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**International Commission on Irrigation and Drainage (ICID)**

**WATSAVE AWARDS 2012**

# Technology Award

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**Summary of Prof. Peng Shizhang's work**

## 'Theory and technology of controlled irrigation of rice in China'

(continued on next page)

**Nominee Statement of about 1500 Words** (in the following format)

## I. Describe the innovation

Grain production in China plays an important role in the food security of China and the world. But food production is facing the challenge of severe water scarcity in China. And the agricultural non-point source pollution caused by unreasonable irrigation and drainage management is increasing in intensity. Therefore, the research and application of irrigation techniques that can save irrigation water, increase grain yield, reduce agricultural non-point pollution and greenhouse gases emissions have very important significance to alleviate water crisis, ensure food security and improve farmland ecological environment in China.

Prof. Peng Shizhang and his research team established an original theory about water-saving irrigation based on 30 years' experimental study. Controlled irrigation of rice is the typical representative of the theory. The controlled irrigation technology has been widely applied in irrigation districts in more than ten provinces, municipalities and autonomous regions of China. The spread of controlled irrigation technology has achieved significant economic and social benefits. The main research achievements were drawn as follows.

Prof. Peng Shizhang and his research team deep researched the water requirement, water physiology, and photosynthetic physiology, nutritional physiology of rice supported by the National Science Foundation of China, National High Technology Research and Development Program of China and so on. In addition, rice real-time growth, stress conditions and precise regulatory mechanism under different water supply were also studied. The after-effects and compensation effects of water stress on rice growth were found. Then the original theory of controlled irrigation was formed. Finally, he put forward the integrated mode of water-saving irrigation for different types of rice irrigation districts based on the combination of the original theory, efficient water and fertilizer management modes and advance agricultural technologies. The advance agricultural technologies included dry stress seedling nursing and thin transplantation of rice, formulated fertilization, site-specific nitrogen management, cast and mechanical transplanting of rice. The integrated mode of water-saving irrigation broke the bottleneck from theoretical research to popularization and application of the technology.

Research achievements of Prof. Peng Shizhang won Second Prize of National Award for Science and Technology Progress in 2005 and 2006, Third Prize of National Award for Science and Technology Progress in 1997, First Prize of Chinese Dayu Water Science and Technology Progress Award in 2004, First Prize of Ningxia Hui Autonomous Region Science and Technology Progress Award in 2002, First Prize of Jiangsu Province Science and Technology Progress Award in 2003 and First Prize of China agricultural water-saving Science and Technology Progress Award in 2010. Moreover, Prof. Peng has published over 200 scientific papers which were indexed more than 200 times by other researchers. 54 scientific papers were retrieved by Science Citation Index and Engineering Index among these papers. 3 monographs have been published about these achievements.

## II. Describe how the innovation saves water

After 8 years' exploration from 1982 to 1990, Prof. Peng Shizhang put forward the concept of rice controlled irrigation, initially defined the lower limits of soil moisture of root layer soil in different growth periods, and then formed a practical mode of controlled irrigation technology. The transpiration and evaporation of rice under controlled irrigation were reduced by 20.7%~43.8% and 7.9%~21.9% compared with traditional

irrigation respectively. Seepage and water consumption of paddy fields under controlled irrigation were decreased by 38.4%~61.4% and 29.4%~36.9% compared with traditional irrigation respectively. Cumulative 120 million $m^3$ of irrigation water was saved due to the application of controlled irrigation.

In the following 15 years, Prof. Peng Shizhang explored the mechanism of rice physiological and ecological water saving around new scientific problems emerging in the water-saving irrigation of rice and further perfected the theory of controlled irrigation of rice. Coordination of water-saving, high-yield and good-quality was realized in paddy fields under controlled irrigation. In the process of technology extension, an integrative water-saving irrigation mode of rice irrigation district was established, which is suitable for irrigation districts with different climate, soil and water conditions. The mode regards controlled irrigation as the core, and well coordinates the agriculture, engineering and water resources scheduling and management. The yield and water use efficiency of rice under controlled irrigation were increased by 3.2%~12.4% and 47.4%~74.1% respectively compared with traditional irrigation. Cumulative 5.04 billion $m^3$ of irrigation water was saved because of the application of controlled irrigation.

Prof. Peng Shizhang and his team have continuously focused on the environmental effects of water-saving irrigation during the past 5 years. Mechanisms of greenhouse gases emissions from paddy fields, migration processes of nitrogen and phosphorus elements in paddy soil and mitigation modes of non-point pollution from paddy fields were deep researched. Then, he proposed the integrative mode of irrigation and drainage of paddy fields. Application of the mode not only leads to irrigation water reduction, yield increase and rice quality enhancement, but also results in the reduction of nitrogen, phosphorus losses and methane emission from paddy fields by 80%, 65% and over 80% respectively. The efficient irrigation and drainage mode has widely applied in rice irrigation districts of Jiangsu Province, Heilongjing Province and Ningxia Hui Autonomous Region in China. Cumulative 4.41 billion $m^3$ of irrigation water was saved because of the application of this efficient irrigation and drainage mode.

**III. Describe how the innovation was introduced and spread (for Young Professional award, describe how the innovation will be introduced and spread).**

In the process of technology extension, an integrative water-saving mode of rice irrigation district was established, which is suitable for irrigation districts with different climate, soil and water conditions. The application of the mode has gone through several stages: experiment plot demonstration, expanding demonstration, large scale application and the general extension. The organized extension of the mode has been done through technology integration demonstration tests, technical training and technical publicity step by step. Finally, an effective dissemination mechanism has been formed, which consists of leadership role in advancing, funding driving, network demonstration, technical training and media campaigns.

During the period of 1991-1995, the technology of controlled irrigation of rice was widely applied in the Xiaobudong irrigation district and the Nansihu irrigation district in Shandong Province. During this period, the accumulated application area reached to 33,300 ha. The accumulated irrigation water was reduced by 120 million $m^3$, and the accumulated total benefits were increased by 2.82 million yuan. Moreover, the technology was widely applied in the irrigation districts of Beijing suburbs, Shanghai state-owned farms, Hunan Province, Jiangxi Province, Anhui Province, Hainan Province in China.

During the period of 1996-2003, the technology of rice controlled irrigation was widely applied in the Ruhai irrigation district and Jiangdu irrigation district in Jiangsu Province, the Qingtongxia irrigation district in Ningxia Hui Autonomous Region and the Ganfu Plain irrigation district in Jiangxi Province of China. In Yancheng city of Jiangsu province, the accumulated application area reached to 1,351,866 ha. The accumulated irrigation water was reduced by 4.46 billion $m^3$, and the accumulated total benefits were

increased by 2.08 billion yuan. In Ningxia Hui Autonomous Region, the accumulated application area reached to 95,600 ha. The accumulated irrigation water was reduced by 580 million $m^3$, and the accumulated total benefits were increased by 98.04 million yuan. The total yield of grain was increased by 48.94 million kg.


**Demonstration guidance and on-site trainning by Prof. Peng Shizhang**

During the period of 2004-2009, the application of the technology of rice controlled irrigation has gone through several stages: experiment plot demonstration, expanding demonstration, large scale application and the general promotion. The technology was widely applied in many rice irrigation districts of Jiangsu Province, Heilongjiang Province and Ningxia Hui Autonomous Region. Accumulated application area reached to 1.9 million ha during this period. Accumulated irrigation water was reduced by 4.56 billion $m^3$. Accumulated rice yield and total benefits were increased by 890 million kg and 1.97 billion yuan, respectively.

The spread of controlled irrigation technology not only achieves tremendous economic benefits, but also brings significant social benefits. Frequency and volume of irrigation are reduced and fertilizer use efficiency is improved due to the spread of controlled irrigation. Meanwhile, non-point source pollution from paddy field under controlled irrigation is obviously reduced compared with traditional irrigation. Controlled irrigation technology has played a positive role in irrigation water management in paddy fields of China. In addition, farmers' awareness and enthusiasm for farmland water saving were strengthened in the spread process of controlled irrigation technology.


**Monographs**

## IV. Describe the scope for further expansion of the innovation

The "integrative water-saving mode of rice irrigation district" has a broad adaptability, and has been applied widely in many irrigation districts with different climate, soil and water conditions. Economic, social and ecological benefits are very significant because of the application of this mode. The technological achievements and extension mode of the research projects will be applied in more rice irrigation districts in China. The "integrative water-saving mode of rice irrigation district" can be applied more than 5.33 million ha in the northern grain producing areas in Heilongjiang, Jilin and Liaoning provinces, and can be widely applied in mid-eastern provinces in China (Jiangsu, Zhejiang, Anhui , Jiangxi, etc.) to achieve a comprehensive extension. The expected applied area of the technological achievements can reach about 16.7 million ha, more than 50 percent of the China's rice fields. The research achievements have very broad application prospects in the background of increasingly grim irrigation water, ecological and environmental security.

## V. Describe the roles of the individual nominees

The nominee’s foresight by establishing the technology of controlled irrigation is commendable. The development of this technology has gone through two stages: establishment of the theory and deep research of it. During the period of technological innovation (1982-1990), the nominee involved in the experimental study as the main backbone and proposed the concept of controlled irrigation. During the subsequent course of the study, the nominee as the academic leader of his team deep researched the theory of controlled irrigation. Then, the nominee proposed the integrative mode of farmland water management: water-saving, high-yield, control of non-point pollution and reduction of greenhouse gases emissions. In China, the technology of controlled irrigation has been widely applied. The application of this technology effectively reduces the irrigation water, effectively alleviates the increasingly severe agriculture water crisis and the food security issues. The nominee is one of the leaders in the field of water-saving irrigation in China, and has a high academic status. He has made outstanding contributions to China's water-saving irrigation project.