Impact Evaluation of Irrigation Projects

Summary of the Analysis

Background of the Evaluation

In recent years, impact evaluations have been promoted internationally, and while the health and education sectors have had many such evaluations, very few have been conducted to verify the impacts of large-scale infrastructure development projects, with technical difficulties being one of the reasons. Bearing this situation in mind, JICA attempted to conduct impact evaluations in the irrigation sector, a sector for which it has provided a number of large-scale infrastructure assistance whereas other aid agencies have implemented few.

Irrigation infrastructure development is expected to generate a number of impacts and their evaluation is also critical, including increases in agricultural production, stable production volume, increases in agricultural incomes, development of social capital[*1] through joint activities, and the promotion of new agricultural methods. These impact evaluations will accurately measure the multi-dimensional impacts of irrigation infrastructure development. In doing so, it aims to extract know-how which will contribute to the generation of further project effects, in addition to feedback items for the design of other similar projects.

Evaluation Framework and Policy

To date, JICA has piloted impact evaluations for the following four of its ODA loan projects in Asia. The series of impact evaluations examine not only the effects of irrigation infrastructure development on agricultural production, but also the effectiveness of the new agricultural method - the System of Rice Intensification (SRI) - expected to enable high yield (Indonesia), as well as the impact on social capital (Philippines, Sri Lanka).

To accurately measure the project's effects, a comparison needs to be made between what happened with the project and what would have happened if the project was not carried out (see "Initiatives for Impact Evaluation" on p.11). In recent years, the randomized controlled trial (RCT) has been considered the most ideal approach for this type of study, and has been widely used. However, RCT is not always feasible in development aid work, particularly for infrastructure development projects. Therefore, the impact evaluations estimated the project's effects using the natural experiment[*2] method and statistical methods such as the difference in differences[*3] method using panel data, the propensity score matching[*4] method, and regression discontinuity design[*5].

Projects Examined for Pilot Impact Evaluation

Country	Project	Impact examined (excl. agricultural production)	Method
Thailand	Pasak Irrigation Project (Kaeng Khoi-Ban Mo pump)	–	Difference in differences
Philippines	Bohol Irrigation Project	Impact on social capital	Propensity score matching
Indonesia	Small Scale Irrigation Project (3)	Impact of SRI introduction	Regression discontinuity design / Propensity score matching
Sri Lanka	Walawe Left Bank Irrigation Upgrading and Extension Project	Impact on social capital	Natural experiment

Analysis Results

Data is still being collected for some impact evaluations, and tentative analyses are now being made. Therefore, the following will describe the impacts of irrigation infrastructure based primarily on those case studies for which final analysis results are available.

Regarding the impact on agricultural production, the evaluation results of Indonesia's Small Scale Irrigation Project (3) for which data collection and analyses have been completed are discussed below. The objective of this project was to increase farmer incomes and reduce poverty through irrigation construction and rehabilitation. Using data from two periods collected in 2007 and 2009 from farming households in one of the project areas of Jeneponto, South Sulawesi, this evaluation analyzed impact on yields during the rainy season and agricultural incomes.

*1 The concept of social capital is multidimensional and lacks a uniform definition, but includes trust, norms of reciprocity, values, social networks, and citizen participation. Reports of JICA and the World Bank have previously presented definitions such as, "social factors that influence collective action necessary for the achievement of the development objective, either within a society / group or among societies and groups" and "internal social and cultural coherence of society, the norms and values that govern interactions among people and the institutions in which they are embedded."
*2 natural experiment: Approach for estimating project impact when the treatment and a homogeneous control group are formed due to unintended and incidental factors.
*3 difference in differences: Method of estimating impact by taking the difference between pre- and post-project and difference between the project treatment and control groups, with regards to the indicator evaluated.
*4 propensity score matching: Method of estimating impact by selecting people from the project's control group with similar characteristics as each person in the treatment group, and comparing the two groups.
*5 regression discontinuity design: Method of estimating impact by comparing the treatment and control groups after project implementation, in which assignment to a treatment is determined by a cutoff figure specified by an external rule.

Indonesia: Small Scale Irrigation Project (3) "Effects of Irrigation Infrastructure Development on Yield and Agricultural Incomes - Rainy Season"

- Both yield and agricultural income are statistically significantly different between upstream, midstream, and rain-fed areas of irrigated area. Construction of irrigation infrastructure, for example, increased rice cultivation yield during rainy season by an average 1.5t per hectare (about a 40% increase from the 2007 rainy season yield) in upstream, and about 1.0t in midstream. Rice cultivation income increased by 2.70 million rupiahs per hectare (about 27,000 yen) and 1.00 million rupiahs, respectively.
- On average, no major difference in yield and agricultural income between downstream and rain-fed areas. Among high-yielding crop farmers, significant difference existed between downstream and rain-fed areas, and irrigation infrastructure had slight impact. Among low-yielding crop farmers, no difference observed between downstream and rain-fed areas.
- Furthermore, between the most downstream area of irrigated land and the rain-fed area nearby, on average, no difference existed in yield or agricultural income, even by sub-groups with different productivities.

From the above analysis results, it was observed that irrigation infrastructure development contributes to increasing the area's average agricultural production. On closer inspection of watersheds, productivity, etc., however, it was confirmed that the effects of infrastructure construction are not uniform, and some areas do not fully benefit from irrigation infrastructure. In particular, while low productivity farmers in downstream areas, believed to be the poorest populations, were assumed to benefit from irrigation infrastructure at the project planning phase, in actuality water was not sufficiently distributed. A challenge will be to improve water distribution within the area in the future.

Although the analysis results are not final for the other projects, they reveal, similar to Indonesia, that irrigation infrastructure has positive impacts on productivity. The Philippines case shows no difference in average yields between canals upstream and canals downstream. Nevertheless, within the same canal, provisional estimates show problems with water distribution between upstream and downstream. Thus, in irrigation infrastructure development, ensuring the appropriate distribution of water is a critical issue. In addition, from the analysis results, it was demonstrated that irrigation infrastructure development as well as the institutional strengthening of water management associations contribute to increasing project effectiveness.

Effectiveness of SRI

The irrigation project in Indonesia introduced the new rice cultivation technology of SRI. SRI features seedling transplantation, single seedling planting, sparse planting and cultivation, and intermittent flooding. It is said the technology is environmentally friendly and dramatically increases rice yields. Meanwhile, some scientists express skeptical views, and note that numerous experiments have not produced any statistical evidence of increased yields. In this evaluation, differences in rice cultivation incomes per yield and unit among farmers adopting SRI were examined using the propensity score matching method. The analysis shed light on the following. While the labor cost of farmers needs to be taken into account, the SRI technology was confirmed to have had impact in the project area.

- Compared to existing agricultural methods, SRI increased yield from 1.9t to 2.1t per hectare (roughly 70% of yields through traditional agricultural methods).
- Rice cultivation income is forecast to increase from 2.90 million rupiahs to 3.20 million rupiahs per hectare (double the rice cultivation income through traditional agricultural methods).

(*However, please note these figures do not exclude imputed wages of private labor, etc.)

Meanwhile, the SRI adoption rate has remained at over 10% in the project area. More detailed studies need to be conducted on why many farmers have not adopted SRI, despite its generation of clear effects, and the factors inhibiting the spread of SRI. This know-how then needs to be applied in practice.

Impact on Social Capital

In Sri Lanka, the impact evaluation examined whether access to irrigation led to the development of social capital, such as mutual trust and norms of cooperation, among farmers. The feature of this evaluation is to quantitatively measure social capital, which was discussed by qualitative or inaccurate information, using an eyperimental economics method. Statistical analysis revealed that the longer farmers have access to trrigation, the more social capital is accumulated.

A canal constructed by the Walawe Left Bank Irrigation Upgrading and Extension Project