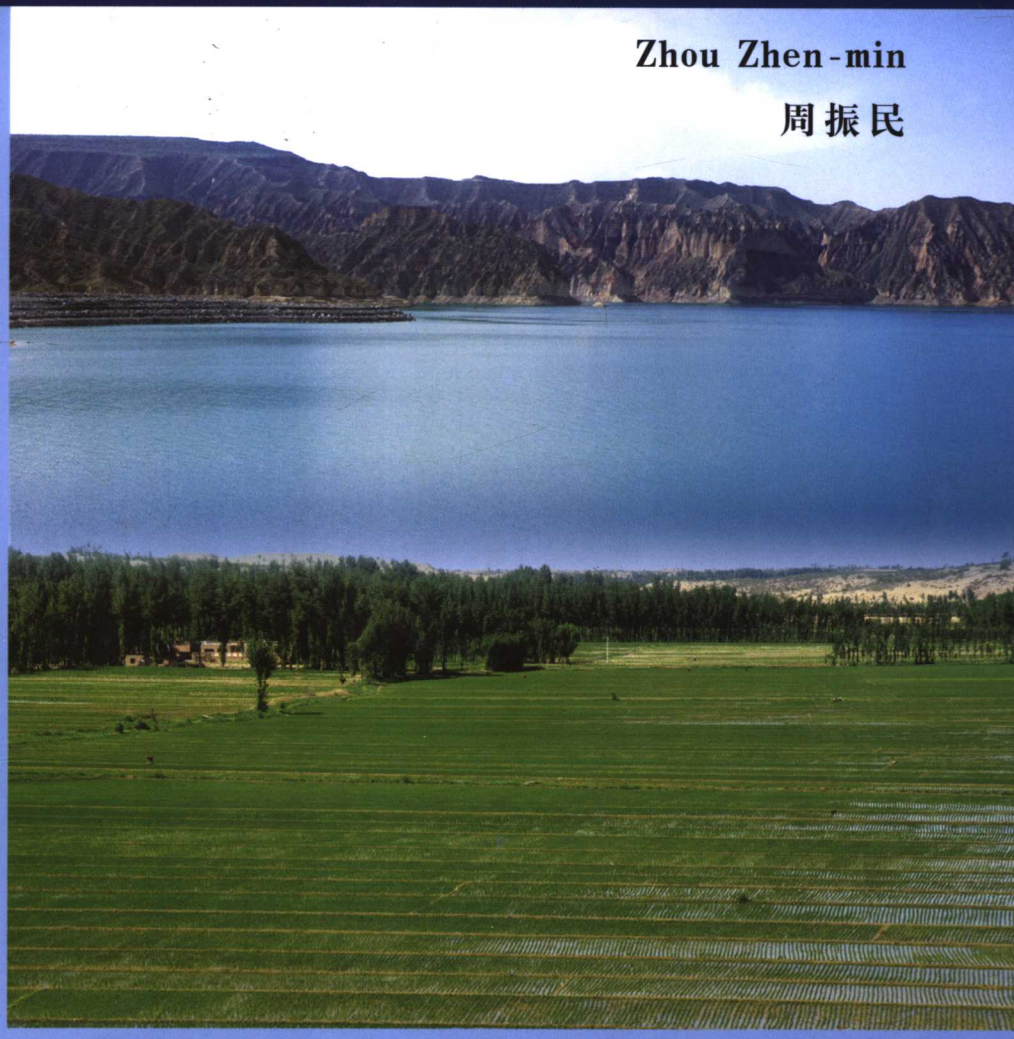
高等院校水利类双语教学教材

AGRICULTURAL WATER RESOURCES AND RURAL ECONOMY IN CHINA

中国农业水资源与农村经济

Zhou Zhen-min

周振民



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Abstract

A series of lectures will discuss development and try to stimulate thinking over how the need for new skills and information is identified, especially related to rural areas of China. Benchmarking will be introduced as a way of improving performance by learning from the best practice and understanding the processes by which they are achieved. Dryland farming will be discussed separately from irrigated farming. Aspects of waste recycling and meeting needs for improved water supply and sanitation will be considered. Opportunities will be examined for greater involvement of rural business in water resources management and protection. Practical instances of demand management will be considered. Opportunity for groundwater recharge and protection will be discussed. Approaches to wastewater treatment will be examined in relation to the benefits to rural communities. Finally, we examine what part rural business will play in promoting clean technology and in providing 10% of China's energy generating capacity by 2010, through the use of renewable energies.

The book should be valuable for those who are concerned with agricultural water and farmland engineering development and utilization, agricultural water resources planning, water saving, rural economy and rural enterprises. It can be used as biliagual teaching book for university and post-graduated students. It can also be a reading material for foreigners who wish to understand rural background in China.

内 容 提 要

本书是一本系统分析我国农业水资源开发利用、经济发展和社会主义新农村建设的全英文专著。内容包括：农业水资源新技术开发和信息系统识别，农业经济发展模式指标分析，干旱农业与节水灌溉，农业供水，污水资源开发利用与生态环境保护，农村企业经济发展机遇分析，水资源管理与保护，地下水开发与补给等。通过实体模型分析，阐述了理论观点在生产中的实际应用。最后研究了可更新能源的开发利用，分析了到2010年农村企业生态清洁型技术开发及其在满足中国能源需求中的贡献。本书内容资料系统完整，理论与实践相结合，对于我国农业水资源合理开发利用以及社会主义新农村建设具有很强的理论与实践指导意义。

本书可供从事农业水土工程开发利用、农业水资源规划、农业节水灌溉、农业工程经济、农业种植规划、政府管理人员、农村企业经营以及农村政策制定等部门的领导、决策者和有关科研技术人员参考。可作为大专院校有关专业本科生和研究生的双语教学教材。也可作为外国人了解中国农村的阅读材料。

Preface

Since reformation of the policy opening to outside, and with the development of science and technology, the agricultural water resources and economy in China have been greatly progressed. But there still exist some obstacles which affect the smooth agricultural production output. At present, five major physical problems confronting people in agriculture are: (i) loss of land (ii) desertification (iii) soil erosion (iv) environmental pollution and (v) shortage of water. A particular element of policy in China is to achieve a combination of measures to resolve problems. The measures covering environmental protection should at the same time be compatible with economic development. Practical measures to address China's pressing problems have been described within its Agenda 21 program (1994). Other more recent versions of "visions" of rural sustainable development are a World Bank publication "Accelerating China's Rural Transformation" (1999) and "China Water Vision" (1999). The latter report was prepared for an international meeting to agree a World Water Vision.

The Agenda 21 program reported " The water resources in more than 50% of China's major towns are not suitable for drinking. Water ecosystems have been severely impacted and health of aquatic life, especially fisheries, is threatened by large-scale reclamation of marshes, inappropriate application of pesticides and chemical fertilizers, and soil erosion. Statistics show that the length of rivers devoid of fish and shrimp totals 2 400 kilometers and the number of lakes has decreased by 543 over a thirty-year period, and a part of the remaining lakes are eutrophic. The loss of fresh water yield caused by the destruction of water ecosystem has reached 80 000 tonnes annually. Protection of water quality and the water ecological environment must be implemented without delay " .

The lack of feasibility studies for the imported projects led to many problems during and after their implementation, including those connected with energy, raw material supply and poor projects sitting away from markets and input sources. The apparently good economic results achieved by some projects had nothing to do with their efficiency. The imported projects were often badly coordinated with domestic capital construction and investment and plans which result in ancillary projects either coming on stream late or not at all, which seriously affected the returns on foreign exchange investment. In some cases, material supply plans made no provision for either capital construction or post-production requirements, resulting in some projects only running at a small fraction of their design capacity.

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Specialized personnel requirements were often unfulfilled, both in terms of skilled negotiators and operators of the imported equipment, whilst gross over-manning with untrained staff was common. A basic lack of understanding of the fact that purchasing equipment is by no means equivalent to acquisition of technological knowledge or understanding of the underlying design and operational principles. This combined with a large technology gap between suppliers and users, leading to the repeated need to import the same equipment as shown by the import of chemical fertilizer plants over a prolonged period. A more indirect consequence of the above is that the development of domestic technical knowledge and capabilities can be hindered through repeated imports in any given sector.

WTO membership raises a significant challenge for the rural community. The fundamental problem in China is the rural problem. According to official data, there is now a working population of 500 million in the rural sector. The actual figure, according to investigation, should be around 600 million because children and old people are also working on farms. It is commonly held that, given agricultural productivity levels in China, it only needs 100 to 150 million farmers to cultivate the available land. Economic laws suggest that when marginal return on labor is decreasing or negative, production ceases to be efficient and excess labor must be substituted. But how can 450-500 million excess peasants be substituted? Even if one takes into account the number of existing workers in urban areas and township and village enterprises, there is still an excess rural labor force of 350 million.

The water conservancy construction in the country has an accumulated asset value of 110 billion Yuan in capital water assets, but this value was not included in the total amount of the nation's fixed assets. The lack of financially effective management of water has led to a difficult situation for the whole conservancy sector.

What then are the sources of market failure? The greatest limit placed on the farmers' technological choice is their lack of ability to pay. To be appropriate for them, therefore, technology has to be extremely low cost; otherwise they simply won't buy it, no matter how good it is. For manufacturing firms such low cost technology need not be unprofitable, but the conditions required to develop it are quite specific. Such technology is generally very simple and easy to copy. Hence in comparison to engineers involved in developing high cost technology, those at the low cost end of the spectrum face not only the market risk (not knowing in advance what the consumer's response to the product will be) but, in addition, they face greater risks of copyright contravention. Because it is so easy for low-cost technology to be ripped off, the developer runs greater risks of losing what he has invested in research and especially in marketing.

Therefore, it is an urgent task that there are a lot of problems deserving further study and putting great concern to rural water resources and economic development.

Considering the problems mentioned-above, the following contents have been studied which include major national water resource concerns, integrated water resources management (IWRM), Chinese water targets and objectives, water-saving irrigation, water supply and treatment, environmental protection, poor quality water use, rural small hydro-power (SHP), benchmarking watershed (Basin) methodology, benchmarking irrigation water management, rural water supply problems, appropriate rural wastewater technologies, groundwater recharge and protection, data collection, storage, evaluation, processing and analysis, innovation management, etc.

It is suggested that the book could be used as a biligual learning material for university students and graduated students. It should be a good reference tool for research scholars who deal with agricultural water resources and economy. I am sure that the practicing engineers, senior professionals, researchers and university students (including policy makers) who deal with agricultural water resources and rural economy should benefit from this book both in their language learning and their professional studies.

Appreciation must be expressed here for who, by their encouragement, constructive criticisms and advice in my study field, have helped in the preparation of this book. By this opportunity I want to express my special thanks to Dr. Martin.Parkes who, as a foreign expert, dedicates himself to Chinese rural water resources research and education causes, and has made great contribution to our country in the research field of agricultural water resources and rural economy. It could be said that without his help I could not finish the book. Thanks are due to those who provided the data. Yu Min, who is an English lecturer of North China University of Water Conservancy and Electric Power, has joined part of the work in this book. The author accepts full responsibility for any omissions, shortcomings or mistakes that may remain.

Zhou Zhen-min
October 1st, 2006

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Chapter 1 Historical Perspective of Sustainable Rural Development

1.1 Rural Problems, Rural Vision: A Historical Perspective

In China five major physical problems confronting people in agriculture are: (i) loss of land (ii) desertification (iii) soil erosion (iv) environmental pollution and (v) shortage of water. A particular element of policy in China is to achieve a combination of measures to resolve problems. So that measures covering environmental protection should at the same time be compatible with economic development. Practical measures to address China's pressing problems have been described within its Agenda 21 programme (1994). Other more recent versions of "visions" of rural sustainable development are a World Bank publication "Accelerating China's Rural Transformation" (1999) and "China Water Vision" (1999). The latter report was prepared for an international meeting to agree a World Water Vision. "Vision" is judged to be part of a set of principles for assessing progress towards sustainable development of a community. Other aspects include a practical focus to link visions and goals to specific indicators of progress.

The Agenda 21 programme reported "The water resources in more than 50% of China's major towns are not suitable for drinking. Water ecosystems have been severely *impacted* and health of aquatic life, especially fisheries, is threatened by large-scale reclamation of marshes, inappropriate application of pesticides and chemical *fertilisers*, and *soil erosion.* Statistics show that the length of rivers *devoid* of fish and *shrimp* totals 2 400 kilometres and the number of lakes has decreased by 543 over a thirty year period, and a part of the remaining lakes are *eutrophic.* The loss of fresh water yield caused by the destruction of water ecosystem has reached 80 000 tonnes annually. Protection of water quality and the water ecological environment must be implemented without delay" (1994).

The World Bank report judges that an unnecessarily large component of the agricultural economy remains focused on cultivating relatively low-valued *cereals*, due in large part to the policy environment. Food-security remains an important element in policy making. The *provision* of relatively inexpensive and stable supplies of *grain* for the urban population still *prevails* in the form of *quotas*, marketing regulations, direct and in-direct *subsidies* and by social pressure from local officials. The emphasis on grain production has resulted in the conversion of some *fragile* ecosystems—wetlands, forests and pastures into cultivated lands, contributing to bio-diversity losses and soil erosion. Relatively *equitable* income distributions prevailed in the late 1970's, but by the mid-1990's income distribution in China was among the world's most *inequitable.* Income growth rates in

rural areas are less than half of the level of urban residents.

1.2 National and Local Government Agencies in Relation to Rural Enterprise

Counties are divided into districts, which consist of townships, which consist in turn of villages. Each *administrative level* has its own government. Rural *collective* industries always belong to one of the last three government levels. The various departments at each government level such as the Supply and Marketing Co-operative or the Bureau of Transportation or the Township and Village Enterprise Bureau then take care of the enterprises in their sectors. However, occasionally a department or bureau crosses its *sectoral* boundary and governs enterprises that belong to other sectors.

The different ownership forms existing now are *complex* to understand, even for most people in China, politicians, academics and *laymen*. Before the reforms, only public enterprises, either state or collectives, existed. Other ownership groups emerged after 1984. Now there are state, *collective* and private enterprises. State enterprises exist at the central, provincial, city and county levels. *Collectives* can be formed by individuals or two or more enterprises combining their efforts. Collectives can be urban or rural. If rural, they exist at the rural district, township or village government level. Ownership or *proprietary* rights correspond to the level of government from which the investment comes. The fact that each government level can be an investment source of parts of an enterprise complicated matters even more. State, collective and private ownership forms might mix and might also form *coalitions* (see the Table1.1).

Table1.1 Present forms of ownership

Public Enterprises		Private Enterprises
Central government	District government (U/R)	Private (U/R)
Provincial government	Township government (R)	Individual (U/R)
City government	Village government (R)	Household (U/R)
County government	Neighbourhood committee (U)	Group/Co-operative/ (U/R)
	(Urban or rural (U/R))	Joint venture/Partnership

Between county and township level, some of the important agencies can include:

- Bureau of Agriculture
- Bureau of Water Resources
- Bureau of Grain
- Bureau of Planning

There are also state responsibilities to *promote* the *well being* of rural people by sound

management of natural resources. These are achieved by linkages with both the Ministry of Water Resources and Ministry of Agriculture.

1.3 Sustainable Development

It is useful to remind reminded of the meaning given to "*sustainability*" and to "*indicators*". One definition from a seminar in California is:

Sustainability may be defined as a dynamic balance among three mutually interdependent elements: 1) protection and enhancement of natural eco-systems and resources; 2) economic *productivity*; and 3) provision of social *infrastructure* such as jobs, housing, education, medical care and cultural opportunities.

Further meaning can be gained from the purposes of "*sustainability indicators*". The following have been suggested:

(1) enabling a community to identify what it values and allowing it to *prioritise* those values;

(2) allowing a community to hold individuals and groups *accountable* for goals identified by the community;

(3) encouraging democracy;

(4) allowing people to measure what is important and to make decisions based on those results.

In Europe it has been said that "agriculture can only be *persistent* and sustainable when resource conserving technologies are developed and used by local institutions and groups, who are supported by external research, extension and development institutions acting in an *enabling* way". The late Professor Ma Shijun provided a similar view of resource use. Ma's concept of ecological engineering is:

A specially designed system of production processes, in which the principles of species symbiosis and the cycling and regeneration of substances with harmony between structure and function in an ecological system, are applied to adopting the new technology of systems engineering and optimum selection methodology, and introducing new technologies and excellent traditional production measures to make multi-step use of substances. The goal of such a system is to reach the synchronous development of ecological and economic benefits by promoting the effective cycling of substances in nature and to thereby maximise the potential for production and minimise pollution and environmental degradation.

Some new Western views of sustainable agriculture contain many parallels with concepts of Chinese agro-ecological engineering (Yan, 1993):

Chinese agro-ecological engineering practices are comprehensive in nature. In contrast to the specialised agricultural practices in Western countries, Chinese agro-environmental engineering takes a comprehensive or integrated approach. The components of

agro-ecological engineering practice may include farming, animal husbandry, fishery, forestry, horticulture and side-line production. Side-line production includes small processing industries and cottage industries. Transformation of waste into useful resources is an important component of Chinese agro-ecological engineering. Organic waste and excrement are used to generate methane as fuel, to substitute for fertiliser, to cultivate edible fungi and to raise earthworms and maggots as feed for fish, pigs and poultry. The organic integration of these components based on principles of ecological engineering forms complex co-ecosystems that are capable of achieving quality, high production with low consumption, and yielding plenty of economic and environmental benefits.

1.4 Town and Village Enterprises (TVE) : Associated Rural Welfare

The decade of the 1980's was the economy taking off in vast areas of the Chinese countryside. By 1987 rural economy *surpassed* agriculture as the dominant source of rural income. Total output generated by rural enterprises rose almost nine-fold from 1980 to 1987, as the output of rural enterprises grew more than 26% annually from 1978 to 1990. These industries have yielded close to one quarter of China's total exports. Between 1978 and 1990, the percentage of the rural labour force *engaged* in village and town enterprises was more than doubled, and the 57 million new jobs created from 1978 to 1986 alone equalled the total number of workers hired in all state-owned enterprises between 1952 and 1986.

Byrd and his colleagues at the World Bank characterise the *dilemma* of local officials as that of wanting to be good businessmen as well as good government administrators responsible for village welfare. Holding property rights over the collective enterprises allowed village leaders to extract and re-distribute profits *legitimately* and directly for the development of the community *infrastructure*. Using information and contacts gained through their routine conduct of administrative work, local officials provide an *array* of essential services and information about new products, technology and markets for finished goods. The degree to which officials get involved in product development, market research and the *acquisition* of technology suggests that this is not the usual provision of bureaucratic services but the activity of an entrepreneurial development state.

From the mid-1980's rural enterprises particularly TVE's provided the major source of growth in the local economies and thus in local government revenues. By 1990 they provided over three times the total revenue raised through agricultural taxes, accounting for 37% of all *fiscal* revenues at and below the county level··· Models of the developmental and entrepreneurial states and the local corporatist state suggest ways in which officials adapted and shaped economic reform to benefit their localities. Their role as market facilitators and entrepreneurs has been (potentially) productive rather than purely *rent-seeking*. In many cases it appears

also to be re-distributive and welfare oriented. Following de- collectivisation, the government has redefined its responsibilities towards the rural population, limiting these to minimal forms of relief and assistance to the very poor and destitute, to specific vulnerable or deserving groups and to those affected by natural disasters. While the main policies for social assistance are defined by central government, provision has increasingly been devolved to "society"—including local communities, mass organisations, work units, families and individuals—through a policy of welfare socialism.

Collective ownership and the contracting system worked remarkably well in generating rural industrial growth in the 1980's. Yet by the early to mid-1990's, problems began to emerge. The success of township and village enterprises in the 1980's had been *facilitated* by the gaps in production left by the large state-owned enterprises. The *pent-up* demand provided a *niche* for these small, low technology enterprises. Using relatively backward and inexpensive technology, resourceful local officials could make a success of these enterprises in a growing market. By the 1990's, however, the international as well as local environment for rural industry had changed. The low cost of technology, a factor that initially allowed these enterprises to grow rapidly in the 1980's, in the 1990's has taken its *toll* as the market has grown and standards have risen. Those who cannot afford to upgrade technologically face increasing difficulties.

The issue of central control took on urgency in the late 1980's as double digit *inflation* gripped the Chinese economy and as state owned enterprises had to compete with the rapidly growing rural industrial sector. Rural industry was accused of overheating the economy, creating useless duplication and wasting valuable and scarce resources that could be better used by the larger state owned enterprises. The rural sector was to be cut back to restore the health of the larger economy. Some categories of enterprise were prohibited and others closed off their *own accord* because of increased costs and reduced profits. National statistics indicate that in 1995, eighty thousand township and village enterprises suffered losses. The number was approximately the same as in 1994, but the total amount of losses had increased by 84.6%, which suggests that larger enterprises were having difficulties.

Despite the pressures, Statistics reveal that by the end of 1994, of the 8.57 million registered enterprises, only 20 000 are large or medium sized concerns, which means that over 99% are small enterprises and policies of letting go of small and medium sized state-owned and collective enterprises, especially at county level and below, were included in the documents of the Third and Fifth Plenary Sessions of the Fourteenth Central Committee of the CPC (Communist Party of China) and the Fourth Session of the Eighth National People's Congress held in 1996.

This year (2000), the Township Management Bureau of the Ministry of Agriculture reported "Township firms contributed 30.3 % to the gross domestic product in 1999,

however, the loans granted to them accounted for only 5% of the country's available loans last year." Policy changes to increase tax refund on agricultural produce and on processed farm produce could help, as could the *extension* of TVE rights to independent import and export.

China's industrial sector displays extreme *heterogeneity*. There is a *hierarchy* of domestic industrial enterprises ranging from foreign-linked firms to state enterprises, urban and rural (TVE) collectives and private businesses. These groups of firms exhibit systematic differences in technological capabilities, cost structures and institutional arrangements. There is an inverse relationship between innovative capability and labour costs. Among the domestic firms, state enterprises have the greatest technical strength. They also have the highest labour costs and suffer the greatest restriction from institutional constraints. TVE are least affected by institutional constraints. The interaction of these different enterprise types creates a kind of innovation and competition ladder. On the top *rung* of China's domestic ladder of technological capabilities are foreign-invested firms; below them are state enterprises, urban collectives, TVE and privately owned firms.

1.5 Chinese Technology Imports

Richard Conroy (1992) has investigated the role of imported technology in promoting technological change. Chinese commentators divide technology *acquisition* into four periods, each with its distinct characteristics. The first phase ran from 1950 to 1960 during which 400 import projects were initiated at a cost of $2.7 billion. The majority came from the Soviet Union in the form of complete sets of equipment and *turnkey plants* for 156 complexes. In addition, technical expertise and data were supplied and large training programmes were set up. This phase is now seen to have been extremely successful both in terms of creating a modern industrial base in many sectors and in terms of strengthening domestic technical and design capabilities.

The second phase from 1962 to 1968 saw a search for alternative suppliers. During this period 84 import contracts were signed with Japan and West European countries at a total of just $280 million. Again, complete sets of equipment predominated. A number of problems in this phase resulted in only 30% of the investment achieving reasonable returns. In the third phase from 1972 to 1978, it was decided to restart the large-scale import of small numbers of technologically advanced industrial complexes concentrating on petrochemicals. Of a total of 220 contracts worth $3.8 billion, 26 *turnkey* projects accounted for over $3 billion. The general consensus is that China suffered serious losses due to various policy and implementation inadequacies.

The latest phase of technology import can be divided into several periods. In the first, from 1979 to 1982, over 400 items were imported at a cost of $4.5 billion. The second

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