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THE ROLE OF BOOKS AND AGRICULTURAL DEVELOPMENT IN  
TRADITIONAL CHINA

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China, an agrarian country par excellence, has experienced a long history of agricultural change and development, which can be counted in thousands of years. Agriculture can be considered to be the basis of the existence, endurance of Chinese civilisation.

The importance of agriculture has been reflected in Chinese philosophy, literature and government policies.

1. Chinese traditional agricultural books

In China, the earliest books on agriculture date from over two thousand years ago. From then till the end of the Qing Dynasty (1644-1911 A.D.), 542 books were written (cf Wang 1964). This was quite an unusual phenomenon in world history in pre-modern times: although books on agriculture were also written by peoples of different civilisations, the Chinese traditional agricultural books seem to have been produced in a more systematic and continuous manner, and to have become a special type of classical literature.

2. The dissemination channels for agricultural books

a first channel: shi

In traditional China, the educated were called shi. In principle, anyone who had education was recognised as a member of the shi stratum, regardless of his social or political background. The shi thus were a combination of educated people from all walks of life who had their occupations and expectations in different sectors.

In Chinese society, the agricultural sector was so respectable that land-holding became a symbol of one's social identity. As a result, many shi members constituted

part of rural population, and agriculture was one of the important areas in which the shi had interests.

More importantly, the shi, influenced by the traditional Chinese philosophies, mainly Confucianism, had a strong sense of mission to civilise people by improving their living standards, which would result in better social behaviour.

In Chinese history, an effort was made by the shi to share their knowledge of agriculture with other rural people to improve their farming techniques. Some Chinese agricultural books were quite obviously written with a teaching purpose: these can be called agricultural textbooks. Evidence also shows that some agricultural books were written in colloquial language and dialect so that less educated people could understand them without much difficulty.

Two patterns of agricultural book dissemination were developed by the shi: person-to-person dissemination and author-to-public dissemination.

One form of the first pattern was joint authorship. Joint authors were sometimes relatives, sometimes teachers and students, and sometimes friends. A dozen cases of this form can be found. Between joint authors there existed substantial person-to-person information exchange, although in such a situation book knowledge may take a rather fluid form. A more clearly delineated exchange is that which takes place between generations, i.e. later generations absorb existing book knowledge from earlier generations. There are about twenty cases of this dissemination form. In addition to the above, there existed a third form, in which some writers took upon themselves the task of editing and annotating works by those they knew personally so that these works could be published in a form which was easier to understand. A dozen cases existed in this form.

The second pattern of dissemination, from author to public, frequently occurred between different generations. It can also be found in several forms. The most common form is compilations of existing agricultural books written by people of earlier generations. Another form is writers' quoting of existing agricultural books. This became a common practice in agricultural book-writing. The third form of this pattern is the annotation and editing of books written by earlier generations in order to bridge the gap between different times. The cases of these three forms are numerous.

In reality, the combination of these two patterns resulted in many sub-patterns. Agricultural book knowledge 'snowballed' and was transmitted widely within China, and sometimes even outside China to Korea and Japan.

#### b. The second channel: government

Government officials who were recruited from the shi often wrote agricultural books for the purpose of instructing the farmers under their authority in order to improve agriculture. Some a hundred such authors can be identified.

The Chinese government was also a distributor of agricultural books. Government often sponsored agricultural books' publication and issue. Evidence shows that the government made an effort to publish some agricultural books to help officials to understand agriculture and to guide farmers. There were more than seventy cases of this kind in Chinese history.

In these cases of agricultural books publication, all levels of government were involved, although in the later dynasties, prefecture government and county government more often took the initiative in sponsoring the publications. This shows that local governments had considerable freedom to undertake their own project to improve local agriculture. The books were carefully selected by government officials: they were all very practical and straightforward texts, and thus it was easy for people to read them and follow their instructions. Several books were considered particularly useful and were repeatedly chosen by governments of different levels at different times. Local needs were specially considered by all the government sponsors in relation to publication of agricultural books.

The efficiency of agricultural book knowledge dissemination by the Chinese government was a consequence of the scope of government power at different levels. For instance, in 686 A.D. the Tang Queen Wu (690-704 A.D.) issued an agricultural book to her high-ranking officials. Later, in 628 A.D., Emperor Wenzong ordered the same book to be copied in all prefectures and counties and issued to villages across the country. In 1008 and 1014 A.D., Emperor Zhenzong of the Song Dynasty ordered two agricultural books to be published and issued nation-wide. In 1318 A.D., Emperor Renzong of the Yuan Dynasty ordered one thousand copies of Illustrations of Sericulture to be printed and issued in each county. Another means of agricultural knowledge dissemination was the official bulletins issued by government at all levels. In 1829, for example, after becoming convinced of the effectiveness of the pit cultivation described in Essential Farming Method for Pan's Village, the Magistrate of Suzhou Prefecture ordered this method to be written up in the official bulletin and posted extensively so that local farmers would know how to apply this method. Many cases of this kind can be found. Some agricultural books were recommended to governments by shi members so that agricultural technology could become available through the administrative network, because the government channel was often more effective than the private channels.

### c. The third channel: migration and travel

Migration could help ideas and techniques to be transferred from one place to another. In traditional China, migration took place frequently, as a result of government appointments, or the pursuit of study or employment opportunities, or a consequence of natural disasters, wars, population pressure or political penalty. In the context of this study, the most significant causes of migration activities were official appointments and study, simply because they are more closely related to the issue of agricultural knowledge dissemination.

Since the personnel of the Chinese bureaucracy were not allowed to be in charge of their home region but were shifted regularly from place to place according to a rotatory system, agricultural book writers with official ranks were never able to work in their home regions. This provided many authors with a broader, comparative view of agricultural technology, and this became one of the characteristics of Chinese agricultural writing.

Travel was a feature of the lives of shi: even ordinary shi members travelled very extensively. The desire to write agricultural books was often triggered by the recognition of regional differences in agriculture and by the desire to introduce better techniques to other regions. Several dozen cases can be identified.

#### d. The fourth channel: book market

In Chinese history, with the development of commerce and of literacy in society, the book market expanded. The booming of the book market was accelerated by the demand for Buddhist and Confucian classics and by the invention of block-printing. Evidence shows that books entered market circulation as early as the Eastern Han Dynasty in the period between the first and third centuries A.D..

In Professor Wang's collection (1964), at least 188 commercial book publishers and 13 government publishers of agricultural books can be identified, from the Tang Dynasty (A.D.) onwards. In addition to these professional publishers, some agricultural books were published privately by the authors or their kin.

The existence of an agricultural book market indicates firstly that the demand for agricultural books was great enough to form a market, and secondly that the demand was not a false force created, for example, by government compulsory policies; instead, market forces played the crucial role. As a result of the market mechanism, most agricultural books which have survived are those which sold well. Some agricultural books were published by a number of different publishers over the centuries.

#### 3. The targeted reader/user groups

The question now is: Who were the readers of agricultural books?

Agricultural books were a kind of special technology, in which a special interest was embodied and a special language used. This confines the readers' circle to such an extent that a concept of 'targeted readers' should be employed. Further, the readers must have had some connection with agricultural production, thus it is more correct to use the concept of 'targeted reader/user groups'.

Although education in traditional China had its supra-class characteristics, this does not mean that education was free. Thus a significant proportion of the educated came from well-to-do families, usually of the rich rural classes: landlords and rich land-holding farmers.

Since the wealth of managerial landlords relied on the techniques they used in practice, and since they themselves or some members of their families were educated, this group were certainly among the targeted agricultural book reader/users. Absentee landlords can at least be considered potential reader/users owing to share-cropping. Like the landlord class, the rich land-holding farmers were also agricultural book reader/users. They tended to be active in applying new technology, which often made them the best farmers in their regions.

The targeted reader/users could thus be individuals or a social class. They could also be within an organisation: in effect, many agricultural books were written for government, which was involved in agriculture. The reasons were not only that agriculture was the main source of government revenue but also that government itself was directly involved in agricultural production. Through Chinese history, the state itself was always a holder of extensive land, which made government to a great extent a managerial landlord. One of the forms of state land was that of 'Agricultural

Colonies', which continued to be established from the Han Dynasty (206 B.C. - 220 A.D.) onwards until the last dynasty, the Qing (1644-1911 A.D.). State land ownership also took the form of 'Land allocated to Citizens'. Governments obtained rent and tax in kind from state land under this system which lasted for hundreds of years. The third form of state land was 'Salary Land' for officials of different ranks to obtain income, which means that officials actually functioned almost as 'landlords' of state land. On the other hand, in traditional China, official positions at different levels were established to take charge of agriculture. They were responsible for encouraging and instructing people to undertake agricultural production. Many cases can be found in the 'Biographies of Model Officials' contained in the Chinese dynastic histories. The officials concerned with agricultural supervision needed specialist knowledge, much of which could be acquired from agricultural books. Thus, it can safely be assumed that a great proportion of government officials belonged to the category of agricultural book reader/users.

The literate agricultural population and government can be defined as the 'primary reader/users stratum', because (1) they undertook agriculture production, and (2) they were able to read and use agricultural books themselves.

Illiterate and semi-literate farmers also constituted a targeted user group. This group could not absorb book knowledge directly; they required a literate intermediary, so that knowledge in written form could be translated into oral form, or even vivid demonstration. As a consequence, uneducated farmers who were affected by book knowledge can be considered 'secondary users'. Evidence shows that some books were written for this particular user group. The knowledge transmission often took the form of regular official supervision. Similarly, managerial landlords followed this practice in order to increase their income from rent. Evidence shows that some agricultural knowledge was passed on within the clan system. Firstly, the clans took the responsibility for sponsoring the education of good students. As a result, although a certain proportion of a clan may have been illiterate, the clan as a whole was literate. Secondly, information including technology was no secret within a clan, with the result that all members were able to benefit from it. Thirdly, some agricultural books were actually written for clan members. In addition, villages in traditional China overlapped with the clans and the primary level of the political structure. Often, the head of a clan was also appointed head of a village. Thus, information including agricultural book knowledge from both governmental and private channels joined at the village level. In this sense, farmers were possibly exposed either directly or indirectly to agricultural books.

In traditional China, the group of agricultural book users was much greater than one might have expected. The identified reader/user groups and channels for agricultural knowledge dissemination suggest that agricultural books were in fact a part of Chinese agriculture. All this explains the occurrence and the persistence of the agricultural book phenomenon in traditional China. More importantly, because Chinese traditional agriculture benefited from book knowledge, the shi, or the educated, were definitely a constructive force in society.

In comparison, in Japan, the 'technologists' who wrote agricultural books to spread technology appeared much later than their Chinese counterparts; they were not as well organized nor as influential as the shi; and their books seem to have been much less systematic than the Chinese agricultural books.

#### 4. The role of agricultural books in the Chinese economy

### a. Technology diffusion

The most obvious technology diffusion took place between different regions. Many agricultural books were written for this purpose. For example, Ji Han, a northerner who worked in Guangdong Province in the South, wrote the well-known Survey of the Vegetation in the South. Wu Qijun, an official who travelled extensively wrote Complete Flora with Illustrations. Wang Zhen, a northerner working in the South, wrote Master Wang's Agricultural Treatise to compare and combine northern and southern technology. Lu Hingshan who came from the northwestern frontier wrote Essentials for Agriculture and Sericulture, which referred mainly to southern technology. Li Ba, who was from Sichuan in the west but worked in Fujian Province in the South, wrote On Sericulture in order to introduce the technology of Sichuan to Fujian. Han Mengzhou, who came from Shandong Province in the North and worked in Anhui Province, between the Huai River and Yangzi River Valleys, wrote Package Method of Silkworm-breeding and arranged for some instructors from Shandong to teach the locals how to undertake sericulture in the Shandong way. Wang Yingxu, another official of Shandong origin, wrote On the Silkworm to introduce the technology of Shandong in the North to Sichuan in the West. He Changling, a well-known writer and historian, wrote Method of Pit Cultivation to change the primitive way of tillage practised in Guizhou Province in the South. Ren Shusen, working in Guizhou Province, wrote Method of Cotton-growing to help solve a local shortage of clothing. Zeng Yun, who worked in Hebei Province and Manchuria in the North, wrote On Tussah-raising to introduce tussah silkworms in these two regions. Many more cases can be found in Chinese history.

Agricultural books were also used to introduce totally new technology in order to upgrade agriculture. For instance, in the mid-first century, Fan Shengzhi wrote Master Fan's Treatise on Agriculture to introduce pit cultivation, a new method of labour-intensive farming. His method became traditional in Chinese agriculture. In the early seventeenth century, Xu Guangqi, a high-ranking official of the Ming Dynasty, wrote a series of agricultural books including Complete Treatise on Agricultural Administration to introduce new methodologies including statistics and deduction, new crops including sweet potatoes and maize and new methods of water control. In his works, for the first time in Chinese agronomic history there was resort to new technology and new crops from overseas: from Western Europe (astronomy and water control) and South-East Asia (maize and sweet potatoes). His books became well-known and widely quoted.

### b. Technology standardisation

Efforts were made by many agriculture writers to standardise existing technology. For example, in four early agricultural monographs entitled 'Land Ecology' (between 475 B.C and 221 B.C.), 'Land Application', 'Soil Amelioration' and 'Agricultural Timing' (c.239 B.C.), the ancient Chinese tackled agronomy from the angle of pedology, and began to recognize the correlation between soil types and natural vegetation, and between soil types and agricultural productivity. The issue then was to find the most suitable soil types for given crop species and varieties, which inspired an extensive nation-wide investigation. In these works, the spatial scope of studies was restricted to the northern region and some early references to intensive farming appeared, such as the description of careful soil preparation, intensive field management and the multi-cropping system. In addition, the timing of different agricultural tasks received special attention, this being considered an important factor in crop yield. This was the beginning of the development of regional agronomy and also was the first attempt to standardise regional agricultural techniques and technology.

The major agronomic achievements of North China up to the sixth century A.D. were described in Essential Techniques for the Peasantry. By this time Chinese agronomy had been enriched by an expansion of agricultural knowledge, covering a greater spatial scope, an enlarged understanding of crop and livestock species and varieties, accurate

assessment of quantitative seeding, a complicated crop rotation system, the effective use of various fertilisers, and more advanced dry farming techniques, including methods of soil preparation and irrigation. All these advances are detailed in the text, which also presents for the first time in Chinese history a methodology of agronomy based on positivist method and induction. This work represents a great effort made by the Chinese to standardise agricultural technology in the Yellow River Valley.

Later, during the period between the ninth and the twelfth centuries A.D., two important books were written, Standards for the Plough and Master Chen's Agricultural Treatise, indicative of the establishment of a new regional agronomy in the Yangzi River Valley. They, with some other books, played an important role in standardising southern agricultural technology.

In the fourteenth century, a book entitled Master Wang's Agricultural Treatise resulted from an effort to standardise both northern and southern agricultural technology, especially in agricultural tools and equipment. Later, in the mid-eighteenth century, the Compendium of Works and Days presented a thorough nationwide investigation into agriculture, to standardise and update agricultural technology.

c. Technological gap-bridging

In Chinese history, severe disasters such as flood, drought and especially wars periodically destroyed its economy. For example, civil wars and outside invasions often depopulated several provinces at a time and destroyed the regional agriculture. This happened repeatedly at the end of each dynasty. Disasters often resulted in a gap in technological development. While in world history disasters caused some civilisations to disappear, the Chinese responded to such pressures. After political catastrophes, for example, agricultural book production in China increased in order to bridge the technological gap resulting from the accompanying man-made destruction. In Chinese history, five economic recovery periods can be taken as good examples: (1) the Han Dynasty (starting in 206 B.C.), (2) the Northern and Southern Dynasty (starting in 420 A.D.), (3) the Song Dynasty (starting in 960 A.D.), (4) the Ming Dynasty (starting in 1368 A.D.) and (5) the Qing Dynasty (starting in 1644 A.D.). Before each of these periods, China had suffered heavy population losses and the abandonment of its once most prosperous agricultural regions; while during these five recovery periods the Chinese economy gradually returned to normal. At the same time, dramatic increases occurred in agricultural book production. This is illustrated in the following table.

Fluctuations of Population and Agricultural Book Titles in the Five Periods

Period	Population Loss (compared with the last pre- vious statistics)	Loss Rate (%)	Increase of Agricultural Book Titles (compared with the last previous statistics)	Increase Rate (%)
Han			7	100
N. & S.	5,302,434	53	4	200
Song	1,864,647	38	77	275
Ming	16,462,180	22	99	354
Qing	37,621,559	73	72	57
Average		47		197



This indicates that agricultural books were part of the effort made by the Chinese to rebuild their economy, by bridging technological gaps caused by wars.

Of the agricultural writers, Jia Sixie and Wang Zhen, who both lived during the troubled non-Chinese regimes, are probably the most shining examples. Jia lived in the period of the Northern and Southern Dynasties (420-581 A.D.), a time of warfare and schism during which China was broken in pieces by the Five Barbarians from the north and west. The Five Barbarian peoples caused trouble similar to those which the Western Roman Empire suffered. The Chinese economy, mainly agriculture, was severely disrupted. The Xianbei, one of the barbarian peoples who had replaced the Huns on the steppes, conquered North China and ruled it from 386 to 534 A.D.. A people who practised nomadism and plunder, the Xianbei could not rule the Chinese without the help of shi. In 386 A.D., at the very beginning of the Xiabei reign, Emperor Daowu (368-408 A.D.) began to appoint some shi members as high-ranking courtiers. In the meantime, the Xiabei herdsmen began to realize that tillage was more profitable than pasturage. Therefore, in 400 A.D., Emperor Daowu set an example for all the Xiabei by ploughing his farm himself. Later, in 485 A.D., Emperor Xiaowen (471-499 A.D.) launched an economic reform and established the Land Equalization System, which enable people to obtain state land so that all able men and women had the basic capital with which to start their own agricultural production. The establishment of the Land Equalization System marked the systematic recovery of Chinese agriculture in the North from the regression caused by the lengthy upheavals that followed external intrusion and alien conquest. For the society, the next step was to collect and systematise agricultural technology. It was in order to help the economic recovery that Jia, a Chinese official in the Xiabei reign, set himself the task of classifying the agricultural knowledge of previous generations. In his Essential Techniques for the Peasantry, Jia cited over 160 classics and 30 peasant proverbs containing information on practical agricultural techniques and reviewed agricultural achievements from as early as the Western Zhou Dynasty (11th century-771 B.C.) up to his own times. His aim was to bridge the technological gap and enable the agricultural sector to recover speedily. To make his book easy to understand Jia wrote in the colloquial idiom, being the first writer to make this effort in Chinese agronomy.

In Wang's time, China suffered a repetition of the fate that had befallen it in Jia's time, except that the Mongols were even more brutal than the Xiabei and were responsible for the bloodiest pages in Chinese history. The Mongols gained firm control of all of China proper in 1279 A.D. and ruled the country under a stratocracy for 97 years. During this time they did more harm than good to the Chinese economy: millions of Chinese were killed or captured to be slaves and serfs; vast agrarian areas were enclosed as grazing land; horses of the Chinese were confiscated; autumn tillage for the second crop was forbidden because the Mongols used the land as grazing land after the summer harvest; the taxation burden increased enormously to maximize the government's revenue. The Mongols even planned to killed all the Chinese to make China their grazing land. It is not surprising that many Chinese agricultural areas were ruined. In administration, the racial discrimination practised by the Mongols against the Chinese further harmed the economy. Nevertheless, when at last the situation stabilised, the Chinese shi once again began to play their role in society. Wang and many other shi members eventually entered official ranks with their political ideals. In Master Wang's Agricultural Treatise Wang established an agronomic system which embraced northern and southern agriculture. He took pains to collect, describe and illustrate a wide range of agricultural tools and equipment, which made his book the first systematic study of this sort in Chinese history. To popularise his book, Wang even invented a new method of moveable type and a new way of organising the type in a rotary frame to make composing quicker.

Many other cases can be found in Chinese history which reflect the shi's mission and actions to preserve Chinese technology and civilisation.

### 5. Time lag

In relation to crop species and tillage methods, the time lag between the development of a practice and its incorporation in book knowledge tended to be short. Usually, new crop species and new methods of cultivation were reported in agricultural books fairly promptly, because the discovery of something new was regarded an individual merit, and adding something new to the list of existing species and methods was therefore a common practice in agricultural writing. In the Ming and Qing Dynasties, the number of crop species, for example, recorded in some comprehensive agricultural books often amounted to over one thousand. Thus, it can safely be assumed that in the case of crop species and tillage methods the time lag would have been very short.

However, the time lag was considerable in the case of farming tools and equipment. For example, although the Chinese started to use the plough long before the Qin Dynasty (221-207 B.C.) the first known systematic description of its structure only appeared in Tang times (618-907 A.D.) in Standards for the Plough. Moreover, a systematic description of existing agricultural tools and equipment was available only in the Yuan Dynasty (1271-1368 A.D.) in Master Wang's Agricultural Treatise. Before this, tools and equipment were only given a passing mention, and more description could be found in ordinary dictionaries than in agricultural books. The reason why tools and equipment were neglected may have been that some special knowledge on mechanics was required to understand and describe them properly; and that, in intensive farming, tools and equipment played a less important role than they did in extensive farming. In effect, in Chinese traditional agriculture, there long existed a wide range of implements, from simple tools such as spades and hoes to sophisticated animal-powered machinery. This situation lasted until the twentieth century, and persists even today.

This is an important characteristic of Chinese traditional agriculture: that the Chinese pursued agricultural achievement mainly by adopting better species and tillage methods, and not by employing better labour-saving equipment. Francesca Bray (1986) presents this argument convincingly, in respect of rice cultivation.

### 6. Chinese agriculture without agricultural books?

Several assumptions can be made under this heading.

Even allowing for some transfer of skills by word of mouth, many techniques would have not become available in other regions, because language barriers would have hindered their rapid spread through so large a country as China. Agricultural books, the vehicles of knowledge, and the shi, the intermediaries of knowledge transfer, worked hand in hand and could overcome regional limits and transfer technology nation-wide.

Secondly, without the agricultural books, Chinese traditional agricultural technology would have been lost, especially during the wars which caused depopulation in huge areas.

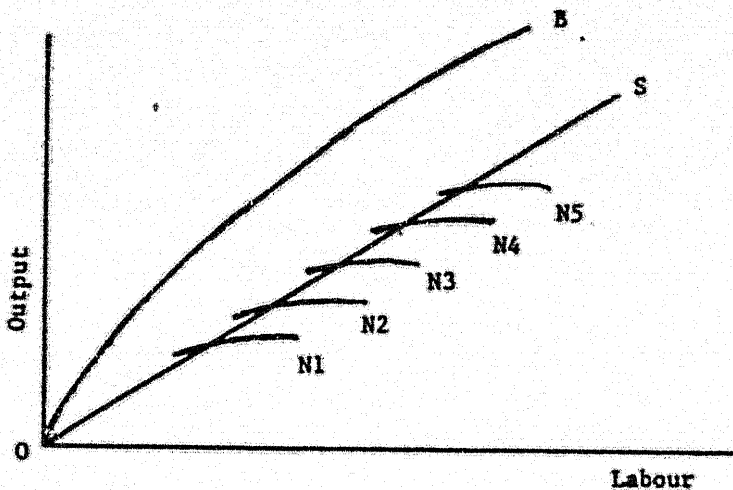
Thirdly, the close ties between agriculture and the shi would have been cut, which means that Chinese agriculture would have lost its 'brain'. The development of agricultural technology would then have slowed greatly.

Fourthly, and most importantly, Chinese civilisation, whose development was dependent on agriculture, would have suffered greatly. In this sense, technological literature of which the agricultural books constituted an important part, was the saviour of the agriculture-based civilisation of China.

### CONCLUSION

Mark Elvin, a western scholar specialising in Chinese economic history, holds that while most Chinese technology stopped progressing well before it reached its limit in pre-modern society, Chinese agriculture was the chief exception (Elvin 1973:298). However, Elvin does not demonstrate what made Chinese agriculture so exceptional. Bray, who has contributed a great deal to the study of Chinese traditional agricultural technology (1984), has nevertheless not established the link between theory and practice nor the mechanism for the dissemination of agricultural technology in traditional China.

The purpose of the present study is to show why Chinese traditional agriculture did not stop progressing and how this happened. The answer is that the educated, through their social influence and their intellectual production of agricultural books, played a crucial role in the updating of Chinese agricultural technology.



This can be illustrated in the above diagram in which OS is the Subsistence Level of Agricultural Production in Society; N1, N2, N3, ... are the Envelopes for the Natural Growth of Agricultural Techniques without the Intervention of the Educated; and OB is the Technological Envelope or Ceiling permitted by Agricultural Book Knowledge. The gap between the Natural Envelope and the Envelope permitted by Book Knowledge was caused by the inefficient diffusion of knowledge, if along the OS line; and by severe disasters, if below the OS line. In stagnant civilisations, the OB envelope did not exist, and thus society relied only on the natural growth of agricultural techniques. In now extinct civilisations, the natural growth of agricultural techniques stopped or even went backwards, so that the natural growth envelopes fell under the subsistence level along the OS line. In China, the OB envelope allowed population growth in spite of disasters because of the constant surplus between OB and OS.

## REFERENCES

- Bray, Francesca. 1984. 'Section 41: Agriculture'. In Joseph Needham: Science and Civilisation in China. Cambridge: Cambridge University Press, vol.6.
- Bray, Francesca. 1986. The Rice Economies. New York: Basil Blackwell.
- Elvin, Mark. 1973. The Pattern of the Chinese Past. Stanford: Stanford University Press.
- Liang Fangzhong. 1980. Zhongguo Lidai Huko Tiandi Tianfu Tongji (Dynastic Data of China's Households, Cultivated Land and Land Taxation). Shanghai: Shanghai People's Press.
- Wang Yuhu. 1964. Zhongguo Nongxue Shulu (Bibliography of Chinese Agronomy). Beijing: Agriculture Press.

## BIBLIOGRAPHY

- Buck, J.L. 1968. Land Utilization in China. New York: Paragon.
- Cater, T.F. 1955. The Invention of Printing in China and its Spread Westernwards. New York: Ronald Press.
- Chang, Chung-li. 1955. The Chinese Gentry. Seattle: University of Washington Press.
- Chen, Huan-chang. 1911. The Economic Principles of Confucius and His School. New York: Columbia University.
- Ho, Ping-ti. 1962. The Ladder of Success in Imperial China. New York: Columbia University Press.
- Jones, E.L. 1981. The European Miracle. Cambridge: Cambridge University Press.
- Perkins, Dwight. 1968. Agricultural Development in China 1368-1968. Edinburgh: Edinburgh University Press.
- Rawski, E.S. 1979. Education and Popular Literacy in Ch'ing China. Ann Arbor: Michigan University Press.
- Smith, T.C. 1965. The Agrarian Origins of Modern Japan. Stanford: Stanford University Press.
- Smith, T.C. 1970. 'Okura Nagtsune and the Technologists'. In A.M. Craig and D.H. Shively (ed.) Personality in Japanese History. Berkeley: University of California Press.

## ACKNOWLEDGEMENTS

I would like to thank Professor Eric L. Jones and Dr. Tom Fisher for their encouragement and supervision of my Ph.D. research programme from which this paper is derived.