# Analysis and Research on the Functional Value and Development Opportunities of Hainan National Breeding and Multiplication

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**Abstract** To further specify significance and development orientation of Hainan National Breeding and Multiplication (hereinafter referred to as HNBM), such concepts as value engineering, industrial cluster and regional economy were introduced by analyzing its properties and interpreting relevant policies, its functions, value and development opportunities were analyzed from multiple perspectives. According to the comprehensive analysis, HNBM concerns national core political and economic benefits in strategic and fundamental sense, which is a result of powerful comprehensive functions of HNBM and need of modern agricultural development. In addition, HNBM has a bottleneck in the development of industrial cluster. Only co-promoted by the province and the ministry, and by applying top-level design, breaking the conditionality, integrating and optimizing existing resources, HNBM will be constructed into a high-new seed industry center.

**Key words** Hainan National Breeding Multiplication (HNBM), Value orientation, Fundamental function, Scientific and technological function, Social value

## 1 Introduction

Hainan National Breeding and Multiplication refers to annual fundamental researches, variety breeding, seed identification, production promotion and other such activities from September to the next May in southern Hainan such as Sanya City, Lingshui County and Ledong County, and this region is endowed with tropical climate, suitable environmental conditions and sufficient biological and ecological resources satisfying the growth and propagation of animals and plants[1]. HNBM has already been expanded to Lingao County in north Hainan. HNBM covers nearly 30 crops such as rice, cotton, corn, beans, melons and vegetables, and even touches on forestry, animal husbandry and fishery. HNBM is an overall, irreplaceable, unique, scientific and pioneering work of Chinese scientists[2]. In previous analysis of its functional value, most attention was given to the utilization of local climatic resources such as light and temperature, that is, time value, but its comprehensive functions and comprehensive value in innovation, location, space and aggregation were neglected, even its research contents were doubted. Through further analyzing functions, value and development opportunities of HNBM, its connotations were methodized and theorized to provide theoretic support for relevant policy-making departments, attract investment, and promote its harmonious and sustainable development.

## 2 Functional analysis

**2.1 Fundamental function** According to the definition, fundamental function of HNBM is to breed and produce seeds, including traditional variety breeding, adding generation, multiplication, producing seeds, and seed identification, and also breeding of fish fries and snakes. Such a function is the essential part of the seed industry chain, and also a powerful engine for the sustainable development of HNBM. HNBM contributes to the low-cost annual variety breeding, pilot production and demonstration, from which two essential properties of HNBM can be deduced, namely, accelerating agricultural scientific research and guaranteeing seed security.

**2.2 Scientific and technological functions** "Ex-situ cultivation and breed" is the theoretical foundation of HNBM, and also a summary of practices of "shuttle breeding between north and south". HNBM refuted the theory of Lysenko with effective practices, and guided the development of genetic breeding in China in the right direction. Innovation is the key of scientific and technological functions of HNBM, including germplasm innovation, variety innovation and technological innovation by using temporal-spatial advantages, climatic and environmental resources and germplasm resources. Scientific and technological functions of HNBM, essentially, enable HNBM bases to become the key pilot fields of breeding applied researches and fundamental researches in China. It not only accelerates the information convey among "government, industry, university, research institute, capital, and intermediary organization", but also enhances the communication of innovative thoughts, and promotes the agricultural upgrading. HNBM as a representative of Chinese breeding researches is a significant symbol of Chinese modern agricultural science and technology.

**2.3 Function of concentrating and popularizing technological fruits** Based on Hainan Province, HNBM drives the seed breeding of China and even influences the global seed industry, such as Chinese hybrid rice. HNBM bases have high-quality crop varieties of China, new cultivation technologies are applied, and

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through promoting the high-quality seeds and effective methods, HNBM promotes the development of Chinese agricultural science and technology. HNBM is not only a brand and card of Hainan, but also a scientific research activity with Chinese characteristics. For example, "rice wild abortive sterile lines" discovered in Sanya HNBM bases leads to the successful test and large-scale production of hybrid rice. Driven by HNBM science and technology, off-season commercial cucumber was cultivated successfully in Nongken Nanbin Farm in 1986, since then winter melons and vegetables have mushroomed in sanya and radiated out to neighboring regions, and directly promoted the restructuring of local agriculture. Winter melons and vegetables have become one of the top three contributions that Hainan makes to the country.

**2.4 Function of promoting industrial economy** Government administration in the age of planned economy plays a substantial role in the formation of HNBM, government control determines the spatial concentration of HNBM bases which produce snowball effect and contribute to the special regional environment. As a result, HNBM has become more attractive with stronger cohesive force, and gradually expanded. In the peak season (1976 and 1977), HNBM achieved 16 000 $hm^2$, and engaged staff 66 401[3]. There have been more than 700 HNBM bases, and more than 5 000 technicians, and the total area has achieved 11 400 $hm^2$, of which breeding area is 1 800 $hm^2$, seed quality identification and seed production area 9 600 $hm^2$ (not including north Hainan). Only Sanya, Lingshui and Ledong sold seeds more than 0.9 billion yuan every year, multiplier effect of HNBM variety promotion is immeasurable. Location advantages of HNBM can also promote Chinese seeding industry to infiltrate into and transfer to Southeast Asia, Africa and South Africa, improve international influence and seed industry competitiveness of China.

**2.5 Service functions of HNBM** HNBM serves 30 provinces, cities and autonomous regions of China. For Hainan Province, HNBM is a kind of technological service and one of the top three contributions it provides for the country. Service functions of HNBM lie in technological services, talent cultivation, communication and cooperation, its core content is modern scientific and technological service industry, which is a guarantee for the further concentration and industrialization of HNBM. Level of service industry is a significant remark of national development, HNBM will be a significant content of modern service industry in Hainan, and also a critical approach of providing more job opportunities, especially for rural residents.

It is an inevitable trend of offering high-end HNBM services through scientific and technological innovation. Based on HNBM advantages, traditional breeding is improved by applying biological technology, Golden Seed Program is listed as the strategic emerging industry of Hainan. HNBM is also a cradle of talents, 8 academicians are from HNBM programs. The communication and cooperation function of HNBM has been gradually demonstrated, First Session of China (Boao) Agricultural Scientific and Technological Innovation Forum was co-hosted by the Ministry of Science and Technology, the Ministry of Agriculture and Hainan Province in January 2010, and Hainan was announced as the permanent host place of the biennial forum. The forum was also hosted successfully in 2012, and its scale and influence has been enhanced.

**2.6 Social functions** High concentration degree of HNBM saves a great deal of resources, and promotes cooperation. Through the development in the past half century, substantial humanistic and tourism materials have been accumulated, and the unique "migrant culture" of HNBM has been formed. Seed quality identification of HNBM ensures that all seeds in the market are qualified, so national agricultural production and operation security is guaranteed, risks are avoided, stability of rural society is maintained. HNBM seed production controls seed production effectively, plays an essential role in relieving disasters and protecting agricultural development in producing areas in case of natural disasters such as flood, drought, ice and snow. Construction of HNBM bases also promotes construction of rural area, and also development of rural society.

## 3 Value analysis

**3.1 Strategic value** There will be a gap about 20 – 25 million ton in food supply, and increasing food production on the basis of petrochemical industries has been close to the limit; so to further increase food production, variety improvement will be the most important approach since the arable land area cannot grow larger[4]. On April 12 and 13, 2007, Han Qide, Vice-chairman of NPC and President of China Association for Science and Technology said in his visit to HNBM bases that HNBM was an engine of modern Chinese agricultural development, and HNBM should be fully used to promote modern agricultural innovation. On April 9, 2008, President Hu Jingtao visited HNBM bases in Phoenix Town, Sanya City. In 2012, Wu Bangguo (Chairman of NPC) and Li Keqiang (Vice-premier) made instructions to promote the construction and management of HNBM[5]. HNBM as a key section of variety breeding is a strategic need and option for achieving national food security and stable economy, and it concerns core political and economic benefits of the country.

**3.2 Economic value** About 70% of new crop varieties in China in the past half century were from HNBM programs, so HNBM has produced immeasurable economic value. For example, accumulated planting area of hybrid rice achieves more than 300 million $hm^2$ in China, accounting for more than 60% of national rice planting area, rice output increases by 450 million ton; according to the price 2 800 yuan per ton, income increase totals 1 260 billion yuan[6]. Li Denghai cultivated a dozen of high-yield high-quality corn varieties – Denghai Series, such varieties have been promoted widely and even accounted for 34% of national corn planting area, producing 100 million ton more corn for the country, increasing the income by 180 billion yuan on the basis of the price 1 800 yuan per ton; Guo Sandui cultivated bivalent insect-resistant cotton in HNBM bases, and more than 160 transgenic insect-resistant cotton varieties were cultivated in China and total

cultivation area achieved more than 2.1 million $hm^2$, and income increase achieved 4.4 million yuan[7]. For the locals, peasants in HNBM bases provide technical services for HNBM organizations, such as multiplying, promoting and identifying crop varieties for the organizations, and they are paid 150 000 yuan per $hm^2$, and it has become a significant income source of the locals.

**3.3 Scientific and technological innovation value** Properties and connotations of HNBM have been gradually enriched through the continuous development and improvement. Its scientific and technological innovation value refers to its capacity of serving innovation of seed industry and innovative competition and the service fruits as well as the objective contributions of such capacity and fruits to regional agricultural development and technological progress. V(HNBM scientific and technological innovation value) = F(HNBM functions and contributions)/C(HNBM total input). There has been no systematic investment to HNBM from central government, but HNBM has already made tremendous economic contributions that any other regional or agricultural park has done.

**3.4 Social value** Social value refers to social obligation and contribution to the society. HNBM has improved scientific researches, lifestyles, behavioral modes, values and cultural value in an all-around way. Public welfare and service properties of HNBM determine that its social value has to be placed on the top priority, "respecting science, pursuing innovation, facing difficulties and hardships bravely, making selfless contribution" is the spirit of HNBM. In addition, HNBM saves social resources greatly. Taking the 1 800-hectare HNBM breeding bases for example, to achieve the similar results in other regions, the annual investment will be more than 12.1 billion yuan. Specifically, (A) greenhouse construction cost = $15 \times 666.7 m^2 \times 1\ 600$ yuan/$m^2$ = 16 000 800 yuan, suppose a life span of 12 years and the annual depreciation cost 1 333 400 yuan; (B) heating facility cost = $15 \times 36$ air conditioners $\times 6\ 500$ yuan = 3 510 000 yuan, suppose a life span of 5 years, the annual depreciation cost 702 000 yuan; (C) energy cost = $15 \times 36$ air conditioners $\times 3$ P $\times 0.735$ kW $\times$ 20 h $\times 150$ d $\times 0.6$ yuan/degree $+ 15 \times 180$ lights $\times 0.8$ kW $\times 10$ h $\times 150$ d $\times 0.6$ yuan/degree = 4 087 300 yuan; (D) greenhouse maintenance and operation cost = [(A) + (B) + (C)] $\times 10\%$ = 612 000 yuan.

## 4 Development opportunities

Chinese seed industry and seed scientific researches have been facing with more pressure as more international seed companies enter the market competition. In the last 4 years, both central and local government have realized that HNBM has irreplaceable strategic value in guaranteeing the development of Chinese modern agriculture, and also food and ecological security, thus HNBM has been stressed in many state and provincial documents, such as *Several Suggestions of CPC Central Committee and State Council on Accelerating Agricultural Scientific and Technological Innovation to Enhance the Agricultural Product Supply Capacity*, *Suggestions of State Council on Accelerating the Development of Modern Crop Seeds* (2011 NO. 8), *Several Suggestions of State Council on Promoting the Construction of Hainan International Tourism Island* (2009 *No.* 44), *National Planning for Increasing* 50 *Million Ton Grain Supply* (2009 – 2020), *"Twelfth Five-year Plan" for Hainan Economic and Social Development*, *Implementation Suggestions of Hainan Province on Accelerating Cultivation and Development of Strategic Emerging Industries* (*Hainan* 2011 *No.* 35), *"Twelfth Five-year Plan" of The Ministry of Agriculture for National Crop Farming*. On May 3, 2012, the Ministry of Agriculture and Hainan government signed the *Memorandum of Enhancing Construction and Management of HNBM Bases*. HNBM has won increasing attention from the society as a national strategy, and its development has been facing with great opportunities.

However, it has to be realized that there is no a suitable strategic environment for the development of HNBM, no top-level design, overall planning or systematic construction for HNBM industries. Even potential eco-security hazards are totally neglected, it is still in need of stable investment and financing channels, talent flow and support mechanism. In addition, HNBM development is also facing with such problems as poor scientific research and experiment infrastructure, insufficient and instable land resources; unbalanced resource distribution, lack of legal support for HNBM organization; poor imbedibility, insufficient cooperation with local universities, colleges and scientific research institutes; lack of interaction and cooperation with the locals; a long distance to industrial cluster.

## 5 Development orientation and prospects

Functional value and advantages of HNBM should be fully used to serve the country and even the world with Hainan as a base, and to guide the transfer of HNBM spatial concentration to industrial cluster. Through top-level design, co-establishment of ministry and province, existing HNBM resources can be integrated and optimized, its embeddability enhanced, farmland and scientific research infrastructure construction promoted, technological support carriers introduced to build a regional research center and cultivate seed industry headquarter economy. Furthermore, HNBM standardization system should be established, HNBM identification and accreditation system promoted; its capacity of supporting and serving national agricultural scientific and technological innovation, international competitiveness and influence should be further enhanced, and HNBM bases can be built into an international high-new seed industry zone on the basis of Hainan Sanya National Agricultural Sci-Tech Park.

## 6 Conclusion and discussion

HNBM is the fruit of Chinese agricultural scientific researches and modernization of seed industry, and also fundamental and strategic resources of Chinese agriculture for its powerful comprehensive functions such as scientific and technological functions, industrial functions and social functions. Multiplier effect of HNBM leads to the geometric growth of its value, and enables HNBM to play a

(To page 143)

**3.3 Promoting computerized agricultural accounting** Currently, many rural grass-roots units still adopt manual accounting, and do not have standardized general account, detailed account and reserve account book. Besides, methods of keeping accounts are not uniform. Some agricultural accountants even arbitrarily set accounting items, leading to inaccurate accounting data and inconsistent account. In this situation, it should promote widespread implementation of computerized accounting in rural areas, and uproot traditional accounting, manual account keeping, declaration of accounting statement and handwritten accounting data. As financial management personnel in agricultural economic development, leaders should actively promote wide implementation of computerized accounting, organize accounting personnel to learn courses of computerized accounting, and put township leaders in place, relevant systems and measures in place, and accounting personnel in place, to strictly guarantee standardized accounting. For accounting vouchers, items and documents, it is required to take uniform management, and review monthly statements of accounting in strict accordance with requirements for management of township statements of accounting.

**3.4 Improving professional and comprehensive quality of rural accountants** As major person responsible for accounting work, accountant's knowledge and work quality are most direct reflection of accounting work[6]. In the process of agricultural economic development, financial and accounting management is essential and highly operational work. Only through stabilizing financial and accounting team and improving quality of accounting personnel, can we better develop agricultural economy. It is required to take strict procedure for appointment and removal of financial and accounting personnel. Financial and accounting personnel must hold respective accounting certificate before going on duty. After taking office, they shall make clear accounting system, know their rights and duties; township government should regularly organize rural accountants to provide reeducation of rural accountants, and keep pace with times, to constantly raise professional level[7]. Accounting work integrates management and accounting, so it is required to combine regulations and rules in economic management and accounting, make accountants perform their own duties and cooperate with each other, scientifically set up accounting posts, detail responsibilities of accounting work, make clear extent of power of accounting post, and put an end to shirking action, to promote coordinated development of accounting work and make accounting preparation for strengthening agricultural economic management.

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(From page 33)

key and overall role in national agricultural development, and also make great contributions to national food and seed industry security. HNBM bases are scientific and technological parks without boundaries, and also the largest and the most influential open agricultural sci-tech pilot zone, and are called "Agricultural Science City of China" by Yuan Longping. Immature strategic development environment and poor embeddability is the key bottleneck in the development of HNBM. All parties have to cooperate with each other closely, grasp the opportunities brought by the construction of Hainan International Tourism Island and State No. 8 Document (2011), so as to promote the further development of HNBM, and its transfer to industrial cluster. Considering current development of HNBM, functional orientation of HNBM should be further studied, value analysis instrument established, such as evaluation tool of HNBM contribution rate, to facilitate statistic evaluation of HNBM, attract more attention from government and make corresponding laws and policies. In addition, existing resources should be integrated and optimized, spatial layout and industrial guidance made properly, scientific research, talent and capital resources attracted, industrial value of key functions expanded, more efforts devoted to support HNBM scientific agencies and seed companies, concrete measures for HNBM development studied and given. And even national HNBM planning should be made to instruct its scientific and sustainable development.

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