On the Consequences of the Different Ways of Appraisal among Similar Public Investments —A Comparison of Roads, Harbor Roads and Regional Farm Roads—

Taishi OHNO*
(Sanwa Research Institute)
(Special Audit Staff, Board of Audit of Japan)

1. Introduction

At present, each ministry or agency uses different cost-benefit analysis manuals to appraise the performance of public works projects. Under these circumstances, although it is possible to compare the effects of projects involving the same type of work, it is difficult to compare the effects of different types of public works that are considered to have similar effects, because the items subject to appraisal are not uniform and different appraisal methods are used. This is partly because projects are implemented by different ministries or bureaus that are divided vertically with no coordination among them. Assuming that different appraisal methods lead to different appraisal results, it is quite likely that local governments will change the name of a certain project and apply for subsidies for the project. As different appraisal methods exist, it is also likely that investment will be duplicated in similar social infrastructures in the same district[1]. From the standpoint that limited resources should be allocated effectively and efficiently, use of a unified appraisal method to compare projects with similar effects is desirable to avoid any appraisal gap due to the use of different appraisal methods[2] .

Chapter 2 of this paper presents and discusses appraisal items and methods for road construction and improvement projects and harbor road projects that are implemented by the Ministry of Land, Infrastructure and Transport, and regional farm road construction and improvement projects that are implemented by the Ministry of Agriculture, Forestry, and Fisheries, as these three types of projects are deemed to be similar public investments. In Chapter 3, individual effects and the methods used to measure these effects for the said three types of projects are appraised and compared to clarify the differences. Chapter 4 presents a discussion of examples of project substitution or duplicate investment that may take place at local government level due to the fact that different appraisal methods apply to similar projects, particularly for ordinary roads and regional farm roads. Chapter 5 discusses how appraisals should be rectified to enable efficient allocation of resources.

*Born in 1965.
Completed master's degree, Graduate School of Economics, Kyoto University in 1997. Has worked for Sanwa Research Institute Corporation since 1990.Special Researcher at 1st Surface Transportation Audit Division, 3rd Bureau, Board of Audit of Japan for FY 2001.Member of Japan Economic Policy Association, Japan Public Choice Society, Society for Environmental Economics and Policy Studies, Applied Regional Science Conference, Japan Society of Civil Engineers, Network for Policy Analysis, Association for Public Policy Analysis and Management and others.Books: '*Public Investment and Road Policy*,' (co-author), Keiso Publishing Co., 2001, '*Structure of National Budget*,' (co-author), Toyo Keizai Inc., 1997.

1) For example, in the "Relay Debate" in Nihon Keizai Shimbun dated September 2,2001, Mr.Fumio Yamamoto (Headman of Soeda Town of Fukuoka prefecture), Chairman of the National Association of Towns and Villages, admitted the existence of cases that a national road runs in parallel with an expressway or a farm road with a very few traffic.

2) Administrative Inspection Bureau of Management and Coordination Agency (2000) pointed out the types of effects that might be appraised using the common method for road/street projects undertaken by the old Ministry of Construction and harbor road projects by the old Ministry of Transport, and for sewerage projects undertaken by the old Ministry of Construction and rural community sewerage improvement projects by the Ministry of Agriculture, Forestry and Fisheries.

2. Appraisal methods for similar public works projects

2.1 Road/street projects

Since the mid 1950s, the Ministry of Land, Infrastructure, and Transport has been implementing appraisals of road projects. However, these appraisals were not based on unified ways and the appraisal results were not disclosed. Since then, appraisal methods have been revised with reference to overseas trends, and the appraisal results have been reflected in decisions on projects. As the decision-making process for social infrastructure projects was increasingly criticized as nontransparent and the effects of projects were questioned, it was decided that appraisals would be made and appraisal results would be disclosed on a trial basis with effect from fiscal 1996 for all road construction and repair projects to be implemented in fiscal 1997. Beginning in fiscal 1998, full-scale appraisals started at the time the project was approved in accordance with the "Guidelines for Implementation of Appraisals at the Time of Project Approval for Public Works under the Control of the Ministry of Construction" (March 1998) and the "Details of the Guidelines for Implementation of Appraisals at the Time of Project Approval for Road and Street Projects" (June 1998). In this connection, the Road Bureau and City Bureau of the old Ministry of Construction have jointly established a "Cost-Benefit Analysis Method (Proposal)" (June 1998; referred to here as the "Road Manual") as the unified appraisal method.

The effects of construction/improvement of roads extend over a wide range, and are both positive and negative—they include reduction in travel time for road users, an increase in industrial production due to the building of new firms, and environmental effects. In the cost-benefit analysis used for road projects as stated in the Road Manual, however, only three items are focused on and assessed as benefits; these are "reductions in travel time," "reductions in vehicle operating costs," and "reductions in traffic accidents" (refer to Table 1).

(1) Procedure for cost-benefit analysis in the Road Manual

Before any new road project is implemented, the road network that will be affected by the new project is identified. Then, traffic volumes on all the existing roads are estimated both for the case where the new road project is implemented (referred to here as the "With Case") and for the case where the new road project is not implemented (referred to here as the "Without Case"). Based on the above traffic volumes, travel time, vehicle operating cost, and traffic accident cost are computed in terms of money for the above two cases. Reduced travel time and operation costs, and reduced traffic accident cost are regarded as benefits. Expenses (land acquisition and construction costs) and maintenance costs are counted as project costs.

Then, the current value of benefits and costs is computed on a yearly basis using a social discount rate of 4% for the total period (construction period + 40 years after the commencement of services) and listed. Then the benefit-to-cost ratio is computed by dividing the total benefit by the total cost.

A flowchart of the cost benefit analysis for a road project is shown in Table 2.

①Estimating traffic demand

When measuring the benefits of a road project, it is necessary to estimate traffic volumes and speeds for the "With Case" (including the affected road) and the "Without Case." In this estimation of traffic demand, a three-stage estimation is used (if the vehicle origin-destination (OD) table is not available, a four-stage estimation is used, because vehicle traffic volumes need additional calculations). This three-stage estimation is one of the estimating methods used often in the field of traffic engineering. Basically, a future OD table is prepared by vehicle type for the "With Case" (including the affected road) and the "Without Case," using the results of the Vehicle Origin-Destination Survey [3)4)] (Vehicle OD Survey) that is conducted as part of the road traffic census.

3) The road traffic census, in which a general traffic survey, a vehicle OD survey and a parking space survey are made, is conducted every five years. The supplementary survey in which only a general traffic survey is made is conducted in the third year after the road traffic census is conducted. The latest road traffic census including a vehicle OD survey was conducted in fiscal 1999.

4) The vehicle OD survey is conducted for each of about 5,500 zones across the country. Each zone is almost equivalent in size to a municipality (about 3,300 municipalities in the country).

Table 1. Effects of Construction/Improvement of Roads

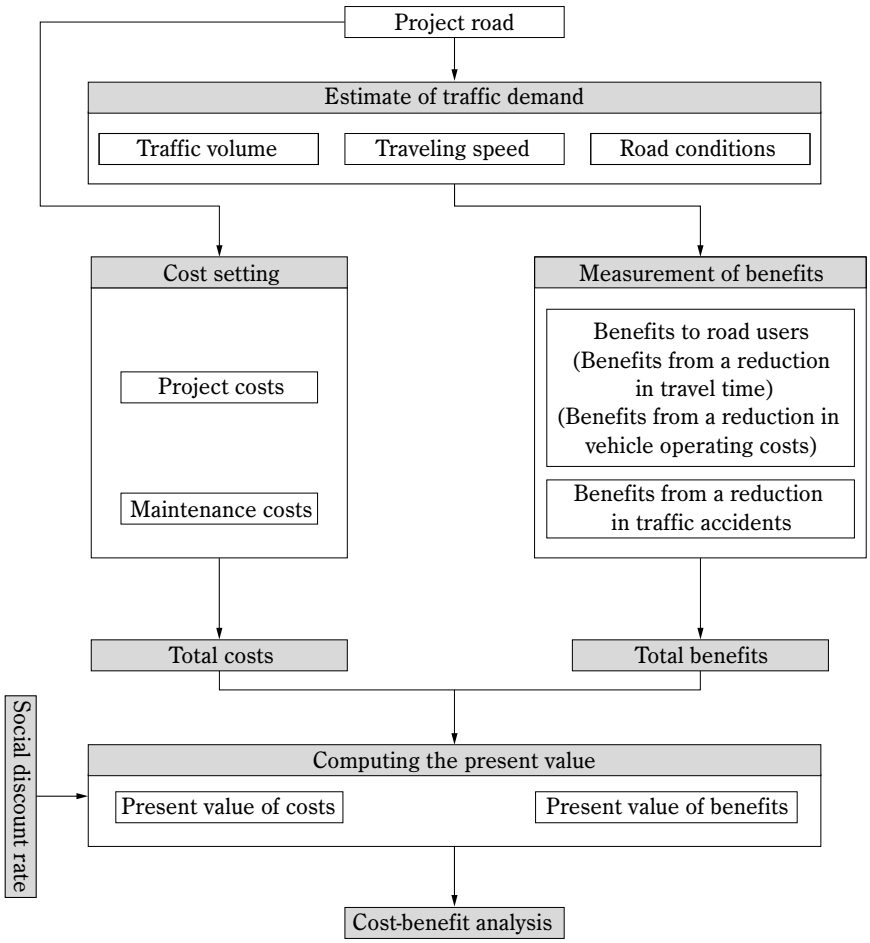
Effects			
Direct effects	Road users	Use of road	○Reduction in travel time and reduction in vehicle operating costs ・Project road ・Other transport systems and roads ○Reduction in traffic accidents ・Project road ・Other transport systems and roads ○Improvement in traveling comfort ○Improvement in travel safety
	Roadside communities	Environment	○Air pollution ・Project road ・Other transport systems and roads ○Noises ・Project road ・Other transport systems and roads ○Landscape ○Ecology ○Energy (global environment)
		Local residents	○Use of road space ○Securing an alternative route during a disaster* ○Enhancement of communications* ○Improvement of public services ○Stabilization of population
Indirect effects		Local economy	○Creation of demand due to construction project* ○Increase in production due to the establishment of new firms ○Increase in employment and income ○Decrease in prices of goods and services ○Improvement in value of assets
	Public sector	Fiscal expenditure	○Reduction in expenses to construct and/or improve public facilitie
		Tax revenues	○Local taxes ○National taxes

Note 1: The Road Manual requires that benefits be computed in terms of money only for the items in the shaded area.
Note 2: Items marked with an asterisk (*)represent non-scheduled or temporary effects.
Source: “Guidelines for the Appraisal of Road Investment (Proposal)” prepared by the Road Investment Appraisal Guidelines Study Committee (Japan Research Institute, June 1998).

②Measuring the benefits

For road projects, “benefits from a reduction in travel time,” “benefits from a reduction in vehicle operating costs,” and“benefits from a reduction in traffic accidents,” which are all considered to be benefits to users, are computed.

Table 2: Flowchart of cost-benefit analysis for road projects



Source: "Cost-benefit Analysis Manual (Proposal)," Road Bureau and City Bureau, Ministry of Construction, June 1998.

a. Benefits from a reduction in travel time

Benefits from a reduction in travel time are measured by the difference between the total travel time costs in the "Without Case" and in the "With Case." Total travel time costs for each road are computed by multiplying the travel time by the vehicle type by the unit time value. The computation formula and unit time value for each vehicle type are described in page 6 of the Road Manual.

<Computation formula>

Benefits from a reduction in travel time: $BT = BT_O - BT_W$

Total travel time costs: $BT_i = \sum_j \sum_i (Q_{ijl} \times T_{ijl} \times \alpha_j) \times 365$

Where,

BT: Benefits from a reduction in travel time (¥/year)

BT_i: Total travel time costs in the case of road condition "i" (¥/year)

Q_{ijl}: Traffic volume of vehicle type "j" on link "l" in the case of road condition "i" (number of vehicles/day)

T_{ijl}: Travel time of vehicle type "j" on link "l" in the case of road condition "i" (minutes)

α_j: Unit time value for vehicle type "j" (¥/vehicle-minutes)

i: "W" in the "With Case" and "O" in the "Without Case"

j: Vehicle type

l: Link

b. Benefits from a reduction in vehicle operating costs

Benefits from a reduction in vehicle operating costs are measured by the difference between costs other than travel time cost, such as the costs of fuel, oil, tires and tubes, maintenance, and depreciation in the "Without Case," and in the "With Case." The computation formula for vehicle operating costs is explained in page 8 of the Road Manual, and the vehicle operating unit cost for each vehicle type is shown in pages 9 and 10.

<Computation formula>

Benefits from a reduction in traveling costs: $BR = BR_0 - BR_w$

Total vehicle operating costs: $BR_i = \sum_j \sum_i (Q_{jl} \times L_l \times \beta_i) \times 365$

Where,

BR: Benefits from a reduction in vehicle operating costs (¥/year)

BR_i: Total vehicle operating costs in the case of road condition "i" (¥/year)

Q_{ijl}: Traffic volume of vehicle type "j" on link "l" in the case of road condition "i" (number of vehicles/day)

L_l: Total length of link "l" (km)

β_j: Vehicle operating unit cost for vehicle type "j" (¥/vehicle-km)

i: "W" in the "With Case" and "O" in the "Without Case"

j: Vehicle type

l: Link

c. Benefits from a reduction in traffic accidents

Benefits from a reduction in traffic accidents are measured by the difference between the aggregate loss due to property damage or fatal accidents in the "Without Case" and the corresponding loss in the "With Case" calculated by the computation formula using the accident rate for each road. Social loss due to traffic accidents includes: personal loss to drivers, fellow passengers and pedestrians; property loss to vehicles or structures damaged by accidents; and loss due to traffic jams as a result of accidents.

<Computation formula>

Benefits from a reduction in annual gross accidents: $BA = BA_0 - BA_w$

Social loss due to traffic accidents : $BA_i = \sum_l (AA_{il})$

Where,

BA: Benefits from a reduction in annual gross accidents (¥1,000/year)

BA_i: Social loss due to traffic accidents in the case of road condition "i" (¥1,000/year)

AA_{il}: Social loss due to traffic accidents on link "i" in the case of road condition "i" (¥1,000/year)

i: "W" in the "With Case" and "O" in the "Without Case"

l: Link

The value of AA_{il} by type of road (10 types in total) is computed using the formula [$AA_{il} = f$ (number of vehicles, total length of the link in km, number of intersections)] on page 11 of the Road Manual.

③ Measurement of expenses

For a road project, the costs of "construction", "land acquisition", and "compensation that arises in the project", and "maintenance expenses" are appropriated every year in the budget. If amounts are fixed in the project plan, those amounts must be used. However, in other cases these expenses may be computed with reference to a similar project. For maintenance expenses including road maintenance, cleaning, lighting, and overlay expenses, the reference value by type of road is shown (page 14 of the Road Manual).

④ Cost-benefit analysis

The benefits and costs of a road project must be computed for each year. Then, the current values of benefits and costs must be computed to determine the benefit-to-cost ratio (B/C).

<Computation formula>

Benefit-to-cost ratio: $B/C = \sum_{j,k}(BofPV_j / CofPV_k) = \sum_{j,k,t}\left\{\frac{1}{(1+r)^{s+t}} \cdot \frac{B_{jt}}{C_{k(s+t)}}\right\}$
Where,
BofPVj: Current value of benefit "j" (¥)
Bjt: Measured value of benefit "j" in the "t"-th year after the commencement of services (¥)
CofPVk: Present value of cost "k" (¥)
Ck(s+t): Value of cost "*k*" in the "*s* + *t*"-th year (¥)
s: Number of years from base year (n) to the year of commencement of services (*n* + *s*) (number of years)
t: Number of years from the year of commencement of services, setting the first year as year 0 (number of years)
j: Type of benefit
k: Type of cost
r: Discount rate (= 4%)

In the Road Manual of the Ministry of Land, Infrastructure, and Transport, the use of a sensitivity analysis is not mandatory. However, the Ministry requires that B/C be equal to or larger than 1.5 (B/C≧1.5) so that benefits should be always larger than costs, even if the demand or costs fluctuate to some degree and affect the appraisal. This is the reason why a requirement is set for B/C≧1.5 for a particular project to be adopted. However, the requirement of B/C≧1.5 is used only as an efficiency criterion. The values of B/C are not used to determine the priority of implementing projects. In the process of examining whether or not to adopt the project, particular elements of local communities are taken into consideration.

2.2 Harbor roads (harbor construction and improvement projects)

Harbor road construction and improvement are a part of harbor construction and improvement projects in which port terminal facilities for passengers and logistics, a waste disposal area, and a marina are constructed or improved. The effects of harbor roads and the method to assess these effects are described in the "Cost-benefit Analysis Manual for Harbor Construction and Improvement Projects" (May 1999; referred to here as the "Harbor Manual") prepared by the Ports and Harbors Bureau of the old Ministry of Transport.

(1) Effects of harbor roads as described in the Harbor Manual

The effects of harbor roads and the method to assess these effects are shown in Table 3. According to the Table, those effects that are measured in a cost-benefit analysis are only the "benefits from the reduction in transportation and movement "(reduction in transportation cost of cargoes and reduction in movement cost of passengers).

The benefit measurement process is the same as is used for road projects. The main characteristic of this benefit measurement process is that reference is made to the results of the study made by the "Road Investment Appraisal Guidelines Study Committee" (1998), which was established as a study committee to prepare the Road Manual, and the Road Manual itself.

Table 3. Effects of harbor roads

Classification of effects		Effect	Method to assess effects
Users	Transportation and movement	Reduction in transportation costs (cargoes)	Measured as benefit
		Reduction in movement costs (passengers)	Measured as benefit
	Communications and recreation	——	——
	Environment	——	——
	Safety	Reduction in traffic accidents	Assessed qualitatively
	Operation	——	——
Local communities	Transportation and movement	Relief of traffic congestion on existing roads	Some effects are measured as benefits Other effects are assessed qualitatively
	Environment	Decrease in exhaust gases	Assessed quantitatively
		Relief of roadside noise, etc	Assessed qualitatively
	Local economy	Increase in employment and income due to construction works	Not measured
		Stabilization and development of local industries	Not measured
Public sector	Taxes	Increase in local and national taxes	Not measured

Source: "Cost-benefit Analysis Manual for Harbor Construction and Improvement Projects," Ports and Harbors Bureau, Ministry of Transport, 1999.

Main differences in appraisals between harbor roads and road projects are as follows.

①In the harbor road appraisal, effects due to reductions in traffic accidents are only assessed qualitatively, and no monetary appraisal is made. (In the road appraisal, effects due to reductions in traffic accidents are assessed in terms of money. In the harbor road appraisal, however, no monetary appraisal is made because there is assumed to be no passage of ordinary vehicles on the harbor road and the significance of any reduction in traffic accidents is marginal.)

②The residual value of land is counted as a benefit. (In the road appraisal, the residual value of land is not counted as such.)

③The appraisal period is the construction period + 50 years after the commencement of services. In the road appraisal, the appraisal period is 40 years after the commencement of services. In the harbor road appraisal, a period of 50 years is used with reference to the concrete road mentioned in the Ordinance Concerning the Life, etc. of Depreciable Assets (Ministry of Finance Ordinance).

(2) Process of cost-benefit analysis as defined in the Harbor Manual

①Measurement of transportation and movement benefits

As in the case of a road project, the road traffic network including the projected harbor road is identified, and traffic volumes by vehicle type are computed using the four-stage estimation method, etc. In the case of a harbor road, the vehicle operating unit cost is specified by type of road, by type of vehicle, and by traveling speed in the Harbor Manual, and the unit travel time cost is also specified by type of vehicle in the Harbor Manual. As in the case of a road project, the traffic volume on the harbor road and adjacent roads is estimated both for the "With Case" and the "Without Case." Then, the travel time cost and vehicle operating cost are computed under the estimated traffic volumes, and reductions in time and reductions in cost are counted as benefits.

In the case of a road appraisal, the vehicle operating unit cost is defined for four types of roads. In the case of harbor road, however, the vehicle operating unit cost is defined only for two types of road. This is probably because a harbor road is rarely constructed in an urban area or a mountainous area and therefore it is enough to examine

only two types; namely, an ordinary road (on a flat area) and an expressway or a high-standard regional road. In addition, for the case of a harbor road project, container trailers must be considered. The vehicle operating unit cost and travel time unit cost of these trailers are determined by conducting hearings with international shipping container operators. The values for vehicle operating unit cost and travel time unit cost for other types of vehicles are specified in the Road Manual and used as they are.

②Measurement of expenses

As in the case of road projects, construction expenses (commission, land cost and compensation cost), management/administration expenses (maintenance and administration costs) and re-investment expenses (construction expenses needed for re-investment after depreciation) are appropriated in the budget.

③Cost-benefit analysis

In the case of a harbor road project, the project is approved and adopted if $B/C \geqq 1.5$ as in the case of a road project. Even if B/C is less than 1.5, however, the project will never be rejected without consideration, as long as B/C is above 1.0 where the appraisal shows that benefits are larger than costs. When approving a harbor road project, more emphasis is placed on the needs of many companies in the industrial parks, intentions of road users, and the ripple effects on the region as a whole, than on the results of a cost-benefit analysis. In other words, harbor road projects are approved based on an overall appraisal. Therefore, the condition ($B/C \geqq 1.0$) is only a necessary condition and not an absolute condition for determining the priorities of various projects.

2.3 Regional farm roads

Farm roads are roads other than those defined in the Road Law (①national expressways/high-standard regional roads, ②ordinary national roads, ③prefectural roads, and ④municipal roads).

The following roads are defined as farm roads:

a. Roads used to transport agricultural machinery and materials;

b. Roads used to collect or ship agricultural products and transport agricultural products to markets (consuming areas);

c. Roads used for agricultural purposes, such as loading and unloading agricultural products and fertilizers;

d. Roads that form part of a traffic network interconnecting villages, and villages and urban areas.

Farm roads are constructed or improved to upgrade the farm environment in collaboration with various agricultural policies.

Agricultural road construction and improvement projects are divided into three types according to their objectives as follows:

①Regional farm road construction and improvement projects for farming communities (regional farm road construction and improvement projects)

In these projects, comparatively large-scale farm roads (where total length is 10 km or longer, and road width is 5 m or wider) are constructed to interconnect many farming areas.

②Ordinary farm road construction and improvement projects

In these projects, ordinary farm roads (total length is 1 km or longer, and road width is 4.5 m or wider) are constructed.

③Farm road construction and improvement projects as alternative measures to reduce gasoline tax for agricultural, forestry, and fishing industries (alternative farm road construction and improvement projects)

In these projects, as one of a variety of alternative measures to reduce gasoline tax for agricultural, forestry, and fishing industries, farm roads are constructed or improved to modernize farming, rationalize the physical distribution of farm products, and improve the village environment.

If a farm road has functions that are similar to an ordinary road, the farm road may be regarded as a regional farm road or a part of an ordinary farm road according to the above classification. However, the appraisal method for regional farm roads is not at all different from that for farm roads.

Farm road construction and improvement projects are implemented to help increase agricultural income and improve agricultural production by reducing various expenses related to the collection and shipment of agricultural products and farm works. At the same time, it consolidates farmland. The effects of farm road construction and improvement are defined in the measured economic effects of land improvement projects[5)]. The effects of the land

improvement work that result from farm road construction and improvement are shown in Table 4.

Table 4. List of effects of farm road construction and improvement projects

Name of project	Name of effects	Details of effects
Farm road construction and improvement project	①Improvement of agricultural productivity	a. Production of agricultural products b. Improvement of quality
	②Improvement of agricultural management	a. Saving on management and maintenance costs b. Saving on vehicle operating costs
	③Preservation of production base	Renewal
	④Improvement of living environment	a. Saving of expenses related to general traffic, etc. b. Improvements in safety
	⑤Preservation of local assets	Discovery of cultural assets
	⑥Preservation of landscape	Improvement of the farm road environment
	⑦Improvement of functions for health and recreation	Improvement of functions for health and recreation
	⑧Dead cost	Dead cost

Source: "Economic Effects of Land Improvement (Revised Edition)," Planning Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry, and Fisheries, Taisei Publishing Co. Ltd., 1997, p.30, "List of Effects by Project."

Those effects that can be seen as a result of farm road construction and improvement projects include those for improvements in quality, saving on management and maintenance costs, saving on vehicle operating costs, renewal, saving of expenses related general traffic, etc., and improvements in safety and dead costs. Depending on the conditions of improvement of the farm road, it is expected that these projects have the effect of improving the farm road environment.

It is understood that the effects of producing agricultural products, the discovery of cultural assets, and the improvements in functions for health and recreation are generated by farm road construction and improvement projects. However, an effect computation formula for these effects has not been established. These effects are regarded as being generated mainly by other projects in the land improvement project.

Now the author would like to discuss briefly the individual effects of a farm road construction and improvement project and the method to compute these effects.

(1) Individual effects of a farm road

①Improvement of agricultural productivity

a. Production of agricultural products

Increased yield due to the effect of reducing the dust with a paved road (unit yield improvement effect per area) is regarded as an effect of producing agricultural products. Since unit yield improvement effects are generated mainly by other projects, however, this effect shall not be computed as the effect of a single farm road construction and improvement project.

b. Improvement of quality

As a farm road is improved, the disposal rate of agricultural products due to damage during transportation decreases, and the quantity of marketable products increases. This increased quantity is regarded as an effect of improving the quality. The amount of money from the increased quantity of marketable products can be computed by multiplying the increased quantity of shipped products (this quantity is obtained by multiplying the production quantity by the reduction in the disposal rate) by the unit price of products.

②Improvement of agricultural management

a. Savings on management and maintenance costs

5) Since 1949, the cost-benefit analysis method has been adopted for land improvement projects. The method has been revised from time to time.

The effect of cost increases resulting from improving a farm road is regarded as savings on management and maintenance costs (negative effect). This effect is measured as the difference between the annual costs of the years before and after the year when the farm road is improved.

b. Saving on vehicle operating costs related to farming

The construction of a new farm road or the improvement of an old one will result in decreased transportation costs for agricultural products and their distribution costs. This is regarded as an effect of saving vehicle operating costs related to farming. This effect is measured as the difference between present and planned vehicle operating costs that are computed based on the differences in traveling distance, traveling speed, and transportation means (change in vehicle types) between the years before and after the year of the improvement.

③Preservation of the production base (renewal effect)

If an old road continues to function due to improvement or renewal, this is regarded as an effect of preserving the production base (renewal effect)[6)].

④Improvement of the living environment

a. Saving on expenses related to general traffic, etc.

The construction of a new farm road or the improvement of an old farm road leads to a saving on expendables, such as fuels and tires, in general traffic other than farming-related traffic. This type of saving is regarded as an effect of saving on expenses related to general traffic, etc. The number of vehicles traveling by type of vehicle before and after a farm road is constructed or improved is estimated based on the actual survey. Then, traveling distance and speed before and after the farm road is constructed or improved are computed, and the effect of savings on vehicle operating costs is computed. The saving on personnel costs as a result of the reduction in time is computed only for trucks. The saving on personnel costs for passenger cars is not computed. For personnel costs, the unit labor cost specified in the "Survey on Agricultural Production Costs" (Ministry of Agriculture, Forestry and Fisheries) is used. This unit labor cost is lower than the time value used in the Road Manual.

b. Improvements in safety

The construction of a new guardrail, sidewalk, etc. leads to an effective improvement in safety. In appraising this effect, a factor of the reduction in traffic accidents is not used. At first, the amount of investment to ensure safety is multiplied by a discount factor depending on the number of years of service of the facility to obtain the discounted investment amount. Then, the annual effect is computed by adding the discounted investment amount and the increased maintenance cost due to the construction of the safety facility (negative effect).

⑤Preservation of local assets (effect of the discovery of cultural assets)

The construction of a new farm road may lead to the discovery of buried cultural properties, and the value of such cultural assets may be clarified. This is regarded as an effect of preserving the local assets (effect of discovering cultural assets). Since the effect of discovering cultural assets is generated in a set of projects including a farmland development project, however, this effect shall not be computed as the effect of a single farm road construction and improvement project.

⑥Preservation of the landscape (the effect of improvement of the farm road environment)

A line of trees, flowerbeds, or colored pavement may offer an "opportunity for communication," "refreshment," etc. to users of the farm road. This is regarded as an effect of preserving the landscape (effect of improvement of the farm road environment). This effect is computed by multiplying the additional investment to add environmental functions by a discount factor.

⑦Improvement of functions for health and recreation

The waterfront created by the construction of a dam for farming, or of an irrigation or drainage canal, may offer opportunities for recreation or relaxation to local residents. This is regarded as an effect of improving functions for health and recreation. In this case, the revenues from the use of the recreational facilities are computed as the amount of effect. Although a farm road provides access to these recreational facilities, the effect of improving functions for health and recreation is not considered to be generated by the farm road construction and

6) If an analysis for the "With Case" and the"Without Case" is applied as in the case of appraisal of other public works, only incremental benefits, other than existing benefits of an old facility, should be regarded as effects, and such benefits that replace the functions of the old facility should not be regarded as effects.

improvement project itself.

⑧Dead cost

If a farm road is constructed or improved, facilities that may be used for more years will generate losses due to the abolition of use or improvement work. These losses are referred to as dead cost, and regarded as negative effects. The dead cost is computed by multiplying (the construction cost of the abolished facility －disposal value) by a residual ratio.

(2) Procedure for cost-benefit analysis

The following process is followed, not only for farm road construction and improvement projects, but also for other land improvement projects, both of which are implemented by the Ministry of Agriculture, Forestry, and Fisheries: the annual effect is computed, and this amount is divided by a discount factor for which the interest during construction is adjusted depending on the number of years of service, and the appropriate investment amount is computed by deducting the dead cost from the discounted amount. Then the investment efficiency (= appropriate investment amount/total project cost) is determined (if investment efficiency is 1.0 or more, the project will be approved). The discount rate that is used for computing the discount factor is 5.5% (note: 4% for projects implemented by the Ministry of Land, Infrastructure, and Transport).

In the case of a land improvement project in which a farm road is also improved, a part of the project cost is sometimes borne by the farm households. Therefore a new project is approved only if the repayment to income ratio (= annual repayment amount/annual total incremental income) is 40% or less. If the repayment to income ratio doesn't exceed 40%, the repayment ratio will be deemed to be reasonable.

①Discount factor

The discount factor represents the ratio of the annual effects (annual cost) to the discounted total effects (total cost). In the computation, the discount rate is i (i = 0.055 in a land improvement project), the number of years of service is n, the annual effect is B, the total effects is TB, and discount is made starting with the first year.

Year Effect

1 B/(1 + i)

2 $B/(1+i)^2$

～

n $B/(1+i)^n$

Then, total effect TB shall be as follows.

$$TB = \sum_{t=1}^{n} \frac{B}{(1+i)^t}$$

This represents the aggregate values of 1st through n-th term of the geometric series with initial member B/(1 + i) and common ratio 1/(1 + i).

$$TB = \frac{B}{1+i} \cdot \frac{1 - \left(\frac{1}{1+i}\right)^n}{1 - \frac{1}{1+i}} = B \cdot \frac{(1+i)^n - 1}{i \cdot (1+i)^n}$$

Therefore, the discount factor $RS = \frac{B}{TB} = \frac{i \cdot (1+i)^n}{(1+i)^n - 1}$

②Investment efficiency

If the appropriate investment amount is AI, the total project cost is TC, the dead cost is DC, and the interest during construction is r,

then,

Investment efficiency can be computed as follows:

$$EI = AI / TC = \frac{\frac{TB}{1+r} - DC}{TC} = \frac{\frac{B}{RS\,(1+r)} - DC}{TC} = \frac{\frac{B \cdot ((1+i)^n - 1)}{i \cdot (1+i)^n (1+r)} - DC}{TC}$$

3. Comparison of effects subject to appraisal and appraisal methods

(1) Difference in effects subject to appraisal and in appraisal methods

According to the various project appraisal manuals mentioned above, there are differences in effects subject to appraisal and in appraisal methods for road, harbor road, and regional farm road projects (see Table 5).

Table 5. Differences in effects subject to appraisal and in appraisal methods for road, harbor road, and regional farm road projects

	Road	Harbor road	Regional farm road
Effect of reduction in travel time that contributes to savings on personnel costs (Saving on vehicle operating cost for farming)* (Saving on general traffic cost)*	Computable for all types of vehicles	Computable for all types of vehicles	For general traffic other than traveling for farming, the effect of reduction in personnel costs can be computed only for trucks. The unit personnel cost is small.
Effect of saving on vehicle operating cost that contributes to vehicles (Saving on vehicle operating cost for farming)* (Saving on general traffic cost)*	Computable for all types of vehicles	Computable for all types of vehicles	Computable for all types of vehicles
Effect of reduction in traffic accidents (Effect of improvement in safety)*	Reduction in traffic accidents is counted as an effect (in terms of money)	Qualitative appraisal	Cost of installing safety facilities is counted.
Effect of improvement of quality*	not measured	not measured	Increased income for farm households is counted
Effect of saving on management and maintenance cost*	Changes in management and maintenance costs are not counted as effects (counted as costs).	Changes in management and maintenance costs are not counted as effects (counted as costs).	Increased management cost due to the construction of facilities is counted as a negative effect.
Effect of preservation of the production base* (Renewal effect)*	not measured	not measured	The portion that replaces functions of old facilities is counted.
Dead cost*	not measured	not measured	Counted as a negative effect.
Residual value of land*	not measured	Counted as effect	not measured
Appraisal period	Construction period + 40 years after the commencement of services	Construction period + 50 years after the commencement of services	Number of years of service (variable depending on facilities)
Social discount rate	4.0%	4.0%	5.5%
Approval criteria	B/C $\geqq$ 1.5	B/C $\geqq$ 1.0	B/C $\geqq$ 1.0 Repayment to income ratio $\leqq$ 0.4

Note 1: Items marked with an asterisk (*) mean the names of effects in farm road construction and improvement projects.
Note 2: In the case of a farm road project, the personnel cost (time value) that is used in computing the effect of a reduction in time is lower than that used in road and harbor road projects.
Source: Prepared based on the cost-benefit analysis manual for each type of project.

The comparison of road and harbor road projects reveals that appraisal items and methods are almost the same for both types of project. This is because the section on harbor roads in the Harbor Manual is prepared with reference to the Road Manual as mentioned earlier. In detail, however, there exist some differences between them reflecting such differences in local conditions or the types of vehicle.

For example, the appraisal period for a road project is 40 years after the commencement of service. In the case of a harbor road project, the appraisal period is 50 years after the commencement of service and the residual value of the land is counted as a benefit in the last year of the appraisal period. Thus, the benefit computed for a harbor road project is larger than that for a road project. On the other hand, the benefit due to a reduction in traffic accidents is only regarded as a qualitative benefit and therefore not counted as a monetary benefit, and also, since the appraisal period is 50 years after commencement for a harbor road project, the maintenance and management cost computed for a harbor road project is larger than that computed for a road project.

Now the author would like to compare road/harbor road projects with farm road projects. When making an appraisal for a farm road project, the effect of a reduction in travel time for ordinary vehicles other than vehicles used for farming can be counted only for trucks, and the effect cannot be counted for passenger cars. In a farm road project, the time value for persons (personnel cost) that is used in computing the effect of a reduction in travel time is smaller that that used for road/harbor road projects, and the social discount rate for a farm road project is 5.5%, which is larger than the 4.0% for road/harbor road projects. In the case of a farm road project, some vehicle types that affect the effect of a reduction in travel time that accounts for a significant portion of the total benefits are not counted and a small time value is introduced. Therefore, the B/C value for a farm road is likely to be smaller than that for an ordinary road. On the other hand, the effect of improving quality which brings an increased income for farm households, and the effect of preserving the production base (renewal effect) can be counted as benefits in a farm road project. However, these effects cannot be counted as benefits in an ordinary road project, even if the road is used by many farm households.

(2) Possibility of inefficient investment made due to differences in appraisal methods

It should be noted that an ordinary road project can only be approved if $B/C \geqq 1.5$, but that a farm road project can be approved if $B/C \geqq 1.0$. Take a case where B/C for a road intended for general vehicles is less than 1.5 (the approval criteria for an ordinary road) due to insufficient traffic. In this case, it is quite possible that this ordinary road is changed to a farm road by overestimating the number of farm households using the road, and B/C for this road may be equal to, or larger than, 1.0 (the approval criteria for a farm road). This may be the reason why a road with light traffic is constructed or a farm road is constructed in parallel with a national road.

The summary in a fiscal 2000 report prepared by the “Study Council on Efficient Implementation of Agricultural or Farming Village Improvement Projects” is as follows. “Since 1965, farm road projects and ordinary road projects have been developed after consultations or coordination with the division in charge of road development. Since fiscal 1995, ‘coordination conferences’ have been held to avoid the duplication of functions between the Ministry of Agriculture, Forestry, and Fisheries and the Ministry of Construction, and between prefectural agricultural or farming village improvement divisions and civil engineering works divisions. Some people point out that redundant regional farm roads and ordinary roads have been constructed. These comments are mainly based on misunderstandings, because regional farm roads and ordinary roads have different objectives and route plans. It is important to examine the combination of roads of different types that best suits the local community, and priorities and roles for roads of different types so that synergy effects may be generated.”

If the above comment is true, there exists no overlapping investment in regional farm roads and ordinary roads. Of course, we cannot say that the fact that an ordinary road runs (or is planned to run) in parallel with a regional farm road represents an overlapping investment. If traffic demand exceeds the design capacity of either the farm or ordinary road, it may be reasonable to construct another road of a different type because the two roads of different types supplement each other. However, we can point out that the existence of a difference in appraisal methods for ordinary and farm roads may tempt local governments to receive subsidies to construct or improve roads, or to make overlapping investment, by exploiting the difference in appraisal methods. In some cases, those regional farm roads that were constructed for the transportation of agricultural products or farming activities are mainly used by

general vehicles, although traffic is light.

In the following chapter of this paper, the author would like to discuss the cases in which an "exploitation" of the difference in appraisal methods or an "overlapping investment" may have taken place.

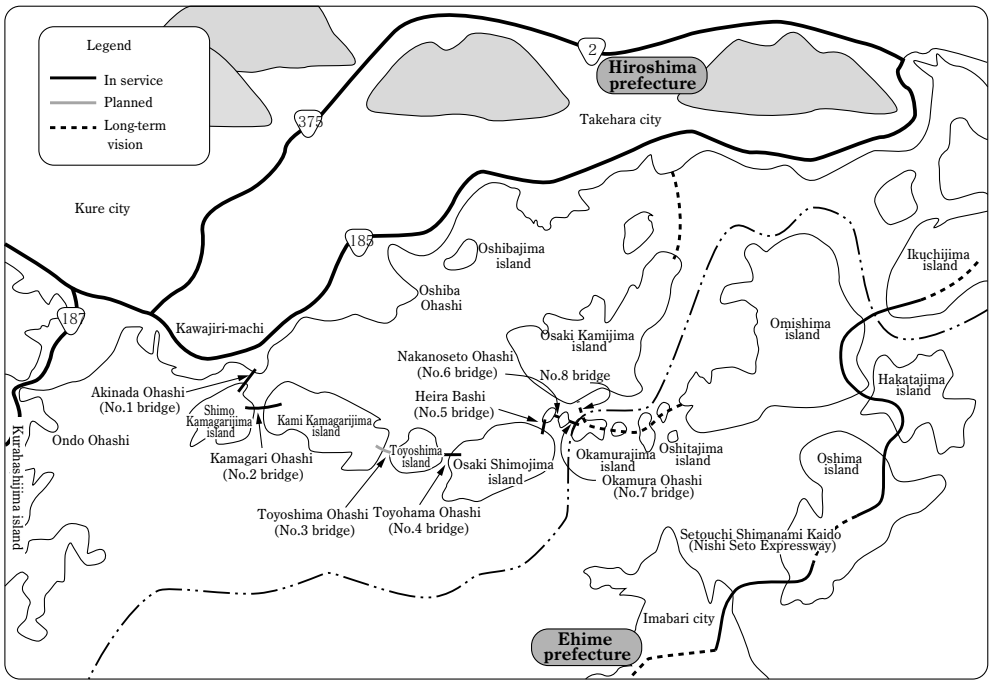
4. Case studies

(1) Construction of roads through an exploitation of the difference in appraisal methods

Suwa (2001) indicated that Akinada Shoto Connection Bridges in Hiroshima prefecture was a typical example of the construction of roads through an "exploitation" of the difference in appraisal methods.

Akinada Shoto Connection Bridges means those roads will be bridges that run from Kawajiri-machi adjoining Kure city in Hiroshima prefecture, through eleven islands in Hiroshima and Ehime prefectures, to Omishima island in Ehime prefecture. If all roads and bridges are completed, these roads will be connected with the Onomichi-Imabari route of the Honshu Shikoku Bridge (Setouchi Shimanami Kaido) in Omishima island. Therefore, Akinada Shoto Connection Bridges may be considered to be the No.4 Honshu-Shikoku Bridge route.

Figure 6. Akinada Shoto Connection Bridges



Note: Nos. 2, 4, 5, 6 and 7 are farm road bridges (these bridges are in service). No.1 (in service) and No.3 (under construction) are road bridges.
Source: Web site of the Hiroshima Prefectural Road Corporation (http://www3.ocn.ne.jp/~hprc/page21.htm)

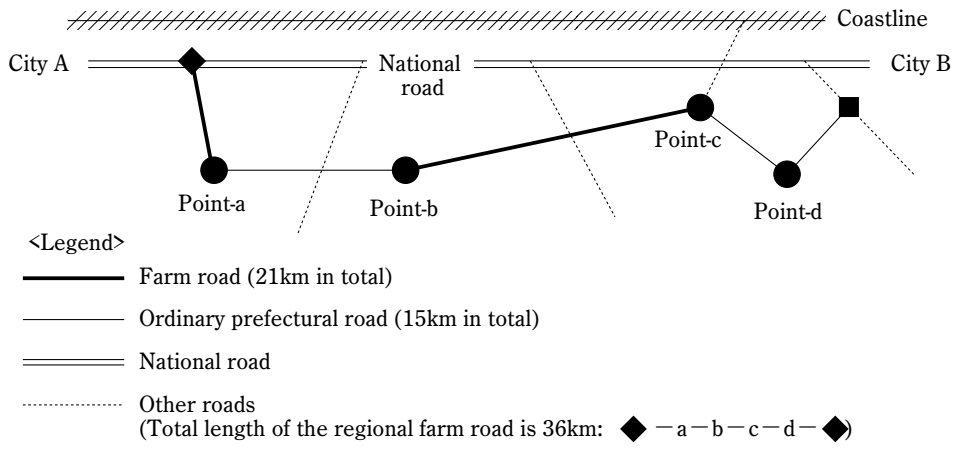
In the 1970s, the Hiroshima prefectural government began to study the feasibility of constructing bridges. The local government expected that the project cost would be considerably large but the traffic would be light. With light traffic, effects such as a reduction in travel time would be insufficient for the local government to apply to the Ministry of Land, Infrastructure, and Transport for subsidies for bridge construction projects. Therefore, if the local government had applied to the Ministry of Land, Infrastructure, and Transport for approval for the construction of all bridges under the Ministry's road construction and improvement projects, the Ministry would have rejected such projects. Therefore, the local government established a unique plan in which mandarin orange-producing areas were divided into three blocks, and prepared a regional farm road construction and improvement

project for each of these blocks, and decided to connect a core island of each block with neighboring islands by farm road bridges. Thus, the local government decided to apply to the Ministry of Agriculture, Forestry, and Fisheries for approval for the construction of some farm road bridges under the Ministry's farm road construction and improvement projects. B/C for these farm road bridges was computed to be 1.01, exceeding the approval criteria of 1.0 in most cases (6 farm road bridges planned by the local government). Construction of these 5 out of 6 farm road bridges began in 1979, and is already completed (total project cost: ¥12.6 billion).

For road bridges under the jurisdiction of the Ministry of Land, Infrastructure, and Transport, the "Akinada Ohashi" (total project cost: ¥47.8 billion), the toll road bridge connecting the Main Island with Shimo Kamagarijima island, went into service in January 2000. The local government began to acquire land for the construction project for the "Toyoshima Ohashi" (total project cost: ¥36.0 billion) connecting Kami Kamagarijima island and Toyoshima island. The Ehime local government has not prepared bridge construction plans to interconnect isolated islands. Therefore, the above farm roads and roads are not yet connected to the Onomichi-Imabari route of the Honshu Shikoku Bridge, because bridges connecting the above farm roads and roads with Omishima island are not constructed. When the construction of Toyoshima Ohashi (No.3 bridge) and planned No.8 bridge are completed, isolated islands in Hiroshima prefecture will be connected to the Main Island as planned.

Another example is a regional farm road in the Hokuriku district for which the author et al. conducted a survey. The regional farm road (total length: 36km) connecting two cities runs in parallel with a national road running alongside the coastline. The distance between the two roads is about 2km. This regional farm road partially overlapped ordinary prefectural roads under the jurisdiction of the Ministry of Land, Infrastructure, and Transport. For the overlapped portions, a farm road was not constructed, and instead the civil engineering division widened the prefectural roads to connect with new farm roads. Thus, farm roads alternate with ordinary prefectural roads under the jurisdiction of the Ministry of Land, Infrastructure, and Transport (see Figure 7). The total length of farm roads is 21km, and the total length of ordinary prefectural roads is 15km (accounting for about 40% of the total length of the regional farm road construction project) (this is a so-called "joint project"). Farm roads whose construction started in 1973 were fully opened to traffic in 1998, although part of the ordinary prefectural roads is not widened yet.

Figure 7. Sketch map of regional farm roads in the Hokuriku district



Since it was assumed that not only farm households but also general vehicles would use this regional farm road, the division in charge at the Ministry of Agriculture, Forestry, and Fisheries and the Civil Engineering Division had consultations before the commencement of construction works to coordinate the progress of this regional farm road project with that of local trunk road projects and to avoid any duplication of functions. Liaison conferences were also held between the Ministry of Agriculture, Forestry, and Fisheries and the Ministry of Land, Infrastructure, and Transport. Therefore, it was understood that the farm road and the ordinary road would not

duplicate each other's function. In consultations, however, the appropriateness of appraisal methods for farm roads and ordinary roads and their appraisal results were not discussed. Since the bypass for the national road is constructed in urban areas, the regional farm road, which is constructed in mountainous areas, would be rarely used as a bypass. Since rainfall-related traffic regulations apply to portions of the national road, however, a part of the regional farm road may be used as a bypass.

The cost-effectiveness of this regional farm road was calculated in accordance with "Tochi Kairyono Keizai Kouka" (The Economic Effects of Land Improvement (The First Edition), Planning Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry, and Fisheries, Taisei Publishing Co. Ltd., 1998)[7] . Whenever the regional farm road construction project was modified, a cost-benefit analysis was conducted. The final such analysis for the regional farm road construction project was conducted in 1988. B/C for farm roads was computed as 1.04, in excess of the approval criteria. In 1988, when the cost-effectiveness was computed, the effects of improvements in safety, etc. were not subject to computation, and therefore these effects were not counted. If these effects are computed according to the current standard, B/C will increase accordingly.

Considering that construction work for the regional farm road project started in 1973, it cannot be denied that the appraisal method used in those days was slightly different from the current method. As for the regional farm road project, it may safely be said that the division in charge at the Ministry of Agriculture, Forestry, and Fisheries and the Civil Engineering Division exploited the difference in their project appraisal methods so that the regional farm road and ordinary road projects would pass the approval criteria and be implemented using subsidies. (If it had been possible to establish the regional farm road project as a single project and to make an appraisal using the appraisal method applicable to the project, it would have been unnecessary to go through a complex procedure, dividing the project into more than two and using different appraisal methods.)

According to an estimation made by the prefectural government, the number of vehicles that would use this regional farm road in a year was 1.04 million agricultural vehicles (excluding those commuting to farms) and 0.86 million general vehicles. Thus, agricultural vehicles accounted for about 55% of all traffic. Now, let's examine this estimation.

The number of vehicles passing four points on ordinary prefectural roads (points a through d in Figure 7) under the jurisdiction of the Civil Engineering Division can be obtained from the "Road Traffic Census" [8] (Table 8). Since the number of vehicles passed each point in the same year differs widely, and the number of vehicles passing the same point in different years differs widely, it is impossible to estimate the number of vehicles traveling along the whole route of the regional farm road. However, it is possible to know the numbers and ratios of passenger cars and trucks that passed each point. Except for the ratio at point b in 1990, the ratios for passenger cars range between 50～70% at every point in every year, and the ratios for trucks at every point in every year range between 30～50%; the ratios accounted for by agricultural vehicles are only part of the ratios for trucks. Of course, the possibility cannot be denied that the number of agricultural vehicles is large only on farm roads. However, it seems clear that the regional farm road has the characteristic of an ordinary road on which passenger cars are the main users. This fact indicates that the regional farm road should have been constructed, not as a farm road, but as an ordinary road. In reality, however, a farm road appraisal was made for 60% of the total length of this regional farm road, and an ordinary road appraisal was made for the remaining 40%.

7) The latest edition available in August 2001 was the 2nd edition published in 1997.

8) In the Road Traffic Census, no survey was conducted for farm roads under the jurisdiction of the division in charge at the Ministry of Agriculture, Forestry, and Fisheries.

Table 8. Traffic on the regional farm road (a portion of ordinary roads)

Name of route	Point	Survey year	Ratio of passenger cars	Ratio of trucks	Traffic for 12 hours (daytime, weekday)
○○route of ordinary prefectural road	Point a	1990	78.8%	21.2%	551
		1994	76.6%	23.4%	667
		1997	57.7%	42.3%	2,119
	Point b	1990	35.0%	65.0%	514
		1994	64.2%	35.8%	617
		1997	57.7%	42.3%	2,119
××route of principal local road	Point c	1990	50.5%	49.5%	6,537
		1994	53.0%	47.0%	6,593
		1997	53.9%	46.1%	7,773
	Point d	1990	47.4%	52.6%	4,650
		1994	49.9%	50.1%	1,777
		1997	51.8%	48.2%	4,076

(2) Overlapping investment due to the difference in appraisal methods

Tanaka (2001) compared the Chita Peninsula Road/Minami-Chita Road, a toll road that runs through the Chita Peninsula in Aichi prefecture from north to south, and the Chita Peninsula Area of a regional farm road for which construction work is under way, with a completion target of 2005. These roads run almost in parallel in the neighborhood. The two-lane toll road (total length: 40.5km) under the management of the Aichi Prefectural Road Corporation went into service in 1970. This toll road was upgraded to a four-lane road in 1999. The new regional farm road with two lanes (total length: 41.2km) was constructed as a joint project between the Ministry of Agriculture, Forestry, and Fisheries and the Ministry of Land, Infrastructure, and Transport. The regional farm road was originally intended for the transportation of agricultural products and the movement of farm machinery. Since the portion under the jurisdiction of the Ministry of Land, Infrastructure, and Transport accounts for 28% of the total length of the regional farm road, and this road includes portions of prefectural and municipal roads to be improved, the regional farm road is considered to have the same functions as those of an ordinary road with two lanes. Tanaka (2001) pointed out that unless traffic significantly increased in the future, the four-lane toll road and the new regional farm road would compete with each other and the coefficient of utilization of either of the two roads would decrease, leading to an overlapping investment.

Then, Tanaka (2001) made appraisals of these two roads in accordance with the Road Manual based on some assumptions, including an assumption that the “upgrading of the toll road to a four-lane road” and the “new construction of a regional farm road” complement each other. According to the Road Manual of the Road Bureau and City Bureau, Ministry of Construction, appraisal items for a toll road and a regional farm road are “benefits from reductions in travel time,”“benefits from reductions in vehicle operating costs” and “benefits from reductions in traffic accidents” as mentioned earlier. The effect of improving agricultural production and other effects that are computed in a cost-benefit analysis for a farm road are not taken into consideration. Although some assumptions were made, B/C for upgrading the toll road to a four-lane road was computed as 3.14, and B/C for the new construction of a regional farm road was computed as 0.16. Therefore, if an appraisal is made on the assumption that the regional farm road now under construction will be used as an ordinary road, the conclusion will be that the new construction of a regional farm road is an overlapping investment because the upgrading of the toll road to a four-lane road is already completed, and the new construction of a regional farm road is undesirable because the

investment performance is lower than the costs [9] .

5. Unified appraisal method is needed

In the preceding chapter, cases where both a road and a farm road were alternatively constructed were examined, or where an overlapping investment was made by exploiting the difference in appraisal methods, although it is difficult to draw clear conclusions because of insufficient evidence.

Since an ordinary road project and a regional farm road project have different purposes, it may be reasonable that the two types of projects have different appraisal items. If a road project passes the approval criteria under a certain appraisal method but doesn't pass the criteria under the other appraisal method, a local government would naturally apply for subsidies for the type of road project that can pass the approval criteria. If a road is constructed using subsidies from the central government, half of the project costs will be borne by the central government and the remaining cost will be borne by the prefectural government and the municipality. The prefectural government and the municipality are authorized to finance the project cost by issuing public bonds. In later years, most of the redemption money for such bonds will be financed by a special allocation tax. Under this system, therefore, local governments may implement road construction projects with smaller project budgets. In the case of subsidized road projects in which the benefits and financial burdens are not balanced, it cannot be denied that local governments may be tempted to seek rent by exploiting the difference between appraisal methods.

When making the appraisals of the road projects, it would be impossible to accurately estimate the traffic after the commencement of service. However, it would not be difficult to forecast whether a planned road will be mainly used by farm households or general users. For example, let's consider the case of constructing a farm road. In this case, when calculating the "effect of reducing costs for general traffic, etc.," the numbers of agricultural vehicles, passenger cars, and trucks that flow into the road are estimated. Therefore, it is possible to compare the number of agricultural vehicles and the number of general vehicles. It would be quite easy for the person in charge of the appraisal work to forecast whether a planned road will be a "farm road," mainly used by farm households, or an "ordinary road," mainly used by general users. At present, it seems that the result of the cost-benefit analysis is examined when the application for subsidies is made, but the details of the cost-benefit analysis are not examined. Therefore, the author believes that if the actual dominant users of a road are different from the intended users of the road, it would be appropriate to make a new appraisal.

In this paper, the author has focused specifically on the cost-benefit analysis, and discussed the difference between appraisal methods and their results. Of course, there may be no perfect project appraisal method, and it would be quite difficult to increase the effectiveness of the existing project appraisal methods. Public works projects are approved not only based on the result of a cost-benefit analysis (B/C) but also based on political considerations. However, it is doubtful that public works that are approved based on an appraisal method that disregards actual road users will be effective or efficient. Therefore, benefits and financial burdens should be balanced for public works projects, including road projects, and at the same time those appraisal methods that suit the projected users should be adopted.

At the Ministry of Land, Infrastructure, and Transport, the Road Bureau and Ports and Harbors Bureau are carrying out preparatory work to unify the appraisal method for road and street projects and harbor road projects. Also, it is reported in newspapers that divisions in charge of public works at various Ministries have started preparatory work to establish a "unified appraisal method for similar public works," including "farm road construction and improvement projects" under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries [10] . However, it seems that there has been no significant progress in this preparatory work yet. To ensure the efficiency of road projects, it is necessary to establish a unified appraisal method that can correctly assess benefits and costs based on projected road user conditions.

9) Suwa (2001) also pointed out that overlapping investments were made for these roads. The problem of overlapping investment was taken up in the "Scoop" column of the Nihon Keizai Shimbun dated January 20, 2002.

10) Refer to the morning edition of the Nihon Keizai Shimbun dated May 30, 2001.

[Bibliography]

[1] Cost-benefit Analysis Manual for Harbor Construction and Improvement Projects, Ports and Harbors Bureau, Ministry of Transport, 1999.
[2] Masayoshi Eguchi, For the Implementation of Overall Appraisals of Public Works by utilizing Cost-Benefit Analysis, SRIC REPORT, Vol.4, No.1, December 1998.
[3] Taishi Ohno, Arata Kuno, Aiko Shibata, and Junichi Nagamine, Cost-Benefit Analysis of Road Investment: Case Study of Nishinomiya-Kita Expressway, in Junichi Nagamine and Taisuke Katayama, "Public Investment and Road Policies," Keiso Shobo, 2001.
[4] Cost-Benefit Analysis Manual (Proposal), Road Bureau and City Bureau, Ministry of Construction, 1998.
[5] Guidelines for the Appraisal of Harbor Investment, the Research Committee on the Social and Economic Appraisal of Harbor Investment, Waterfront Vitalization and Environment Research Center, 1999.
[6] Yuzo Suwa, "The Study of Public Works," Shinhyoron Co. Ltd., 2001.
[7] For the Improvement of Efficiency and Transparency of Public Works, Administrative Inspection Bureau, Management and Coordination Agency, 2000.
[8] Hiroki Tanaka, A Cost-Benefit Analysis of Road Investment: Appraisal of Outcomes Using a Multi-Standard Approach, "Appraisal of Policies for Public Fixed Capital Formation," PHP Institute, Inc., 2001.
[9] Guidelines for the Appraisal of Road Investment (Proposal), Road Investment Appraisal Guideline Study Committee, Japan Research Institute, 1998.
[10] Feature: Efforts Concerning the Project Appraisal System for Roads, Japan Road Association, September 2000.
[11]Fiscal 2000 Report, Study Council on Efficient Implementation of Agriculture and Farming Village Improvement Projects, February 2001.
[12] "The Economic Effects of Land Improvement (Revised Edition)," Planning Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry, and Fisheries, Taisei Publishing Co. Ltd., 1997.