitional region where the northern subtropical zone gradually changes toward the warm temperate zone, with a

**Common acts for the
production-teaching-
research combination**

humid to semi-humid continental monsoon climate. As one of the major agricultural provinces in China, Henan is the important production base for wheat, maize, rice, tobacco, and animal husbandry products, etc. An arable land area of 9.8 million hm² is devoted to food crop production, yielding an annual output of 55 million tons accounting for about 10% of the total grain output in China. Recent 30 years have witnessed a rapid development of agricultural production and rural economy in Henan. In particular, Henan has made remarkable progress in accelerating extension of agricultural S&T achievements and transformation of agricultural development patterns.

Henan Agricultural University (HAU) is a comprehensive agricultural university co-sponsored by the People's Government of Henan Province and Ministry of Agriculture of the People's Republic of China. It celebrated its 100th anniversary on the beginning of Higher Agricultural Education in July of this year. The university has devoted itself for years not only to higher education at different levels but also to development of economy and society by strengthening cooperation with local governmental institutions or enterprises. "100-year-old HAU: irreplaceable!" commented by Mr. Lu, Governor of the People's Government of Henan Province, at the 100th anniversary ceremony of HAU.

Accelerating industrialisation process of agricultural S&T achievements by means of HAU-based national and provincial research platforms. In recent years, HAU has undertaken and completed a lot of important research programmes/plans especially for wheat, maize, rice, tobacco, paulownia, and in areas of rural energy and livestock, etc. More than 200 valuable S&T achievements have been obtained, many of which are granted for the National Award for S&T Progress, National Award for Technology Invention, and awards for S&T progress at provincial and ministerial levels. Meanwhile, establishment of 29 HAU-based national and provincial research platforms including the National Engineering Research Center for Wheat and the Incubation Base for State Key Laboratory of Physiological Ecology and Genetic Improvement of Food Crops enables the university to set up strong academic innovation teams, to improve its teaching levels, and to raise its independent S&T innovation ability. Especially, under the principle of "mutual benefit and joint development", HAU encourages all the research platforms to achieve better effects of cooperation with local governmental institutions, research entities and enterprises

by promoting extension and application of agricultural S&T achievements.

Typical cases of industrialisation of agricultural S&T achievements. The National Engineering Research Center for Wheat gives birth to industrialisation patterns of “leading seed enterprises + research entities + production bases + farm households” and “order-based production + purchase on contract + quality-oriented price” in industrialising development of good-quality wheat cultivars in China. The patterns have driven wheat industrial structure to optimise and upgrade, and achieved “Four Satisfactions”——simultaneously satisfying local governmental institutions, farmers, enterprises, and research entities.

The Sub-Center (Zhengzhou) of the National Maize Improvement Center actively promotes industrialisation of S&T achievements and extension of new hybrids by taking the right paths both of self development and joint development with large-scale seed enterprises. “Yudan 998”, a summer maize hybrid bred from the sub-center, is characteristic of high tolerance to dense planting, hard seed, and high resistance to diseases. The hybrid brought in a technology transfer fee of ¥4 million CNY to HAU when it was approved for release by the National Crop Variety Appraisal Committee.

Innovating the production-teaching-research combination model of “321” and establishing cooperation base to promote development of local economy. HAU is annually undertaking over 500 research programmes of various types and at different levels, including the National Basic Research Plan (“973” Plan), the National High-Tech R&D Plan (“863” Plan), and the National Natural Science Foundation of China (NSFC). Since process of these programmes need to carry out in the open field and the results also need to demonstrate in the actual production practice, construction of high-level scientific research bases are of absolute necessity. For this reason, HAU has built up scores of production-teaching-research combination bases by linking the research programmes as a tie. Recently, 194 such cooperation bases have been successively established to provide a stage for professors and local enterprising businessmen and farmers in all the 18 prefecture-level cities in Henan, and also in provinces of Sichuan, Chongqing, Guizhou, etc. This act has proved successful in achieving a win-win situation between promotion of local economic and social development and upgrading of the university-running level.

The model “321” of production-teaching-research combination has been set up at the beginning of the exploring process: (1) constructing “**3 systems**”: a new-type agricultural S&T innovation system, an agricultural S&T extension system, and a three-level personnel training system; (2) improving “**2 sets of mechanisms**”: two sets of safeguard mechanisms; and (3) innovating “**one pattern**”: a new-type cooperation pattern between HAU and local governmental institutions or enterprises. For the purpose to serve the development of modern agriculture, HAU strongly pushes forward regional economic development by enhancing cooperation between the university and local governmental institutions or enterprises.

Typical case - Fangcheng Production-Teaching-Research Combination Base. As early as the mid-1970’s, HAU began to conduct all-sided exchanges and cooperations in agricultural S&T and education with the People’s Government of Fangcheng County, Henan. Main cooperative areas between the two sides are as follows: high-yield techniques for grain crop production, improvement in soil fertility of the low- and medium-yield field, growing and industrialisation of special crops with local characteristics (such as little chili pepper), industrialising development of traditional Chinese medicinal herbs, and training of S&T personnel in rural areas, etc. Close cooperations in as long as four decades have strongly promoted sustainable development of agricultural S&T and local-characteristic industries in Fangcheng, and simultaneously crystallised “Success of Fangcheng Model” of “Special Action Plan for Enriching Farmers by S&T” of HAU. This resounding “Success of Fangcheng Model” has drawn much attention from various circles of society and produced sound social echo. It has been successively reported by the mainstream media: People’s Daily, Guangming Daily, S&T Daily, Henan Daily, and others.

Innovatively designing “9:1” model to explore the brand-new agricultural development pattern. China has been invariably attaching strategic importance to food production, and actively committed to increasing grain production, agricultural efficiency, and farmer’s income. In solving the contradiction between increases in farmer’s income and grain production, it is first necessary to implement system innovation of agricultural management and corresponding operating mechanisms. In order to search for a practicable way for agricultural development pattern, HAU has designed a “9:1”

model and put it into practice. In 2010, the university decided to start this “9:1” model with local governmental institutions upon sufficient consideration and scientific demonstration. Choosing Fangcheng and Minquan from the large low- and medium-yield agricultural counties in Henan, the university has schemed and constructed “Pilot Zone for Comprehensive Reforms on Transformation of Agricultural Development Patterns” focused on the “9:1” model. On the premise without sacrifice to agricultural sustainable development, grain production, ecological conservation, and environments, food crops are grown on 90% of the arable land to produce what would be obtained from 100% or even 110% of the land as before by means of application of S&T achievements for high- & steady-yield, and high-efficiency crop production. And the 10% spare land is used to build up green and high-efficiency agricultural region so that the quadruple goal of “sufficient grain output by high-yield agricultural techniques, increased income from the spare land, ecologically livable place, good-quality personnel training” would be finally realised.

The “9:1” model is booster for increasing utilisation rate of agricultural resources, for realisation of industrialised agriculture, and for integration of urban and rural areas. Compared with the common practice of “increasing grain production and agricultural benefit”, the “9:1” model has marked advantages and unique characteristics: (1) being of great practical significance by persisting comprehensive harmonious development; (2) being duplicable by persisting simple and easy operations; (3) being long-lasting by persisting a win-win cooperation; and (4) being sustainable by persisting optimised transformation of agricultural development patterns.

Typical case——Pilot Zone for Comprehensive Reforms on Transformation of Agricultural Development Patterns (Fangcheng). The pilot zone, located in Zhaohe Town, Fangcheng, Henan, covers an arable land of 3333 hm² in 13 administrative villages. The results showed that average yield of wheat was 7740 kg/hm² with an increase of 15% and that of maize was 7080 kg/hm² with an increase of 11%, respectively, in grain-producing area (90% of the planned arable land) in 2011 growing seasons. Meanwhile, in the remaining 10% arable land for high-efficiency agriculture, greenhouse vegetable production and husbandry were developed so that traditional local farmers became farm workers living mainly on wage earnings. Ultimately, high- and steady-yield grain-producing

**Advancing
cooperations to
achieve a win-win
situation between
HAU and local
Governmental
Institutions or Enter-
prises**

region, high-efficiency agricultural industry cluster district, ecologically livable rural community, eco-tourism and leisure agriculture area, and experimental base for teaching reforms were all successfully built up by the win-win move of “9:1” model.

HAU remarkably improves its ability to provide service for development both of modern agriculture and local economy by fully exerting its own advantages to establish closer cooperations with either local governmental institutions or enterprises. It has built wide-range cooperations with 25 counties or cities such as Nanyang, Xinyang, Jiyuan, Puyang, Xuchang, Fangcheng, Wenxian, Xunxian, Lankao, Nanzhao in a random order. Such cooperations have effectively accelerated industrialisation of agricultural S&T achievements, improved sustainable efficiency of agriculture and stable income of farmers, and promoted development of regional economy.

It also actively explores different models to strengthen cooperations between the university and enterprises. So far, HAU has already established close ties with large-scale state-run enterprises or leading enterprises such as China National Tobacco Corporation, CGC Overseas Construction Co., Ltd., Henan Luohe Shuanghui Industry Group Co., Ltd., Gushi San’gao Development Co., Ltd., Henan Sanlu Huahua’niu Dairy Co., Ltd., Henan Doyoo Group, Henan Huaying Poultry Group, and Bokang Lushi Chicken Development Co., Ltd. It has developed more than 300 new agricultural products or patents for the enterprises with considerable economic benefits. At the same time, HAU’s ability to run the university and to complete R&D works were all enhanced where a win-win situation has been achieved.

Typical case of cooperation between HAU and Gushi San’gao Development Co., Ltd. HAU collaborated with Gushi San’gao Development Co., Ltd. to complete the programme “Study on Breeding Techniques for New Varieties of Quality and Special Gushi Chicken and Sanhuang Chicken”(“863” Plan), and obtained 10 national innovation patents. The long-term cooperation made R&D of Gushi chicken embark on a track of specialisation, scalisation, and commercialisation while a new industrialisation model of “breeding center + production base + marketing company + core farm households + common farm households “ was developed. As a result, Gushi San’gao Development Co., Ltd.

**Extending and
applying advanced
S&T achievements
by popularisation
activities in rural
areas**

has become the biggest local quality-chicken-breeding and breeding-chicken-supply enterprise in nowadays China, and gained an annual profit growth of ¥80 million CNY. Meanwhile, the company has brought along 6477 farmers to gain a profit of ¥171 million CNY and found a new way for farmers to get rid of poverty.

Annually, HAU undertakes more than 100 extension-type S&T programmes at different levels such as the National Agricultural Comprehensive Development, Poverty Reduction by Reliance on S&T, S&T Popularisation Project, Popularisation of S&T in Farm Households. Upon completion of these programmes, HAU has set up more than 150 S&T demonstration bases all over the province, and sent professors and other S&T personnel to go deep into the forefront of agricultural production in more than 200 counties or towns to provide local farmers with all-round S&T services for resolving practical problems in agricultural production.

Major ways of S&T service HAU has tried to provide are as follows: (1) establishing S&T management system and mechanism of modern agriculture by sending deputy county magistrates or township chiefs to a county or town in charge of S&T affairs; (2) implementing “Action Plan of S&T Commissioners”. Up to now, HAU has selected and sent about 100 S&T commissioners to local governmental institutions or enterprises, more than 70 of which are provincial; and (3) setting up S&T information service centers so that HAU could better play its role in extension of advanced agricultural techniques.

**[Typical case——S&T Service Model in Village Baqian:
Cooperation between HAU and a poor village]**

Cooperation between HAU and a poor village, Baqian, Xinzheng, in central Henan was a successful attempt for the university to innovate S&T service patterns. Village Baqian is located in the poor sandy area with rather a low S&T level of agricultural production. Years ago, HAU sent an S&T service group consisting of 11 professors and other technical personnel to guide local farmers to establish economic forests as wind-break and sand-fixing defense, to separately grow economic and grain crops in sub-areas, and to convert the old river course into S&T demonstration gardens of ecological agriculture. At the moment, the Village Baqian has a flourishing economy and with beautiful environment.

Major effects of and experience in the production-teaching-research combination

Rapid and sound development of agricultural production has been pushed forward and the pace of agricultural modernisation has been quickened up. By extension and application of new crop varieties and advanced agricultural techniques, HAU has strongly pushed forward renewal and upgrading of crop varieties and development of agricultural production, and quickened up the pace of agricultural modernisation in Henan. In recent years, there have been more than 20 crop varieties such as “Yu’nong 949” (wheat), “Yu’nong 202” (wheat), “Yudan 998” (maize), “Yuyu 22” (maize), “Fangxin 1” (rice) approved for release by the National Crop Variety Appraisal Committee or Henan Crop Variety Appraisal Committee.

Taking **maize hybrid “Yuyu 22”** as the carrier, HAU has initiated a brand-new development pattern of improved variety industrialisation in China and driven great changes to take place in crop seed industry. The university has given 3 seed enterprises its authorisation to popularise “Yuyu 22” in a planting area of 6.67 million hm² covering 22 provinces in the mid-northern China. Through industrialisation of this hybrid with the largest planting area in summer-sown maize belt in the Huang-Huai-Hai Plains, HAU has obtained usable expense of ¥5.23 million CNY, and those 3 authorised enterprises have earned economic benefits of ¥556 million CNY.

Newly-developed veterinary medicines, aiming at curing the most common and the most harmful diseases in the poultry industry, dramatically decreased the cost of the chicken industry, for the medicines fulfilled multiple purposes just by only one injection. Inner Mongolia Biological Pharmaceutical Factory paid ¥5 million CNY to HAU for the tetravalent oil emulsion inactivated vaccine techniques.

Independent innovation ability and core competition ability of enterprises have been enhanced. Aiming at solving the key technical problems faced by enterprises and making full use of its own advantages in intelligence and S&T resources, HAU makes an effort to improve independent S&T innovation ability and core competition ability of enterprises. Till now, in areas of crop growing, livestock and poultry industry, food processing, agricultural mechanisation, biological products, etc., HAU has brought new vigor and vitality into about 100 enterprises of which are Gansu Dunhuang Seed Co., Ltd., Henan Gerui Agriculture Co., Ltd., Henan Luohe Shuanghui

Industry Group Co., Ltd., Jiangsu Code Modern Agriculture Co., Ltd., and Liaoning Yikang Biological Products Co., Ltd., and helped them obtain significant economic and social benefits.

HAU has collaborated with enterprises to establish more than 10 agricultural S&T innovation bases, and with academies of agricultural sciences in Zhoukou, Nanyang, and Shangqiu to build dozens of experimental stations and research work stations in the localities. It has collaborated with Gushi San'gao Development Co., Ltd. to set up a research workstation of Henan Poultry Engineering Center and made an outstanding contribution to industrialisation of Gushi chicken. The university has also collaborated with Henan Doyoo Group and Henan Huaying Poultry Group to apply for establishment of post-doctoral research stations, respectively, and helped the latter enhance their S&T innovation ability.

Large numbers of high-quality S&T personnel have been well educated for the society. HAU exerts itself to educating agricultural S&T personnel at three levels: (1) attempting to train high-level innovative talents mainly by academic/diploma education on the core position, the campus; (2) attempting to train high-quality labors by vocational or continuing education on the auxiliary position, the local governmental institutions or other organisations; (3) attempting to conduct agricultural S&T training on the outer position, the field edges.

Presently, there are 12 continuing education sites and 17 workstations of college-student “village officials” in Henan to train leaders or organisers for rural communities. And in 2004, HAU was determined by the People’s Government of Henan Province as “Training Center for County-Level Agriculture-Linked Administrative Staffs.” In 2009, HAU was picked up as “Training Base for Modern Agricultural Technology, Ministry of Agriculture” and “Training Base for Modern Agricultural Technology, the People’s Government of Henan Province”, and till now thousands of professional technicians have been trained. In the meantime, the university often sends professors to go to the production forefront to conduct technical trainings. Only in Fangcheng, more than 500000 person-times have been trained in recent years and over 80% of farm labors have passed through the corresponding trainings.

Educational quality of HAU has been improved and its S&T innovation ability enhanced. Through S&T services

in various forms for the society, HAU has not only promoted sustainable and healthy development of regional economy but also improved its own educational quality and independent S&T innovation ability. It has actively undertaken R&D programs from local governmental institutions or enterprises all the time. Only in 2010, there were as many as 130 contracted programs with a total research funds of ¥28 million CNY. Implementation of such programs in turn has provided professors and students with platforms for practice teaching and experimental investigation, and finally helped HAU improve its own university-running level.

The above mentioned is a brief introduction to the roles HAU plays in extension and application of agricultural S&T achievements, and in transformation of agricultural development patterns in Henan—the biggest agricultural province in China.

Last but not the least, hereby, HAU and Chinese people look forward to working together with Ugandan people or other African people to establish friendly and close relations in area of agricultural S&T! Forms of cooperation might be cooperative R&D, exchange of students, technical assistance and cooperation, leasing of farm to show high- and steady-yield and high-efficiency demonstration field, etc. By making use of the ready agricultural S&T achievements and experiences in transformation of agricultural development patterns of China, we earnestly expect to make positive contributions to development of economy and society in Uganda and other African countries or regions with the similar agricultural ecological conditions!