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Agriculture and Economic Growth

Japan's Experience



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Agriculture and Economic Growth: Japan's Experience

**AGRICULTURE AND
ECONOMIC GROWTH:
JAPAN'S EXPERIENCE**

Edited by

**Kazushi OHKAWA
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EDITORS' PREFACE

The chapters in this volume are the final version of a set of papers that were examined critically at the International Conference on Agriculture and Economic Development—A Symposium on Japan's Experience, which was held in Tokyo, July 3–7, 1967. The objective of the Conference was to make a comprehensive reappraisal of Japan's agricultural development and its relevance to economic growth over the last 100 years. The advance that has been made in the past decade, centering on our group study on this subject encouraged us to hold the first conference of this kind in Japan with an international group of participants. The Conference placed emphasis on the long-term view in analyzing Japan's agricultural development, with the historical scope being set as the century following the Meiji Restoration of 1868 to the postwar years, but in view of the importance of the pattern of the initial development of Japan's agriculture and its contribution to economic growth, consideration was also given to the Meiji Era, 1868–1912.

The Nippon Agricultural Research Institute, a private organization founded in 1942, was the Conference's sponsor. Mr. Einosuke Ishii, chief director, represented the Institute. An organizing committee prepared for the symposium in collaboration with Director Ishii. The committee consisted of Professors Kazushi Ohkawa, Shigeto Kawano (co-chairmen), Yuzuru Kato, Kenzo Hemmi, Yujiro Hayami and Saburo Yamada. Professor Bruce F. Johnston was of assistance regarding international affairs. While the symposium was in progress, the organizing committee, headed by Professor Yujiro Hayami, functioned as a management committee to ensure a successful meeting.

To facilitate a productive and intensive exchange of views, participants were kept to the modest number of 31, comprised of 19 Japanese and 12 foreign scholars. English was adopted as the conference language with provision for occasional interpretation into Japanese when necessary. The papers were not read at the Conference, but circulated beforehand. Each author gave a brief summary of his paper. The discussants for each paper were asked to prepare written comments in advance to review the assigned paper and open

vi *Editors' Preface*

the discussion on it. The session was then opened for general discussions and questions from the floor, the author being given an opportunity to reply. The program of the Symposium appears at the end of this volume.

Following the Conference an editorial committee was established, the members of which were Professors Bruce F. Johnston and Hiro-mitsu Kaneda in addition to the above-mentioned members of the organizing committee. The Editorial Committee agreed to publish both an English and Japanese version of the proceedings. Professors Ohkawa, Johnston and Kaneda were asked to be co-editors of the English version and Professors Kawano and Kato were asked to serve as co-editors of the Japanese version. The committee agreed in principle to include all the papers presented to the Conference in this volume subject to the revisions suggested in the comments by the assigned discussants, comments from the floor, and changes recommended by the editors. The editors gratefully acknowledge the contributions of the discussants, which have led to improvements in the papers as published in this volume, although the written comments could not be included.

Yuize's conference paper, "An Econometric Model of Agriculture in Japan," is not included. It is the most ambitious attempt of this kind ever tried in Japan. The committee agreed with the author's view that it is in the preliminary stage and needs further work. (The paper appeared in a brief form in *Keizai Kenkyu*, XVIII, October 4, 1967, in Japanese.) On the other hand, the committee decided to include three papers which were not presented to the Symposium by Professors Gustav Ranis, Arlon R. Tussing, and Ryoshin Minami. These papers are closely related to our group study and the committee believes that their inclusion is highly desirable. We are grateful to have both the cooperation of these authors and the generous permission of the *Economic History Review*, the *Journal of Economic History* and the *Quarterly Journal of Economics* to include these in this volume.

The committee expresses its sincere thanks to Mr. Bernard Key for his major contribution to the task of editing the papers and to the NARI staff for local arrangements. The committee would also like to express its appreciation to the Ford Foundation and the Asia

Foundation for their financial support which enabled the foreign participants to take part in the Conference. Finally, the committee is deeply indebted to Professor T. W. Schultz for accepting our invitation to contribute a Foreword to this volume based on his participation at the Conference.

The selected papers are arranged in four parts. Part I, with three papers, gives overall analyses of the significance of Japan's experience in different dimensions; Part II consists of three papers which deal with productivity growth and technological progress; five papers are included in Part III which treats the agricultural population and the labor force; Part IV includes a set of papers which deal with exports of primary products, credit and financial institutions, farm-household savings, the impact of the Land Reform, and food consumption patterns.

Part I begins with Ohkawa's identification of three historical phases of the agricultural development in Japan. In so doing, Ohkawa attempts to give a comprehensive exposition of Japan's longterm experience. Taking up agriculture from the viewpoint of general economic growth, Ranis discusses the crucial role played by agriculture in financing the initial economic development of Japan—a controversial and important issue. Johnston then treats the international significance of Japan's model to the development strategy of currently developing countries, especially in Southeast Asia.

Part II begins with an attempt to reappraise the statistical documentation of the Meiji agriculture with respect to output and productivity growth measurement, another controversial issue. Hayami and Yamada, on the basis of their newly-estimated data, confirm the validity of the widely-accepted view in favor of the "concurrent growth thesis." It is followed by Sawada's longer-term analysis of the effects of the technological changes using the production function approach. Here, Sawada discovers three phases of technical changes in agriculture. Next, the impressive progress of small-scale mechanization in postwar agriculture is taken up specifically by Tsuchiya using an econometric approach, and a widely prevailing view that emphasizes non-economic motives of mechanization is challenged. Tsuchiya identifies distinct effects of substitution of power-tillers for labor, the price of which has drastically risen.

viii *Editors' Preface*

Part III begins with Umemura's paper, which characterizes Japan's demographic transition internationally and clarifies the pattern and causes of changes in labor force distribution between agricultural and non-agricultural employment. Here, Umemura reveals vividly the features of two historical phases: a labor growth-dominant and a productivity growth-dominant pattern in Japan's prewar economic development. To compensate for the paucity of data for the whole country, we have presented next Tussing's detailed quantitative study of Yamanashi prefecture, for which special surveys are available, on the labor employment and input distribution among major industries, particularly related to agriculture. Tussing suggests that it is important to make a distinction between labor's marginal contribution and the earnings of workers in the early years of economic development. This is followed by the papers of Masui and Misawa, both of which deal with the labor and related problems of the farm economy. Focusing on a farm-household basis instead of an individual basis, Masui attempts to identify various supply prices of farm workers of different categories, aiming at clarifying particularly the differences in the pattern of labor movement as seen between the pre- and postwar periods, whereas Misawa concentrates on the postwar farm economy, clarifying the causes of the remarkable increase in part-time farming. Last, Minami's long-term analysis of labor supply from agriculture to non-agriculture is presented to conclude Part III. Here, Minami places the turning point (in W. A. Lewis' sense) of the Japanese economy in the 1950's, not at the end of World War I as suggested by others.

Part IV begins with a problem of international trade. It is widely known that silk exports made a large and sustained contribution to foreign exchange earnings. Hemmi attempts to reveal the causes and significance for its early economic development; satisfactory financing of capital to silk industry and technological progress realized in sericulture, among others, are identified as the major causes. The problems of providing the developing agriculture with credit is further described historically by Kato with reference to government-administered long-term credit; functions of the Hypothec Bank and other special banks are clarified. An analysis of farmers'

savings behavior is directed to the postwar experience because of data limitations for the prewar years. Next, Noda tries to apply a special device to measure the savings function of farm households in order to clarify the effects of increases in non-farm incomes such as wages and salaries. The impact of the Land Reform, which was undertaken immediately after the war, is then taken up in by Kawano. The treatment of the subject does not try to deal with the difficult problem of assessing the output-productivity effects of land reform; the analysis is focused on the positive impact on the farm economy, particularly on the increase in both consumption and investment of the farmers who became owner-cultivators in the postwar period. In Chapter 1, however, brief comments are made on the probable effects of the Land Reform on incentives and output, and it is also suggested, that as a result of the remarkable change in the structure of the Japanese economy that has occurred in the postwar period, the Land Reform restraints such as maximum farm size have now become negative factors impeding necessary structural adjustments within Japanese agriculture. Finally, Kaneda has reappraised Japan's distinctive food consumption pattern with respect to the demand for farm products. Kanada's analysis, based on new long-term data, found that income elasticity of food demand remained low throughout the prewar period whereas it increased substantially in the postwar years. He concludes that the process of the slow change in food consumption patterns in the prewar period contributed to the development of the Japanese economy by freeing foreign exchange that might have been required to finance food imports, for other resources.

We believe that the major objective of the Symposium was achieved. In fact, the participants found a great deal of broad agreement in most of the empirical findings and their interpretation. In particular, they agreed that the Symposium established a broad generalization that Japan's experience of agricultural development does not present a simple, unchanging pattern over a century; instead it contains three historical phases, including both rapid growth and stagnation. Throughout the discussions, however, not a small number of important points were raised and directed for further

x *Editors' Preface*

study. In regard to our analytical approach as a whole, apart from the individual papers, we would like to mention the following points in particular:

Although the organizing committee had intended to cover all the important topics of agricultural development relating to Japan's economic growth, some topics were missing from the conference program. For instance, no paper dealt with the long-run behavior of commodity prices or the sectoral flow of savings-investment. Such gaps were intended to be filled partly by Chapter 1 and by the inclusion of the three papers not presented to the Conference. Yet a gap remains. The main reason for this deficiency is incompleteness of data. The data limitation is also true for the selected topics to a certain extent and attention is called in Ohkawa's paper to each particular point. Many papers depended upon the volumes of the *Estimates of Long-Term Economic Statistics of Japan Since 1868*, edited by K. Ohkawa, M. Shinohara and M. Umemura (Tokyo: Tōyō Keizai Shinpōsha, 1965—), referred to in this volume as *LTES*. Particularly useful was the volume, by M. Umemura, S. Yamada, Y. Hayami, N. Takamatsu and M. Kumazaki, *Nōringyō (Agriculture and Forestry)* (1966) referred to in this volume as *LTES*, IX. The new estimates contained in these volumes contributed greatly to furthering the quantitative analysis of Japan's experience. Although some of the papers are the results of efforts at original data preparation, some others are not satisfactory in this respect. Further efforts are called for in preparing a more consistent body of data. This is particularly urgent for the early Meiji years before 1885, for which the Symposium could not reach agreement with respect to output-productivity performance of agriculture.

Also affected by later limitations were analyses of major substantive issues such as the concurrent growth vs. the preconditions thesis; different interpretations of the significance and of the transferability of Japan's experience to currently developing countries; different ways of approaching the study of productivity growth in agriculture. Much more relevant, however, are the theoretical frameworks. The organizing committee intended that the conference papers and discussions should concentrate on "economic analysis" using modern theoretical concepts and tools. This was largely

successful in that emphasis was on examining testable hypotheses against the complex historical realities and in avoiding empty topics. Despite a broad agreement among the participants with respect to this methodological approach, some disagreement was felt and a fuller exchange of views to ascertain issues would have been desirable. We believe this was mostly related to the basic problem we face in analyzing the process of modernizing agriculture: the historical vs. an analytical approach. Not a small number of papers described the historical patterns exclusively while others adopted a functional approach with econometric tools. Those in favor of the latter approach criticized the former for its weak "analytical results," whereas those in favor of the former expressed dissatisfaction with the latter approach for parting from the "realities." Through discussion, mutual understanding was promoted to a considerable extent as far as the individual problems were concerned. However, some disagreement remained explicitly and probably more implicitly through various sessions. Finally, a basic theoretical problem was raised by Professor Schultz in the last session: what is "productivity increase"? or what is "technological change"? As explained in his Foreword, he proposed "a more complete input and capital accounting method based on the concept of the rate of return on "investment." In view of the use of the "conventional" productivity concept in many papers presented to the Conference, there was stimulating discussion of opposing views, and several participants defended the useful aspects of the "residual" approach. Further theoretical studies are thus strongly encouraged by this disagreement.

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FOREWORD

We have here the core of the best International Conference I have had the privilege to attend. It is most assuredly a landmark. The topics, the approach, and the analysis, both theoretical and empirical in solving real problems, make it quite valuable to economists. It adds depth to our understanding of the modernization of agriculture and economic growth. Those who planned the program and those who prepared the main papers that we discussed at the Conference avoided the many empty topics which have been so fashionable in recent years. The economic perversity of farmers is not here—thank goodness! Nor are the papers burdened with backward sloping supply curves. Resource allocation is not wholly determined culturally, labor is not to be had at zero marginal cost, and the modernization of agriculture is not dependent upon gigantic farms. Above all else, the Conference papers do not exclude changes in the relative prices of products and factors.

Instead, the Conference set the stage for a series of meaningful dialogues. It came to grips with consumer behavior as it is revealed in food consumption, with savings and capital formation in agriculture, with land reforms, with the population transition, the labor market and the supply price of labor, and with small farms and part-time farming in terms of economic efficiency and in adjusting to the requirements of economic growth. In treating these topics, the advance in knowledge is a joint product of economic theory and empirical analysis. These papers are not a mere display of ever more economic models or an appeal to more history without theory.

What emerges clearly and cogently is that remarkable *Japanese Invention* of a modern agriculture under Asian conditions. Japanese agriculture is technically in the vanguard and efficient in its economic performance. Although the farms are very small, they have successfully demonstrated that they have the capability of using a wide array of complex, modern inputs including mechanization. Although the area of farm land is exceedingly small by any relevant standards, Japanese agriculture has taken this limitation in stride. This Japanese Invention has to its credit three achievements in which Japan excels Western countries. One of them is the rise and success of part-

time farming. In schooling and improvements in the quality of farm labor and its utilization, Japan also appears to excel; and not least, is the extent to which Japan is avoiding the burden of severe depressed areas in agriculture, areas such as Appalachia in the United States and the agriculture, for example, of southern Italy and France.

Doubts were expressed at the Conference with respect to the views of some American economists that Japanese farmers not only financed the modernization of agriculture in Japan but also supplied much of the capital for the industrialization of Japan. I share these doubts. The capital accounting of all private and public capital formation appears vulnerable for reasons of omission. (The Ranis paper was not on the agenda of the Conference and I have not had an opportunity to read it.)

Turning to agriculture's part in the economic growth of a country and how this part of growth can best be optimized, under the conditions that characterize Asia, I confess to a long-standing belief, namely, that the successful Japanese experience can teach us much more on this score than we can learn from the economic history of the United States. I am of this view still, although these papers convince me that the underlying and as yet unsolved analytical problems are precisely the same in Japan as in the United States. Farms, undoubtedly, differ but not the state of economics. In our studies of economic growth, we are up against the same puzzles.

Professor Ohkawa's paper gives us the long view covering virtually a century. I know of no comparable analysis of agriculture for the United States which covers the period since our Civil War. Ohkawa's approach is akin to the scholarship of Simon Kuznets from whom we also have learned much about our economy. But the economic growth from our agriculture has not been analyzed in depth along these lines over so long a period. Professor Ohkawa identifies three distinctive sub-periods (his phases I, II and III). They emerge clearly from his data. They, also, characterize the economic history of agriculture in Taiwan judging from the recent study by Yih-Min Ho.¹ Professor Ohkawa analyzes changes over time in inputs and in productivity. The distinction between inputs that

¹ Yih-Min Ho. *Agricultural Development of Taiwan 1903-1960* (Nashville: Vanderbilt University Press, 1966).

originate from within agriculture and the inputs that are acquired from the non-agricultural sectors represents a marked advance analytically. Transforming the inputs that are reproducible and that become a part of the resources in agriculture into stocks of capital is another step in his analysis. The apparent constancy over many decades of the scale of the farm-firm greatly simplifies the analytical problem. His concepts of complementarity between and among the changing pattern of inputs is surely relevant.

It is beyond my competence to evaluate the adequacy of the underlying data. Professor Ohkawa with much care, again and again, throughout the paper calls attention to some omissions and to other data limitations. I would presume that the estimates of agricultural output are in good repair but that the estimates of inputs are necessarily much less satisfactory. Even for land and labor they are hard to ascertain. For the other inputs, whether purchased by farmers from year to year and used currently or transformed into reproducible stocks of agricultural capital, the measurement problems are beset by many difficulties. These difficulties, so it seems to me, take us to the heart of the unsolved analytical problems in determining agriculture's contributions to economic growth and in discovering how to achieve this growth efficiently.

Despite the difficulties of which I speak, there are many policy lessons at hand from these studies. But since the conference was not policy oriented, I shall not elaborate on these lessons. Instead, let me turn to a consideration of analytical difficulties, not that I have solutions, but to help clarify the problems that await solution.

1. What is the economic meaning of an index of productivity? Leave aside any particular factor productivity indexes, that is for land or labor, and consider only an index of the productivity of total inputs used by a sector, or the economy as a whole. Suppose such a sectoral index shows a gain in agricultural productivity between two periods, namely, that measured output increases more than the measured aggregate of inputs, what economic inferences are permissible from these measurements? The implication would seem to be that the economic value of the output has increased more than the economic value of the inputs over such a period. If so, to farmer-entrepreneurs in the second period would presumably accrue a

windfall gain relative to the profitability of farming in the first period. Suppose, however, that the agricultural sector were in equilibrium in each of these two periods and that profits were normal and identical, the economic value of the output in each period would be equal to the value of the productive services of the inputs plus normal profits during each of the two periods. In this sense, an index of total factor (inputs) productivity is an anomaly; it is inconsistent with economic theory.

Thus, we cannot infer from a gain in productivity which is revealed by such an index that farming has become more profitable, that the value of output exceeds the value of the productive services of the inputs, that the increase in output attributed to the gain in productivity was obtained at no cost or relatively cheaply, or that the investment in achieving the additional outputs was in accordance with priorities set by the relative rates of return. I wish to suggest that such an index of productivity is a proxy for an *economic unknown*. This troublesome unknown is presumably hidden somewhere in what we are treating as inputs.

2. Can this problem be solved by introducing an adjustment for technical change? The productivity index can be transformed into shifts of the production function using Professor Solow's 1957 approach (See Professor Sawada's paper). But it is no solution; it merely provides another name for the troublesome unknown lurking among the inputs. The specific inputs that account for what we loosely call "technical change" are quite elusive. How can they be identified? Acceptable answers are not at hand. Is technical change a matter of definition or of evidence? The distinction between solutions of this problem that depend on definitions and those that rely on evidence is, so it seems to me, a relevant distinction.² Turning to the *embodiment hypothesis*, Professor Jorgenson has advanced and clarified this distinction in his argument that "one can never distinguish a model of embodied technical change from a model of disembodied technical change on the basis of factual evidence."³ Here we are at one of the frontiers of economic growth theory and

² I draw here on my paper, "The Rate of Return in Allocating Investment Resources to Education," *The Journal of Human Resources*, II, No. 3 (Summer, 1967).

the terrain is still far from settled. In treating the sources of economic growth at the macro-level, I doubt that the vintage or the embodiment conception of technical change is likely to prove rewarding. It should be noted that at the micro level, as many studies in agricultural economics have shown, a new input, for example the tractor (tiller), can be handled straightaway and its economic effects analyzed.

3. Why not treat the productivity index as one would any other partial productivity index? We do this for land and also for labor. Such an index is of some use and we are not misled into drawing unwarranted inferences from gains in productivity revealed by such an index. The advantage of this approach lies in the fact that we serve notice on ourselves at the outset that we are not taking all of the inputs into account. It, also, alerts us to the analytical importance of continuing our search for an all-inclusive specification of inputs.

4. Is the solution in devising a more complete input and capital accounting method? The advance in reducing this unknown that Professor Griliches has achieved using this approach, in the case of U.S. agriculture, is noteworthy.⁴ It entails a specification of additional identifiable productive services from different forms of material and human capital in an accounting framework from which refutable hypotheses can be derived.⁵ These hypotheses can then be put to test by confronting the data. It is an approach that requires additional information.

Although the challenge which arose out of the observed increases

³ Dale W. Jorgenson, "The Embodiment Hypothesis," *Journal of Political Economy*, LXXIV (February, 1966), pp. 1-17. I am indebted to Jorgenson for this distinction. This distinction is somewhat too strong if one were to say the embodiment approach solves the problem wholly by definition. It, too, leads to an appeal to data but in a manner and under what seems to be implausible assumptions, e.g., that there is a constant relationship between the rate of technical progress and the rate of investment.

⁴ Zvi Griliches, "Estimates of Aggregate Agricultural Production Function from Cross-Sectional Data," *Journal of Farm Economics*, XLV (May, 1963), pp. 419-28; "The Sources of Measured Productivity Growth: United States Agriculture, 1940-60," *Journal of Political Economy*, LXXI (August, 1963), pp. 331-346; "Research Expenditure, Education and the Aggregate Agricultural Production Function," *American Economic Review*, LIV (December, 1964), pp. 961-974.

in output exceeding the observed increases in inputs—the residual, the productivity index attributed to aggregate inputs, the troublesome unknown—has led to many false starts, it has opened new analytical doors. The one which seems most promising, so it seems to me, is an all-inclusive concept of capital. I turned to it in my “Reflections on Investment in Man.”⁶ It is at the heart of the Jorgenson-Griliches approach to the U.S. private domestic economy in which they proceed to a specification and measurement of improvements in the quality of both human and non-human capital, and succeed in their growth accounting to explain the increases in macro production without an appeal to technical change.⁷ Also relevant here is the formulation advanced by Professor Johnson, his “generalized capital accumulation approach to economic development.”⁸

I close by listing some of the unfinished work implied by the all-inclusive concept of capital approach. In our endeavor to provide knowledge for improving economic decisions “the central concept in capital theory should be the *rate of return on investment*”⁹ and investment resources should be allocated in accordance with priorities set by the relative rates of return on alternative investment opportuni-

⁶ Despite my strong inclination to rely on “refutable hypotheses,” I realize that Solow can point out that not all of the observable total factor productivity may be of this sort. A part of it may still prove to be a “residual,” whether it is labelled a “return to scale” or something else. Thus it may be that a part of it may not be imputable to any resource cost, or that whoever makes such a residual technical change is unable to collect the return. While the capital accounting approach is a way of identifying and measuring new forms of capital, it is not possible empirically to account for all of it, and the notion of a once and for all refutable hypothesis settling the measurement problem is too strong. As Zvi Griliches has taught me, his approach to input and capital accounting succeeds in reducing the unaccounted part.

⁶ Theodore W. Schultz, “Reflections on Investment in Man,” *Journal of Political Economy*, Supplement (October, 1962), pp. 1–8; also in *Transforming Traditional Agriculture* (New Haven: Yale University Press, 1964).

⁷ D. W. Jorgenson and Z. Griliches, “The Explanation of Productivity Change,” *The Review of Economic Studies*, XXXIV (3), No. 99 (1967), pp. 249–283.

⁸ See Harry G. Johnson’s comment on this approach in *The Residual Factor and Economic Growth* (Paris, OECD, 1964), pp. 219–25.

⁹ Robert M. Solow, *Capital Theory and the Rate of Return* (Amsterdam: North-Holland Publishing Co., 1963).

xx *Foreword*

ties. My short list is as follows: (1) treat organized agricultural research as a production activity and determine the rate of return on investment in this activity; (2) treat human agents as human capital and ascertain the rates of return on investing in different types and levels of schooling; (3) attempt to analyze the cost and returns associated with agricultural extension activities; and (4) treat new agricultural inputs in the same manner.

Lastly, I wish to express once again the high value to us professionally of this remarkable Conference.

July 29, 1968

Theodore W. Schultz
The University of Chicago

CONTENTS

PART I

1. Phases of Agricultural Development and Economic Growth, by Kazushi OHKAWA 3
2. The Financing of Japanese Economic Development, by Gustav RANIS 37
3. The Japanese "Model" of Agricultural Development: Its Relevance to Developing Nations, by Bruce F. JOHNSTON 58

PART II

4. Agricultural Productivity at the Beginning of Industrialization, by Yūjirō HAYAMI and Saburō YAMADA 105
5. Technological Change in Japanese Agriculture: A Long-Term Analysis, by Shūjirō SAWADA 136
6. Economics of Mechanization in Small-Scale Agriculture, by Keizō TSUCHIYA 155

PART III

7. Agriculture and Labor Supply in the Meiji Era, by Mataji UMEMURA 175
8. The Labor Force in Meiji Economic Growth: A Quantitative Study of Yamanashi Prefecture, by Arlon R. TUSSING 198
9. The Supply Price of Labor: Farm Family Workers, by Yukio MASUI 222
10. An Analysis of Part-Time Farming in the Post-war Period, by Takeo MISAWA 250
11. The Supply of Farm Labor and the "Turning Point" in the Japanese Economy, by Ryōshin MINAMI 270

PART IV

12. Primary Product Exports and Economic Development: The Case of Silk, by Kenzō HEMMI 303

13.	Development of Long-Term Agricultural Credit, by Yuzuru KATŌ	324
14.	Savings of Farm Households, by Tsutomu NODA	352
15.	Effects of the Land Reform on Consumption and Investment of Farmers, by Shigeto KAWANO	374
16.	Long-Term Changes in Food Consumption Pat- terns in Japan, by Hiromitsu KANEDA	398

PART I

CHAPTER 1

PHASES OF AGRICULTURAL DEVELOPMENT AND ECONOMIC GROWTH[†]

KAZUSHI OHKAWA

Introduction

All the papers presented in this volume analyze specific topics, selected individually by each author, contributing much to our further understanding of various aspects of agricultural development and its relation to economic growth in Japan. Taken together, they seem to cover adequately, if not completely, all the important aspects of our subject. The purpose of this chapter is, therefore, not to analyze an additional topic, but to present a summary discussion. Although such a summary discussion could have been presented as a comprehensive account of the findings of the individual papers, I have instead attempted to describe historically the overall picture of Japan's agricultural development in terms of "growth phases." I believe this will "complement" other chapters.

Although this is not the place to enter into a detailed discussion of the concept of growth phases, a brief explanation is in order. In our conceptual framework, a growth phase is a distinct time segment of long-term growth, the unique characteristics of which can be identified by certain indicators. I might remark here that the criteria for these indicators can vary according to the purpose of the analysis one has in mind. Although this concept has previously been applied to the aggregate growth of the economy in order to avoid use of the much more rigid concept of "stages,"¹ I believe it can also be used for certain sectoral analyses. In the discussions that follow, the major criterion for the phases of agriculture will be the growth

[†] I would like to acknowledge the valuable comments received at the conference and Mr. N. Takamatsu's work on the statistical data.

¹ For a more detailed description see Ohkawa and Rosovsky (1965).

4 *Agriculture and Economic Growth*

pattern of output and input. The dating, identification and interpretation of the phases thus defined will be attempted first and then their relationship to other aspects of the economy will follow, in reference to three interrelated problems:

1. To what extent can we agree in recognizing and appraising the growth pattern of Japan's agriculture—an experience which now extends over a century since the Meiji Restoration?

2. Both in the output and input approaches, what further research is specifically called for to fill the important gaps in our present knowledge?

3. In order to arrive at a more consistent interpretation of the long-term growth pattern of Japan's agriculture and its relation to economic growth, what analytical approach seems most desirable at the present stage of our knowledge?

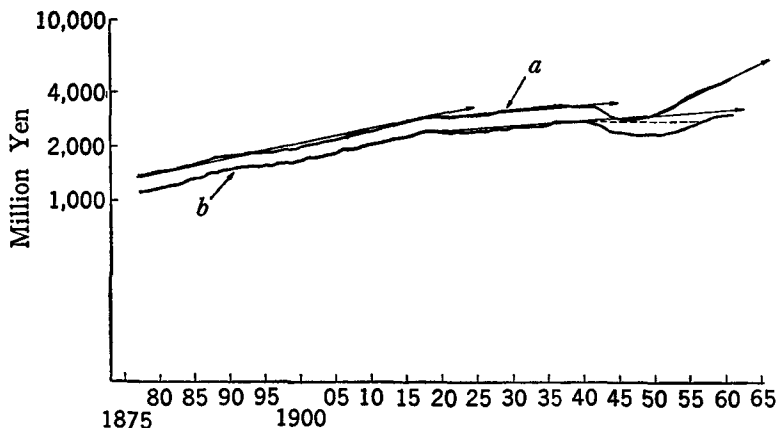
I. Long-Range Growth Pattern of Agriculture: A Statistical View

Let us begin our investigation of growth phases by presenting a general picture of the long-range output growth pattern of Japanese agriculture based on the latest data which are available continuously for the entire period under consideration (hereafter referred to as Yamada-Hayami or Y-H Series; Umemura et al., pp. 182, 226–27, hereafter referred to as *LTES*, IX). In Figure 1, two kinds of output data are shown, both in a smoothed series of 1934–36 prices: *A*—farm value of production and *B*—value added gross of depreciation. Series *A* and *B* suggest four broad observations: (1) From the mid-1870's to World War I, Japanese agriculture shows a continuous, unretarded growth. (2) From that time until the thirties, it entered a period of prolonged retardation; it is clear that the growth rate during this interval became much smaller than that of the preceding period. (3) Even more obvious is the dislocation caused by World War II. During and immediately after the war, agricultural output tended to decline towards an abnormal low: its average of 1946–50 fell to pre-World War I levels. (4) Postwar agriculture has grown at an unprecedentedly high pace, especially in Series *A*. However, the prewar annual peak, reached in about 1938–39, was not attained again until 1954–55 in Series *B*. The extrapolated position

Agricultural Development and Economic Growth 5

of the trend line passing through 1919 and 1938 has only recently been attained.

FIGURE 1
Output of Agriculture in Seven-Year
Moving Averages in 1934-36 Prices*



* Data from Hayami and Yamada, *LTES*, IX, pp. 182, 226-227. These figures are for the most part estimates which are a revised version of the often-used estimates contained in Ohkawa et al., *The Growth Rate of the Japanese Economy since 1878* (hereafter referred to as *GRJE*).

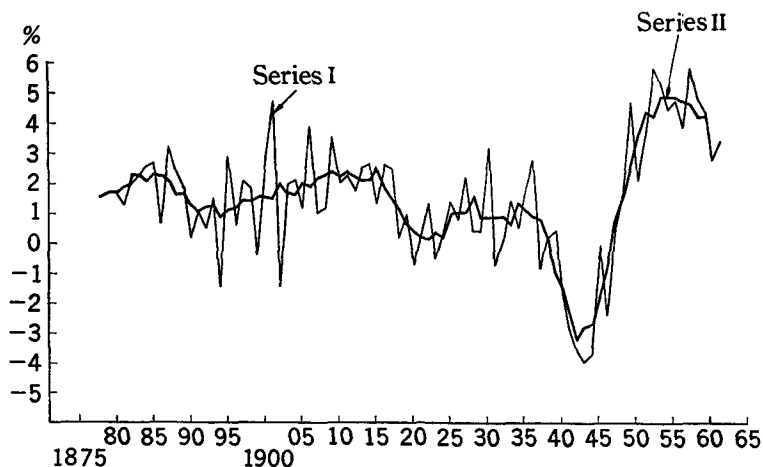
a) Farm value of production in 1934-36 prices, gross of both intermediate goods and of capital depreciation. In the Y-H series, two kinds of value added series are presented in real terms: one is estimated directly by using 1934-36 prices and the other estimated by deflating by price indexes. The former is used in Figure 1 simply because the latter is not available for 1941-50.

b) Value added gross of depreciation.

In Figure 2 the average annual rate of farm output (Series A) is shown in two forms: Series I simply depicts year-to-year changes in seven-year moving averages, while Series II shows those annual rates smoothed by a five-year moving average. The seven-year moving average of the original data is intended primarily to eliminate the effects of crop fluctuations. Since this is close to the average duration of the business cycle of the prewar Japanese economy, we can also expect its effect, if any, to be eliminated. Annual fluctuations, however, still remain large in Series I, so that Series II is added to give an indication of the long swing pattern.

6 Agriculture and Economic Growth

FIGURE 2
Average Annual Rates of Growth of Farm Value
of Production in 1934-36 Prices*



* Data from *LTES*, IX.

TABLE 1
Trend Changes in Terms of Average Annual Rates of Growth*
(Unit: %)

	(A) Farm value of production	(B) Value added
1877-1919	1.78	1.80
1919-1938	0.77	0.46
1877-1938	1.46	1.39
1919-1960	1.16	0.51
1877-1960	1.48	1.17

* Data from *LTES*, IX, pp. 192, 226-227.

a) All figures from seven-year moving averages.

Let us calculate average annual growth rates for selected intervals to show trend changes (Table 1). If we take the longest interval, 1877-1960 (83 years), the growth rate is 1.48 per cent (A) and 1.17 per cent (B); this provides the simplest indicator of the pace of Japan's agricultural development. It is difficult to offer an international comparison here because of limited information; nevertheless, Japan's average rate of long-run growth can probably be appraised as moderate. What appears to be striking are the changes which appear in the general trend over time. During the years of

Agricultural Development and Economic Growth 7

early development previous to 1919, the rate was 1.8 per cent, a high even by international standards, whereas during 1919–38 it dropped to a low 0.77 per cent (*A*) and 0.46 per cent (*B*). The prewar period as a whole (1877–1938) thus records 1.46 per cent (*A*) and 1.39 per cent (*B*), the former being very close to that of 1877–1960 and the latter higher than that of 1877–1960. This implies that the 1960 level in terms of value added was still a bit under the long-term prewar trend. Furthermore, the figures for 1919–1960 are 1.16 per cent (*A*) and 0.5 per cent (*B*), so that if we discuss Japan's experience of agricultural development for the period since World War I, its growth rate would be said to have been very slow, particularly in terms of value added.

TABLE 2
Output-Input Relations in Terms of Average Annual Rate of Growth*
(Unit: %)

	Output index ^a	Input index ^b	Productivity index ^c	Gross added value (1) ^d	(2) ^e
(1) 1877–85	2.18	0.03	2.03	2.43	2.36
(2) 1885–94	1.67	0.05	1.50	1.57	1.49
(3) 1894–1905	1.85	0.19	1.43	1.45	1.73
(4) 1905–19	2.24	0.74	1.48	1.73	1.78
(5) 1919–31	0.95	0.45	0.50	0.63	0.52
(6) 1931–38	0.95	0.47	0.56	0.61	0.63
(7) 1938–54	0.54	0.81	−0.32	−0.07	−0.45
(8) 1954–61	4.26	2.13	2.51	2.13	2.46
(9) 1885–1919	1.96	0.49	1.47	1.60	1.69
(10) 1919–1954	0.70	0.56	0.14	0.31	0.17

* Data from *LTES*, IX, pp. 222–223, 224.

a) Linked of several indexes of different weights valued at constant (i.e., 1934–36) prices.

b) *Ibid.*

c) Output index/input index.

d) In 1934–36 prices obtained by using linked deflators.

e) Directly valued in 1934–36 prices.

These observations may lead to a number of questions and suggestions. Among them, the following are most relevant here: First, does it suggest that in Japan's century of growth there are contained not only elements of growth acceleration but also of deceleration? If the answer is affirmative, what approach can insure a consistent

8 *Agriculture and Economic Growth*

interpretation of both growth and retardation? The conventional approach to answering these questions is to make use of output-input analysis. The Y-H Series are shown in Table 2 in terms of average annual rates of growth for selected intervals, the choice of which will be explained later. The corresponding figures for value added are provided for reference.

Changes in the rate of output growth show the swings previously observed, whereas the rate of increase in the input index presents a conspicuous pattern. It is extremely low during the initial years of development, periods (1) and (2), and accelerates rapidly from period (3) to period (4). After showing a moderate rate of increase during periods (6) and (7), it jumps to an unprecedentedly high rate exceeding 2 per cent. A combined result of these output and input movements is seen in the pattern of productivity growth. Until period (4) high rates of more than 1.4 per cent are sustained, but from period (5) the rate of growth drops to as low as 0.5 per cent. Furthermore, the rate for period (7), which includes the war and reconstruction years, even shows a negative value. The highest rate of productivity increase, attained during period (8), is a result of an unprecedentedly high rate of output growth combined with the highest rate of input increases. Thus a more or less similar pattern is suggested by the two series of gross value added.

These findings lead to the following important propositions. The entire process of agricultural development can broadly be divided into three long periods: first, from (1) to (4), i.e., the period ending in 1919; second, from (5) to (7), the interwar, war, and immediate postwar period; third, (8), the postwar period. The first is characterized by a high rate of output growth despite a low rate of increase in input. The second is characterized by a low rate of output growth despite a slightly higher rate of input increase. The postwar period is marked by a combination of the highest rates of both output and input growth, although its duration is still too short to be comparable with the other periods. The figures for periods (9), (10) and (8) in the table offer us a good basis for marking growth phases. The characteristics of each period seem to be distinct enough to be demarcated from other periods in terms of our criteria of output-input relationship. Of course final identification of these phases can

be given later because we do not have sufficient knowledge as yet about the factors responsible for characterizing these different periods. As an operational assumption, therefore, let us call these time segments Phase I, Phase II, and Phase III. We have following questions: How could output increase so fast despite a very slow increase in input during Phase I? Why did the rate of input increase slow down and why did the rate of output growth decelerate with the level of input increases during Phase II? Why was the postwar spurt possible in Phase III following the long retardation of the interwar period and wartime years?

II. Long-Term Performance of Various Inputs to Agriculture

The performance of inputs and relevant factors such as technological progress and changes in incentives for farmers must be examined. Two preliminary remarks, however, are necessary: one concerning the problem of reliability of the basic statistics and the other, the method of approach.

Since the publication of the GRJE series, the method to be used to revise the possible underestimation of agricultural output data for the early Meiji years has become an important problem. Our research group made serious efforts to carry out this difficult task. The result is the Y-H Series on which the previous observations have depended entirely. James Nakamura contends that the question raised above with respect to Phase I is largely a statistical illusion caused by the underestimation of the output level for these early years. He believes that such a rapid growth did not occur in Phase I. To confirm the underestimation of the official statistics for the period in question is one thing. To make an appropriate adjustment for them is another. While I appreciate his work on the former, I cannot share his view with respect to the latter. The Hayami-Yamada paper appearing in this volume seems to confirm the reliability of their output estimates, and largely share their views. Nobody can be perfect, however, in pursuing such a task and there still seem to remain some doubtful points in the Y-H Series for the

² For example, the year 1885 appears to be a peak of the first swing as is seen in Figure 2. In the *GRJE* series it was a trough; the Y-H series shows no retardation for the years immediately before 1905 which was witnessed in the *GRJE* series.

10 *Agriculture and Economic Growth*

very early Meiji years.² In the following discussion, an acceleration in output growth in Phase I is found *not* to be a mere statistical illusion.

Agricultural development depends upon a complex of various inputs. Because the required data, as well as our analytical tools, are still limited, the questions previously posed cannot be answered comprehensively in a rigorous way, at least at this stage of our knowledge. Recent model analysis, for example, appears to have been successful in long-term analysis only when the relevant factors have been narrowly specified. The discussion that follows, therefore, is intended as a first step toward clarifying the broad historical pattern of changes in various inputs in terms of the three growth phases. Sawada attempts a production function analysis in his article in this volume. This is one of the most ambitious approaches for clarifying the long-term pattern of Japanese agricultural production. I believe that the results he presents are complementary to a considerable extent with my historical analysis that follows.

To facilitate the discussion, two assumptions are made. First, changes in inputs take place due to two major factors: one, the potential of technological progress to be applied to agriculture and, the other, the incentives for farmers. Each of the above factors is complex, and it may be too simple to treat them in such a framework. Furthermore, other factors than these two are often relevant to the input changes in agriculture. Yet I believe this framework will serve as a useful convention. Secondly, inputs can best be classified into two categories: one, the internal (or of agricultural origin) and the other, the external (or of non-agricultural origin). This distinction is useful not only in clarifying the pattern of sectoral inter-dependence through the flow of inputs, but also in dealing with the relationship of technological progress between agriculture and industry.

Let us begin with the internal input which has labor and land as its two basic items. In Table 3 average annual rates of change in land and labor and their related terms are shown in the same periodization as Table 2. Unlike Western farming, the area of arable land, i.e., the sum of paddy and upland fields, can approximate the land stock, because pastures are insignificant in Japanese farming. Modern economic growth in Japan has been characterized

Agricultural Development and Economic Growth 11

historically by the initial condition of an unfavorable land-man ratio (the reciprocal of the more conventional term, man-land ratio). In 1877 the total arable land is estimated at 4,624,000 chō (a chō is approximately equal to a hectare), which, together with 14,773,000 gainful workers in agriculture, gives a land-man ratio of 0.32 chō per worker—an extremely low ratio even by Asian standards. There remained only a little room to expand the area of arable land. Under such conditions which prevailed in subsequent years, any change in the ratio, even though slight, must be a good indicator of the farmers' attitudes toward farming: when incentives were favorable they made great efforts to expand the area of cultivation. In Table 3 we see that the average annual rate of increase in arable land was continuously accelerated from period (1) through period (4) and since then became more or less stagnant. This performance coincides with our tentative phasing. No index of change in the rate of land utilization is available so that a supplementary indicator is provided by changes in the area of the second crop of paddy fields, which show the farmer's marginal activity. The cultivated area of barley

TABLE 3
Changes in Land and Labor and Related Terms: Average Annual Rate*
(Unit: %)

	Arable land	Labor	Land/ Labor	Land productivity		Labor productivity	
				(1)	(2)	(1)	(2)
(1) 1877-85	0.37	-0.24	0.61	1.81	1.99	2.60	2.42
(2) 1885-94	0.42	-0.19	0.61	1.26	1.07	1.68	1.86
(3) 1894-1905	0.55	-0.08	0.63	1.30	1.18	1.81	1.93
(4) 1905-19	0.80	-0.08	0.88	1.44	0.98	1.86	2.32
(5) 1919-31	0.09	-0.03	0.12	0.86	0.43	0.55	0.99
(6) 1931-38	0.28	-0.25	0.53	0.67	0.35	0.88	1.20
(7) 1938-54	-0.41	0.55	-0.96	0.95	-0.03	-1.00	0.99
(8) 1954-61	0.30	-2.74	2.44	3.96	2.16	5.20	7.00
(9) 1885-1919	0.62	-0.03	0.65	1.34	1.07	1.72	1.98
(10) 1919-1954	0.00	0.25	-0.25	0.70	0.17	-0.08	0.45

* Data from *LTES*, IX, pp. 182, 216, 226.

a) All land (in area of arable land) and labor (in number of gainfully employed workers) figures are in terms of seven-year moving averages except for 1961 which is in terms of five-year moving averages.

b) (1) and (2) under land and labor productivities correspond to (1) and (2) of gross added value in Table 2.

12 *Agriculture and Economic Growth*

and wheat crops was 524,000 chō in 1889, the first year for which nationwide official statistics are available. It continuously increased until 1919, reaching some 730,000 chō, but declined during the twenties. Double cropping is a traditional method of fuller utilization of paddy fields; it prevailed even before the Meiji Restoration. The improvements in water-control facilities and in cultivating methods during these years undoubtedly supported its expansion. Thus the attitude toward fuller utilization of land shows a distinct change by about 1919; it was positive during Phase I and turned out to be the opposite during Phase II. In Phase III, because of food shortages immediately after the war, enormous efforts were made to expand arable land, but the prewar levels were barely recovered due mainly to the limitation of natural resources.

The number of people "gainfully occupied" in agriculture is shown as "labor" in the table. The figures are based on Minami's recent estimates (*LTES*, IX) which are in turn the revision of previous ones including estimates by both Ohkawa and Hemmi. Not only the paucity of basic data, but also the insufficient knowledge regarding the actual working situation in the rural community make it difficult to apply the more appropriate concept of "labor input" with quality adjustment to the prewar Japanese agriculture. The articles contained in this volume by Umemura and Tussing contribute much to clarifying the early situation in this and other respects. But still further study is needed.³ The figures in the table are, therefore, approximate. Yet we believe they can indicate a broad trend. The number of laborers had continuously decreased, although very slowly and with some fluctuations, during the entire prewar period. This trend was interrupted by a great increase immediately after the war due to the large number of people repatriated from

³ The lack of a continuous series of labor input data (i.e., man hours) in agriculture as well as in non-agriculture is a great handicap. Tussing's regional analysis in his paper contained in this volume is illuminating concerning this point. I share the view that the attitude toward fuller utilization of resources in Phase I mentioned here might also have been accompanied by a fuller utilization of existing labor. Illustrative of this attitude regarding farming we have the expansion of second crops, introduction of summer-autumn cocoon crops and increased production of farm-supplied fertilizers. Further studies will be necessary, however, before we can reach any quantitative conclusions on this point.

Agricultural Development and Economic Growth 13

abroad and the abnormally weakened power of industry to absorb labor. Its peak was reached in 1951, amounting to 15,734,000 in the smoothed series, an increase of some 2 million as compared with 1938. From 1951 on a rapid decrease set in, which has continued up to the pre sent: the average annual rate of decrease for 1954–61 is 2.74 per cent—a percentage close to those of Western countries—and the rate of decrease has been even higher since 1961. Thus, Phase III is characterized by a distinct declining trend in the number of workers; no such distinction can be made between Phases I and II.

A combined result of these two patterns is shown in Table 3 by the average annual rate of change in the land-labor ratio. During Phase I it had increased at a sizable pace of 0.6–0.9 per cent; during Phase II it slowed down, and at the time of World War II it even became negative. The postwar phase is marked by an unprecedentedly high rate, simply described by a comparison of the figures for periods (9), (10) and (8) in the table. The partial productivities with respect to land and labor are also shown in Table 3. Their annual rates of increase show broadly the same three-phase pattern. No further explanation would be required except to point out that during the postwar phase the increases of both productivities are large and the rise of labor productivity is particularly spectacular because of the decrease in the number of workers in agriculture. Granted that these can only be a crude measure, they seem to serve as broad indicators for our purpose. The pattern of land-labor input together with that of their partial productivities fit well into our tentative phasing.

How about the other internal inputs? Some parts of capital formation represented by increases in the stock of trees, shrubs and livestock as well as inputs of intermediate goods of agricultural origin are of importance as internal inputs. For the sake of convenience of description, however, they will be dealt with later in relation to the external inputs. Let us now take up the strategic indicator of technological potential: supplies of improved varieties (seeds, silkworm eggs, etc.) included in the input of internal origin valued at market prices. I share the view that the development of improved varieties of various crops together with related methods

14 *Agriculture and Economic Growth*

of cultivation can represent the technological potential previously referred to; their diffusion can then explain a good part of output and productivity increases in agriculture. Johnston's article contained in this volume is particularly illuminating in this respect. This must have been especially eminent in rice cultivation during Phase I. By contrast, the relative retardation during Phase II must be relevant to the tendency of such technological potential to fade away. The renewed spurt in Phase III can be explained substantially by the emergence and diffusion of new technological potentials based on scientific research. This may be too brief a description to weigh appropriately the importance of the subject, but both the factual evidence and the analytical results in this regard have been widely accepted and need not be repeated here.⁴

In summing up the foregoing discussion, what specifically concerns us is the general growth potential within agriculture. A backlog of technological knowledge about agriculture and the capacity of the farming community to absorb it, which involves farmers' attitudes and institutional factors—these two are the main determinants of the growth potential. The performance of inputs of internal origin and the realized pattern and speed of technological progress—these two major phenomena discussed above provide us with knowledge about the historical changes in the growth potentials within agriculture and help to confirm the appropriateness of our phasing.

The three phases are dated as follows: Phase I, 1885 - 1919; Phase II, 1919 - 1954; and Phase III, 1954-? A brief explanation is needed with respect to the above periodization. First, our periodization is based on a smoothed series so that instead of single year points in time they relate to broad demarcations, i.e., bands of years. Second, the very early years before 1885 are excluded for a reason to be mentioned later. Third, although World War II years and the subsequent period of rehabilitation are included in Phase II, these years could have been omitted from our phasing because of the abnormalities involved. However, agriculture suffered least from direct war damage; from the standpoint of growth potential, I believe, they are better included in our phasing. I have chosen to set

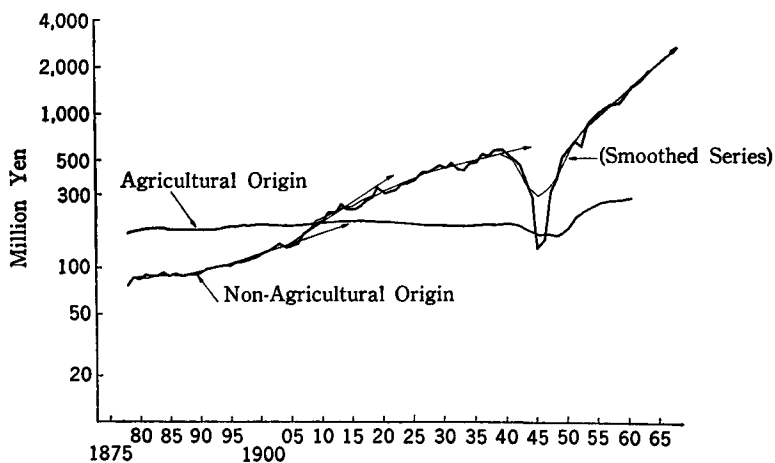
⁴ For a recent representative work see Hayami and Yamada.

Agricultural Development and Economic Growth 15

the beginning of Phase III from the point where the rehabilitation process more or less ends. As is shown in Figure 1, the level of value added reached the 1938-39 prewar peak in about 1954, and the labor force in agriculture began to decrease steadily from around this year. We would not deny that some of the effects of war dislocation continued to be felt even after 1954. For example, the once swollen agricultural population must have contributed to accelerating the rate of its decrease during the subsequent years. The fact that until about 1960 the agricultural output growth followed the long-term prewar trend may also be indicative of possible recovery factors. Even so, the inclusion of these years in Phase II would serve our purpose. Last, according to our criteria, Phase III seems to be continuing and at present we have no knowledge about its end.

We should reiterate here that our technique of phasing is based tentatively on observations of output-input relations in terms of growth rates and then confirmed by observing the pattern of internal inputs, the criteria being the growth potentials within agriculture. Furthermore, this technique assumes long-lasting distinctions, instead of short-term changes, in the growth potential in the century

FIGURE 3
Current Inputs to Agriculture*



* Data from *LTES*, IX, p. 185.

16 *Agriculture and Economic Growth*

of development of Japan's agriculture. It should be added, however, that we have, as yet, said almost nothing about the relationship of the agricultural with the non-agricultural sector. One of the important characteristics of Japan's agricultural development is that it took place concurrently with the growth of industry and that the pattern of sectoral interdependence is particularly crucial for understanding its performance. Without entering into a detailed discussion of this aspect,⁵ let us take up inputs of external origin as a representative indicator for our present purpose and look at their performance in the light of the above phasing.

Figure 3 gives a general picture of current inputs to agriculture based on the Y-H data of seven-year moving averages in 1934–36 prices. We can see here a sharp contrast between the two series: inputs of external origin show a rapidly increasing trend except for the period of World War II and its aftermath, whereas the changes in inputs of internal origin show a very moderate trend. The estimates of the latter series are less reliable and do not include manures produced on farms except for green manures mostly produced as a second paddy-field crop. Increases in inputs of manure seem to be more important as we go back to earlier years, so that a considerable reservation must be made here. Yet it is intuitively obvious that the changes in the total current inputs were caused mostly by the changes in inputs of external origin. Their average annual rate of change is shown with smoothed values in Figure 4, which can be compared with that of output in Figure 2. Our comparison will be made essentially from two aspects: First, from the viewpoint of swings, unlike the case of output, a trough appears around 1885, showing a reverse movement between output and input during the early years. This might be explained in one of two ways:

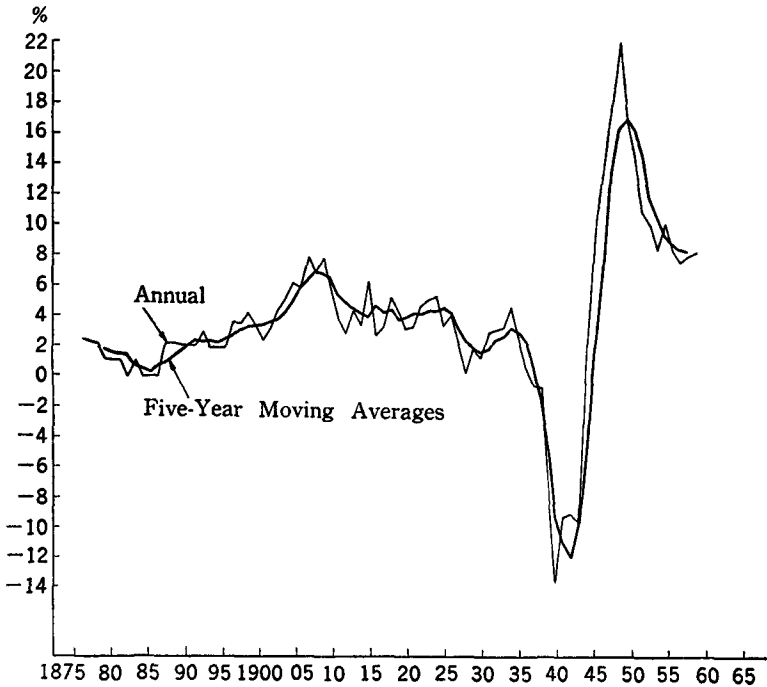
1) The short swing with a peak around 1885 presented in Figure 2 might be a statistical illusion; or 2) because of the dominance of inputs of internal origin at that time, the change in the inputs of

⁵ The concept of concurrent growth is first developed in Ohkawa (1964). In denying the thesis of preconditions, the Hayami-Yamada paper presented here takes a similar view and supports the concurrent growth thesis with convincing data. In order to establish this thesis more firmly, it is desirable to have a quantitative identification of a distinct kink in the growth curve of agriculture which marks a change between the Tokugawa and Meiji Era.

Agricultural Development and Economic Growth 17

external origin was insignificant. In any event it is clear that further work is needed before any firm conclusion can be reached on this point. This is the reason why the years before 1885 have been excluded from our phasing. The exclusion may not be a serious defect historically because, in our view, modern economic growth started in about 1885 and the excluded years belong to the "transition" phase (Ohkawa and Rosovsky). Secondly, the entire prewar period, broadly speaking, is divided into two segments demarcated at about 1908 into a period of acceleration and a period of deceleration which roughly corresponds to the performance of the rate of output growth. Third, the sharp drop during the World War II years and the rapid recovery during the rehabilitation period again correspond to the output performance.

FIGURE 4
Current Inputs of Non-Agricultural Origin:
Average Annual Rates of Change*



* Data from *LTES*, IX, pp. 183-4.

18 *Agriculture and Economic Growth*

Looking at the level of average rate of input growth, the following three points are noted: First, during the period of acceleration it jumped to a high of 6 per cent from a very low level, but before around 1905 it was still largely under 4 per cent, a rate which was more or less sustained through the twenties. The stagnation of output growth during Phase II cannot therefore be explained by a low rate of input increase. On the other hand, a comparatively high rate of output growth during Phase I cannot fully be explained by a high rate of current input increases. Second, the sharp drop in the growth rate of inputs during World War II must have been the main factor responsible for the drop in output increases, as Japanese agriculture at that time depended heavily upon inputs of external origin. Third, the postwar level of the growth rate of inputs is unprecedentedly high. Although it falls following the rehabilitation period, its normal rate is more than 8 per cent—distinctly higher than the highest pre-war level which reached its peak in about 1908. It goes without saying that this pattern corresponds to the high rates of output growth. During Phase III the degree of dependence on external inputs becomes much heavier because of the rapid increases in the input of chemical sprays as well as other chemicals, imported livestock feed, etc., in addition to fertilizers. In order to quantify these observations, the average annual growth rate of current inputs is shown in

TABLE 4
Changes in the Current Inputs to Agriculture:
Average Annual Rate of Increase*

	Total	External origin	Internal origin
(1) 1877-85	1.03	1.62	0.73
(2) 1885-94	0.35	1.50	0.19
(3) 1894-1905	1.46	3.20	0.04
(4) 1905-19	2.74	4.97	0.52
(5) 1919-31	2.36	3.67	-0.53
(6) 1931-38	1.93	2.54	0.38
(7) 1938-54	2.86	3.24	1.68
(8) 1954-61	8.16	9.55	1.90
(9) 1885-1919	1.76	3.47	0.29
(10) 1919-1954	2.43	3.22	0.68

* Data from *LTES*, IX, pp. 183-4.

Agricultural Development and Economic Growth 19

Table 4 for selected intervals. The selection of the demarcating years is the same as in previous tables. No further explanation will be needed except on one important point. We have shown in Table 4 the total current inputs of external and internal origin. Even with the reservation made previously regarding the statistical reliability of the internal series together with the reservation mentioned in the footnote,⁶ it is to be understood that the rate of increase in current inputs was generally higher for Phase II than for Phase I, except for the period 1905–19.

In interpreting the effects of current inputs on output, the widely prevailing view both in Japan and abroad maintains that the rapid increase in the fertilizer input played the greatest role in raising output and productivity in Japanese agriculture. Recent econometric studies have confirmed this.⁷ It is also the consensus that seed improvements which produced varieties with greater capacity to respond to fertilizer and related progress in cultivation practices in farming have a technical complementarity with increases in fertilizer input. In terms of our framework, this can be called an important technological linkage between the growth potential within agriculture and current inputs of external origin, i.e., a carrier of the technical advance in industry. From this particular point of view, let us finally observe the pattern of each phase.

Beginning with Phase II, we observe that the conditions in agriculture in this phase (except the World War II period) were much more favorable than during Phase I regarding current inputs of external origin. For example, we see here an increased supply of fertilizers as a result of the development of the modern chemical industry, which also helped to increase demand for fertilizers by lowering their prices. And yet the subsequent decline in the rate of output growth in agriculture must be explained mainly by the decline in growth potentials within agriculture—a fact suggested previously—is more firmly recognized here.⁸ Next, for Phase I, the

⁶ The greater rate of increase in the inputs of agricultural origin during periods (7) and (8) was caused by a postwar increase in forage crops which was accompanied by the development of livestock farming. This point should be taken into account when comparing the figures of periods (9) and (10).

⁷ See Hayami (1964, 1967).

⁸ It should be noted, however, that external factors—notably the increase in

20 *Agriculture and Economic Growth*

period of 1905–19 deserves special attention. The growth potentials in agriculture were found previously to be still sustained towards the end of this period. In addition, the accelerated growth rate of current inputs coincided with the spurt of the modern industries of the Japanese economy. Although the causes of associated movements of the two should be explored further, it is clear that the two-fold effects combined must be the cause for the high rate of agricultural growth during this period. It is interesting to note that the year 1905 is identified also as the beginning point of an investment spurt, indicating the independent growth of the modern sectors in Japan. By contrast, the experience during 1931–38 draws special attention. Unlike in 1905–19, agriculture did not show a high rate of growth despite a big spurt in investment and output of the industrial sector. As is shown in Figure 4, toward the end of the twenties the rate of current inputs of external origin began to show a sign of increase but this did not continue, due to the lack of growth potentials in agriculture at that time. Secondly, how about the early years before 1905? We have some difficulty in interpreting a relatively high rate of output growth during this period. The twofold effect mentioned above could not be expected as current inputs of external origin at that time were mostly the product of traditional industries, whose weight in the total current inputs was small. As has previously been mentioned, under the existence of growth potentials the main driving force had been a nationwide diffusion of improved traditional varieties combined with an improved method of cultivation, both of which took place with increasing returns to current inputs. However, to obtain more convincing evidence, further research seems to be needed with respect to other relevant factors, some of which will be discussed later. Last, with respect to Phase III, there is no particular difficulty in interpreting its characteristics. This subject will be taken up in the next section because

imports of cheap rice from Korea and Taiwan (discussed in the following section) and the slowing of the growth of the non-farm labor demand—meant that Japan's farmers faced less favorable demand conditions which reduced the incentive to introduce output-increasing innovations and made it difficult to reduce farm labor inputs.

agriculture came to depend more heavily upon industry, and the different nature of technological advance raises different problems.

III. Relationship between the Phases of Agriculture and the Pattern of Economic Growth

In the previous section three phases of agricultural development have been identified, and suggestions were made in order to arrive at a consistent interpretation of Japan's experience in the light of that framework. In so doing, attention has solely been concentrated on the peculiar characteristics of this particular sector of the economy. This kind of approach, though it appears too narrow, is specifically intended to clarify the peculiar nature of agricultural development, which the usual approach of the macro-type would be likely to miss. However, agriculture does possess, to a certain extent, characteristics in common with other sectors of the economy and this aspect becomes more important as the economy grows. In posing the problem of agricultural development in relation to other sectors of the economy, therefore, common terms of growth analysis are indispensable. This section attempts to discuss several topics selected from this viewpoint: capital formation and its related problems, commodity prices and trade, demand for farm products and income formation in agriculture. Except for the first topic, discussion will be brief as they are specifically dealt with in other papers in this volume.

Beginning with capital formation, the general picture is as follows: In 1881, from which time smoothed series are available, the existing total gross fixed capital stock, residential buildings excluded, was distributed 72.4 per cent and 27.6 per cent, respectively, between primary and non-primary sectors. Although the former includes forestry and fishery, agriculture constitutes the major component. In 1937, the last year representing normal prewar economic activities, the existing gross capital stock was distributed 18.9 per cent in the primary sector vs. 81.1 per cent in the non-primary sector. These figures emphasize quite dramatically the extent to which capital formation was concentrated in the non-agricultural sector. Two particular points, among others, are implied. First, it makes clear that, at the beginning of modern economic growth, the major

22 Agriculture and Economic Growth

portion of capital stock had been accumulated in agriculture. In fact, gross capital stock per gainful worker in the primary sector was at a level of 62 per cent that of the non-primary sector, indicating that capital intensity of agriculture was comparatively not so low. This in turn implies that a certain amount of capital was indispensable even for farming of the traditional type—a fact which has often not been adequately recognized. In 1885 the breakdown by type of capital goods in agriculture was: producers' durable equipment, 13.4 per cent; non-residential buildings, 68.5 per cent; and livestock, trees, and shrubs, 18.1 per cent. Secondly, as will be shown shortly, it nevertheless suggests a fact often referred to roughly as the function of "capital-saving" in agriculture.

With these preliminaries, let us observe the time pattern of capital formation. Table 5 shows the data in terms of average rates of annual growth. Total capital stock in agriculture increased at a very slow pace during the entire prewar period, the highest rate being 0.72 per cent. This is largely due to a slight increase in the level of non-residential buildings on the farm. However, it is noted that the

TABLE 5
Gross Capital Stock in Agriculture and Related Terms:
Average Annual Rates^a of Changes*

	(Unit: %)				
	Total	Livestock	Trees, shrubs	Equipment	Capital intensity ^b
(1) 1877-85	0.24	0.30	1.56	0.77	0.48
(2) 1885-94	0.34	0.45	2.43	0.73	0.48
(3) 1894-1905	0.48	0.26	2.26	1.26	0.56
(4) 1905-19	0.72	0.84	1.93	2.10	0.80
(5) 1919-31	0.70	1.26	0.87	2.03	0.73
(6) 1931-38	0.24	0.85	0.03	1.49	0.49
(7) 1938-54	0.60	1.81	-2.51	1.03	0.05
(8) 1954-61	3.18	3.52	5.25	8.63	5.92
(9) 1885-1919	0.54	0.52	2.17	1.45	0.57
(10) 1919-1954	0.54	1.38	0.83	1.48	0.29

* Data from Ohkawa et al., *Capital Stock*, III, *Long-Term Economic Statistics of Japan since 1868* (hereafter referred to as *LTES*, III), p. 154 and *LTES*, IX, p. 226.

a) All figures taken from five-year moving averages.

b) Capital intensity based on capital stock/labor.

Agricultural Development and Economic Growth 23

rate of increase is somewhat accelerated through periods (1) to (4). Since no acceleration occurred following period (4), these years can be grouped as one phase, a pattern which conforms exactly with the previous phasing, noting at the same time the remarkably high rate of growth that characterizes the postwar years. The movement appears similarly in capital intensity except for period (7) whose exceptionally low rate is caused by an abnormal increase in the labor force in agriculture following the end of World War II. These provide a general picture of the fixed capital movement in agriculture together with the figures for longer periods (9) and (10).

Regarding the performance of components, the importance of equipment or producers' durables is stressed as a representative indicator of capital formation of external origin. Its rate of increase is distinctly accelerated through period (4) and then decelerates to period (7). Its postwar rate is as high as 8.6 per cent, showing a rapid process of mechanization. The pattern of equipment thus broadly coincides with that of current inputs of external origin and suggests an operation of common factors. As a matter of fact, it consists of agricultural tools and equipment of small size designed to fit the traditional production organization of small-scale farming. Their function must have been complementary to, instead of substitutable for, the other inputs as well as the labor (except for the case of threshing). Particular attention is drawn to the fact that the rate of increase in these capital goods shows a distinct kink around 1905, coinciding with the investment spurt of the non-agricultural sector. The performance of capital stock largely of internal origin is briefly seen as follows. Trees and shrubs increased at a rather rapid pace during Phase I while the rate of increase in livestock appears larger for Phase II. The former, including a rapid expansion of mulberry cultivation, gives further evidence for the growth potentials that existed in agriculture during Phase II. The latter seems to be caused by changes in the demand pattern. The postwar rate of increase in both livestock and trees and shrubs is considerably accelerated and this indicates that Japan's agriculture is undergoing a rapid diversification for the first time after a century of development.

Statistical estimation and valuation of capital stock in traditional agriculture is a hazardous task. The data used above are based on a