Resource Allocation of Agricultural Science and Technology R&D

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Abstract The status quo of resource allocation of agricultural science and technology R&D (research and development) both at home and abroad, including the amount and function of agricultural science and technology research funds, human resources in the resources of agricultural science and technology R&D , the efficiency of resource allocation of agricultural science and technology R&D, the management system of agricultural scientific innovation and the operation status of scientific funds, is analyzed. The problems in the current resource allocation of agricultural science and technology R&D are put forward, including unreasonable resource allocation; low efficiency, and low efficiency of the transformation of agricultural scientific achievements. The highly effective resource allocation of agricultural science and technology R&D is analyzed from the aspects of resource allocation structure, environment, channel, spatial layout and industrial chain.

Key words Resource of agricultural science and technology R&D, Resource allocation, Efficiency, Mode, China

The developmental tempo of various rural undertakings in China always lags behind that in urban areas and the urban-rural gap becomes wider and wider. Farmers' income increase and the sustainable development of agriculture need the optimized allocation of agricultural science and technology R&D resources, thus, the study on the reasonable allocation of agricultural science and technology R&D resources is of great importance. The paper analyzed the status quo of the domestic and foreign studies on the resource allocation of agricultural science and technology R&D and discussed the effective allocation way of agricultural science and technology R&D resources.

1 The status quo of studies on resource allocation of agricultural science and technology R&D

1.1 The status quo of foreign researches Generally, the return rate of agricultural science and technology investment is high. Foreign scholars' researches often concern the following two aspects. For one thing, the return rate of agricultural research and collective investment. Most of the researches showed that the return rate of agricultural research and collective investment was among 40% and 50%. In 1968, by studying the resource allocation of the same history, Evenson obtained that the return rate of agricultural research and collective investment was 47%[1]. In 1975, by researching the data from the year of 1939 to 1948, Cline got the return rate among 41% and 45%[2]. In 1989, by analyzing the data of America from 1950 to 1982, Huffmanand Evenson got the return rate of 41%[3]. For another thing, the studies on the return rate of special research in agricultural system. In 1958, through analyzing the investment efficient of the research on hybrid maize in America from 1940 to 1955, Griliches worked out that the return rate was among 35% -45%; at the same year, he analyzed the input efficiency on soybean, and the return rate was 20%[4].

As for the factors that affected the efficiency of resource allocation of agricultural scientific R&D, the statistics, obtained by Huffman and Everson, have covered 42 states of the U. S. from 1950 to 1982. It was found that, in general, public agricultural input had positive impact on agricultural production efficiency, but in the specific research field of animal husbandry, it had negative impact[3]. From another statistics of 42 states in the U. S. , Craig and Pardey found that government played an active role in agricultural research and agricultural promotion[5].

1.2 The status quo of domestic research

1.2.1 The status quo of resource allocation of agricultural scientific R&D.

1.2.1.1 The status quo of the amount and functions of agricultural research funds. Firstly, the government is the main body of resource investment of agricultural science and technology R&D. If the government increases the investment, the efficiency will be increased. HUANG Ji-kun *et al.* pointed out that the government is the main body of agricultural science and technology investment and agricultural science and technology industrialization and rural enterprises can not bear the great responsibility, so the effective agricultural scientific innovation system relies on the country's public investment[6]. Secondly, the increase of agricultural science and technology funds is in positive correlation to the increase of agricultural output performance. ZHAO Zhi-jun *et al.* pushed forward that from the year of 1996 to 2003, Chinese agricultural science and technology funds had increased from 4.355 billion yuan to 8.575 billion

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yuan, which had increased about one time; the ratio of investment in agricultural science and technology investment had also increased from 0.31% to 0.50%[7].

1.2.1.2 The human resources of agricultural science and technology R&D resources. One of the most important elements of resource allocation of agricultural science and technology R&D is talents. The reasonable resource allocation requires the investment in human resources. LIU Yi *et al*., thought that agricultural research was the human resource-intensive activities, therefore, the quality of agricultural science and technology researchers determines the scientific research capability of agricultural research institutions[8]. But at present, the science and technology persons are distributed unevenly, so the thought pattern should be transferred to coordinate the development of each sector.

1.2.1.3 The current efficiency of resource allocation of agricultural science and technology R&D. Firstly, agricultural science and technology R&D resource are public goods, so the government should lead it and introduce into private capital. LI Huan-zhang *et al*. pointed out that those developmental resources of agricultural science are public goods and they greatly restrict the potential of Chinese agricultural sustainable development[9]. Secondly, an important aspect of the high efficiency of agricultural research output is to increase the technological and scale efficiency of agriculture research. LI Shi-bao *et al*., found that the scale returns of some provinces have shown the descending trend and it was imperative to adjust resource allocation. The regional agricultural research efficiency is in close relations with the regional agricultural economy[10].

1.2.1.4 The status quo of innovation management system and scientific fund operation of agricultural science. Firstly, the innovation management system relates to the factors that can be adjusted in the resource allocation of agricultural science and technology R&D; the maximum functions displayed by human resources and the highest innovation efficiency under the reasonable allocation of the resources such as capital, labors, information, *etc*. WANG Zheng-guo pointed out that the agricultural innovation system, led by enterprises, dominated by market and combined with production and research, should be established[11]. Secondly, in the operation mechanism of agricultural science and technology research funds, the input on expenses should prevent being abused to allocate the capital to effective places though proper channels. ZHANG Yin-ding *et al*. studied the operation of science and technology funds from the aspect of operation mechanism. Besides, the reasons for the embezzlement of capital in the input mechanism and supervision mechanism are analyzed[12].

1.2.2 Problems in the resource allocation of agricultural science and technology R&D.

1.2.2.1 Unreasonable resource allocation of agricultural science and technology R&D. Firstly, in the current situation of resource allocation of agricultural science and technology R&D, the human resources, labors, information can not be effectively allocated. YANG Rui *et al*., found that in China, the agricultural infrastructure is weak, the industrialization of agricultural technology results is low, the unreasonable industrial structure and agricultural technological policy is imperfect, some agricultural science and technology R&D resources stay in isolated state[13]. Secondly, in the imbalance of agricultural science and technology R&D resources, WANG Jian-wen, found that the power of agricultural science and technology mainly focuses on the production period rather than on pre-production and after-production periods. The resources of agricultural science and technology R&D are relatively concentrated on research area, but the resources on the sections of achievements conversion and industrialization are relatively weak[14].

The reasons of unreasonable resource allocation of agricultural science and technology R&D are as follows. Firstly, the development and use of agricultural science and technology R&D resources are insufficient. WANG Yu-meng found that inaccurate science and technology results and the evaluation standard of science and technology staff; the weak promotion of agricultural science and technology results and incomplete use of science and technology resources; brain drain and imperfect development of human resources[15]. Secondly, the defect of land system affects the source allocation of agricultural science and technology R&D, for the current land system can not satisfy the stable expected income of people and will reduce the input on agricultural science and technology R&D. PANG Bo-lin pointed out that the current land system has hindered the resource allocation of agricultural science and technology[16].

1.2.2.2 Low efficiency of resource allocation of agricultural science and technology. The resource allocation of agricultural science and technology stays on the stage of " low efficiency" and many places have shown the descending trend. LI Shi-bao *et al*. pointed out that the scale returns in some province have shown the descending tend, so it is imperative to improve the efficiency of resource allocation of agricultural science and technology R&D[10]. Secondly, the resource allocation of agricultural science and technology R&D, the factor transfer market should be established to break the equilibrium state of low efficiency. In terms of market mechanism, SUN Tai-qing, found that the overall scale of agricultural science and technology R&D resource was small. It was caused by the government, who applied the macro-control mechanism and market mechanism to the non-agricultural sectors and cities. Thus, the development of agriculture always lays on the low-efficient stage[17].

1.2.2.3 Low transformation efficiency of the agricultural science and technology. In the research of the output efficiency of resource allocation, it is found that the transformation efficiency of many scientific achievements was low, which led to the ineffective supply. In the study of industrialization of scientific achievements, HE Jing found the problems including ineffective supply of agricultural scientific achievements; the low-compensation or no-compensation of agricultural scientific achievement; small scale of agricultural production; low cultural quality of farmers hinders their acceptance of scientific achievements and the agricultural promotion mechanism[18]. In terms of the ways for resource allocation of agricultural science and technology, JIANG Shao-jing *et al*., found that the " dislocation" and

"omission" existed in the channel of resource allocation of agricultural scientific R&D[19].

1.2.3 The effective mode for resource allocation of agricultural science and technology R&D should be established.

1.2.3.1 Establishing service system of agricultural science and technology and reforming the allocation mode of agricultural science and technology. JIANG Shao-jing *et al.*, put forward establishing the service system of agricultural science and technology, which takes rural cooperatives as the core[17]. In terms of reforming agricultural science and technology R&D, LIU Huazhou *et al.*, put forward the following suggestions: establishing innovation platform for agricultural science and technology; fully displaying the leading role of agricultural scientific institutions; supporting the science and technology-based agricultural enterprises; establishing favorable propagation channel, in the end, realizing the rational allocation of agricultural scientific R&D resources[20].

1.2.3.2 Developing advanced agriculture and intensifying the promotion functions. The government should improve the agricultural science and technology R&D resources from quality and quantity aspects through developing advanced agricultural types and intensifying the promotion function of agricultural science and technology R&D resources, and then enhance the efficiency of resource allocation. HU Bao-di thought that the delicate agriculture, ecological agriculture, export-oriented agriculture and information-based agriculture should be developed greatly. The science and technology-based agriculture should be cultivated to ultimately realize the rational allocation of agricultural science and technology R&D resources and the sustainable development of agriculture[21].

1.2.3.3 Rationally allocating resource through reasonable channels. An important problem in the resource allocation of agricultural science and technology R&D is to clarify the allocation channels for different resources. Only through reasonable channels, could the resource be allocated effectively. Once the allocation way is wrong, the low efficiency is inevitable. GAO Qi-jie pointed out that the functions of five allocation channels should be clarified: emphasizing administration-based agricultural promotion organization to improve the efficiency of resource allocation through institutional innovation; education-based agricultural promotion organization should deepen the reform of scientific management system of higher education; scientific research-based agricultural promotion organization should transfer the direction of scientific research; enterprise-based agricultural promotion organization should pay attention to technology innovation and system innovation; the self-help agricultural promotion organization should intensify the organizational management[22].

2 Researches on resource allocation of agricultural science and technology R&D

2.1 The status quo of foreign researches on resource allocation of agricultural science and technology R&D Although different scholars have different results of the return rates of agricultural science and technology input at different time periods of America, in general, the results are approximate, which reflects that the return rates of investment, single investment and return rate of agricultural scientific input are all high. So the government should intensify the input on agricultural science and technology and increase the aggregate quantity of agricultural science and technology R&D. In analyzing the influencing factors that affect the resource allocation of agricultural scientific R&D, it can be seen that the government should endeavor to improve the environment of agricultural science and technology R&D, to improve the efficiency of development and input; rationalize the allocation mode and let allocation input generate higher agricultural productive efficiency.

2.2 The status quo of domestic research

2.2.1 The status quo of resource allocation of agricultural science and technology R&D. The government should intensify the support on agricultural scientific investment and direct the entrance of private capital. The reasonable distribution should be established to make full use of agricultural scientific funds. The efficiency of agricultural scientific investment depends on the advanced technology and the effective supply of the advanced technology. It also includes the problem of resource allocation of various resources. The resource allocation of agricultural scientific development includes human resources, capital resources and information resources. Therefore, finding out the reasonable allocation of human resources, capitals and materials through the current research is of important practical significance.

2.2.2 Problems in the resource allocation of agricultural science and technology R&D. The resource allocation of agricultural science and technology R&D has many problems in allocation mode, allocation channels, allocation scale, allocation efficiency and capital input. The problems are reflected on the unreasonable allocation mode; the single reliance on government of allocation channels and the dislocation of government; small allocation scale in public-owned areas and large allocation scale in private areas; irrational allocation structure: less input on fundamental research and high input on application and experimental research, which lead to the irrational inner distribution structure; low efficient allocation, which is reflected on the difficulties in transforming agricultural scientific achievements. The resource allocation of agricultural science and technology R&D in some areas has shown the descending trend, so it is imperative to update the existing agricultural science and technology R&D resources and improve the allocation efficiency.

2.2.3 Resource allocation mode of agricultural science and technology R&D. The reasonable allocation of agricultural science and technology R&D needs the establishment of proper laws and regulations. Under the restriction of resources, environment and capital, the maximum interest of resource allocation should be achieved through innovating resource allocation channels, absorbing diversified investment; developing market-oriented agricultural science and technology R&D resource; establishing new allocation channels and intensifying the support of financial insurance on the development of science and technology R&D.

3 Analysis on the resource allocation of reasonable agricultural science and technology R&D mode

3.1 Analysis from the structure, environment, channel and aim of agricultural science and technology R&D

3.1.1 Allocation structure. By using empirical analysis, the study tries to find out the relations between human resources, capital, labors and information of agricultural science and technology R&D resources and reasonable allocation. Besides, its relations with the total volume of agricultural economy and the quantity of enterprises concerning agriculture are analyzed as well.

3.1.2 Allocation environment. In terms of external environment, the government should pay attention to the tendency of policies to create a virtuous input and output cycle. The government should fairly distribute the R&D resources to agriculture sector, forestry, animal husbandry, sideline production and fishery; rationally allocate the scientific resources among enterprises, colleges and universities and scientific institutions; input into different areas. In terms of internal environment, it mainly includes the specific arrangement of each specific index to let each agricultural science and technology R&D units get high efficient output.

3.1.3 Allocation channel. The market allocation is the leading way and the governmental assistance is the auxiliary way. Agricultural science and technology R&D resources are a kind of public goods and the government should adjust and direst the entrance of private capital. Thus, the demand on capital can be net. Besides, due to the vitality of private capital, the innovation will be faster and the efficiency will be higher.

3.1.4 Allocation target. Through the reasonable arrangement of human resources, capital, labors and information, to enhance the output efficiency of agriculture and the sustainable income increase of farmers.

3.2 Analysis form the perspective of spatial layout

3.2.1 From vertical aspects. The variations of agricultural scientific resource allocation at different time and aspects should be laid stress on, for the variation of external environment needs the variation of the elements of agricultural scientific resource allocation. The market demand will change with the changed of consumers' favors, so the transformation sector of scientific achievements of agricultural scientific resources should change with the environment.

3.2.2 From horizontal aspects. In order to rationally allocate the resources of each area, the agricultural market should allocate the agricultural science and technology R&D resources, which adjusts to its agricultural industrial scale. The pillar enterprises should be established at the sources of raw materials. The agricultural scientific resources should be transformed efficiently by using the productive functions of pillar enterprises. The fundamental research should be intensified and the transformation of scientific achievements should be accelerated. The agricultural technological experts should go to countryside to promote the agricultural science and technology and let farmers realize the benefits of scientific achievements.

3.3 Analysis from the perspective of industrial chain

3.3.1 Before production. The relations of fundamental research, experimental research, the transformation of scientific achievements in agricultural science and technology R&D resources should be paid attention to. The proportion of fundamental research should be intensified in order to change the situation of only paying attention to the transformation of scientific achievements and experimental researches.

3.3.2 In the mid of production. The enterprises should pay attention to the combination of agricultural scientific achievements and farmers' need, and then benefit both the enterprises and farmers; protect the ecological environment and improve the sustainable development capability of various levels of agricultural environment.

3.3.3 After production. In terminal of industrial chain, the study on logistics and supply-demand should be paid attention to. The agricultural science and technology R&D resources should be allocated to the terminal production. Only when giving priority to the supply-demand of market and high effective allocation of products, then the products can be effectively transformed. The demands on agricultural science and technology R&D resources are the real demands.

4 Researching expectation

Farmers' income increase and the stability of rural society need the reasonable allocation of agricultural science and technology R&D resources. Although at the current stage, there are certain achievements in the area of allocation, with the change of environment, many new problems need handling. The promotion functions of agricultural science and technology R&D resources to agricultural ecological environment, economical developmental status, social cultural situation, agricultural sustainable development capability and the causal connection of various aspects and the resource allocation mode of agricultural science and technology R&D can all become the future research topics.

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ures to escort the healthy development of agriculture insurance.

3.4 Establishing the laws and regulations of agriculture insurance American *Federal Crop Insurance Act*, Japanese *Basic Law of Food*, *Agriculture and Rural Area and Agricultural Disaster Compensation Law* and French *Agriculture Insurance Law* are all complete. The special laws play an important role in protecting and promoting the healthy development of agriculture insurance.

American government provides great support on agriculture insurance and the means are more direct and effective. The emphasis is reflected on the subsidies of premium is targeted at agricultural crops rather than at insurance institutions. And then, though reinsurance to disperse the risks of insurance company. The Japanese government implements the imperative insurance on the cultivation and breeding that concerning the national economy and people's livelihood to provide the premium for farmers. The more the rate of premium, the more the subsidies of national treasury will be. Japanese government also provides subsidies for service costs to the organizations that open agriculture insurance (except for the voluntary insurance), and provides the reinsurance business to associated society of Masonic group. French *Agriculture Insurance Law* stipulates that the agriculture insurance items are determined the national laws. The insurance responsibility, reinsurance, premium rate of insurance and claim calculation, *etc.* are all stipulated by legal form. French government implements the imperative insurance on staple products, which include agro-products (rice, wheat, fruit tree, *etc.*) and domesticated animals (cow, horse, pig and silkworm). By comparison, Chinese government should learn from the reality.

At present, the China Insurance Regulatory Commission and the State Council are trying to stipulate the *Agriculture Insurance Act* and the primary framework has been formed. It should be clarified that the agriculture insurance belongs to policy insurance, and the supervision mechanism is the Insurance Supervision, the supervision on agriculture insurance conducted by the Insurance Supervision Commission of the State Council, the State Treasury and the department of agricultural administration and governments at various levels. The institutions take the responsibilities of supervising agriculture insurance and establishing communication and coordination mechanism. In terms of fiscal subsidy, the central government and the local government should provide the premium subsidies to farmers and operation subsidies to insurance company according the contents of agriculture insurance. In terms of premium subsidy, the central and local government should not only subsidize the rural households, but also subsidize the insurance companies. The government should cancel the operation taxes and income taxes of agricultural insurance. Besides, the financial institutions should give priority and preference to rural households, who have insured the policy-based agriculture insurance, when the rural households want to get loan. In addition, the country should set up the reserve system of policy-based agriculture insurance to promote the healthy development of agriculture insurance.

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