

STUDIES ON ASIAN TOPICS NO. 3

---

# India–China Comparative Research

*Technology and science  
for development*

Erik Baark · Jon Sigurdson

Curzon Press

---

SCANDINAVIAN INSTITUTE OF ASIAN STUDIES

STUDIES ON ASIAN TOPICS NO. 3

INDIA-CHINA  
COMPARATIVE RESEARCH

*Technology and Science  
for Development*

Edited by  
ERIK BAARK and JON SIGURDSON

CURZON PRESS

SCANDINAVIAN INSTITUTE OF ASIAN STUDIES  
*Kejsergade 2, DK-1155 Copenhagen K*

First published 1981

Curzon Press Ltd : London and Malmö

© SIAS 1980

ISBN 0 7007 0138 9

ISSN 0142 6028

Printed in Great Britain by  
Biddles Ltd, Guildford, Surrey

# CONTENTS

Contributors	v
1 Studies on Technology and Science in India and China: Prospects and Methodology <i>Erik Baark</i>	1
2 Self-reliance Versus Modernization: The Dialectics of Indian and Chinese Development Strategies <i>Björn Hettne</i>	20
3 Science and Technology in Development: Policy Options for India and China <i>Aqueil Ahmad</i>	57
4 Local Technology Systems in India and China <i>Ward Morehouse</i>	83
5 The Growth and Development of the Instruments Sector in China and India: A Comparison <i>Richard Conroy</i>	100
6 Survey of India-China Comparative Research <i>Erik Baark</i>	121
7 The Methodology of Comparative Research: A Selected Bibliography <i>Erik Baark</i>	143
Bibliography of India-China Comparisons	147
Appendix I: List of Participants at the Symposium 'Technology in Development: The Cases of India and China'.	152
Appendix II: List of Papers Presented at the Symposium 'Technology in Development: The Cases of India and China'.	154

*STUDIES ON TECHNOLOGY AND SCIENCE IN INDIA AND CHINA:  
PROSPECTS AND METHODOLOGY*

*Erik Baark*

This paper discusses the questions relating to the role of technology and science in development. As the symposium *Technology in Development: The Cases of India and China* addressed itself to these questions, it was revealed that comparative research on the experiences of India and China would present significant contributions on this issue. Therefore I will summarize here the proposals for future research areas presented at the symposium, and discuss theoretical and practical problems connected with comparative research on India and China.<sup>1</sup>

*1. Technology and Science in Development*

In the decades which have elapsed since the Second World War, researchers in social and political science have shown an increased interest in problems connected with development. Technology, in its conception as the systematic use of all technical knowledge, methods and operations in the control of nature, has been increasingly recognized as one of the most important elements in the development process. Technological modernization can justifiably be considered to be the most important element in the growth of developing economies, and the debate on development has thus increasingly centred on the role of technology in the modernization of developing economies.<sup>2</sup>

In addition, science has been recognized as a crucial factor in technological development. An advanced scientific establishment in developing countries appears to be one of the prerequisites for industrialization in the modern sense of the word. In most of the less developed countries, an independent scientific and technological base is lacking, and this problem can be seen as one of the major hindrances for modernization of the economies of these countries.

In the international debate on development, the role of technology and science in the development process has been the subject of a number of studies. These studies have approached the issue from a variety of conceptual frameworks and have suggested alternative solutions to the problems created by the introduction of modern

technologies in developing countries. In this debate one can identify a number of central concepts which have been widely discussed during recent years.

The divergence between the socio-economic contexts in which modern technologies appear is the basis for one influential school of thought. By adopting the concept of *appropriate technologies*, the proponents of this school seek to call attention to the problems created by an uncritical transfer of technology from advanced countries to developing countries. Two problems are particularly noteworthy: first, capital-intensive, advanced technologies will often be inappropriate in the economies of developing countries, which lack the necessary capital; secondly, advanced technologies are usually not appropriate in the context of the labour-abundant developing economy. Labour-intensive technologies which do not demand large amounts of capital are therefore 'appropriate' in developing economies, and a more critical choice of technologies is proposed.

Another concept which has been widely discussed in recent times is *self-reliance*. When discussing this concept, certain development theorists have proposed that developing economies should go through a period of isolation from the international market in order to be able to establish a 'self-reliant' basis for technological development. The reason for proposing such a strategy can be found in the unequal economic conditions between advanced and less developed countries. This inequality has had the effect that developing countries often rely to a large extent on foreign enterprise in their own economies. In many cases this foreign influence, even if it may contribute to economic growth in the developing country as such, works in ways detrimental to the establishment of an indigenous base for technology and science. The self-reliant strategy of development is thus regarded as an effective means to counteract this foreign influence.

A third viewpoint which has become influential lately is that economic growth should be coupled with equity in order to be successful. In the concept of *technology for basic human needs*, the technology employed in developing countries should preferably be ordered to serve the needs of the population at large. The experience of many countries in the Third World indicates that roughly the opposite is the case: that economic and technological progress is used to benefit a limited, already privileged, stratum of society. Through the concept of technology for basic human needs, a strategy for technological and scientific development is proposed

which could serve to alleviate the widespread poverty of the unprivileged strata of society.

Many of these new concepts have been applied in empirical research as well as in development programmes all over the world. Among the participants at the symposium, however, it was felt that comparative studies of India and China could provide a basis for further examination of the practical and theoretical implications of these concepts. One reason is that a number of the concepts mentioned above have been incorporated in the development strategies of both India and China. Another reason can be found in the similarities in macro-economic conditions of the two countries on the one hand, and the differences in approaches in development strategy on the other hand. An interesting aspect of the role of technology and science in development in India and China is the relationship between the particular social and political contexts of these countries and the development strategies chosen. The symposium led to the conclusion that India-China comparative research could be a valuable instrument for the attainment of a deeper understanding of the role of technology and science in development.

## *2. An Agenda for India-China Comparative Research*

A selective bibliography was compiled in connection with the symposium where a list of India-China comparisons was included.<sup>3</sup> The compilers lamented the fact that 'literature on India-China comparative analysis is in short supply', and when a stock-taking survey of this literature was made for the present volume (see Chapter VI), it appeared that the field of India-China comparative research is biased in several respects.

The subjects most frequently treated in recent India-China comparative research appear to be comparative economic performance, studies in development strategies, and rural issues. When one notes that, in addition, most of this research has been carried out by Indian scholars, one is left with the impression that comparisons between India and China are made chiefly with reference to political issues in India. While this bias is obviously rooted in a genuine concern over the advantages of the Indian or the Chinese model of development, the purpose of the symposium was to call attention to a different aspect of India-China comparisons. This aspect is the

promotion of a deeper understanding of the role of technology and science in development, not only in India and China but in all developing countries.

Therefore, a number of new research areas were proposed by the participants, and this section will attempt to delineate these research areas and their possible contributions to India-China comparative research.

#### *a. Political conditions*

Science and technology must be studied in the political contexts of both countries, as the fate of scientific and technological development is likely to depend on the policies adopted. Björn Hettne's paper on development strategies (included in this volume) provides an example of an analysis of political conditions. The paper compares the role of different political lines in the formulation of development strategies. Through his analysis of the dialectical evolution of policies on development issues in India and China, Hettne provides a detailed picture of the political conditions in which development has taken place.

While for instance Hettne's analysis gives an outline of the process of *policy formulation* in India and China, comparative studies of *policy implementation* appear to have been neglected so far. Particularly with reference to science policy, a discrepancy between the political goals formulated by governments and the actual implementation carried out by local authorities has presented serious problems in developing countries. Neither India nor China appear to be exceptions in this regard. Comparative research on the implementation of policies on technology and science in India and China is a vital element in the correct assessment of these policies.

#### *b. Social conditions*

The political contexts of science and technology strategies are embedded in the context of the social structures of both countries. In a comparative perspective, the social structures of a country may influence the technological and scientific developments. Comparative research on social structures in India and China can thus be considered essential for the specific studies of issues related to technology and science.



For example, a comparison of social structures within units of similar size in the two countries - e.g. villages - is a necessary prerequisite to studies on the effects of technology transfer. In the debate on the role of technology in development, the opinion has been voiced that the question of political and financial influence is most crucial for the successful introduction of modern technologies. One typical example is the differences which appear when modern agricultural technology is adopted by various rural social units. Some forms of agricultural machinery will be inaccessible to small farmers, but may be profitable to large landowners - and cooperatives organized by small farmers!

At the symposium it was suggested that the social context of technology and science in India and China could be analysed by means of comparative research on the class structure in these countries. This could incorporate a theory of the contradictions between social classes, a description of the ways in which social classes recognize and formulate their interests, and possibly a theory of class hegemony over state power. While the heterogeneity of both societies must be recognized, comparative research on class structure and power relations in India and China is likely to facilitate an increased understanding of the social context for technological and scientific development.

### *c. Economic conditions*

Social structures in India and China are relevant factors in the composition of a very important element in India-China comparisons: the economic conditions for development. In the experience of many developing countries, the introduction of advanced technology and science has placed severe strains on the national economy. India and China have the potential, as large nations, to devote considerable resources to technological and scientific development; but this potential may be exploited in different ways due to social and political factors.

One way to attack this complex problem is to make a comparative study of capital accumulation in India and China. The socio-economic structure of each country is likely to have a decisive influence on the pattern and effectiveness of capital accumulation in the economy. Thus, several programmes for social change in India and China have been motivated by economic efficiency. Units such as the People's Communes in China and Community

Development in India can be regarded as instruments to promote capital accumulation in the rural economy.

On the other hand, *allocation of resources* is an equally rewarding area for India-China comparative research. Policies on technological and scientific development are linked with the ability, within a developing economy, to allocate capital to this purpose. The establishment of scientific and educational institutions, for instance, depends to a considerable degree on available resources. A phenomenon like 'mass science' in China indicates that inexpensive, local scientific networks can be a solution to the problem of limited resources. The question of resource-allocation processes is also linked to the question of class interests mentioned above. In this area of research, a comparative study of the formulation and effects of economic planning is likely to present interesting results.

Finally, the questions of *employment and labour mobilization* are significant among the economic conditions for development. These questions seem to apply in particular to predominantly rural economies. Therefore, comparative research is essential on the Indian and Chinese experience with, for instance, labour-intensive technologies.

#### *d. International conditions*

The nature of world technological development is unfortunately such that the greater part of modern technology is situated in the industrialized countries. In addition, most of the prerequisites for further development of existing and new technologies are also found in these countries. Consequently a developing country is obliged to engage in a bargain on the world market for the technology it needs, and usually this bargain is conducted on the basis of conditions set by the industrialized countries. The effect is often that foreign influence on the developing economy becomes a major constraint to the independent formulation of a development policy.

India and China have approached this problem in entirely different ways during the last three decades. India has generally been more open to foreign investment, while China has insisted on varying degrees of isolation from the international market. In both countries, however, the concept of self-reliance has been frequently used in connection with development

policies. In India, restrictions on foreign activities have been limited by an adherence to the principles of liberal capitalism and democracy. In China, on the contrary, self-reliance has at times implied virtual isolation from the world market. Although this subject has been treated in many comparisons between India and China, only a few of these have been devoted to the effects of these strategies on technology and science.

Finally, it was suggested at the symposium that comparative research on India and China as recipients or donors of technology would be valuable. The Soviet Union has, at different times, supplied technology to both China and India. If the effects of the introduction of Soviet technology are compared in India and China, this study could present an interesting case-study of India and China as recipients of technology. On the otherhand, both have supplied technology to Tanzania, and a comparative study of India and China as donors of technology might cast more light on an essential question: whether Indian or Chinese adaptations of Western technology might be more appropriate for developing economies generally.

#### *e. Case studies*

The preceding sections have outlined some of the important research areas in relation to conditioning factors. But suggestions were also made at the symposium regarding some case studies in technological and scientific areas where India-China comparisons might prove particularly valuable.

A paper by Richard Conroy included in this volume serves to illustrate the value of a case study in an aspect of technology in India and China. This paper analyses the development and performance of the industrial sector producing instruments for laboratories and factories in each country. It is concluded that the development of this science-based industrial sector has been significantly dependent on political and economical strategies in India and China. The study thus indicates the conditions for technological development, and the effects of these conditions, for a key industrial branch in the developing economy.

A number of research fields in technology and science will be outlined below; it should be noted, however, that these represent only a fraction of the potentially relevant study areas.

1. *Education.* The importance of education for research and development has often been recognized, and a few comparative studies of India and China have been devoted to this issue. However, most of this research has been concerned with higher education, training of scientists, and so on; some of the fundamental areas in education for widespread technical change have been largely neglected. This is the case, for instance, with vocational training for industrial workers, spare-time education through correspondence courses and television, and rural extension services. Such studies may reveal significant problems at the lower levels of the educational systems.

2. *Energy.* As a result of modernization in India and China, both countries have to face the problems of a smooth transformation from low levels of energy consumption to comparatively higher levels. In addition, a choice has to be made with regard to different technologies for production of energy, exploitation of natural resources, and reliance on domestic or foreign sources of energy. The experience of China and India in these areas may present alternative paths of development.

3. *Military.* Much of China's research and development activity has been applied in the defence industry as well as in the civil sectors. Indian defence has also rested on the level of technological and scientific research reached in the civil sectors of the economy. This relation between military and civil priorities can be observed in particular in the progress of high-energy physics. A case-study of this research field in India and China would probably bring forth interesting facts about the capabilities of developing economies in advanced science.

4. *Medicine.* The technologies used in the health sector - and in birth control - can be studied as a case of technology applied to social purposes. A comparison of the Indian and Chinese approaches to production of medical instruments, the pharmaceutical industry, and the application of traditional and modern medical techniques would be valuable in this connection. Furthermore, the contradictions between traditional and modern medical science in India and China, and their eventual integration to form a new medical tradition, will be worth studying as a case of science applied to social needs.

### *3. The Methodology of India-China Comparative Research*

The cultural, political, and social differences between India and China imply that comparative research on issues related to technology and science will face a number of methodological problems. First of all, there is the problem of collecting material for the research. This problem includes questions such as the cultural and political bias of data, the comparability of two sets of data, and the scarcity or abundance of relevant data. The second problem is related to the analysis of the collected material. In this connection one must distinguish among a number of approaches by which the material can be arranged and employed in an analysis. Finally, the concept of methodology has come to include the viewpoints which the researcher may have on the purpose of the research, that is, the question of partisanship in research. Each of these aspects of methodology shall subsequently be discussed below.

The question of actual comparability of India and China was also discussed at the symposium. It was argued that differences in social and political structure in the two countries deprive comparative conclusions of their meaning. This argument, however, appears to be based on the biased approach of some forms of comparative studies; that is, the tendency to let India become the scapegoat for all mistakes in development policy. It should be pointed out that by explicitly choosing an approach among those described below, it should be possible to maintain a more neutral position.

#### *a. The data*

One matter that appeared to meet with universal agreement from the participants at the symposium concerned the reservations which must be made when data for comparative research on India and China is collected. The problems connected with data for India-China Comparisons have been adequately summarized by Ward Morehouse as 'jigsaw puzzle' scholarship in relation to Chinese sources, and 'needle in the haystack' scholarship in relation to sources from India. What these phrases describe is the nature of the process which the researcher must engage in when he is using Chinese and Indian sources. In the case of China, the information available is scarce and often constructed in such ways that they are not readily applied to the

purposes of the research. The researcher is therefore obliged to collect separate pieces of data from a wide variety of sources and subsequently try to place these separate items in a pattern in order to construct a complete picture." In the case of India, data is often available in staggering amounts, and the researcher will then have to sift out the relevant information from a large number of sources.

In the following short presentation of the major questions relating to data collection, however, I shall draw a distinction between qualitative and quantitative information, where qualitative information includes, e.g., political statements and descriptions of organization, while quantitative information refers to, e.g., statistics on volume of production, prices, etc.

One of the major problems is the *availability* of data. As pointed out in the preceding discussion, this problem is most acute with information from China. In general, however, the availability of quantitative data is more restricted than that of qualitative data. The Chinese in fact release many statements of a political nature, and when for instance the general political aims of the Chinese leadership in relation to economic planning are analysed, there are a number of sources which can provide a substantial amount of information on the organizations involved, the measures taken to implement the planning objectives, and so on. The collection of quantitative data, such as statistics on growth of production, is unfortunately often impeded by the Chinese habit of releasing such information sporadically. In addition, such data is frequently formulated in percentages of increase and decrease in relation to years for which actual figures are also missing. The Indian statistical service, by contrast, is organized according to the scope and concepts of Western counterparts. A wealth of statistical information is thus available on the national and regional level of the Indian economy and society.

With reference to the internal and external circulation of information, China can consequently be characterized as a 'closed system', while India is an 'open system'. The result of China's closed system for information availability has been that estimates, in part based on data from the 1950s, have often been the only way to describe China's performance in recent times. A change has been initiated in the last few years, but this change has not yet resulted in an amount of quantitative information comparable to that of India. The open system of India has enabled

researchers to have access to much larger amounts of data, both quantitative and qualitative, but several authorities have indicated that this fact may conceal some biases which are nevertheless inherent in the information.

Consequently, the *reliability* of the available data is an additional question which the researcher must consider. It has been quite common among researchers to question the reliability of Chinese data, but the absence of alternative sources in relation to which the data can be checked will often have the effect that the information must be used as it stands. But the reliability of data can depend on several factors; some forms of information, notably qualitative data on political issues, may be unreliable on account of editing, omissions, changes in scope of concepts, etc.; other forms of information, e.g., quantitative data on production may not be reliable simply because the source is itself unaware of the actual figures.

Another problem, which appears to apply equally to the Chinese and the Indian contexts, is the lack of a continuous relationship between macro-level information and micro-level information. A typical example is that figures for agricultural mechanization may be available for villages or communes, and perhaps also for the national level, but absent for an intermediate, regional level. A comprehensive framework for the interpretation of the micro-level figures may thus be lacking. The problem is, however, also part of general methodological problems concerning the focus of comparative research, and it will be taken up again in the following section.

Once the researcher has found ways of dealing with problems of availability and reliability for the data from India and China, the difficult question of assessing the *comparability* of data must be considered. This question will often have to be dealt with through specific research into the nature of the data used. An illustrative example of differences in the nature of quantitative data is the fact that figures for production of food-grains in Chinese sources include potatoes and unhusked grain, while Indian statistics exclude potatoes and are based on the weight of grains after husking. Obviously such figures must be corrected before a comparison can be made. But problems of comparability are not restricted to quantitative data. Differences in concepts used in qualitative data may be even more annoying in comparative research. The term *scientist*, for instance, carries different implications in Indian and Chinese sources. These differences refer not only to the educational qualifications of Indian and Chinese

scientists, but they apply equally to divergent conceptions of the role of scientists in society, their status in relation to other groups, the purpose of research generally, and so on. Consequently, the information released by Chinese and Indian sources regarding, e.g., the number of scientists graduated per year must be carefully studied before a comparison is made.

In conclusion it must be emphasized that it is an essential task for anyone engaged in comparative research to make sure that a critical evaluation of the reliability and comparability of data has been conducted throughout the process of investigation. Furthermore, the results of such a critical evaluation should be made explicit when the research is presented in published form.

#### *b. Focus of research*

It was stressed several times during the symposium that comparative studies of India and China would be possible on several levels and with various foci. The comparisons could be made on both macro- and micro-levels and an intermediate level was also suggested. In addition, the comparisons could focus on synchronic as well as diachronic comparisons.

Comparisons on the macro-level are exemplified by such sweeping studies as the development strategies or science policies in India and China. Research on the intermediate level could be studies of, for example, industrial sectors or provincial regions in both nations. At the micro-level, one could imagine research on the patterns of production in factories or villages. There is no doubt a great deal of heterogeneity in both nations, and regional, cultural and political differences in various sections of both nations in the vertical as well as the horizontal perspective, and this heterogeneity must be taken into account when the subjects for India-China comparisons are chosen. The choice of level of research has also important implications for both the availability and the comparability of data, as well as for the best approach in research methods. There is a constant interaction between the availability of data, the comparability of the data obtained, and the focus of the study.

In an intermediate-level study, for instance, the information obtained will often have to be illuminated in macro-level perspective in order to determine the



comparability of the two sets of data; by implication, a small set of data may be sufficient for a comparison to be made if information relating to other levels are used to qualify the data with respect to comparability.

The choice of focus will also influence the choice of methodological approach. In the following section I shall present an outline of three possible types of approach; each of these approaches may have strong points of its own when the level of research has already been chosen with the subject. The analytic approach, for instance, involves the formulation of a hypothesis which is to be examined with different sets of data. This approach is less likely to be valuable at the macro-level - where a descriptive approach may yield the best results - but would probably be an adequate tool at the micro-level.

With reference to the question of synchronic versus diachronic studies, it was suggested at the symposium that the synchronic analysis which is usually applied in India-China comparisons may be too limited in many subjects. An example may be found in the Chinese and Indian efforts to transform the mode of production in agriculture, which have taken place in different historical periods; in this case, a diachronic focus of research may be more valuable.

### *c. Approaches*

Comparative research can be approached through different research methods. In the following exposition, it has been considered useful to distinguish between three forms of approach: the descriptive, the normative, and the analytic research method. The establishment of these concepts has had a dual purpose; first, the distinction between the three different approaches have been employed in the classification of research presented in Chapter VI; secondly, each of the three approaches has particular applications according to the subjects studied, the focus of research, and so on.

The methodology of comparative research is, however, also the subject of several theoretical works which have been published in recent years. Much of this theoretical research has been used as a basis for the conceptual framework for research methods outlined in this paragraph, but in order to introduce researchers to this interesting subject, an annotated bibliography has been compiled for this volume.<sup>5</sup> It should be emphatically stressed that a more conscious approach to these theoretical questions