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# SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE ROLE OF INTERNATIONAL COOPERATION

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*Capital Formation of the Farm Household and Resource Allocation in  
Agricultural–Rural Sectors: An Analysis of Sustainability of Japanese  
Agriculture*

INTRODUCTION

The terminology of ‘sustainability’ is quite new to Japanese agriculture. The main reason for the lack of the concept of sustainable development is the fact that rice-based Japanese agriculture has developed and continued for nearly two thousand years under the temperate, monsoon climate. Needless to say, rice is produced in paddy fields, which necessarily contain a certain depth and amount of water during the growing period. Hence rice production has possessed an ecologically and biologically sustainable system, which has enabled farmers to produce rice in paddy fields year after year, for a considerable time.

However, such a sustainable system has been gradually changing since the early 1960s, when Japan entered a highly industrial economic development stage. Part-time farming has been widespread among rice farmers, and rice production has also changed from one of relatively low input and low output, to one of high input and high output. In other words, Japanese agriculture has rapidly increased its productivity by means of intensified capital inputs, which has at the same time caused such problems as deterioration of soil fertility, soil and ground water pollution, and other conservation problems. Recently, Japanese people have become more and more concerned about these issues, as global environment problems such as global warming and desertification have become serious global issues.

The main purpose of this paper is three-fold. First, we outline the development and major characteristics of capital formation among farm households in Japan. Second, we examine the impact of such capital investment on income and employment patterns, and on the sustainability of land use systems. Finally, using these findings we discuss the future perspectives for long-term development and research needs.

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## CHANGE IN EMPLOYMENT-INCOME STRUCTURE OF JAPANESE AGRICULTURE

One of the major factors restricting the development of Japanese agriculture has been the limited land resources for agricultural purposes. About 66 per cent of the total land area in Japan is mountainous. Of the remaining 34 per cent, 20 per cent is given over to urban use, which leaves the agricultural land area in Japan at about only 14 per cent.

When compared to the major agricultural producing countries, the percentage of arable land in Japan is one of the lowest. In particular, the land given over to meadows and pasture in Japan is only a tiny percentage of the total land area and illustrates the restrictions placed on dairy and livestock production in this country. The land use figures of Japan basically show the differing nature of Japanese agriculture – the large percentage of forested area, and limited arable and pasture land, make for a highly intensive farming structure.

An overview of the general trend in the farm population and in the number of farms in Japan is necessary for the purpose of this section. Before the Second World War, the Japanese farm population was stable at around 35 million. Since the war the number has declined, from 37 million in 1950 to 20 million in 1985. The share of the farm population in the total population has gradually decreased, from around 45 per cent just after the war to 16.4 per cent in 1985. The rate of decline is, however, rather slow compared with that in the United States. The decline in the number of farms was even slower than the decline in the farm population.

Like the farm population, the number of farms in prewar days was stable at around 5.3 to 5.5 million, but, in the postwar period, the number of farms declined gradually, from 6.2 million in 1950 to 4.2 million in 1988. Since the total area of cultivated land in Japan has not changed very much throughout these periods, the average size of holding has been very stable at around one hectare, although the present trend shows a slight increase in average size. It should be noted, however, that the composition of the working population has changed significantly. Also changed is the inner structure of farm families, a change due especially to off-farm employment and income. In other words, the increase of part-time farm families is the most noticeable postwar change in Japanese agricultural and rural structure.

Part-time farming *per se* is not a recent phenomenon in rural Japan. Almost 30 per cent of farm households were classified as part-time farm households even in prewar days. Opportunities for rural people in those days were to work as craftsmen or local merchants, or to run small cottage industries. After the Second World War, however, the number of full-time farm households decreased quite drastically, from about 2 million in 1960 to only 0.06 million in 1990. At the same time, the absolute number and ratio of Type II part-time farm households (where off-farm income is greater than farm income) increased from 1.9 million in 1960 to 3.0 million in 1990.

The ratio of off-farm income to total family income has steadily increased, from 12.2 per cent in 1921 to 67.8 per cent in 1975, with an especially remarkable increase after 1960. The share of off-farm income exceeded that of farm income in 1963 for the first time. Moreover, it should be noted that

per capita disposable income of the farm population exceeded that of the non-farm population in 1972 for the first time in Japanese history. The trend thereafter has been a further widening of the gap between the two.

The variety of off-farm jobs, in the postwar period especially, has widened from rural or agriculture-related employment to include urban manufacturing or service-related jobs. This widening of job opportunities was made possible through decentralization of industry and concomitant development of transport. Now off-farm jobs are available not only for the young, but also for middle-aged and elderly members of the farm family. In addition, the nature of off-farm jobs has changed from casual, part-time to permanent (or at least long-term) employment.

Increased off-farm employment by farm family members means a reduction in the working population engaged in the family's agricultural work. The number of the working population in agriculture fell dramatically during the period 1950–85, decreasing from 16 million to 5 million. Also changed was the composition of the working population. The decrease of young workers in agriculture was quite drastic between 1960–65, when the Japanese economy expanded more than 10 per cent per annum. Thus, combined with the changes in the number of farm households mentioned above, the working population per farm household decreased from 2.6 persons in 1950 to 1.6 persons by 1975.

### TECHNOLOGICAL CHANGE WITH INTENSIFIED CAPITAL FORMATION

Technological change has been a remarkable feature in postwar Japanese agriculture. Just after the war the pressing need to increase the food supply was achieved mainly by the development and diffusion of yield-increasing techniques such as a new rice bedding system, breeding of more high-yielding varieties, and the rationalization of fertilizer inputs. After the late 1950s, however, as Japan entered a labour-scarce economy, labour was replaced by

**TABLE 1** *Agricultural capital formation in Japan (nominal; unit:1 billion yen)*

Item	Year	1960	1965	1970	1975	1980	1985	1988
1. Agricultural fixed capital		240.4	523.9	1091.7	2453.5	3674.4	3670.9	3929.5
Land improvement		99.6	212.4	406.8	872.6	1765.9	1763.3	2063.9
Agr'l buildings		30.2	82.5	213.7	427.1	635.2	544.9	517.5
Farm machinery		84.1	166.0	376.2	968.5	1045.3	1146.0	1122.8
Plants & trees		12.3	30.4	44.2	83.4	76.9	80.4	72.1
Livestock		14.2	32.6	50.8	101.9	151.1	136.3	153.2
2. Changes in inventory		7.5	27.6	3.4	20.1	15.5	-20.6	8.2
Crops		-3.3	0.0	-0.3	0.3	-52.6	-15.8	-63.3
Livestock		10.8	-26.3	3.0	13.8	63.0	23.1	53.3
Farm equipment		0.0	-1.3	0.7	-12.0	5.1	-27.9	18.2
3. Total capital formation		247.9	496.3	1095.1	2445.6	3689.9	3650.3	3937.7

machinery in the work of land tillage, and later, in the late 1960s to 1970s, the substitution was further intensified by machines doing the work of harvesting and rice transplanting (see Table 1 on the change in farm investment).

Farm mechanization has increased even among part-time farm families, where the labour shortage in the family is keenly felt. In other words, the pattern of part-time farming has been sustained by the development of labour-saving technologies. Historically, Japanese agricultural development has been achieved by means of land-saving or labour-intensive technology. Now, however, more machinery is used instead of labour, and land intensity is dropping.

In terms of land intensity, winter crops have been abandoned as the trend towards part-time farming has increased. Part-time farm families have specialized in single cropping of rice, which combined with decreasing per capita consumption of rice, brought about serious rice surplus problems in the late 1960s.

### **CHANGES IN THE NATURE OF RURAL AREAS AND COMMUNITIES**

Starting in the early 1960s, the high economic growth of Japan has changed not only urban–metropolitan areas, but also rural areas, under the wave of continuous industrialization and modernization. Technological progress within the agricultural sector is characterized by modern farm mechanization and other heavy capital investments in farming systems. This has certainly lessened the burden of human labour inputs, but, in the process, more and more young people have left rural areas and most agricultural labour has been taken over by elderly people and women.

This exodus of the rural labour force has, on the one hand, endangered the maintenance and management of rural community functions. There are basically two categories of rural areas involved in this process. In the relatively flat rural areas close to urban centres, the majority of farm households became more dependent upon non-agricultural incomes and employment. Furthermore, more and more non-agricultural city people have moved to the rural areas to live. The mixture of agricultural and non-agricultural households in the boundaries of rural areas is very common in this flat zone. On the other hand, in more remote and mountainous areas, such rural exodus has caused what may be called ‘depopulation’ problems, where many communities have been deserted and have lost major social and economic functions, especially during the 1960s and early 1970s.

However, when we look at the essential nature and function of rural villages, most of the rural communities still maintain their institutional and cultural functions to maintain their agricultural land, farm production and rural life. It is a surprising fact that the last three decades of high economic growth have undoubtedly changed the physical and material life of rural areas, but have not changed the institutional systems and social relationships within the village. The reasons for this are important for our understanding of present-day rural Japan in a comparative sense.

Let us next examine the changing nature of farmers and farm households. In the past, most farmers were dependent upon solely small-scale, paddy-based agriculture. But in the long-term process of Japanese industrialization and modernization, such a homogeneous structure of farms has given way to a more heterogeneous structure. In brief, we can say that there exist three basic types of farm households in contemporary rural Japan. The first category is full-time farmers, who believe agriculture is the most important family business to be continued over generations. Although the number of these farms is very small and still shrinking in the overall agricultural population, they are 'real farmers', undertaking modern, capital-intensive types of agriculture, and are thus considered to play an important role in Japanese agricultural production. The problem is, however, that they do not possess much political power in decision-making processes because of their small numbers.

The second group is part-time farming households, which comprise the majority of rural households. Their heavy dependence upon outside incomes and time allocation to non-agricultural activity has tended to shift their concerns towards things urban and modern. But the important point is that, when it comes to the issues of agricultural land use and rural community problems, their attitudes are still very conservative and they try to maintain the traditional functions of the community. This is largely due to their way of thinking about the possession and succession of assets and status holding within rural communities.

The third group is farm households where only elderly people are living, maintaining more or less subsistence agriculture. Statistically speaking, about 10 per cent of the total of farm households are classified in this category, but the category is not important in agricultural production or political power in rural areas. However, as the age structure of rural areas shifts to one in which the elderly are increasing, this category of farmers will also increase in the future. Another point which must not be forgotten is that there are more and more middle-aged and retired people who are returning to the rural areas, taking up again the farm households which they had left in their younger days.

One of the difficulties facing rural communities today is this heterogeneity of farming populations, particularly when it comes to land consolidation projects and land-use planning in general. Rationalization of land use by means of increased farm size has been constrained by the difficulty of creating a consensus among villagers. Interestingly enough, decision making in rural communities in Japan is not by majority vote, nor is it by election. Rather, their rule might be expressed as unanimous decision making, after protracted discussion among all rural community members. It may appear that this is old-fashioned, but it was actually quite wise of villagers to have such a well defined and sustainable community function. It has been their biggest concern not to split the communities among villagers, which in the past meant disastrous consequences in their lives in poorly resourced and over-populated rural Japan.

Another reason for this unanimous decision-making process is that resource conservation, including farmland, water and community roads, is only made possible by the participation of all the members. The unit of agriculture in Japan is not really farming by individual families. It is rather more a system of

the 'community farm', where the whole village maintains its territory and functions cooperatively; for example, cropping patterns are in effect decided upon as a group, according to unspoken social conventions.

Probably the nature of Japanese rural areas can be identified by the following three key ideas: (1) continuity of rural community functions, (2) adjustability to outside changes, and (3) egalitarian principles and unanimous decision-making processes. For hundreds of years, rural community people have cooperatively maintained their agricultural production and rural life. Egalitarian principles are the basis of their attitudes even in modern times. Illustrations of this can be easily found in such examples as the maintenance of water use and drainage systems, common rural roads they use in their daily life, and other communal activities such as agriculture-related festivals and religious activities. Irrespective of their farm size, economic well-being, or any other indicator of social class, each farm household has equal opportunities and equal political rights.

Another example of this is the method of setting aside paddy fields, where in Japan quotas were almost equally distributed using the same percentage of reduction among rice growers. Certainly, by doing this, these communities have sacrificed to a great degree the efficiency of rice production from a narrowly defined economic point of view. But they have enjoyed a relatively harmonious, long-standing community life instead.

## CHANGES IN AGRICULTURAL PRODUCTION AND LAND USE

Agricultural production in Japan is currently facing over-supply problems in several major farm products, including rice and mandarin oranges, while low self-sufficiency commodities such as wheat, soybeans and feed-grains emphasize the need for diversification. The decline in the growth of products such as rice is countered by the growth of livestock products, from 15 per cent of total agricultural output in 1960 to 27 per cent in 1987. Japan's area for cultivation is small in comparison with her competitors, thus the increase in livestock is connected with her need for a highly intensive farming system, and increases the need for her to import feed.

The pattern of land use in Japan has also been changing constantly. The most noticeable change has been the overall reduction in Japan's agricultural land. Total agricultural land use has been reduced by 8 per cent, from 5796 thousand hectares in 1970 to 5317 thousand hectares in 1988. This reduction is basically a result of the difference between agricultural land expanded and land ruined. The total area of cultivated land expanded was 23.7 thousand hectares in 1988, and the total area of cultivated land ruined in the same year was 46.6 thousand hectares, which includes 40.4 thousand hectares for artificially transformed land. In Japan, there has been a strong external demand for agricultural land, and though the Japanese government has endeavoured to conserve the superior farmland, overall figures have decreased. It is remarkable that the upland field area has increased by 2 per cent, while the paddy field area has decreased by 15 per cent during the same period.



In 1988, paddy fields constituted 54 per cent, continuing to dominate the total agricultural land area. Of the 46 per cent of upland field area, 24 per cent was normal upland field, 12 per cent meadows and 10 per cent land under permanent field. Although the importance of meadow land to the Japanese economy is growing, it still only constitutes 12 per cent of Japan's total agricultural land area.

A few words should be said about the Rice Crop Diversion Policy which was initiated in 1971, and the Paddy Field Reorganization Policy which was introduced in 1978. In recent years, the Japanese government has endeavoured to combat the surplus situation in rice production through diversification. The total diversification area in 1988 was 817 thousand hectares, which was 15.4 per cent of the total cultivated area. The paddy use diversion from rice is concentrated upon vegetables, soybeans, forage crops, wheat and barley. For example, in 1988, 817 thousand hectares diverted from rice included 120 thousand hectares for vegetable production, 135 thousand hectares for forage crops, 134 thousand hectares for wheat and barley and 96 thousand hectares for soybeans. The fact that forage crops constitute the largest area of diversification from rice helps the shift towards livestock production. Diversification is also being promoted by the increase in multi-purpose paddy-fields, which can produce a variety of other crops as well as rice.

It is not surprising to note that the actual planted area has been reduced by 12 per cent during the period from 1970 to 1987. The major crops reduced are obviously rice, of which the area decreased from 2923 thousand hectares in 1970 to 2146 thousand hectares in 1987, a reduction of 26.6 per cent, while wheat and barley have also been reduced on a large scale – total reduction is around 20 per cent. The question of farm size and productivity is obviously dictated by this intensive agricultural system. The paddy field area reached its peak in 1965 at 0.71 ha per farm household, and by 1988 had been reduced to 0.61 ha.

On the other hand, the growth of livestock and greenhouse production is still continuing at a steady pace. Dairy cattle have increased 8.4 times, from 3.4 head per farm household in 1965 to 28.6 head in 1988; beef cattle have increased 7.8 times, from 1.3 head in 1965 to 10.2 head in 1988; hogs have increased 35.8 times, from 5.7 head in 1965 to 203.9 head in 1988; layers have increased from 27 head in 1965 to 1356 head in 1988, which is 50.2 times the earlier number; chickens have increased 28.6 times, from 892 in 1965 to 25 500 in 1988. The number of greenhouses per farm household has also undergone a tremendous increase (see Table 2 on these farm size changes).

Before the Second World War, higher productivity was achieved by a number of methods. These included improved rice varieties, use of animal power and improved fertilization. The small farm management system was also improved through a heavier input of both fertilizer and labour. Following the war, however, it was brought about by labour-saving techniques, mainly through mechanized farming. The difference in productivity by cultivation size basically shows that, the smaller the area of agricultural production, the longer are the hours worked per unit area, and the higher the cost of farm production. For example, farmers with agricultural areas of less than 0.3 ha. worked 82 hours

**TABLE 2** *Change in farm size*

	1965	1988
Paddy field (ha)	0.71	0.61
Dairy cattle (head)	3.4	28.6
Beef cattle (head)	1.3	10.2
Hog (head)	5.7	203.9
Layer (head)	27.0	1 356.0
Chicken (head)	892.0	25 500.0

per 0.1 ha in 1982. Those farmers with more than 5 ha worked only 32 hours per 0.1 ha.

Under the monsoon climatic conditions of high summer temperatures and high humidity, Japan has high productivity of vegetation growth. The average production of organic matter of Japanese forests, for example, is 13 to 23 tonnes (dry matter basis) per hectare, which is often as much as tropical forests producing 10 to 35 tonnes, as contrasted to Mediterranean Europe where average forest production is between 2.5 and 15 tonnes. Such high production capacity has enabled Japan to produce rice as the most productive, population-supportive crop for nearly 2000 years. In paddy fields, soil tends to possess the following characteristics, as rice is continuously planted over long periods. First, since the paddy field is covered by water during summer, decomposition of organic matter in the soil is very slight even at high temperatures. During winter, too, the soil becomes dry, but decomposition is minimal owing to cold temperatures. As a whole, decomposition of organic matter can be minimized in the paddy field. In addition, rice straws and roots are retained, which aids soil fertility to a certain degree. As a result, rice production tends to be relatively easily stabilized over long periods of time.

Secondly, ferrous ions deoxidize to ferric ions in a watered paddy field. The acid condition of soil becomes neutral, which makes rice plants grow well. Thirdly, phosphorous ions separated from ferrous compounds become available for rice plants in that condition. Furthermore, many minerals dissolved in water are supplied to the paddy fields during the irrigation period. These minerals can be conserved and used as nutrients for growing plants since water does not leak out through the base soil of the field. Finally, soil erosion caused by heavy rainfall is minimized when terraced paddy fields are located stepwise on the slope of a mountain.

For all these reasons, Japanese farmers have endeavoured to create paddy fields, as much as possible, out of the total agricultural land area. In areas where winter is not very cold, paddy fields have been utilized to produce barley and other upland crops in winter. This system of crop rotation has long been established in various parts of Japan. Generally speaking, since the average farm size in Japan is very small, farmers have tried to produce as much as possible per unit of land, and adopted a crop rotation system. In this system, livestock and human manure, as well as residues of leaves, are widely

used to supplement soil fertility. This established a self-contained, recycling system of paddy land use.

However, when Japan entered a high economic growth period, Japanese agriculture started to change very dramatically. More and more farm household members took up non-farm employment, and the agricultural population started to decline very rapidly. As a result, many rice farmers became part-time farmers, with only rice being produced in a monoculture system. The remaining farmers tended to specialize in vegetable or livestock. Among rice farmers, there was heavy use of machinery, chemicals, and chemical fertilizer. The intensity of land use became very much lower. In livestock farming, feeds were mostly purchased to increase the number of livestock.

These changes have not only broken down the crop rotation system, but also created agricultural pollution problems, such as an accumulation of intensive livestock manure. On the other hand, soil fertility on crop farms gradually deteriorated owing to the heavy dependence upon chemicals and chemical fertilizer.

These days Japanese people are eating more and more livestock and dairy products, less and less rice. Demand-side change has necessarily reduced the acreage of paddy production. The Japanese government has encouraged rice farmers to divert to other crops, with government subsidies. However, these crops diverted from rice are not as profitable. Some paddy fields have become idle, without any production. Naturally, the self-sufficiency rate of food production in Japan has rapidly decreased.

### CONCLUDING REMARKS : A TIME OF CHANGE

Since the high economic growth period, the nature of Japanese agriculture has shifted towards more and more energy-intensive and resource-exploitative techniques. As a result of increased use of chemical fertilizers and agricultural chemicals, yield has been increased and stabilized, and quality has been improved. At the same time, however, a number of problems have occurred in this transformation process, such as over-production of rice and other crops, deterioration of soil fertility, and dangers for food safety. These issues are not only raised by the agricultural side, but also by consumer groups and the general public in Japan. There is also an increasing concern among Japanese consumers to seek safety of agricultural products, both domestically produced and imported.

It is a time of change in the system of agricultural production and land use. More and more efforts should be devoted to recreating the viability and sustainability of Japanese agriculture, not simply by encouraging farmers to seek more intensive farming.

**DISCUSSION OPENING – YANG BOO CHOE\***

The paper presented by Professor Kada, which focuses attention on rural labour market conditions in Japan, is particularly interesting since it deals with a country in which there has been massive industrial development impinging on a very traditional, small-scale, agricultural sector.

The sustainability issues in Japanese agriculture include both ecological and socio-political concerns. Traditional paddy farming has been sustainable over many centuries in Japan but, since the 1960s, considerable intensification has occurred in rice production. Increasingly, Kada emphasized, the Japanese, too, are becoming more aware of the issues of sustainable agriculture. My particular interest, however, was in the socio-political area, where the author noted the aging structure of the agricultural labour force, the very limited entry of the young into farming, and the depopulation of remoter areas. This has been accompanied by an increasing role for part-time farming.

The question is whether the latter is sustainable over the longer term. There appears to be an extremely difficult policy problem in Japan associated with part-time farmers who receive most of their income from off-farm sources. In most Japanese farm households, the younger generation tends to work in urban areas, leaving agricultural work to older people and to females. It is not easy to squeeze the latter out of agriculture because their skills and work opportunities are relatively poorer. Furthermore, it appears that the key part-time 'farmer' often tends to over-invest in farm machinery in order to be able to cope with peak workloads. The result must be that the sector as a whole becomes less than responsive to market signals. Change has taken place, but there is little indication that it has been aided by any real policy response. Specifically, I wonder whether the concept of 'part-time farming' is still relevant to the needs of the rural sector, or whether there should be greater recognition of the need to encourage the development of the 'pluriactive household', as has been occurring in Europe.