Pro-smallholders' Agricultural Science and Technology Policies in China

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Abstract

China's agricultural science and technology system has benefited the economy more than it has benefited smallholder farmers in China. The impact of the management structure of China's agricultural science and technology policy, together with the project management system and achievement award system has not favored smallholders, despite the fact that the system has actively embraced a 'livelihoods' focus and is well advanced in transition to a 'farmer-centered' science and technology system.

Introduction

For thirty years after the foundation of the People's Republic of China, national food security dominated the thinking of those responsible for guiding the development of China's agricultural science and technology policy. Increasing agricultural output and productivity as rapidly as possible was the one over-riding goal. Macro-economic and social policies were fashioned to serve and protect national food security. An associated priority was the development of China's chemical industry, on which farmers were increasingly dependent as agriculture increased its dependence on chemical fertilizers and other agricultural inputs. Food security was at the core of China's agricultural science and technology, with research concentrated in applied areas expected to result in increased total grain production and the unit yields. Management of the system was organized in parallel fashion on a 'project plus professional' basis, with research units responsible for research and the people's work units on communes and state farms responsible for production. Universities played an education role using pedagogy largely divorced from the realities of farmers' fields, government departments issued scientific research and production targets. The system was highly centralized and controlled, driven by administrative edicts reflecting China's centralized planning structure and goal setting processes.

In the years immediately after China's radical 'open-door' reforms of 1978 and thereafter, the importance of market signals as arbiters of resource allocations decisions at farm level increased. Over the subsequent decade and an half, the sleeping giant of China's agriculture shook off it torpor as farmers across the country responded to the opportunity that the new responsibility system provided to produce for the private market. In the most favored regions, well resourced farmers prospered, leaving their poorer and less favored cousins behind. The impact on productivity and national food security was nothing less than amazing. By the close of the 1990s, the problem of food security had slipped from centre stage. China was not only producing enough to feed its population, but consumers had the where-with-all to buy the food brought daily to the market. Nonetheless, the income gap between poor and not-poor farmers and between urban and rural households widened dramatically. The contrary micro interests of smallholders, who wanted higher farm gate returns for higher income, and national macro objectives, that wanted cheap food so as to contain inflation and upward pressures on wages, gradually emerged as an important issue in rural poverty reduction. Agricultural science policy quickly

found itself between a rock and a hard place, escape from which had to combine increasing smallholders' incomes while at the same time containing any inflationary pressures that would come from increasing farm gate prices. Consequently, the core objective of agricultural science and technology policy shifted to (i) improving the quality of agricultural products farmers deliver to the market; and (ii) promoting the diversification of smallholders' incomes. A neat trick if it could be pulled off, which history has shown it has to the benefit of consumers and farmers in general, but with little benefit to smallholders at the bottom of the poverty pyramid.

The new millennium saw yet another sizeable shift in China's approach to agriculture and the role of science and technology. China began its entry into 21st century agriculture by promulgating a 'Program for the Development of Agricultural Science and Technology 2001-2010'. This new policy sought to integrate objectives that had previously been dealt with as separate and almost isolated areas of public policy. On the one hand the pursuit of food security remained of high importance, as did the protection of farmers' incomes to prevent backsliding of newly prosperous farmers into traditional rural poverty. On the other hand, government now added goals concerning the environment and resource sustainability, plus improvement in international competitiveness in keeping with the freer trade that would follow in the wake of China's entry into the WTO. The supporting role of agricultural science and technology policy changed in lock-step. Hereafter, agricultural technologies were to serve a broader domain of technologies. Science and technology would continue to help farmers upgrade their skills and access 'scientific approaches' to rural production, but science and technology would also acknowledge the importance of environmental concerns, the unique differences between renewable and non-renewable resources, as well as the technology transfers needed to ensure that China's farmers could compete with the rest of the world. There followed polices such as the 'Project of Technology Entering Into Farmers' Households', the 'Spark Plan', the 'Project of Agricultural Experts in Villages Yards', the 'Science and Technology Correspondence System', the 'Agricultural Technical Services 110' and many others. The tenor of these policies was to nurture a trend in research policy that was diverting the role of agricultural science and technology to the service both farmers' livelihoods and 'sustainable' development, while the real plight of the hard core poor farmers remained largely unattended.

A cursory look at the data shows that the fastest period of decline in the incidence of rural poverty in China coincides with the fastest period of growth in agriculture production and the period of fastest development of China's agricultural research. This result provides a prima-facie basis for describing China's agricultural research policy as pro-poor. The contribution of agriculture research to agricultural growth is estimated to have increased from 20% during the period of China's 'First Five-Year Plan', 1953-57, to 48% in the year of 2006. Agricultural mechanization is believed to be responsible for up to 38%. New varieties and other new technologies account for the difference.

There can be little doubt that China's agricultural science and technology policy has been developed and adjusted to meet the practical needs for farmers and rural development. But, it is also clear that there has been and important impact on demand for research following the policy reforms that opened up the land system in China to the more liberal and market directed regimes of the household contract responsibility system. This reform enabled many farmers to remake themselves from simple laborers in the collective into independent operators, responsive to market shifts and opportunities to produce for profit. The impact that this change had on farmers' demand of agricultural technology services should not be under-stated. It resulted not only in an increase in demand but a diversification of demand.

The responsibility system of land tenure allocation was rolled out in China at a time when there was also rising competition between farmers and other members of the community for land. The trend to farmers working an increasing number of ever smaller plots of land, often scattered over a considerable area, was in conflict with the scale of operations that scientific and sustainable farming demanded. National census data for 2004 shows that the average rural household of four persons farmed an area of only 0.7 hectares but consisting of scattered plots of land. Various legal promulgations have been used to arrest the decline in land availability and encourage land amalgamations to suit the adoption of 'scientific farming', but the reality is that annually quality farm land is being lost in China to urban growth, infrastructure investment in roads, communications and public buildings, and growth in rural manufacturing capacity. In this environment, the role of agriculture research has and must shift yet again, though the pressures will continue to come primarily from those able invest.

The structure of agricultural science and technology researching and extending system and its impact on farmers

Three main parts respectively researching system, extending system and awarding system are included by agricultural science and technology system of China. As the social and economic transformation, a hybrid structure of the system that including public and non-public parts are emerging compared with the single part as before, at the same time we can see this new structure is institutionalizing day by day and the role of non-public parts is more and more important. But a desponding phenomenon is that the state administrative management system to the public parts has not yet changing in practical, which characterized by traditional "planed plus professional" style.

In public research system, different parts of research agencies separated by different field, such as planting, forestry, irrigation, mechanism and agricultural education and others, were be formed from state level to regional level in all of the country. In according to statistics supported by the Ministry of Agriculture, there were almost more than 1100 agricultural research agencies from state level to regional level all over the country in 2001, of which 636 agencies' main researching field on planting, and 125 on stockbreeding, 125 on fishery, 171 on mechanization of farming and 43 on others, and we can see in all of these agencies could be separated by state level of 59 and provincial level 424, regional level 617. Another case for this is in the agency of China Agricultural academy we can see 39 institutions of research centers, of which 16 for planting and 10 for stockbreeding, 8 for agricultural economy and environment and resource, 5 for agricultural engineering and high level technology research. All of these 39 agencies separated in 16 provinces or regions according different research field, such as Hemp institution is in Hunan province, Silk institution is in Jiangsu province and Water buffalo institution is in Guangxi province. This special public researching system comes from its special state administrative management system which means each level agencies are managed by corresponding government's department. For example, the agricultural researching system in state level is separated into different parts according to special fields and managed by special ministry of bureau, such as agriculture research agencies are managed by Ministry of Agriculture, forestry research are managed by Bureau of State Forestry, and agricultural mechanism research agencies are managed by Bureau of State Mechanism and Industry. Each ministry or bureau makes their science and technology development plan and then all collected and facilitated by the Ministry of Science and technology to form the final state science and technology development plan. The State Council could be the top leading department and the State Committee of Development and Transformation would be the final facilitating department in the process of state overall agricultural science and technology

development planning, of which the Ministry of Finance makes the role of facilitating budget planning. Similar with the state level, in provincial and regional level, different agricultural researching agencies are also managed by same level government's department.

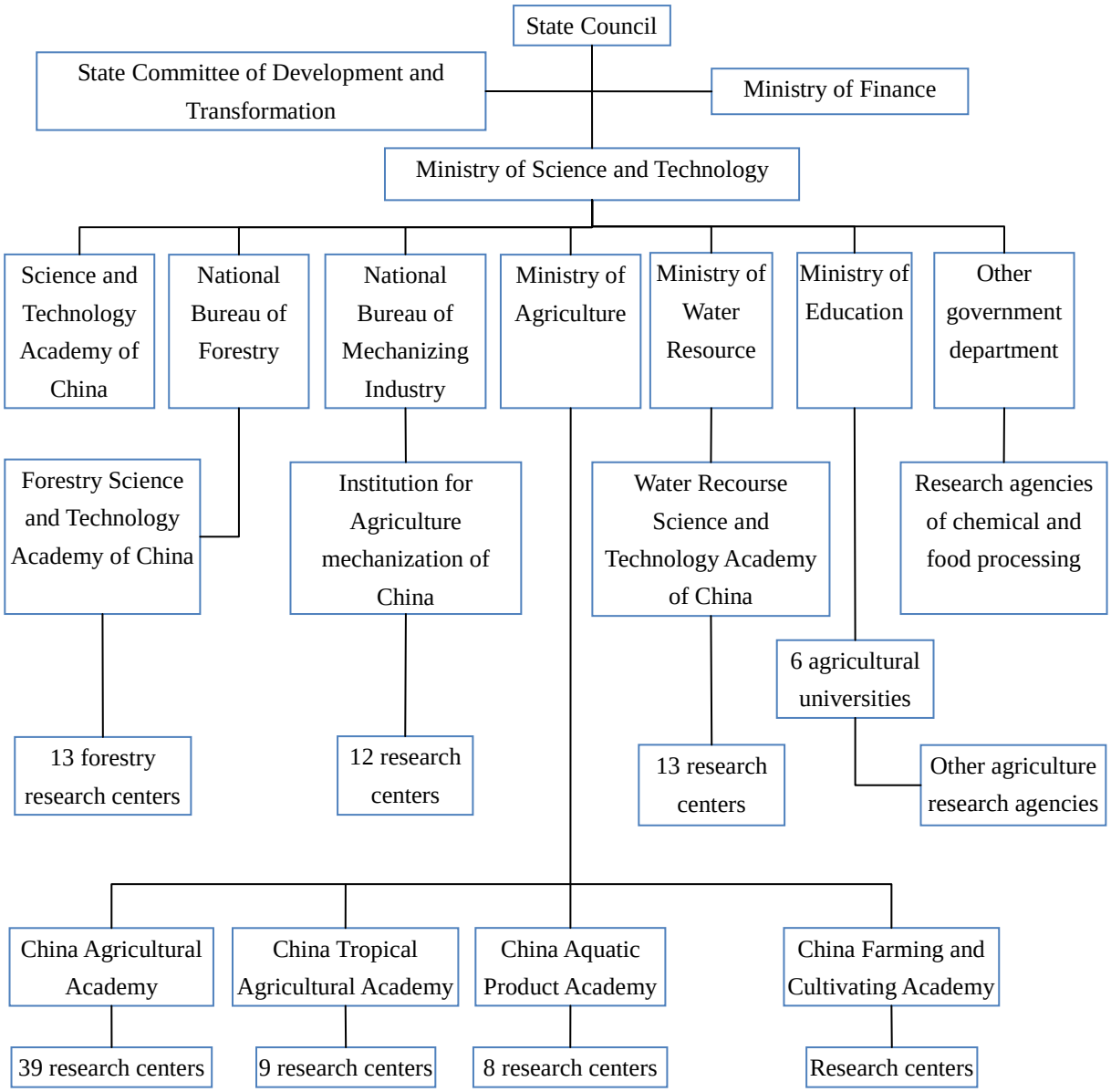
A similar public extending system, companied with this special structure of public agricultural researching system, is also separated by professional and administrative level. From now on, a "five levels agricultural technology extending network" was formed from state to township level on the support and managed by government, of which respectively are State Agricultural Technology Extending Center, followed by provincial, regional, county and township level extending department. By the perspective of professional the extending system would be separated by five parts such as farming technology, planting prevention and protecting, fertilizing, seed supporting and farming mechanizing. These public extending agencies normally are parts of government department and sometimes will be combined with them, a case of this example is in Changshun County on Guizhou Province, the agricultural technology extending agencies are parts of agriculture department in county. After years of development and adjustment, a sampling statistics from Ministry of Agriculture shows that by the year of 2006 there have more than 20,000 agricultural extending agencies all over the country just only on the county level, and more than 150,000 on township level in the total.

This special structure of public agricultural researching and extending system makes heavy efforts to improve farmers' livelihoods by supporting kinds of different agricultural technologies and skills in different fields to improve farmers' household income or laboring efficiency. As different area could focus their research resource on some special fields according to their own special needs by farmers, and state level research agencies would make more attention to the issues of all country level. Meanwhile, this characteristic of multi level structure makes national agencies makes more resource on basic research and local agencies on applied research. A statistics showed that in the period of the tenth Five year plan of Guizhou Province, 2001-2005, there are almost 90% percent of total agriculture research inputs in Guizhou province were applied research, but only 9.58% of them are basic research. However, state administrative control also resulted in a system that was exceptionally diverse but largely unresponsive to the need of farmers. The responsibility system released pressures from within the market economy that challenged the strong inertial roles of the system, encouraging changes that, though far from complete, reflect the place of farmers as the ultimate reason why the system exists. A big gap between these two systems makes much new technologies would not be extended or used in reality as there normally without frequently communication between research and farmers real needs. The biggest reason to cause this issue is because the separate of agricultural research and extending in state administrate control model which make 'professional plus plan' characteristics structure. A not precise statistics shows that in the period of tenth 'Five year plan' between 2001 to 2005, there were only about 30% to 40% of new agricultural technologies were been extended in practical.

Beside the public agriculture research and extending system in China there has emerged a non-public system that is profit and client driven, which includes enterprises, professional associations, individuals and some other organizations or agencies that not only support new technologies but also extending services to farmers. Statistics showed that even in the year of 2001, there had more than 100,000 professional agriculture associations all over the country and more than 400,000 village technology service organizations, no matter than uncountable agriculture enterprises and other types of organizations or agencies. The reason why this system has flourished is not a mystery. The public system, for all its reforms and embrace of radical transformation, remains constrained by tradition and

bureaucratic momentum. Non-public sector providers have found a niche where flexibility and responsiveness to farmer's needs can generate profits. Increasingly the public and non-public systems of agricultural research, at least at the technology adaptation and extension end of the research spectrum, overlap. In many respects the separate existence of a large number of enterprises and the emergence of the forms of independent innovation by farmers are signs of emerging maturity of the market-based agricultural research system. However, there are benefits to society if the two systems can be made to integrate where the cause of market externalities and public goods intersect. The case of Shandong Denghai Seed Industry Co. is an example. This corporation is led by Mr. Li Denghai, a top scientist in the maize breeding sector in China. He was a peasant, even though he has not received any systematic higher education, in the past 30 years he has created more than 20 new varieties of high-quality and high-yielding maize. He self-financing his research, but the varieties he created is now grown across a large area of the country. At the same time, the seed company founded by him has become one of the rare enterprises with strong international competitiveness in China's seed industry.

Figure 1: The structure of national agriculture research system



(Huang Jikun,2003)

There is no doubt that the agricultural science and technology makes an un-replaceable role in rural development and farmers' livelihood's improving in the past decades of years. Statistics shows that because of kinds of new technologies' applying, the total yields of farm crops all of the country increased about twice from 305 million ton in 1978 to the top yields year of 1999,512 million ton on the background of total arable land's dramatic decreasing for industrialization, and also companied with dramatic decreasing of poor population from almost 250 million in the end of 1970s to about 2.3 million in the year of 2006. New technologies such as weeds killer also saved lots of farmers' labor input in farming and translate it into other ways to get more money. In a hybrid structure of agriculture research and extending system, almost all of basic agricultural technologies or innovations are made by public research system and also for most of applied research, but the functions for non-public research system could not be neglected especially in applied technologies. A diversified technologies

demanding structure by farmers is not yet a future events in rapid developing Chinese rural area in market environment, more and more rich farmers' technologies' demand is not limited in traditional high crop yields but for high quality, new varieties, multi-structure planting and market oriented technologies. Besides the source of public system, enterprises, as main part of non-public system, make big role in agricultural technologies' multi-source supporting and extending.

But a big problem in the shadow of splendid is that the gap of rich and poor farmer in development level as part of reasons is because of different capacity to assess new agricultural technologies as they need, although many farmer oriented technologies made by public system were be extending and spreading in market by the effort of public agricultural extending system. The reasons for this gap happened parts come from farmers' actual income decreasing made by market waving, especially when high yields by new technologies applying made the total market unbalance as more support and but less demand. Poor farmers as high vulnerable compared with rich ones would be the first and biggest losers. Another reason for this is because of public extending actions often combined with some developing actions that leading by local government, a typical case for this is in the county of Changshun, a normal county in northwest province of Guizhou, there are at least five large agricultural technologies extending actions such as marsh gas skill, new fruit trees planting and training, mushroom planting, tobacco planting, capsicum planting in the past two years and all of this are parts of whole development plan made by county government. But because of high finance and labor cost and market risk for new technologies using, only little farmers who most of them are rich had participated in these extending actions although there had little subsidy from government. But because of many other influencing actors such as officers' corruption and market changing that farmer cannot control, most of these extending activities were failed or did not receive farmer's expectation.

As a new solution for farmers to get new technologies they want is non-public extending system that makes more and more important role, such as enterprise and associations. A field survey from Changshun County shows that almost all new technologies farmers they use are come from market in sampling of about 50% farmers in a village, and more than 80% percent of new technology information they received are come from mass media or other people or market, compared with only little come from public extending system. But a same problem like public system, although most farmers can find technologies they want, yet only little of them have enough capacity to use them as high price for them, especially for poor farmers. An example for this is in 2005 in Changshun County, when farmers faced a high price as 10 RMB yuan for one fruit tree seeding in a normal village, one rich farmer bought 200 and earned more than 5000 RMB yuan compared with a poor one who bought 50 and earned only about 1000 yuan this year.

A fortunate changing that is being happened is that more and more non-profit organizations such as farmer professional association are emerging in much area, who organized farmers as a unit to face market and support technologies and skill service to them. A good example is Xiajia pig breeding association in Jilin province, whose members all are pig breeding farmers in a township. Farmers will receive much training they want in time support by association or from some relevant enterprise or experts. In actually, this association was also received many support and encourage from local government and public services system as its good achievement, an obvious case for this is that the pig breeding farmers' income in the association normally were higher about 5% or even more than other ones who are not including in the association.

Prospected for farmer-centered agriculture science and technology system

With the rapid developing of civil society, more and more grassroots NGOs, associations, research agencies and some government officials are practicing and promoting farmer centered agriculture research to meet farmer especially poor farmer's needs with the facilitation of those participatory development projects introduced by international donors since the end of 1980s'. An informal academic group called Farmer-centered Research Network consisting of around 16 provincial Agricultural Academies in China has been practiced Farmer-centered research approach for 7 years. And at the same time we can see more and more similar organizations are emerging. An exciting result is that farmers who participated in the process not only had higher income but also higher capacity compared with non-participants. Farmers become the key role in decide making process about what technologies or services they want but not traditional government or researchers.

A milestone for this change comes from political transformation what is happening in China nowadays, people centered development idea is becoming primary principle for all over the country. A new agriculture research and extending structure with integrating public and non-public research and extending system, and researching and extending agencies together as one organic group to support technologies and services to farmers is become one important goal in 'Program for the Development of Agricultural Science and Technology 2001-2010'. The CPC 17th national congress report that published recently also makes much more ink in developing a farmer centered agriculture research and extending system.

However, this innovated system is to be built up based on those efforts and good signs that have been showed.

Agricultural science and technology award system and its impact on farmers

In the status of small-scale production, demand for Agricultural Science and Technology showed whether the science and technology award system was a kind of institutional inducement for encouraging "farmers' demand-centered" technology development. At present, the structural characteristics of Chinese agricultural science and technology award system mainly combined by officially incentives and social incentives indicate that the institutional inducement is gradually taking shape and perfecting, and it has played an important role in guiding and motivating to greatly improve the livelihood of farmers in the past few decades.

Official reward system is divided into two major awards at national and provincial or ministerial levels. There are five major national awards in the provisions of "the State Science and Technology Award" implemented in 2003, which are: the State Supreme Science and Technology Award, the State Natural Science Award, the State Technological Invention Award, the State Scientific and Technological Progress Award, the International Science and Technology Cooperation Award. Usually the provincial and ministerial levels award is established by the long-term planning of science and technology development implemented by agricultural science and technology departments and key scientific research projects, such as Spark Program Award of the Ministry of Science and Technology. Each province can establish a Science and Technology Award. In addition, local governments usually establish relative agricultural science and technology awards according to the local characteristics. Both the principles of the official incentive system and the actual awards indicate that, considering the balance between the basic and applied research, the large-scale application of agricultural science and

technology achievements aiming at raising the level of farmers' subsistence become the focus of scientific and technological incentives, such as improved development, water-saving & fertilized technologies, weeding technology, and irrigation technology and so on. Besides it, in order to solve the problems which are too many academic achievements but insufficient results of practical and applicable research for farmers and little public welfare research results, "national long-term scientific and technological development Outline (2006-2020)" clearly states that it will provide the system of incentives for practical application of technology research through the reform of the evaluation and reward system. And the social reward system, as an important component of China's agricultural science and technology reward system, has complemented for the system defects of the official incentive system to a large extent, mostly because of its preference for practical application of technology or basic pioneering innovation.

Table 1: Agricultural science and technology award system

Grades	**Awards**	**The major award types**	**The award sector**
State-level Awards	State Supreme Science and Technology Award	Basic Research / Applied Research	The State Council
	National Natural Science Award	Basic research and applied basic research	
	State Technological Invention Award	Major technological inventions	
	The State Science and Technology Progress Award	Technology development category, type of foundation, the major engineering	
	International Science and Technology Cooperation Award	International technical cooperation	
The provincial and ministerial levels Awards	Science and Technology Progress Award	Application of research-based	The provincial government
	Spark plan	Application of Research and Technology Extension	Ministry of Science and Technology
	Basic Research Program (973 Program)	Basic research	
	High-tech Research and Development Program (863 Program)	Basic research & applied research	
	Research programs	Application Technology Research	
	Climbing program	Basic research and applied basic research	
	The National Science and Technology Support Program	Application Technology Research	

Grades	Awards	The major award types	The award sector
	Key scientific and technological achievements Extension Program	Application Technology Research & Extension	
	The Torch Plan	Application Technology Research & Extension	
	Leap plans	Application Technology Research & Extension	The Ministry of Agriculture
	The harvest plan for Agriculture, Herding and Fisheries	Application Technology Research & Extension	
Society Awards	HeLiang& HeLi "Science and Technology Achievement Award"	Basic Research / Applied Research	The social sectors
	DuPont Technology Innovation Awards	Basic Research / Applied Research	
	The Chinese Academy of Sciences - Bayer Young Scientist Award	Applied Research	

The real functions for awarding system is not the awards itself to researchers in normally, but the other benefits that the researchers can receive from awards such as reputation, social status, income improving, subsidy improving, more projects and some other privileges in the organization compared with others. These invisible benefits make the researchers full of energy to do research and submit application for awards on the guideline of nowadays awarding system. A good way is that the ratio of applied technologies and practical skills and extending activities for farmers are increasing in these years. We can believe that more and more farmer oriented technologies and skills will be made in the future although there also will have many others just only for obtain an awarding. A very famous example is Yuan Longping, a very famous and top scientist in rice breeding sector in China and the world who improved the rice yield more than double compared with the past ones in last 30 years, wined the State Supreme Science and Technology Award in the year of 2000 when this award first issue in China. A statistics analysis shows that from the year of 1995 to 1999, there were 2292 awarded researches at national and ministry level, of which more than 80% are applied research. Another example is that about 77% national level awarded researches in China Agricultural Academy were applied research, and another 15% were applied basic research, left only 8% percent were pure basic research from the just beginning of its foundation.

Conclusions

The institutionalization of China's agricultural science and technology policy has played a significant role in promoting agricultural development and improving farmers' living standards. With the reform of the agricultural science and technology policy, the inter-linkage between the agricultural research and extension becomes stronger, and the research and development of technology meets the actual needs of the farmers more and more. Along with the improvement of agricultural science and technology

system of incentives, farmers' actual needs for the applied technology development is paid more attention. Although the agricultural research system driven by the state administration still showed fragmentary structure, with the reform of national decentralized management and the involvement of non-government scientific research institutes, a diversified agricultural science and technology policy system meeting the diversified technological needs is emerging, and the "farmer-centered" agricultural research & extension system become the trend in future.

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