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An Evaluation of the Role of Public Investment for Agricultural Development in Hokkaido, Japan, 1963-1995.*

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1. Introduction

Government expenditures are generally regarded as a major influence on the pace and pattern of the Agricultural development. Agricultural research, rural education, extension of technology to the farming community and development of a wide range of agricultural activities from fertilizer distribution to credit are commonly funded by the government. Nevertheless, there have been few studies of the government expenditures on agriculture and its effect on the output. The study starts with the definition of investment. Investment means the commitment of resources to the formation of capital assets which in turn allows a stream of new resources to be generated in future. The value of the capital assets created in the form of plant or construction depends upon the capital flows. For the investment to be acceptable then the value of the assets must exceed its cost. Investment has got two different types which are public and private investment.

A distinction must be made between public and private investment. The public investment has their origin in the government plans for different sectors while private investment is carried out by the individual or groups of enterprises. In the present study we will focus only on the public investment for agriculture in Hokkaido. Stockfish (1969) said that the decision makers should apply to the government investment projects an interest that equals the opportunity return on investment in the private sector of the economy.

1.1 Background of the Study and Statement of the Problem

There are many problems related to the public investment for agriculture in Hokkaido, Japan that is the investment made by central government and the provincial government. Some of the main problems related to the government and to the farmers regarding the public investment are as follows.

1) The government prepares the developmental projects in Hokkaido. The system of the investment is such that 80% of the cost is being paid by the government, 18% by the municipalities and the remaining 2% the government requests the beneficiaries or the farmers to pay from their side. Actually, the farmers are reluctant to pay the cost from their side due to which many of the projects failed to get implemented. Therefore, keeping in view the difficulty of the investment from the farmers side, the government has to prepare new projects which is not only time consuming but also requires a lot of capital.

2) As environment is directly related to the economy. Therefore, the government should improve the environment. But unfortunately, the government does not have good theories for calculating the environmental cost for improving the environment.

3) Maintenance of the projects from the farmers side is cited as one of the major problems faced by the government. Once the projects are being implemented in joint co-operation of the farmers by the government then it becomes entirely the responsibility of the farmers to maintain these projects. But unfortunately either because of the technical efficiency or the lack of the capital from the farmers side they are not properly maintained which means that the investment that the government made would be wasted.

1.2 Purpose and Significance of the Study

The main objectives of this study is to evaluate the public investment in the agricultural sector in Hokkaido. The current study consists of two major parts.

- i. Evaluation and assessment of the public investment for agriculture in Hokkaido in the pe-riod between 1963 to 1995 made by central government and Hokkaido government by using production function approach.
- ii. To undertake the analysis of the data using the total factor productivity (TFP).

The public investment is important because of several reasons. Firstly, the government expenditures has become a significant fraction of the national income. Secondly, public capital has a powerful impact on the productivity of private capital. Thirdly, the public investment is confined by and large to those goods and services that the private sector will not produce in optimal amounts. Fourthly, public investment also could effect private capital formation indirectly by augmenting demand for goods and services produce by the private sector and influencing private investors profit and sales expectations. Lastly, public investment in streets and highways, airports, ports, electrical and gas facilities, mass transit, water and sewerage's, health facilities and education services, increases both total factor productivity and labor productivity. Aschauer (1989) triggered a boom in the literature on the public investment. Aschauer results suggested that the public investment had a strong positive effect on the productivity of the private capital and that the slow down in the United States since the early 1970s was due to the shortage in the public infrastructure.

1.3 Review of Literature

The major purpose of this section is to develop some conceptual and theoretical frame of reference from the literature on the Public investment for Agriculture. Little research work seems to have been done on the problem under investigation in Hokkaido. However, some relevant references are discussed below.

Ahmed Shagil (1986) said that the government deficits are thought to have a variety of effects on the private economy, ranging from forcing up real interest rates and crowding out private investment in additional plant and equipment to raising wealth and stimulating household consumption demand.

Arrow and Kurz (1970) were the first authors to formulate government expenditures as a form of investment.

Barrow and Robert (1989) investigates the determination of economic growth in a cross section of countries. The growth rate is found to be negatively related to the government consumption and not significantly related to the public investment.

Baxter and King (1993) studied the macroeconomic implications of increases in the stocks of public goods. They derived the transitional dynamic response of output, investment, consumption, employment and interest rates to such policies by calibrating a real business cycle model.

Evidence by Buffs, John and Anwar Shah (1993) also showed that the impact of the government spending is contingent on what the government spends its resources on.

Berndt and Khaled (1979) found that the apparent presence of the substantial economies of scale and relatively little technological progress is important for policy decisions. For example when promoting an industry, the government

must decide how subsidies should be divided between the promotion of scale economies and the promotion of the technical progress e.g research and development.

Barro and Sala-I-Martin (1981) Barro and Sala-I-Martin (1981) said that it is conceivable that the relationship between the public capital and productivity is merely evidence of a reverse causation from productivity, proxying for per capita income to the demand for the public capital.

Corley and Chaivi (1973) reported that the relative productivity of the public and the private investments in less developed countries is obviously important and topical.

David Alan Aschauer (1989) suggested that the public investment had a strong positive effect on the productivity of private capital and that the slow down in the productivity growth in the United States since the early 1970s was due to a shortage in public infrastructure.

Is the social value of the private investment greater than a dollar of consumption from private consumption. David Bardford (1975) addresses this issue with a sophisticated analysis of stream of the consumption from the private investment. His conclusion in a wide variety of circumstances is that the social present value of a dollar of private investment is worth little than a social rate of time preference.

Deininger, Klams and Lyne Squire (1996) reported that the income distribution also varies among LDCs and hence the government may play an active role for the redistribution of the resources within many of these countries. Whether redistribution actually enhances economic growth is however disputed.

Denison (1974) among others concluded that the economies of scale are a significant reason for the TFP (total factor productivity) growth in the United State.

Devarjan et al (1996) investigates how a change in the composition of the government expenditure may affect government economic growth. Their main findings are that for a sample of only LDCs an increasing share of the current public expenditure has a positive effect on economic growth while the relation between the capital and component of the public expenditure and growth is negative.

Diewert (1976) derived the formal relationship between the growth accounting and econometric fitting of production functions and showed that both approaches are equivalent. He proved that under cost minimisation behaviour and by utilising a translog mathematical formulation, the input quantity or the input price aggregate can be equivalently calculated by means of either the Tornquist index or the translog production or cost function.

Easterly and Rebelo (1993) investigated the effects of the fiscal policy on growth using mainly Barrow type cross section regression analysis.

Edward Gramlich (1994) felt that the U.S productivity growth slowed down

dramatically in about 1873 due to the fact that the United States investment in public capital has been down since the late 1960s

Hirshleifer (1965) argues that where investments can be undertaken separately they should be discounted at rates determined in the market.

According to Jean Marie, Baland and Ashok Kotwal (1999) owners of the sector specific factors form political lobbies. In order to influence government policy in a closed economy, public terms of trade against Agriculture (due to Angel's Law) thereby increased the surplus of the unrecognised classes which cannot be appropriated by the lobbies. As a result the latter push to increase subsidies (or reduce taxes) to their members at the expenses of the public investment which falls below its socially optimal level of trade against.

Kaplan (1984) has strongly advocated the need for new performance measures in his articles that have influenced the development of what is now called "Activity Based Cost" (ABC) Accounting.

Kenneth Arrow (1966) argues to the fact that whether the future cost and benefits of the public projects should be discounted by a social rate of time preference or a marginal rate of return on the private investment torical time series.

Khan-Reinhart (1990) reported that the productivity of the private investment is large and positive and shows strong statistical significance.

According to Kuasdet's (1986) TFPM is a tool that management can use to measure productivity, price recovery and profitability.

Loggerenberg and Cucchiaro (1982) stated that since productivity and price recovery have strategic implications not presently portrayed by most financial reports, TFPM (total factor productivity measurement) should appeal to managers and controllers who are not just concerned with short term profits but also with long term survival, growth and excellence.

Miller (1989) said that data collections is not really a problem as long as there is a support from the management and the control.

Miller, Robert And Mariusz Sumsilinski (1970) showed the trends in the private investment in developing countries

Eckstein (1958) said that which discount rate is relevant for comparison between the public and the private investment that compete for scarce resources.

Pestieau (1974) assumes that the government has a positive social rate of time preference, it is believed that the government should not discount the welfare of the future generations on ethical grounds as in Ramsey, although it is recognised that the individual may have a time preference in the two periods of his lifetime.

According to Stenier (1959) the marginal social rate of discount reflects the community marginal weight on consumption at different times, the appropriate basis for comparison of alternatives public and private investment is the present value of their net benefits to society at the marginal social rate of discount. Thus in the planning of the public investment the present value of the benefits of

private investment that the public investment displaces evaluated at the marginal social rate of investment as the measure of its true social rate of discount supercedes the money cost of the public investment as the measure of its true social cost.

It was pointed out by Pigou (1947) that the financing of the public expenditures by distortionary taxes imposes an efficiency loss on the economy and this efficiency cost should be added to the direct resource cost of the public expenditure.

According to Pindyck and Rubinfeld (1988) positive approaches mostly rely on the econometrics regressions analysis or simultaneous equation systems that allow explanation of the current land use pattern but can also be used for predictive purposes merely through the extrapolation of his investment decisions in which each project can take any number of dollars.

Sandmo and Dreze concluded that the second best discount rate for the public investment in a one good, two period economy distorted with the corporation income tax should be a weighted average of the rate facing consumers and the tax distorted rate used by the firms, the weights being the compensated interest derivative of consumption and the interest derivative of the private investment, respectively.

Stephen Marglin said that market determined rates of investment and interest even rates determined in a competitive market need to have no normative significance and that the optimal level of investment from marginal social rate of discount incorporating external effects rather than the level at which the marginal productivity equals the market rate of discount determined by unilateral investment and saving decisions.

Jacob Stockfish (1969) said that the decision makers should apply to the government investment projects an interest that equals the opportunity return on investment in the private sector of the economy.

Schultz has suggested that estimates of the social rates of return on these kinds of the government expenditures may be biased and that the interaction between the price and expenditure policies can explain the low response of the agricultural productivity.

2. Expenditures for Agricultural Infrastructure Construction and Improvement Programmes

This chapter presents the review of the improvement project of agriculture and rural expenditures in Hokkaido. These projects are implemented by the central, provincial and the municipal corporations etc. This chapter also briefly explains and analyses the performance of the various projects between the periods 1963 to 1995. Crop wise analysis of the various crops in Hokkaido were also undertaken which will also briefly be presented in this chapter. The analy-

Table 1-1 LIST OF THE IMPROVEMENT PROJECT OF AGRICULTURE AND AGRICULTURAL VILLAGE IN HOKKAIDO

Government-operated project	Irrigation and drainage project	Integrated upland field improvement project	Land consolidation project, miscellaneous land improvement works	Agricultural land reclamation and readjustment project	Grassland development	Farm road improvement	Rural development	Agricultural land conservation and agricultural infrastructure maintenance
Government-operated project	Irrigation and drainage project Government-operated drainage canal improvement project Rehabilitation works Operation and maintenance works of government-constructed irrigation and drainage facilities	Integrated upland field improvement project Relation improvement of farmland reorganization	Land consolidation project Integrated land improvement works Agricultural land conservation project	Farmland reclamation project Government-operated agricultural land reclamation and readjustment pilot project Integrated agricultural land development project	<u>Meadow development</u>			
Public-operated project	Old reservoir rehabilitation project Irrigation pond Integrated upland field improvement project Special drainage improvement project for conversion into multi-purpose paddy field Inundation prevention project Promotion model farmland of irrigation Repair of main irrigation and drainage facilities	Integrated upland field improvement project Relation improvement of farmland reorganization	Land consolidation project Integrated land improvement works Agricultural land conservation project	Integrated agricultural land development project Farmland reclamation project Agro-forestry land development pilot project	<u>Meadow development</u>	Wide-area farm road improvement project Farm road improvement project by the funds of tax derived from agricultural oil use Farm road takeoff and landing scene	Integrated rural infrastructure improvement pilot model project Integrated rural improvement project Integrated rural infrastructure improvement conservation project Watery environment improvement project Community environment infrastructure improvement project	Disaster prevention dam project Land-slide prevention project Agricultural land conservation project Emergency measure for agriculture river construction thing
Public-operated project	Agricultural land conservation urgent project	Wide-area agricultural development	Wide-area agricultural development	Construction of stock raising base Wide-area agricultural development		Integrated agricultural land improvement project	Seacoast environment improvement project Integrated improvement project for activating rural communities in less favored area Habitat environment improvement project	Seacoast conservation facilities improvement Natural environment conservation

Source: Hokkaido Development Bureau

Note: Project name with underline indicate that these names are translated from Japanese to English and these projects were not included in the original source of data.

sis relating to the characteristics and trends of the Agricultural and rural improvement project cost will also be undertaken by converting the original data to stock data. Moreover, the originality of this chapter lies in the fact that until this time no research work was done on the public investment for Agriculture in Hokkaido using the stock data.

2.1 Review and Feature of Agricultural infra-Structure Construction and Improvement Programmes

Different type of projects are implemented by the central, provincial governments and the corporations. Those projects which are implemented by the central government are directly operated by the central government. Those projects which are operated by the provincial government are also partly subsidised by the central government. In case of the Projects being implemented by the corporations are directly related to the agricultural investment. Devarjan et al (1996) investigates how a change in the composition of the government expenditure may affect government economic growth. Their main findings are that for a sample of only less developing countries an increasing share of the current public expenditure has a positive effect on economic growth while the relation between the capital and component of the public expenditure and growth is negative. The projects operated by the central, provincial and the corporations include irrigation and drainage, integrated upland field improvement, farmland consolidation, agricultural land development, grassland development, farmland improvement, rural improvement projects, agricultural land conservation etc. Investment is being made by the government in the irrigation and drainage for the construction and the improvement of the canals or dams. The integrated upland field improvement projects include land, soil improvement and dressing. The farmland consolidation projects include paddy field improvement such as soil dressing, land readjustment and farm roads etc. The agricultural land development projects deals with the foundation works, reclamation and farmland reclamation etc. In case of the grassland development public pasture, construction and improvement, grassland improvement and livestock basement etc are being implemented. For the farm roads farm road construction and improvement except farm roads for paddy field mentioned under the farmland consolidation projects are being undertaken. The rural improvement projects include integrated rural improvement model projects, integrated rural infrastructure improvement pilot projects etc. In case of the agricultural land conservation slide prevention, agricultural land conservation project, water pollution project etc are included. Hirshleifer (1965) argues that where investments can be undertaken separately they should be discounted at rates determined in the market.

2.2 Investment Trends for the Total Project Cost in Hokkaido

The investment trend for the total project cost in Hokkaido was such that the

investment increased in four periods that is between the 1963 to 1972, 1974 to 1979, 1985 to 1988 and 1991 to 1995 whereas the investment decreased in three periods that is between the period 1972 to 1974, 1979 to 1985, 1985 to 1991. Moreover, the total project cost increased about five times between the period 1963 to 1995 in 32 years. Pestieau (1974) assumes that the government has a positive social rate of time preference, it is believed that the government should not discount the welfare of the future generations on ethical grounds as in Ramsey, although it is recognized that the individual may have a time preference in the two periods of his lifetime.

2.3 Review of the Improvement Project of Agriculture and Agricultural Village

2.3.1 Trend for the Agricultural Production Infrastructure Improvement Programmes

The agricultural public investment for the agricultural production infrastructure in Hokkaido between the period 1963 to 1995 was such that the investment started initially from 1963 and increased for nine years between the period 1963 to 1972. From 1972 onwards, it declined for two years between the period 1972 to 1974 and thereafter the situation changed and the trend showed an upward movement for about five more years that is between the period 1974 to 1979. The trend of the investment after 1979 again changed and it was such that the investment again declined for about six years between the period 1979 to 1985. From 1985 onwards, the trend again showed an upward movement and increased for three more years between the periods 1985 to 1988. Thereafter, the investment again increased for three more years between the periods 1988 to 1991 and declined slightly until the very last end that is until 1995. Khan-Reinhert reported that the productivity of the private investment is large and positive and shows strong statistical significance. Moreover, the share of the Agricultural production infrastructure was 99.8% in 1963. However, the share gradually decreased and was under 80% in 1970s. Thereafter, the share was over 20% in 1980s. Miller (1989) said that data collections is not really a problem as long as there is a support from the management and the control.

2.3.2 Rural Improvement

The investment trend for the rural improvement project in Hokkaido between the periods 1963 to 1995 was such that the investment initially started in 1965 and gradually increased for about seven years that is between the periods 1965 to 1972. From 1972 onwards the situation changed and it again declined for two more years between the periods 1972 to 1974. The situation changed from 1974 onwards and the investment by the government increased for five more years that is between the periods 1974 to 1979. From 1979 onwards, the investment trend showed a downward movement and again declined for six more years between the periods 1979 to 1985. The investment trend again changed and

showed an upward movement for three years between the periods 1985 to 1988. Thereafter, it again declined for three years that is between the periods 1988 to 1991. Finally, the investment increased for four years between the periods 1991 to 1995. Schultz has suggested that estimates of the social rates of return on these kinds of the government expenditures may be biased and that the interaction between the price and expenditure policies can explain the low response of the agricultural productivity.

2.3.3 Agricultural Land Conservation

The investment trend for the agricultural land conservation project in Hokkaido between the periods 1963 to 1995 was such that the investment by the government started initially in 1966 and increased for about six years between the periods 1966 to 1972. Thereafter, it declined for two years between the periods 1972 to 1974. The situation changed from 1974 onwards and the investment again increased between the periods 1974 to 1979 for about five years. The investment trend after 1979 was such that it declined for six years between the periods 1979 to 1985. The trend of the investment after 1985 was such that it increased for

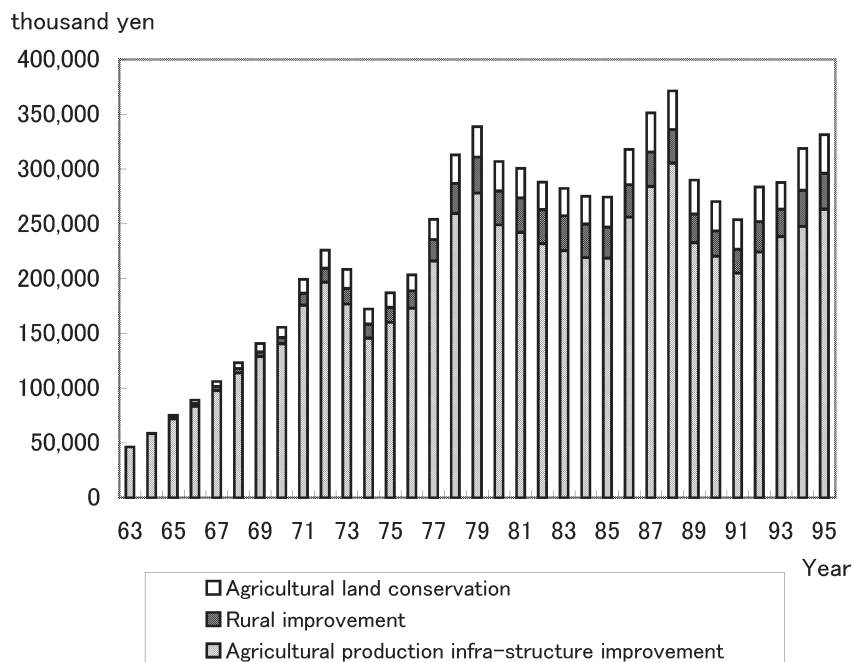


Figure 2-1 Trend Graph showing the trend of the Agricultural land conservation, Rural improvement, Agricultural production infra-structure improvement in Hokkaido between the period 1963 to 1995
 Source: Hokkaido Development Agency, Sapporo Japan.

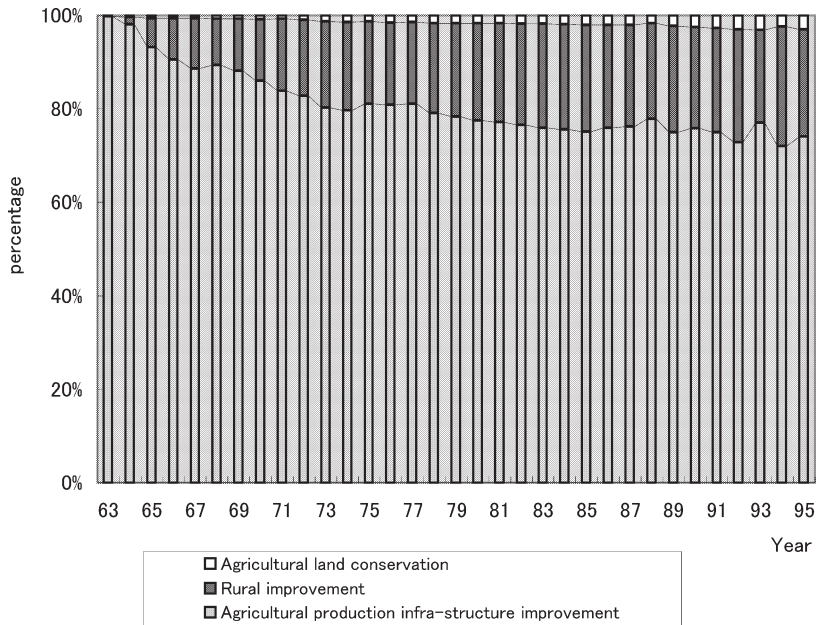


Figure 2-2 Share Graph showing the share of the Agricultural land conservation, Rural improvement and Agricultural production infra-structure in Hokkaido between the period 1963 to 1995

Source: Hokkaido Development Agency, Sapporo Japan.

three more years between the periods 1985 to 1988. The situation again changed after 1988 and the investment again declined for three more years between the periods 1988 to 1991. Finally, the investment showed an upward movement between the periods 1991 to 1995 (see Figure 2-1 and Figure 2-2). Kenneth Arrow (1966) argues to the fact that whether the future cost and benefits of the Public projects should be discounted by a social rate of time preference or a marginal rate of return on the private investment topical time series.

The agricultural production infra-structure improvement project in Hokkaido is again sub-divided into the five different projects that is irrigation and drainage project, integrated upland field improvement, farmland consolidation, agricultural land development, grassland development Project. These projects are being implemented for the land improvement in Hokkaido. The land improvement projects in Hokkaido directly effects the farm management. The project wise explanation that is the investment trends for each project implemented under the agricultural production infrastructure is given on the next page. Edward Garmlich (1994) felt that the U.S productivity growth slowed down dramatically in about 1873 due to the fact that the United States investment in public capital has been down since the late 1960s.

2.4 Review of Agricultural Infrastructure Construction and Improvement Programmes

2.4.1 Irrigation and Drainage

The trend for the irrigation and drainage projects in Hokkaido between the periods 1963 to 1995 was such that the agricultural public investment started initially in 1963 and went on to increase for about ten years between the period 1963 to 1973. The situation of the investment changed after 1973 and it showed a downward movement and declined gradually from 1973 onwards for about four more years between the periods 1973 to 1977. The trends of the investment for the irrigation and drainage project again changed and showed an upward movement and the investment increased gradually from 1977 onwards for eighteen years between the between the period 1977 to 1995 that is until the very last end between the period 1977 to 1995 that is until the very last end. Ahmed Shagil (1986) said that the government deficits are thought to have a variety of effects on the private economy, ranging from forcing up real interest rates and crowding out private investment in additional plant and equipment to raising wealth and stimulating household consumption demand.

2.4.2 Integrated Upland Field Improvement Project

The government investment for the integrated upland field improvement project in Hokkaido between the periods 1963 to 1995 was such that the investment started initially in 1970 and showed an upward movement and gradually increased for two years that is between the periods 1970 to 1972. The situation changed after 1970 and the trend of the investment was such that it again showed a downward movement and declined until 1974 and thereafter again increased again until 1979. From 1979 onwards the trend of the investment remained at one level and gradually increased from 1979 onwards until the very last end that is until the period 1995. Kaplan (1984) has strongly advocated the need for new performance measures in his articles that have influenced the development of what is now called "Activity Based Cost" (ABC) Accounting.

2.4.3 Farmland Consolidation

The trend of the government investment for the farmland consolidation project in Hokkaido between the periods 1963 to 1995 was such that the investment initially started in 1964 and gradually increased from 1964 onwards. The investment trend remained almost in one level until 1976 that is increased slowly until 1976 and then all of a sudden showed an upward movement and went on to increase until 1988. The situation of the investment by the government again changed in 1988 and the investment again showed a downward movement and declined until the very last that is until 1995. Baxter and King (1993) study the macroeconomic implications of increases in the stocks of public goods. They derived the transitional dynamic response of output, investment, consumption, employment and interest rates to such policies by calibrating a real business cycle model.

2.4.4 Agricultural Land Development

The investment trend for the agricultural land development project in Hokkaido between the periods 1963 to 1995 was such that the investment started initially in 1964 and increased gradually from 1964 onwards. The investment increased from 1964 onwards for about twenty-four years between the periods 1964 to 1988. During these twenty-four years the trend of the investment almost remained at one level. The situation again changed in 1988 and the investment trend showed a downward movement and declined from 1988 onwards for about seven years between the periods 1988 to 1995 that is until the very last end. According to Jean Marie and Ashok Kotwal (1999) owners of the sector specific factors form political lobbies. In order to influence government policy in a closed economy, public terms of trade against Agriculture due to Angel's Law thereby increased the surplus of the unrecognized classes which cannot be appropriated by the lobbies. As a result the latter push to increase subsidies or reduce taxes to their members at the expenses of the public investment which falls below its socially optimal level.

2.4.5 Grassland Development

The agricultural public investment for the grassland development project in Hokkaido between the periods 1963 to 1995 was such that the investment started initially in 1963 and gradually increased until 1972. The trend of the investment increased slowly and gradually from 1972 onwards for about twelve years that is between the periods 1972 to 1984. From 1984 onwards, it again declined for one year that is between the periods 1984 to 1985. The trend of the investment after 1985 was such that investment again increased for three more years between the periods 1985 to 1988. The situation changed after 1988 and the trend of the investment was such that it showed a downward movement and declined for about seven years between the periods 1988 to 1995 that is until the very last end (see Figure 2-3 and Figure 2-4). Barro and Sala-I-Martin (1995) have argued virtually all public services are characterised by some degree of congestion. Even national defence sometimes cited as the purest of the public goods is not congestion free.

2.5 Comparison between Hokkaido and Tofuken

Comparison regarding the agricultural production infrastructure improvement and rural improvement project was made of Hokkaido with that of Tofuken for two different years that is for 1985 and 1995. By Tofuken we mean to say other areas in Japan excluding Hokkaido and consists of 46 prefectures. In Tofuken, the share of the agricultural production infrastructure improvement project cost was such that it was 66.5% in 1985. Thereafter, it decreased to 50.3% in 1995. The share of the same project in Hokkaido was 81% and 77.7% in 1985 and 1995 respectively. The share of this project was high in Hokkaido because of the fact that the government wanted to improve the productivity in

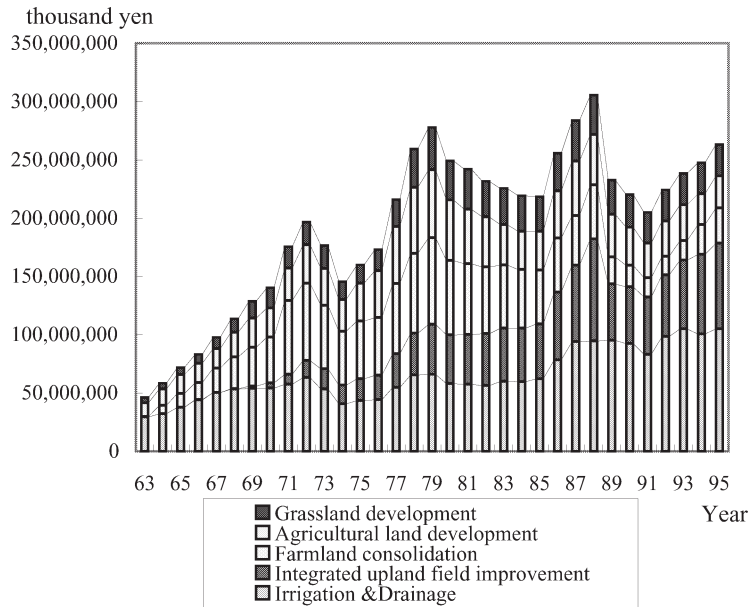


Figure 2-3 Projectwise total project cost trend for the Grassland development, Agricultural land development, Farmland consolidation, Integrated upland field improvement, Irrigation and drainage in Hokkaido
 Source: Hokkaido Development Agency, Sapporo Japan.

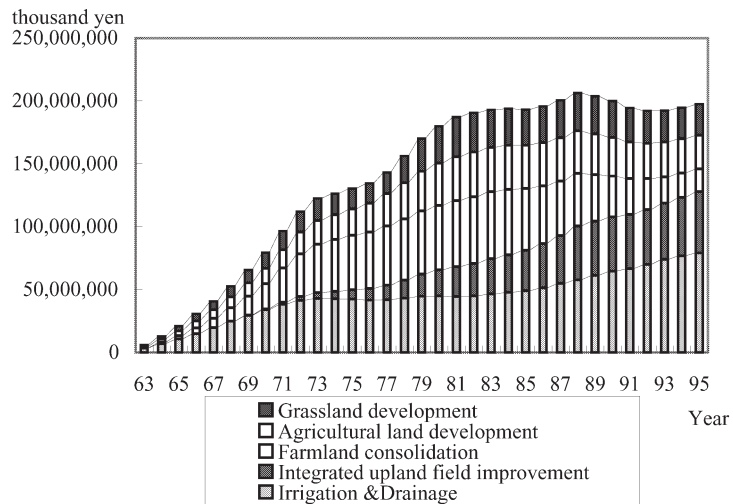


Figure 2-4 Projectwise reaggregated project cost trends for the Grassland development, Agricultural land development, Farmland consolidation, Integrated upland field and Irrigation and drainage in Hokkaido (Real data)
 Source: Same as Figure 2-3.

Hokkaido.

In case of the share of the rural area improvement project the share of the Tofuken was high compared to Hokkaido that is the share in Tofuken was 22.9% in 1985 and increased to 38.9% in 1995 whereas for Hokkaido it was 16.4% and 18.7% in 1985 and 1995 respectively. The reason is because of the fact that the government wanted to concentrate more in developing other rural areas in Japan.

For the Agricultural land resources conservation and management programs again the share was high in Tofuken that is it was 10.6 and 10.9% in 1985 and 1995 respectively whereas for Hokkaido it was 2.6 and 3.6% in 1985 and 1995 respectively. The same reason is also coated for the high share of the Tofuken (see Figure 2-5). Khan-Reinhart (1990) reported that the productivity of the private investment is large and positive and shows strong statistical significance.

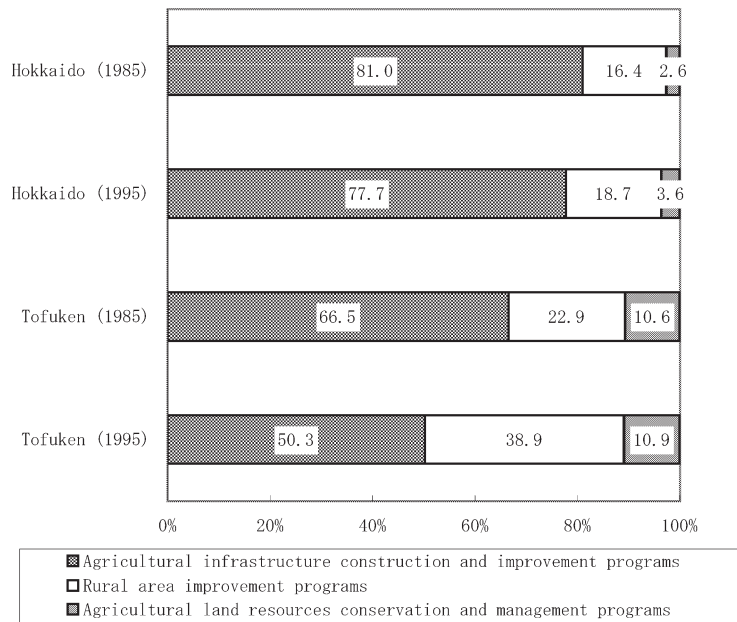


Figure 2-5 Share of the Expenditures for the Improvement Project of Agriculture and Agricultural Village by Programm

Source: Same as Figure 2-1.

Note: By Tofuken we mean to say other areas in Japan excluding Hokkaido and consists of 46 Prefectures.

2.6 Expenditures for Agricultural Infra-Structure Construction and Improvement Programmes by Agricultural Area in Hokkaido

2.6.1 Cropwise Classification of Hokkaido

As was also mentioned earlier Hokkaido consists of a total of 14 areas. Each of these 14 areas were therefore classified according to the type of farming

performed e.g. Ishiakri, Sorachi, Kamikawa, Hiyama, Oshima are considered to be Paddy growing areas whereas Rumoi, Oshima, Shiribishi, Hidaka, and Abashiri are considered to be dairy growing areas and Kushiro, Nemuro and Soya are considered to be upland growing areas. This classification was undertaken from the rate of the paddy field that is the percentage area under the rice crop which is specified in the statistical table of Hokkaido government. From this rate of rice crop, the classification was undertaken in such a manner that where 30% and above of the agricultural area was under paddy was considered to be a paddy growing area where 0-30% of the area was under upland field was considered to be an upland field area and where there was no paddy and upland was considered to be dairy area. Table 2-1 clearly shows the 14 areas of Hokkaido, the total agricultural land, the land under the cultivation of the rice, the share of the rice crop, the government classification of Hokkaido and the original classification which was made from the statistical table of Hokkaido government. It was pointed out by Pigou 1947 that the financing of the public expenditure by distortionary taxes imposes an efficiency loss on the economy and this efficiency cost should be added to the direct resource cost of public expenditure.

Table 2-1 THE CLASSIFICATION OF THE AGRICULTURAL AREA IN HOKKAIDO
Unit: (ha,%)

Area Name	Total Agr. Land (A)	Rice Area (B)	Share of rice area (%) (A/B)	Cropwise Division
Ishikari	46419	25308	54.5	Paddy
Sorachi	120396	95812	79.6	do
Kamikawa	133945	66533	49.7	do
Rumoi	38746	9183	23.7	Upland
Oshima	31959	7496	23.5	do
Hiyama	23282	9786	42	Paddy
Shiribeshi	40803	11202	27.5	Upland
Iburi	38094	10460	27.5	do
Hidaka	40716	7179	17.6	do
Tokachi	251739	1343	0.5	do
Kushiro	104415	0	0	Dairy
Soya	56605	0	0	Dairy
Abashiri	169375	5437	3.2	Upland
Nemuro	122065	0	0	Dairy

SOURCE: Hokkaido Government Office, Sapporo, Japan.

Note: The classification of Hokkaido was undertaken in such a manner that where 30% and above of the land was under rice was considered to be rice growing area, where 0-30% of the area was under upland was considered to be an upland growing area and where there was no upland and rice was considered to be a grassland or dairy area. This classification was undertaken from the rate of rice which is given in the statistical table of Hokkaido government.

2.7 Cropwise Investment Trends in Hokkaido

As was also mentioned earlier that Hokkaido consists of a total of 14 areas. Different type of farming is undertaken depending on the climatic conditions of each area. Hokkaido is therefore classified according to the type of farming performed in each area and it was found that there were two main crops cultivated that is rice and upland and then dairy farming was also undertaken. Arrow and Kurz (1970) were the first authors to formulate government expenditures, as a form of investment. The following is a brief explanation of the crop wise trends in Hokkaido.

2.7.1 Dairy

The investment trend for the dairy in Hokkaido between the period 1963 to 1995 that is in Kushiro, Nemuro and Soya was such that the investment started from the very beginning that is in 1963 and gradually increased for about nine years that is the period from 1963 to 1972. From 1972, the situation changed and it again declined for two years that is from 1972 to 1974. The situation after 1974 again changed and the investment increased again for about five years between the periods 1974 to 1979. The trend of the investment after the period 1979 was such that the investment again showed a downward movement for about six years from 1979 to 1985. The investment trend once again changed and the investment again showed an upward movement for three years between the periods 1985 to 1988. From 1988 onwards, the trend of the investment again showed a downward movement for three years from 1988 to 1991. From 1991 onwards the investment remained at one level for two years between the periods 1991 to 1993. David Bradford (1975) addresses this issue with a sophisticated analysis of stream of the consumption from the private investment. His conclusion in a wide variety of circumstances is that the social present value of a dollar of private investment is worth little than a social rate of time preference.

2.7.2 Upland Field

The investment trend for the upland field in Hokkaido between the period 1963 to 1995 that is in Rumoi, Oshima, Shirbishi, Iburi, Hidaka, Tokachi and Abashiri was such that the investment increased from the very beginning that is from 1963 for about nine years that is between the periods 1963 to 1972. The situation of the investment changed after 1972 and it declined for two years from 1972 to 1974. The trend of the investment again showed an upward movement from 1974 onwards and the investment increased for about five years between the periods 1974 to 1979. The investment started to decline after 1979 for six years between the periods 1979 to 1985. The investment trend changed from 1985 onwards and again showed an upward movement for three years between the periods 1985 to 1988. From the period 1988 onwards the investment trend changed once again and it declined for three more years between the periods 1988 to 1991. The investment almost remained at one level from 1991 onwards for two years from 1991 to 1993. Finally, the investment trend showed an upward

movement from 1993 onwards until the very last end that is until 1995. Is the social value of the private investment greater than a dollar of consumption from private consumption. Barrow (1989) investigates the determination of economic growth in a cross section of countries. The growth rate is found to be negatively related to the government consumption and not significantly related to the public investment.

2.7.3 Rice crop

The investment trend for the rice crop in Hokkaido that is in Ishikari, Sorachi, Kamikawa, Hiyama between the periods 1963 to 1995 was such that the investment started initially in 1963 and gradually increased from the very beginning for about nine between the periods 1963 to 1972. The situation changed after 1972 and the investment showed a downward movement for about two years that is between the periods 1972 to 1974. From the period 1974 onwards the trend of the investment changed once again and the investment increased for about five years between the periods 1974 to 1979. The situation again changed after 1979 and the trend of the investment was such that it again showed a downward movement for three years between the periods 1979 to 1982. From 1982 onwards it again increased for one more year from 1982 to 1983 and thereafter the trend of the investment showed a downward movement and declined for two more years from 1982 to 1984. The trend line again showed an upward movement after 1984 for four more years between the periods 1984 to 1988. It again showed a downward movement and declined after the period 1988 for three more years between the period 1988 to 1991. Finally, the trend line again showed an upward movement from 1991 onwards until the very last end that is until 1995. Corley and Chiavi (1973) reported that the relative productivity of the public and the private investments in less developed countries is obviously important and topical.

2.8 Cropwise Share including Dairy

2.8.1 Dairy

It is quite evident from the share graph for dairy in Hokkaido between the period 1963 to 1995 that the share of dairy started to increase from the very beginning that is from 1963 and increased for fourteen years between the period 1963 to 1977. From 1977 onwards the share of the dairy declined for six years from 1977 to 1983 and from 1983 onwards the situation was such that it again increased until 1988. The situation from 1988 onwards was such that the share of the dairy sometimes increases and sometimes it decreases until the very last end that is until 1995. Evidence by Buffs and Shah, Deverjan et al. (1996) also showed that the impact of the government spending is contingent on what the government spends its resources on.

2.8.2 Upland Field

The share of the upland field was such that it increased from the very beginning that is from 1963 onwards until 1970. The situation after the period

1970 changed and the share slightly declined for one year between the periods 1970 to 1971. From 1971 onwards the share again started to increase gradually until it reaches to its maximum in 1995. It is quite evident from the graph that the share remained at almost one level between the periods 1971 to 1995. The minimum share was obtained in 1963.

2.8.3 Rice Crop

The share of the rice crop in Hokkaido between the periods 1963 to 1995 was such that the minimum share was obtained in 1995 and the maximum share was obtained in 1963. Since the share was at its maximum in 1963 it declined from 1963 onwards until the period between 1970 to 1971. From 1971 onwards the situation changed once again and the share again decreased until the period 1982 and thereafter increased for one year between the periods 1982 to 1983. The situation of the share for the rice crop after 1983 was such that the share sometimes increases and sometimes it decreases until the very last end that is until 1995 (see Figure 2-6 and Figure 2-7). O.Eckstein (1958) said that which

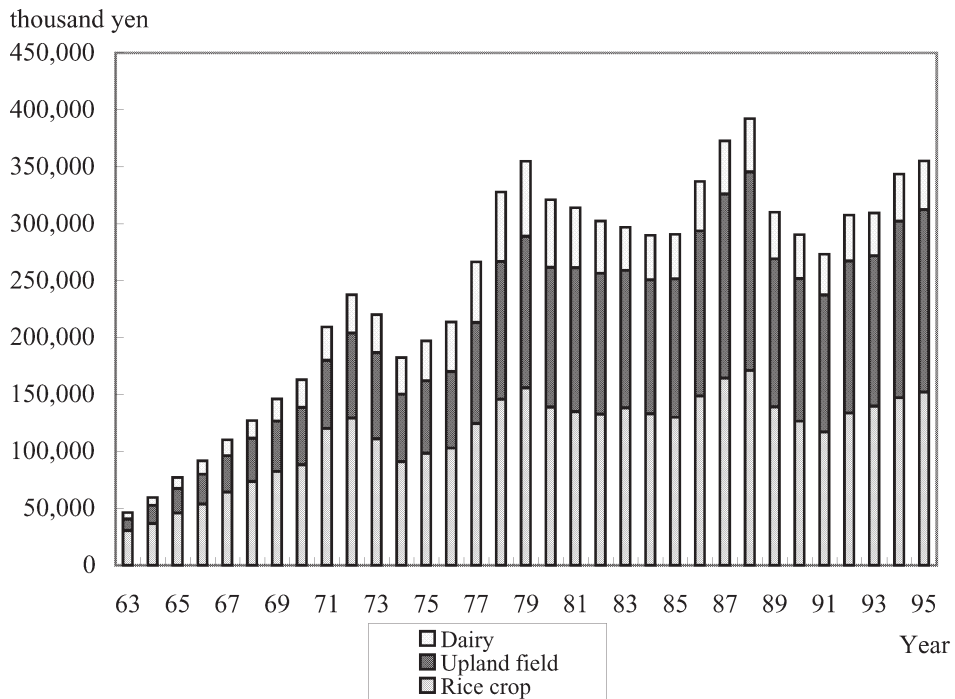


Figure 2-6 Trend graph showing the trend of the Dairy, Upland field, and Rice crop in Hokkaido between the period 1963 to 1995
Source: Hokkaido Development Agency, Sapporo Japan

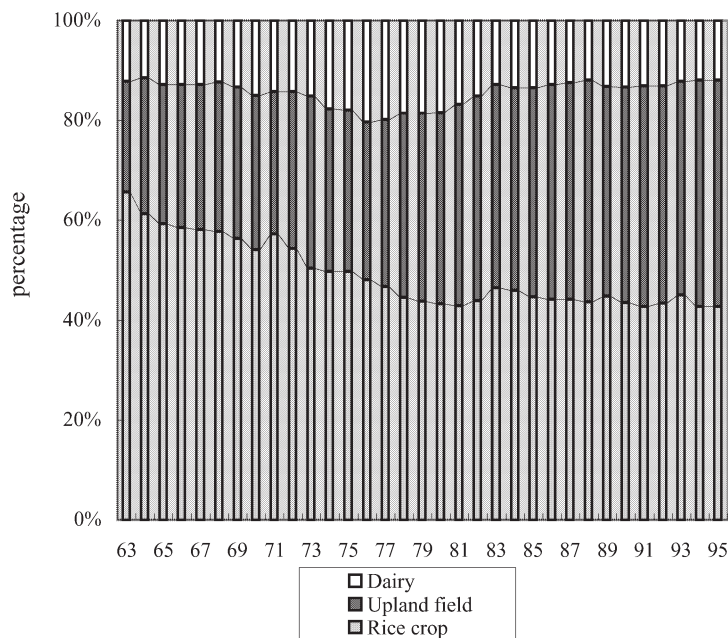


Figure 2-7 Share graph showing the share of the Dairy, Upland field and Rice crop in Hokkaido between the period 1963 to 1995
 Source: Hokkaido Development Agency, Sapporo Japan

discount rate is relevant for comparison between the public and the private investment that compete for scarce resources

2.9 Analysis of the Data

2.9.1 Cropwise Analysis

The project cost for the rice area was 60% of the total cost in 1963. However, the share of the upland field increased and was over the share of the rice crop in 1995. The share of the grassland increased until 1976 and decreased slightly from 1977 and it was 12% in 1995. Compared to paddy and upland, the share of the dairy was less. The minimum share for the dairy was obtained in 1963 and the maximum share was obtained in 1977. However, the share gradually increased from 1964 onwards until it reaches to its maximum in 1976. From 1976 onwards, the share sometimes increases and sometimes it declines until the very last end that is until 1995. Deininger, Klams and Lyne Squire (1996) reported that the income distribution also varies among less developing countries and hence the government may play an active role for the redistribution of the resources within many of these countries. Whether redistribution actually enhances economic growth is however disputed.

2.9.2 Project Contentswise Analysis

The share of the agricultural land conservation was such that the share slightly increased from the very beginning and then remained at one level until 1995. The minimum share was obtained in 1968. The share of the agricultural land conservation was very little as compared to the rural improvement and agricultural production infrastructure. For the case of the rural improvement, the share increased from the very beginning and was over the share of the agricultural land conservation in 1995. The share of the agricultural production infrastructure was over the share of the rural improvement and agricultural land conservation and was at its maximum in 1963 and in 1994 it was at its minimum. Miller, Robert R. and Mariusz A. Sumsilinski (1994) showed the trends in the private investment in developing countries.

2.10 Conversion of the Data

The government allocates budget each year for implementing different projects in Hokkaido. The data that is being used in this study is the agricultural and rural infrastructure improvement data. However, this data does not explain the actual situation. There is a specific project life for each project in Hokkaido. However, the effect or the impact assessment is not during the whole of the project life. Therefore, in order to assess the effect or the impact, we re-aggregated the data according to the project periods e.g. if the project period is 10 years and the cost is 1 million, then we divided 1 million by 10 and we got the figure for each year and we assessed the impact from year 10th of that project. The Project life that we used in our analysis is the standard project period that is being used by the government departments in Japan. Moreover, we have to assume the project life for each project, as we are not sure about the actual project life. The project life depends on the type of projects implemented. For example, in case of integrated upland field improvement project, the project life is 10 years. For the farmland consolidation, the project life is 4 years. For the agricultural land improvement, the project life is 10 years. For the grassland development, the project life is 7 years. In case of the irrigation and drainage project, allocation is being made by the central and provincial governments. Since the project life and the allocation made by the central and the provincial government varies, therefore the weighted average for these projects were calculated. Sandmo and Dreze concluded that the second best discount rate for the public investment in a one good, two period economy distorted with the corporation income tax should be a weighted average of the rate facing consumers and the tax distorted rate used by the firms, the weights being the compensated interest derivative of consumption and the interest derivative of the private investment, respectively.

3. The Role of the Improvement Project of Agriculture and Agricultural Villages in Hokkaido

This chapter briefly presents the method of study that was used, the analysis undertaken to assess the impact of the investment on the output or the production of the various crops using the cost function approach. In this chapter, analysis relating to the effect or the impact of the investment for Agricultural expenditures and the total factor productivity in Hokkaido will be undertaken. In order to reach the above-mentioned objectives, the cost function model was used and using the cost function analysis, estimation of the data was undertaken. The empirical results obtained from this analysis are also explained in this chapter.

3.1 Methodology and Data

3.1.1 Cost Function Model

The growth accounting approach uses index number measures to technology to quantify the components of productivity change. Alternatively, econometric methods can be used to estimate the components of the production cost and profit function. Each approach requires certain assumptions which must be considered in interpreting the findings of the productivity studies. Consider the production function as the output as a function of capital, labor, material and time. Then the equation is given by

$$Y = F(K, L, T).$$

Where Y = output F = function K, L are the various inputs like seed, fertilizer etc and T shows the Public investment for Agriculture. The function should be linear homogenous and should be in the log form to calculate the shares of the inputs such as alpha, beta, gama. Econometric model will be applied to assess the effectiveness of the Government investment on the economy of Hokkaido in general and the productivity of the crops in specific. In order to obtain quantitatively the impacts of the public investment for Agriculture in Hokkaido. The following cobdouglass form is specified for the cost function equation.

$$\begin{aligned} \ln C = & \alpha_0 + \alpha_1 \ln P_L + \alpha_2 \ln P_M + \alpha_3 \ln P_K + \alpha_4 \ln Q + \alpha_5 \ln S + \alpha_6 \ln I_t + \beta_1 \ln P_L \ln I_t \\ & + \beta_2 \ln P_M \ln I_t + \beta_3 \ln P_K \ln I_t + \beta_4 \ln Q \ln I_t. \end{aligned} \quad (1)$$

Where C is the Cost, P_L is the labor, P_k is the capital, I_t is the investment, Q is the Agricultural product and S is the land.

$$\partial \ln C / \partial \ln P_L = S_L = \alpha_1 + \beta_1 \ln I_t. \quad (2)$$

$$\partial \ln C / \partial \ln P_M = S_M = \alpha_2 + \beta_2 \ln I_t. \quad (3)$$

The equation 2 and 3 shows the share of the cost, labor, intermediate inputs and product etc.

3.1.2 Data Collection

The data on the Public investment was collected from the office of the Hokkaido Development Agency whose office is located in Sapporo. This data was related to the investment being made by the central and the provincial government in various developmental. The data related to the investment made by the government is between the period 1963 to 1993. But since the data before 1963 was not available and the data of the labor after the period 1993 could not be arranged. Therefore, using the regression equation the data before 1972 was made available. However, the values before 1972 comes out to be in negative, which is not natural due to which the values in parallel were taken¹. The researcher visited the office personally and collected the data from there whereas the data on the production or the output was obtained from the office of the Bureau of the Statistics, Sapporo. The data obtained from the office of the Bureau of Statistics is related to the output or the production of various crops between the period 1950 to 1995. Only secondary data is being used in this thesis. Moreover, since the data obtained from the office of the Hokkaido Development Agency and the Bureau of the Statistics was in Japanese, therefore, the main contents of the data were translated from Japanese into English. The data originally obtained from the office of the Hokkaido Development Agency was converted in such a manner that the figures were converted from the nominal to the actual ones by multiplying the figures of the data with the cost of co-efficient given at the end of the data. For the simplicity of the graphs, the actual figures were converted once again by making 100 as the base of the total and converting all the figures accordingly.

We used the stock data in our analysis. By stock data we mean to say that for example if the project would start in 1972 then the same project will also remain in 1973 and also the new projects would start in 1973. Therefore, we converted the original data and made it to stock data and used this data in our analysis. The method that was used to convert the original data to stock data was that we took that project cost of each project and divided it by the number of years and the average lag that came out was 9 years. Therefore, we used 9 years as the lag in our analysis.² The Figure 3-1 clearly shows the same. Moreover, since we used 9 years as the lag in our analysis due to which the data before 1972 was not available. We made the data before the period 1972 using the regression. After we made the regression, the values that came out were negative which is not natural. In order to avoid the negative values we did parallel moving and then got positive values.

The statistical trends related to the Agricultural management of Hokkaido

1. The paper shows only the direct effects and the indirect effects such as rural roads, waste water management was added to the paper.

2. The time lag shown is 9 years. However, the time lag in some cases like dam etc could be more than 9 years and could be 20 years for instance.

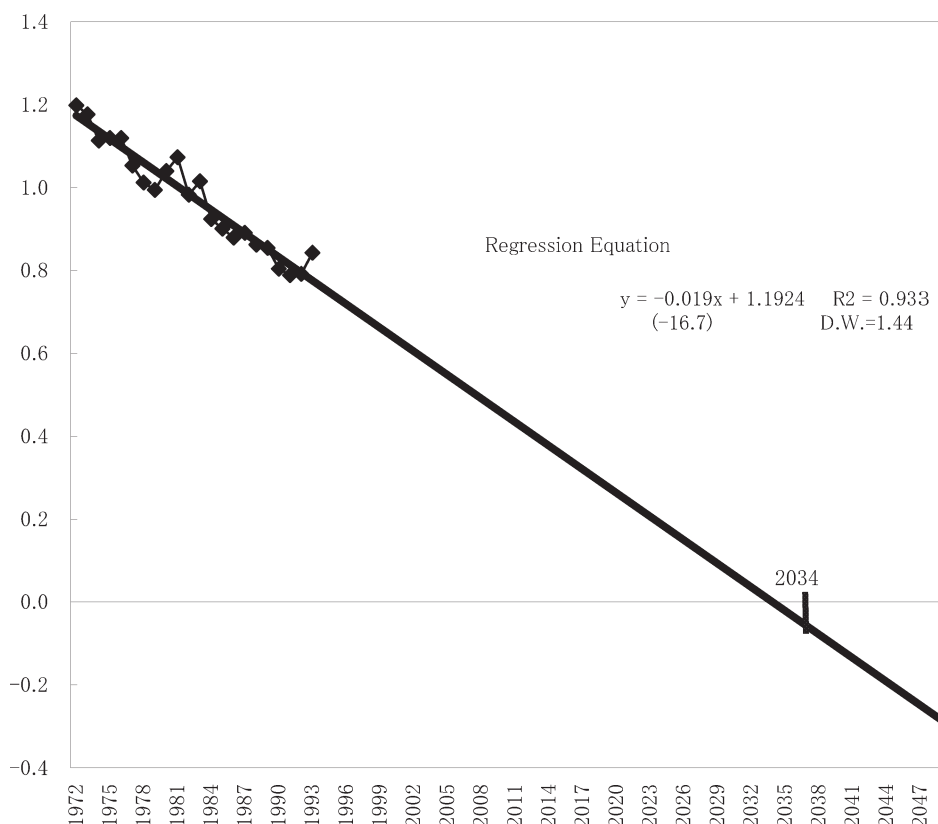


Figure 3-1 Graph Showing the Agricultural Expenditures Cost Reducing Effect of Agricultural Production Structure Project

was based on the data from 1963 to 1995. This data is divided into two parts. Part one consists of the data related to the farm economic statistical value between the periods 1963 to 1965 whereas the second part consists of farm economic investigation report from the period 1966 to 1994. Yet due to changes in the definition of the terms and discontinuity of date, the following method was used to process the data.

i) Labor in Agriculture

In case of the data for the labor again the farm economic survey and report of the farm economy were used. The family labor charges were calculated using the following formula No. of hours of men × wages/hr + No. of hrs of women × 0.8 × Wage/hr

ii) Intermediate Input Price

The cost of intermediate inputs was obtained by adding up the expenditures on seed and seedling, fertilizer, feed, agricultural chemicals, fuel, light, heat and pulses, agricultural clothing, aggregate agricultural production materials. There are a total of ten intermediate input prices that is being used in this study

which are seed and seedling, fertilizer, feed, agricultural chemicals, miscellaneous materials, fuel, light, heat and pulses, agricultural clothing, aggregate that is being used in this study which are seed and seedling, fertilizer, feed, agricultural chemicals, miscellaneous materials, fuel, light, heat and pulses, agricultural clothing, aggregate agricultural production materials. The cost of intermediate inputs was obtained by adding up the expenditures on seed and seedling, fertiliser, feed, agricultural chemicals, fuel, light, heat and pulses, agricultural clothing, aggregate agricultural production materials. The source of the data for the intermediate input price is the Statistics Prices and Wages in Rural areas (1972–1993) from Statistics and Information Department Ministry of Agriculture. The tornqvist quantity and price indices of the intermediate inputs were obtained using the set of data on the expenditures and price indices of the above eight items of intermediate inputs.

iii)Capital Input

The source of the data for the capital input is again the statistics prices and wages in rural areas 1972–1993 from Statistics and Information Department Ministry of Agriculture and Forestry.. There are a total of five items included in the Capital input that is animal and insemination charges, agricultural implements, agricultural motor vehicle, maintenance and repair of the farm building, rent and charges. The price index for the above mentioned products was also computed in such a manner that the quantity of each product was taken and it was divided by the total quantity for all products.

iv)Agricultural Product

There is a total of ten items under the Agricultural product, which are rice, wheat and barley, pulses, potatoes and sweet potatoes, vegetables, fruits and nuts, industrial crops, flowering plants, livestock The data was obtained from the Statistics and Information Department Ministry of Agriculture and forestry. The source of data for the quantity of these products was the farm household economic survey and report of the farm economy. These products were aggregated in such a manner that the quantity of each product was taken and it was divided by the total quantity.

3.2 Trend of the Data Using Analysis

3.2.1 Trend of Labor in Agriculture

The trend of the wage rate of labor was such that it is increasing from the very beginning that is from the period 1972 until 1986 and then it declined for one year in 1987. From 1987 onwards again it increased for three more years from the period 1987 to 1990 and finally it showed an upward movement for three more years that is between the periods 1991 to 1993 (see Figure 3-2).

3.2.2 Trend of the Intermediate Input

There were a total of eight items that were included in the intermediate input which are seed and seedling, fertilizer and manures, feed, agricultural chemicals,

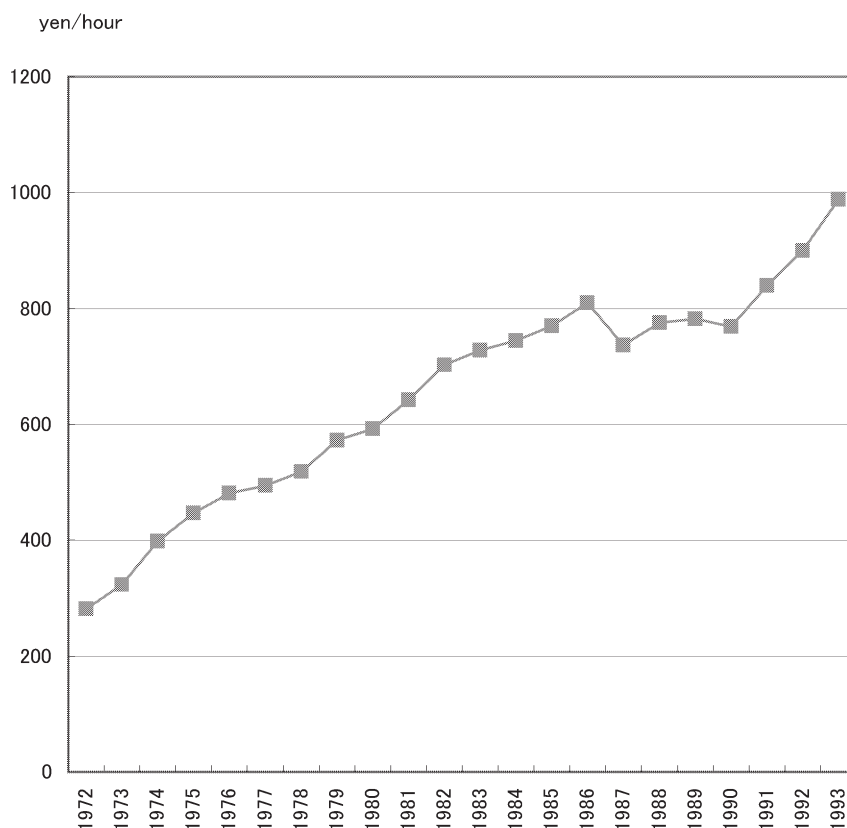


Figure 3-2 Wage Rate of Labour

Source: Farm household economy survey, various issues, MAFF, JAPAN and Report of the farm economy, various issues, MAFF, JAPAN.

miscellaneous material, light, heat and power, agricultural clothing.

The trend of the seed and seedling was such that it is increasing from the very beginning until 1988 and then it showed a little downward movement for one year that is in 1989. From that period onwards sometimes it increases and sometimes it decreases until it reaches to its maximum in 1992. In case of the fertilizer and manures the trend was such that it increases from the very beginning until the period 1989 and then it showed an upward movement during the last three years that is between the period 1991, 1992 and 1993. The trend of the feed was such that it is also increasing from the very beginning until the period 1988 and then all of a sudden again it showed an upward movement until the very last end that is until 1993. The trend of the Agricultural chemicals was such that it also increasing from the very beginning until it reaches to 1988 and then sometimes it will increase and sometimes it will decrease until the very last end that is until 1993. The trend of the miscellaneous materials the trend was such that it is also increasing from the very beginning until 1988 and then it showed a downward

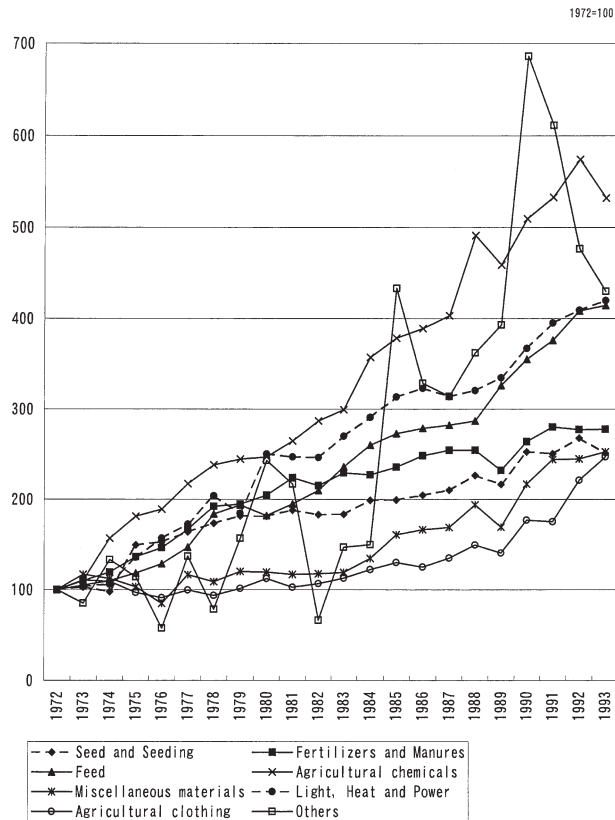


Figure 3-3 Production Index of the Intermediate Input
Source: Same as Figure 3-2

movement for one year that is in 1989. From this period onwards that is from 1989 it again increased during the last three years. The trend of the light, heat and power was such that it is increasing from the very beginning and reaches to its maximum in 1993. In case of the Agricultural clothing the trend was such that it is increasing gradually from the very beginning until 1989 and from that period onwards it showed an upward movement until the very last end that is until the period 1993. The last is others and the trend was such that sometimes it shows an upward movement and sometimes downward movement until the very last end that is until 1993 (see Figure 3-3).

3.2.3 Price Index of the Capital Input

There were a total of five items included in the price index of the capital input that is animal and insemination charges, agricultural implements, agricultural motor vehicle, maintenance and repair of the farm building and rent and charges. The trend of the animal and insemination charges was such that it is increasing from the very beginning until it reaches to its maximum in 1980. From 1980 onwards, it declined until the very last end that is until 1993. The

trend of the agricultural implements was such that it also increasing from the very beginning until it reaches to its maximum in 1993. The trend of the agricultural motor vehicle was such that it also increasing from the very beginning until the very last end that is until 1993. In case of the maintenance and repair the trend was such that it is increasing from the very beginning until it reaches to its maximum in 1979 and from that period onwards it declined until the very last end that is until 1993. The last one is the rent and charges and the trend was such that it is also increasing from the very beginning until it reaches to its maximum in 1993 (see Figure 3-4).

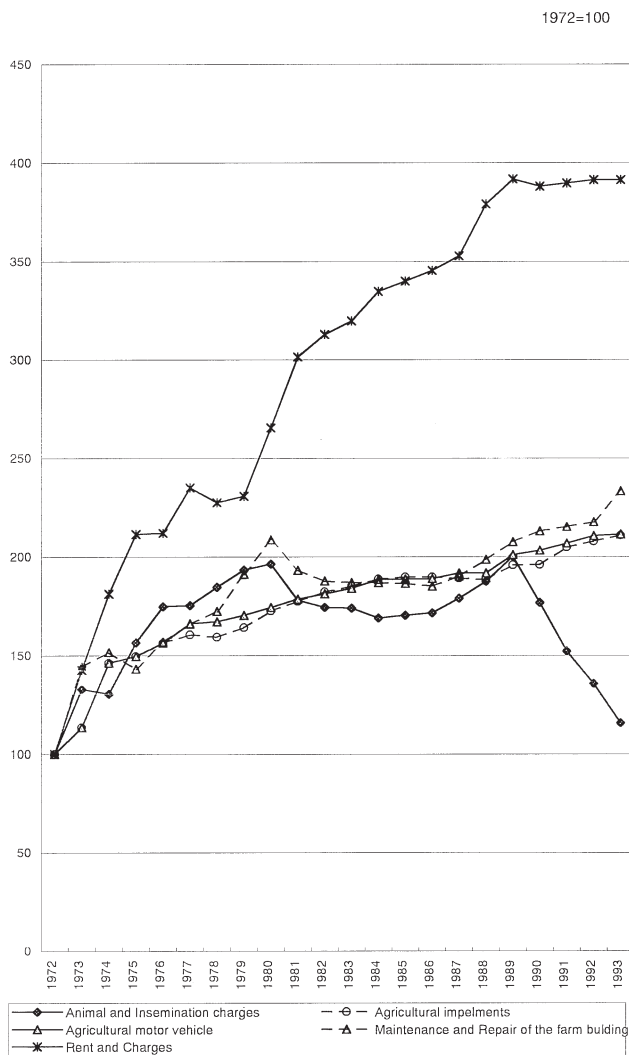


Figure 3-4 Price Index of the Capital Input
 Source: Same as Figure 3-1

3.2.4 Production Index of the Capital Input

The trend of the production index of the capital input was such that there were a total of five items included that is animal and insemination charges, agricultural implements, agricultural motor vehicle, maintenance and repair of the farm building and rent and charges. The trend of the animal and insemination charges was such that it is increasing from the very beginning until 1983 and from that period onwards it showed a slight downward movement until 1989 and from 1989 onwards it again showed an upward movement until the very last end that is until 1993 and this was also the point where it was at its maximum (see Figure 3-5).

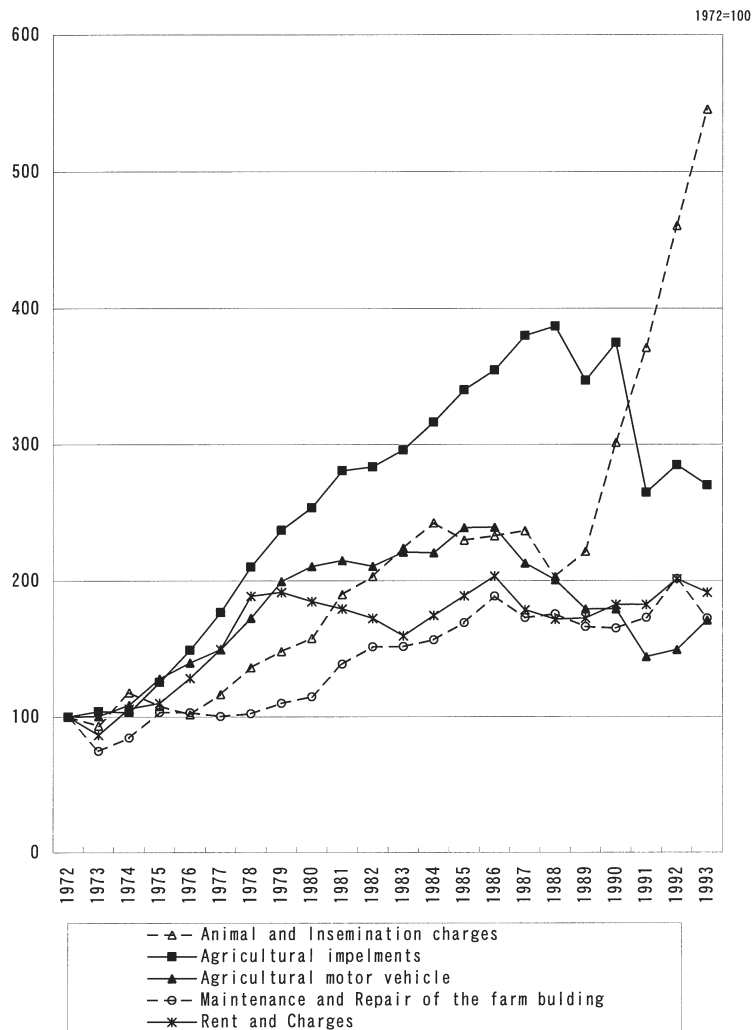


Figure 3-5 Production Index of the Agricultural Products
Source: Same as Figure 3-1

3.2.5 Trend of the Agricultural Product

The trend of the agricultural product was such that there were a total of nine items included that is rice, wheat and barley, pulses, potatoes, vegetables, fruits and nuts, industrial crops, flowering plants, livestock products. The trend of the rice crop was such that it remained at one level from the very beginning until the very last end that is from the period 1972 to 1993. The trend of the wheat and barley was such that it is increasing from the very beginning until the period 1982. From the period 1982 onwards, the trend was such that it again declined for two more years that is between the period 1983 and 1984. From 1984 onwards, the trend was such that it again increased until the period 1988 and from 1988 onwards the trend showed a downward movement until the very last end that is until the period 1993 (see Figure 3-6).

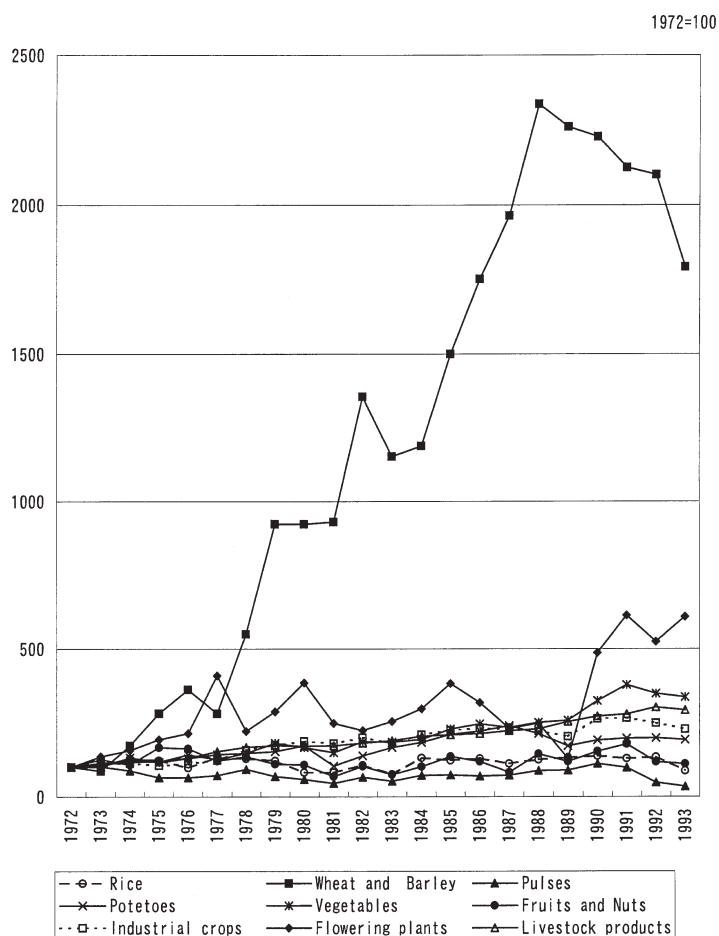


Figure 3-6 Production Index of the Agricultural Products
 Source: Same as Figure 3-1

3.2.6 Price Index of the Agricultural Product

There were a total of nine items included in the price index of the agricultural products that is rice, potatoes, pulses, potatoes, vegetables, fruits and nuts, industrial crop, flowering plants and livestock products. The trend of the rice crop was such that it remained at one level from the very beginning that is from the period 1972 until the very last end that is until 1993. The trend of the wheat and barley was such that it is increasing from the very beginning and then showed a downward movement at the very last end that is in 1993. In case of the trend for the pulses sometimes it is increase and sometimes it decreases until the very last end that is until 1993. The trend of the potatoes was also such that sometimes increases and sometimes it decreases until the very last end that is until 1993.

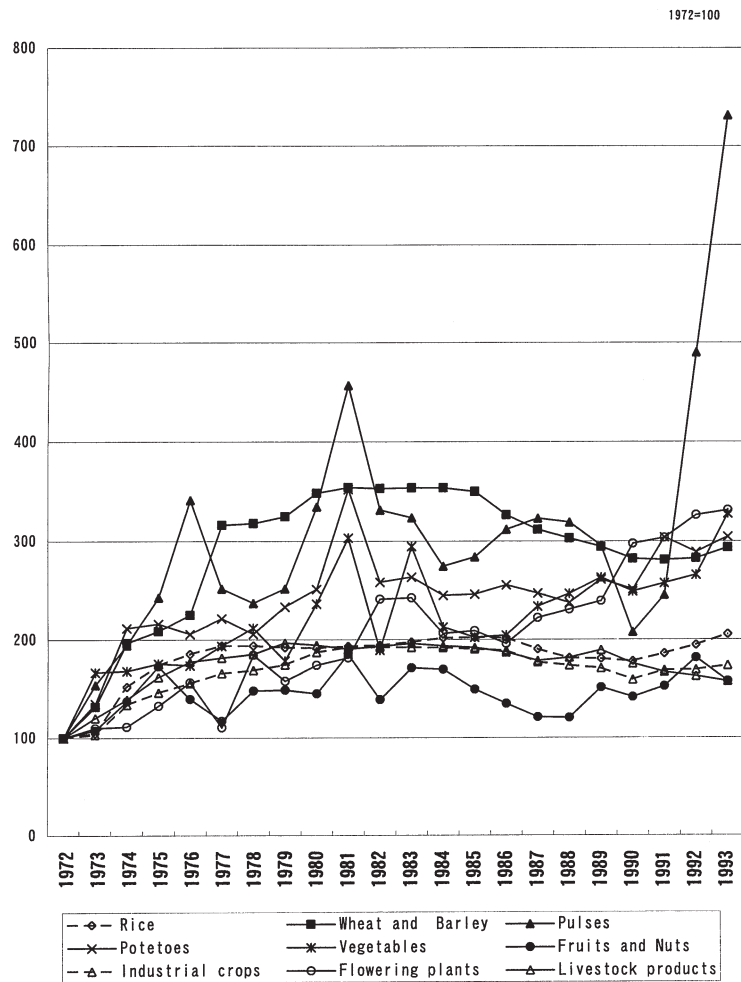


Figure 3-7 Price Index of the Agricultural Products

Source: Same as Figure 3-1

The trend of the vegetables was such that it remained at one level from the very beginning until the very last end that is until 1993. In case of the trend for the pulses, sometimes it increases and sometimes it decreases until the very last end. It also reaches to its maximum in 1993. The trend of the potatoes was such that sometimes it increases and sometimes it decreases until the very last end and also reaches to its maximum in 1993. The trend of the vegetables was such that it remained at one level from the very beginning until the very last end. In case of the fruits and nuts the trend sometimes increases and sometimes it decreases until the very last end that is until the period 1993. The trend of the industrial crops was such that it also sometimes increases and sometimes it decreases until the very last end that is until 1993. In case of the industrial crops the trend was such that it also sometimes increases and sometimes it decreases until the very last end that is until 1993. The trend of the flowering plants was such that it sometimes increases and sometimes it decreases until the very last end that is until 1993. It also reaches to its maximum in 1993. The last one is the livestock product and the trend was such that it sometimes increases and sometimes it decreases until the very last end that is until 1993 (see Figure 3-7).

3.3 Empirical Results

The statistical trends related to the Agricultural management of Hokkaido was based on the data from 1963 to 1993. However, the impact assessment of the public investment for Agriculture is from period 1972 to 1993. This is because of the fact that the project life for each project is different and also because of the fact that we used lag in our study and the average lag that was calculated that came out was nine. Different parameters were used to estimate the data of the public investment for Agriculture, which is given in Table 3-1. These parameters

Table 3-1 ESTIMATED RESULTS OF THE COST FUNCTION ANALYSIS

Variables	Estimated Value	t-value
a_s (Farm land)	0.334	(1.356)
a_L (Labour)	0.099	27.531*
a_Q (Agricultural product)	-0.449	5.7206*
a_M (Intermediate input)	0.429	68.41*
a_K (Capital input)	0.472	66.561*
a_I (Agricultural production structure)	0.901	4.8188*
β_{LI} (Labour* Agricultural production infra-structure)	-0.071	7.2513*
β_{QI} (Agricultural products* Agricultural production structure)	-0.467	3.957*
β_{MI} (Intermediate input* Agricultural production structure)	-0.001	(-0.059)
β_{KI} (Capital input* Agricultural production structure)	0.072	3.7258*
a_0 (Constant)	0.092	2.9029*
R^2 (Cost function)		0.998
R^2 (Cost share equation)		0.991
R^2 (Cost share equation of the Intermediate input)		0.998

* indicate statistical significance at 5%.

are α, β, δ etc. It is quite clear from this table that when the result obtained is negative, it means that the inputs were saved in Agriculture and when it is positive it means that these inputs were used in Agriculture. It was also found that the parameters α_s, β_{MI} were not statistically insignificant and the remaining parameters were found to be statistically significant at 5% level. The parameters α_s, β_{MI} were found to be statistically insignificant means that their performance was not satisfactory and the other parameters which were found to be statistically significant shows that their performance was satisfactory. There are also three different R^2 values in Table 3-1 because of the fact that we used three different equations in our study.

3.4 Analysis of the Effect on Agricultural Expenditures of Agricultural Infrastructure Construction and Improvement Programmes

The cost reducing effect of the improvement project of Agriculture and Agricultural village expenditures is shown in Figure 3-8. The figure clearly shows that the elasticity is positive and the value of the average elasticity is 0.97. Moreover, the absolute value of the elasticity of the investment for Agricultural expenditure is decreasing with the passage of time and is positive between the period 1972 to 1993 and it will become negative in 2034. This negative value in Figure 3-8 indicate the cost reducing effect of the public investment for Agricultural expenditure in Hokkaido. The following formula shows the share of the different factors of production.

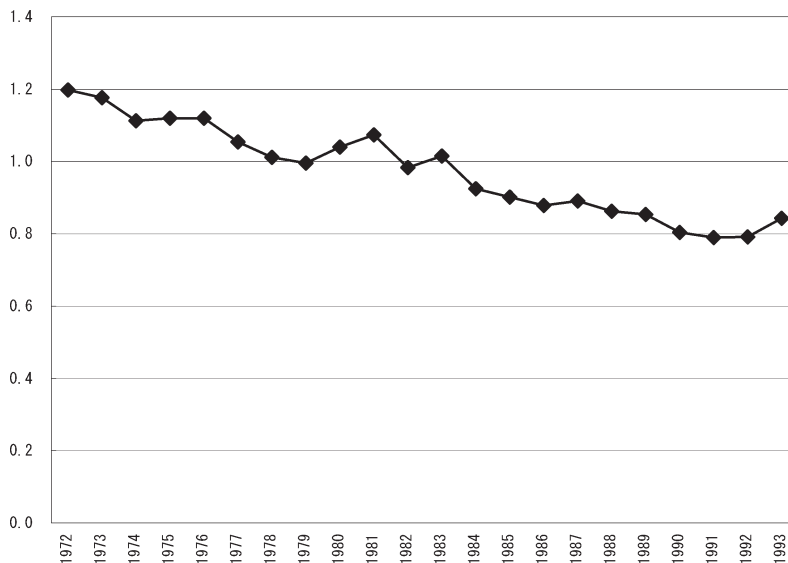


Figure 3-8 Effect of Agricultural Production Structure Project for Agricultural Expenditures

$$\partial \ln C / \partial \ln I = \alpha_6 + \beta_1 \ln P_L + \beta_2 \ln P_K + \beta_3 \ln P_M + \beta_4 \ln Q. \quad (4)$$

Where C is the cost, I represent the investment, α_6 is the parameter, P_L is the labor, P_K is the capital, P_M is the intermediate inputs and Q represents the product or the quantity.

$$\begin{aligned} -\partial \ln c / \partial \ln t &= 1/2 [-\partial \ln c / \partial \ln C] \{t-s\} \\ &= \ln C_t / C_s - \sum S_{jt} + S_{st} / 2 \ln P_{jt} / P_{js} - 1/2 \{ \partial \ln c / \partial \ln Q_t + \partial \ln c / \partial \ln Q_s \} \ln Q_t / Q_s - 1/2. \end{aligned} \quad (5)$$

$$\begin{aligned} &[\partial \ln c / \partial \ln S_t] \ln S_t / S_s \\ \partial F / \partial I &= \sum n \partial f / \partial I = -\sum n \partial C / \partial I \partial C / \partial Q. \end{aligned} \quad (6)$$

3.5 Analysis of the Total Factor Productivity of Agriculture in Hokkaido (1972-1993)

Figure 3-9 shows the trend of the total factor productivity between the periods 1972 to 1993. In our study we have assessed the impact from the period 1972 to 1993 as the effect or the impact of the project starts after a few years after the project is implemented. However, the original data used in this study is between the period 1963 to 1993. The trend clearly shows that it is increasing

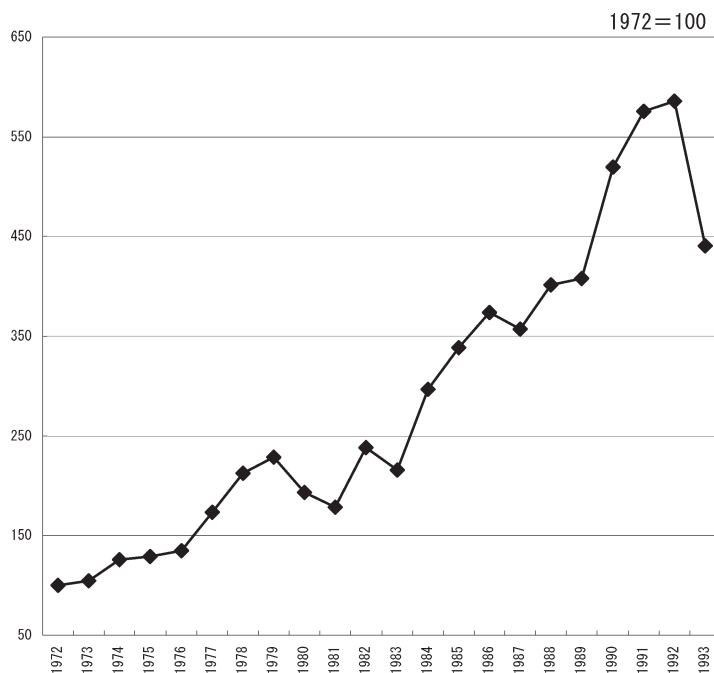


Figure 3-9 Growth of the Total Factor Productivity in Hokkaido between the period 1972 to 1993

with the passage of time that is between the periods 1949 to 1993. It is quite clear from the figure for the total factor productivity that the trend of the total factor productivity between the periods 1972 to 1993 was such that initially the trend showed an upward movement for five years that is between the periods 1972 to 1976. From 1976 onwards, the trend of the total production again increases for three more years from 1976 to 1979. The situation changed after 1979 and it showed a little downward movement and declined for two years from 1979 to 1981. From 1981 onwards again it increased for one year from 1981 to 1982 and then again declined for one year from 1982 to 1983. The trend of the total factor productivity again showed an upward movement from 1983 to 1986 and then again decreased for one year from 1986 to 1987. The situation again changed after 1987 and the trend of the total production showed an upward movement for five years from 1987 to 1992 and then it again showed a downward movement and declined for one year from 1992 to 1993. The trend showed a downward movement because of the fact that the weather conditions were extremely bad in Japan in the year 1993. Moreover, the investment effect of the scale economy is also increasing with the passage of time. Denison (1974) among others concluded that the economies of scale are a significant reason for the TFP growth in the United States.

4. Summary and Conclusion

The productivity of the public investment is obviously an important issue. Although the question is topical and important very few studies have investigated the empirical evidence in Hokkaido, Japan. One reason for the paucity of the empirical evidence in this area may be the lack of good data on public investment. Government expenditures are generally regarded as a major influence on the pace and pattern of the Agricultural development. Agricultural research, rural education, extension of technology to the farming community and development of a wide range of agricultural activities from fertilizer distribution to credit are commonly funded by the Government.

The main objectives of this study is to evaluate the public investment in the agricultural sector in Hokkaido. The current study consists of two major parts. 1) Evaluation and assessment of the public investment for agriculture in Hokkaido in the pe-riod between 1963 to 1995 made by central government and Hokkaido government by using production function approach. 2) To undertake the analysis of the data using the total factor productivity (TFP).

The data on the Public investment was collected from the office of the Hokkaido Development Agency whose office is located in Sapporo. This data was related to the investment being made by the central and the provincial government in various developmental. The data related to the investment made

by the government is between the periods 1963 to 1993. But since the data before 1963 was not available and the data of the labor after the period 1993 could not be arranged. Therefore, using the regression equation the data before 1972 was made available. However, the values before 1972 comes out to be in negative, which is not natural due to which the values in parallel were taken. The researcher visited the office personally and collected the data from there whereas the data on the production or the output was obtained from the office of the Bureau of the Statistics, Sapporo. The data obtained from the office of the Bureau of Statistics is related to the output or the production of various crops between the periods 1950 to 1995. Only secondary data is being used in this thesis. Moreover, since the data obtained from the office of the Hokkaido Development Agency and the Bureau of the Statistics was in Japanese, therefore, the main contents of the data were translated from Japanese into English.

Different type of projects are implemented by the central, provincial governments and the corporations. Those projects which are implemented by the central government are directly operated by the central government. Those projects which are operated by the provincial government are also partly subsidised by the central government. In case of the Projects being implemented by the corporations are directly related to the agricultural investment.

The projects operated by the central, provincial and the corporations include irrigation and drainage, integrated upland field improvement, farmland consolidation, agricultural land development, grassland development, farmland improvement, rural improvement projects, agricultural land conservation etc. Investment is being made by the government in the irrigation and drainage for the construction and the improvement of the canals or dams. The integrated upland field improvement projects include land, soil improvement and dressing. The farmland consolidation projects include paddy field improvement such as soil dressing, land readjustment and farm roads etc. The agricultural land development projects deals with the foundation works, reclamation and farmland reclamation etc. In case of the grassland development public pasture, construction and improvement, grassland improvement and livestock basement etc are being implemented. For the farm roads farm road construction and improvement except farm roads for paddy field mentioned under the farmland consolidation projects are being undertaken. The rural improvement projects include integrated rural improvement model projects, integrated rural infrastructure improvement pilot projects etc. In case of the agricultural land conservation slide prevention, agricultural land conservation project, water pollution project etc are included.

The statistical trends related to the Agricultural management of Hokkaido was based on the data from 1963 to 1993. However, the impact assessment of the public investment for Agriculture is from period 1972 to 1993. This is because of the fact that the project life for each project is different and also because of the

fact that we used lag in our study and the average lag that was calculated that came out was nine.

The data related to the agricultural land in Hokkaido was collected from the farm economic survey report of the farm economy. This data consists of the ordinary upland field, land under permanent crops, temporary meadows and paddy field etc. The data for all these crops was then aggregated. As was also mentioned in the methodology section of this thesis two types of data is being used in this thesis that is the investment data between the period 1963–1995 for the central, provincial governments and the corporations obtained from the office of the Hokkaido Development Agency, Sapporo. The second type of data is that of the output or the yield data between the period 1950 to 1995 obtained from the Bureau of Statistics office in Sapporo. Using the three types of data, evaluation of the investment made by the Government in various developmental projects was made. Moreover, evaluation of the share of each project was also undertaken. The investment trends showed that with the passage of time the investment made in various developmental projects in the Government has increased. Moreover, the share of each project was also undertaken. The investment trends showed that with the passage of time, the investment made in various developmental projects by the Government has increased. As is also quite clear from the results of our analysis that the elasticity of the cost reducing effect of the investment is positive until 2033 and the value of the average elasticity is 0.97. Moreover, the absolute value of the elasticity is decreasing with the passage of time. Therefore, it can be concluded from this study that the cost reducing effect of the Agricultural expenditures in Hokkaido is positive between the period 1972 to 2033 and it will become negative in 2034. Therefore, if the Government would like that the cost reducing effect of the agricultural expenditure should be negative much earlier than 2034, then it is recommended that the Government should increase the investment. Moreover, based on all the data presented, it can also be concluded from this study that in order to improve the economy of Hokkaido in general and to increase the productivity of the various crops in specific, the Government should continue to invest. This investment will not only improve the economy of Hokkaido and the productivity of the various crops but will also indeed improve the economic and the social conditions of the people of Hokkaido. Public investment expenditures had a positive and significant effect on the output growth. While much of the literature attribute weak growth to the public investment and social expenditures. For the Hokkaido agricultural productivity to improve, Government and donors must invest in programmes and policies that will improve the incentives and capacity of the farmers to make investments that increase farm productivity and soil fertility while protecting the environment. With rapid population growth, agriculture must rapidly intensify if Hokkaido farmers are to meet the rapid growth in demand for food and fibre.

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