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Agricultural Engineering Research Development and Food Production in China

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ABSTRACT: China has the world largest population and faced with the attendant need to feed the huge population which by all means is a huge challenge. The traditional form of farming is obsolete and can not cope with the present need for massive and rapid food production. In the light of this, the Chinese government embarked on aggressive agricultural production policy and implementations in all sphere of agriculture. Deliberate agricultural mechanization and development of Agricultural Engineering played a great role in achieving the target of food sufficiency target set by the government. This feat is remarkable and this paper intends to highlight some steps taken in this direction. Research and development in Agricultural Engineering contributed immensely to enhance production capacity, reduction of labor and production cost, mechanization of crop and animal production, improved post-harvest technology, advanced irrigation farming, conservation of soil and water, effective utilization of resources and agricultural environmental protection among others. The task of self reliance in food production in China continues to be the challenge of the government and agricultural engineering development. Funding and expansion of the scope of research and development in agricultural engineering will continue to provide new technologies to increased production of quality and safe agricultural products. The future trend will be to improve the quality and standard of agricultural production process in order to provide better quality of food and be competitive in the present dynamic economic environment.

KEYWORDS*:* China, Agricultural Engineering, Food, Research and Development, Technology.

I. INTRODUCTION

As an old saying in China goes “food is the first necessity of man”, which shows how highly the Chinese people value food. As a basic necessity in life, food has remained an issue of top concern for the Chinese government and common people. China is traditionally an agricultural country, with most of its residents living in rural areas. Agriculture has always been considered the lifeline of the national economy.

Peoples Republic of China is a big developing agricultural country with a population of 1.3 billion which is about 21% of the world population. With this huge increasing population to feed and the arable farmland per capita decreasing from 0.18 ha to about 0.094 ha which is only 40% of the world average, China faces a challenging task to feed the world 21% population with only about 7% of the world’s total cultivated farmland.

This task is further compounded with the fact that China is a country with poor water and soil resources. China per capita water resources is only 28% of the world average. Annually, China’s agriculture is short of 30 billion cubic meter water and 5 billions tons of soil is lost to soil erosion (CAY, 2006). Agricultural labor productivity is quite low in China and it is about 1/108 of that in Canada, or 1/120 of that in United States. There are about 150 million surplus labor forces in rural area with additional 6 million every year.

With the above-mentioned problems, the traditional mode of agricultural production can no longer meet the requirements of food self-sufficiency. Agricultural production has to be modernized, production capacity increased, income levels of the farmers has to be enhanced which bring into the forefront the urgent need and great importance for the development of agricultural engineering in China (Adekola et al, 2014).

The achievements of China agriculture was acknowledged in the “China 2020” World Bank report, China, with a population more than the total of Africa, spent only a generation of time to make the achievement which have taken several centuries for other countries (Zhou et al, 2003).

Agricultural development and achievements in China benefited immensely from the engineering application especially since the reform and opening policy started in 1978. Without agricultural engineering, China can not produce enough food to feed her population.

II. AGRICULTURAL ENGINEERING RESEARCH AND DEVELOPMENT STRATEGIES

The Reform of Agricultural R & D System (Including Agricultural Engineering R&D) in the past 20 years had been classified into 3 stages: –Decentralization period (1986-1992), Readjustment period (1992-2000) and Classification of R&D institutes period (2000-2006). The emphasis of the recent reform is on: strengthening support to R&D institutes for public welfare, encouraging the transformation of applied research institutes to enterprises, enhancing academic discipline development and research platform construction, and improvement of internal management (Zhang, 2004).
Review of Agricultural Engineering R & D in China has achieved the following results between 1949 and 2005，machinery power increased from nearly zero to 684 million KW, rural electricity supply reached 438 billion KWh, reclaimed arable lands of over 20 million hectare, irrigated farming areas increased by a third and 80,000 reservoirs with water storage capacity of 480 billion m3 were built. Agricultural Engineering R & D in China is divided into four stages: 1950-1980, 1981-1994, 1995-2003 and 2004 to date (Zhu, 2005).

1950-1980: Preliminary Stage of AE Development
Farming machinery and equipments as well as operation technology were imported or supported by the former Soviet Union. The infrastructure and technology development were under strict control of the state's planned economy system. The state promoted the farm machinery production and industry development. The main fields of engineering services for agriculture are in agricultural mechanization, rural electrification, field water conservancy and others.

The focus of agricultural mechanization technology was on the development of new and improved farm tools application, small engines or electrically powered irrigation equipment. State-owned tractor stations to provide mechanized tillage services were set up across the country.

State-owned farms and specialized colleges and professional training schools were established. An agricultural machinery industry was established while Agricultural mechanization Institutes and departments set up.

1981-1994: Economic Reform Stage
In 1978, the people's community system was abolished and the farmland household contract responsibility system was introduced. In early 1980's, rural industries and village and township enterprises were encouraged and by 1985, exclusive state purchasing of farm produce was abolished in order to have sustainable development of open door policy.

Farmers gradually become major investors and owners with the implementation of contract responsibility for collectively owned agricultural machinery. Combination of planned and marketing-oriented operational system expanded to forestry, livestock farming, subsidiary processing, fishery and rural transportation. The focus was on developing small-scale mechanization

1995-2003: Market-Oriented Stage
No more subsidized diesel for farm uses. All preferential policies to support agricultural mechanization were abolished. There was increase in competition among producers and this led to improved quality and lowered cost. Produce distribution networks were set up and after-sale services improved. The target of R&D is to meet the needs of farmers and transfer scientific research results to farming practices, develop appropriate agricultural machinery and produce cost efficient mechanization technologies for crop harvesting, paddy field mechanization, and arid farming technologies.

The administrative management functions of government organizations were replaced by macroeconomic guidelines, policies and regulations to promote agricultural mechanization. Agricultural engineering R&D extended to horticultural engineering facility, intensive livestock and aquatic production, value-added agro-product processing among others. More attention was paid to ecological and environment-friendly technologies.

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Vol. 1, Issue 4 , November 2014

Between 1995 and 2000, advancement were recorded in paddy rice seedling nursery technology in greenhouses, rice planting machinery, high-performance rice combine harvesters, rice dryers, tillage machinery, nursery and planting machinery for inter-tilled crops

2004 to date: Balancing of Urban and Rural Development

In general, the problems of agriculture, rural areas and farmers have become a top priority of the National Social & Economic Development Program. In 2004, measures were introduced by the central government to reduce farmers' burden which includes subsidies of US $18 billion for grain production, seeds and farm machinery. State and local governments have greatly enhanced financial subsidies for farmers to buy machinery. The agricultural tax paid by farmers estimated yearly to be about 126.5 billion RMB was completely cancelled throughout the country as from 2006. Exemption of fee was granted for passing through the public road for trans-regional harvesting and rice planting machinery services.

During the period between 2001 and 2005, there was increased funding of about 280 million RMB 5-6 times the estimate of 1996-2000. Furthermore, corn harvesting machinery technology was perfected. Breakthroughs were recorded for high-performance rice combine- harvester and planting machinery. Potato planting, fertilizing machinery and combine harvesters were introduced. R&D on rapeseed and sugarcane harvesting was promoted. In addition, R&D on forage seed harvesting and processing equipment was also encouraged.

III. PRESENT AND FUTURE PROSPECT OF CHINESE MECHANIZED AGRICULTURE

China has the world's largest agricultural economy and one of the most varied. The nation stands first among all others in the production of rice, cotton, tobacco, and hogs and is a major producer of wheat, corn, millet, tea, jute, and hemp. This wide range of crops is possible because of the country's varied climate and agricultural zones.

Since 2003, the state has set up six types of demonstration projects for the industrialization of modern agro-technology, so as to promote the use of advanced technology for agricultural production, and enhance foreign earnings from exports of farm products. These projects include industrialization of breeding and cultivation of excellent new varieties and fine strains; high-efficiency, eco-friendly planting and aquatic breeding technology; water-saving and precision technologies; downstream processing of agricultural and ancillary products; pollution-free inputs (e.g., fertilizer and fodder) and the establishment of an agricultural information platform.

The "downstream processing of main agricultural products project" was listed as an important sci-tech project during the 2000-2005 Five-Year Plan period. It aims at developing key technologies and equipment for downstream processing of staple agricultural products, research into integrated quality control systems and the quick testing of agro-product technology and equipment. Once completed, some of China's technological aspects will meet the advanced international standard. Meanwhile, the "dairy industry development" and "water-saving agriculture" projects have been listed among important sci-tech application programs initiated by the Ministry of Science and Technology.

In order for China to continue to be able to maintain food sufficiency for her growing population, the following measures needs to be implemented. The current limitation of agriculture in China is water rather than land. China needs to greatly improve water use efficiency in agriculture. Large parts of the existing agricultural areas in the North cannot be cultivated to their full potential due to insufficient rainfall.

There are also some 30 million hectares of land reserves, some of these could only be utilized with efficient irrigation system. Therefore, China's central (and provincial) governments will have to focus on projects to increase water supply in agricultural deficit regions, projects to improve water quality and waste water treatment. Trans-basin water diversion from the Yangtze to the Yellow river is probably the only option in the long run to develop an effective water supply for the North of China.

Bottlenecks in transportation infrastructure, technology, and logistics especially in the rural areas have to be removed. China's insufficient transportation infrastructure, outdated transportation technology, and under-developed logistics are serious bottlenecks in the food sector. Particularly, the insufficient harbor capacity, the overburdened railroads, and the lack of adequate roads in many remote areas pose serious risks in case of local or regional food shortages.

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China should encourage larger farm sizes through gradual privatization of the arable land. Large number of very small farms is one of the bottlenecks, which prevent further modernization in China's agriculture. China's family farms are usually too small to take advantage of economies of scale.

Floods are a serious threat to food security in China. Between 1988 and 1995 China has lost some 856,000 hectares of cropland due to disasters - primarily flooding. Some 33,000 medium and smaller dams and dykes in China need urgent repairs, better maintenance, or even reconstruction. Flood forecasting and prevention measures must be intensified.

Research in bio-technology should be further supported. China is already one of the leading countries in advanced rice biotechnology research. Since the mid-1980s, Chinese research centers have begun to develop advanced biotechnological tools, such as recombinant DNA technology. Because of the potential (but also risks) of genetically modified plants and animals for China's future food supply, these research efforts should be strengthened.

In the next five years, priorities of Agricultural Engineering R&D should be on accelerating agricultural mechanization. This includes: mechanization of grain production, recycling biomass and energy, mechanization of healthy animal production, harvesting technology for cotton, rapeseed, sugarcane, peanut, forage, processing of value-added product, waste treatment equipment, tillage machinery, development of agricultural water conservation, development of efficient irrigation technologies, information and communication technology among others.

IV. CONCLUSION

It has been considered a miracle for China, a country with only seven percent of the world's farming land to feed a population of over 1.3 million, covering 22 percent of the total population of the world.

With the contributions of Agricultural Engineering, agricultural production can now meet the overall need for food, feed and other materials, the farmer’s average net income per capita is increasing and the rural industry is reducing migration of rural labor.

To solve the grain problem of China, the Chinese government has taken a series of favorable measures such as reducing or relieving tax revenue, giving grain subsidy directly to farmers and building grain bases, and encouraging enterprises to produce grain overseas by leasing foreign farmland.

China has enough arable land and water to feed its projected population of 1.48 billion in 2025 - even at *currently* available levels of agricultural technology. However, problems areas identified need to be seriously tackled and priorities areas should be equally noted. Finally, it should be emphasized that economic and policy measures are the key to China's food security.

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