

Republic of Moldova

FY2020 Ex-Post Evaluation Report of

Japanese Grant Aid Project

“Project for Effective Use of Biomass Fuel in the Republic of Moldova”

External Evaluator: Miyuki Koga, Octavia Japan, Co., Ltd.

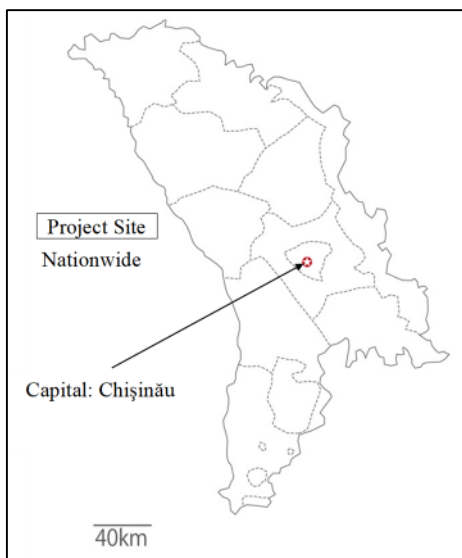
0. Summary

This project aimed to reduce energy cost and enable sustainable operation of heating facilities at public facilities (mainly education facilities such as primary schools) in Moldova by introducing pellet boilers and pellet plant, thereby contributing to the improvement in the living environment of the residents. The *Energy Strategy of the Republic of Moldova until 2020* and the *National Development Strategy Moldova 2030*, formulated by the government of Moldova, advocate improving energy utilization efficiency and reducing energy consumption through biomass fuel and renewable energy. They recognize biomass fuel as a beneficial alternative to natural gas and indispensable for the country's stable energy supply. The project is also in line with Japan's assistance policy and is therefore highly relevant. Regarding efficiency, although the output was generally as planned and the project cost was within the planned budget, the project period was slightly longer than planned as it took time to agree on the pellet boiler connection cost between the executing agency and some local target sites. Therefore, efficiency is fair. With regard to effectiveness, as a result of the decline in natural gas prices since 2018, gas heating tends to be prioritized in the country. As a result, only 9 of the 24 pellet boilers installed in rural areas are in operation at the time of ex-post evaluation. For this evaluation study, targets and actual results were available at 7 of the 9 operating sites; data required to analyze quantitative effects were limited. Keeping this in mind, 1) the heating cost reduction is above the target and 2) job creation was slightly below the target. On the other hand, a means of heating that is cheaper than coal, firewood and electricity, and safer and more environmentally friendly than natural gas, is secured, and heating can be used in winter regardless of the price trend of imported energy in the target areas of this project. The non-operational pellet boilers are scheduled to operate in the future, while the fact that renewable energy makes effective use of agricultural waste is widely known and promoted, and the project is contributing to the diversification of energy sources (energy security) in the country. Therefore, overall, the effectiveness and impacts are judged to be fair. Regarding sustainability, 9 operational pellet boilers have no breakage or malfunctions and 11 non-operational pellet boilers have been connected and are ready for operation from this winter (2021/2022). Thus, no problems are observed in the institutional, technical or financial aspects of

operation and maintenance. However, there is no prospect for the operation and utilization of the pellet plant and the demonstration pellet boiler, and concerned parties need to discuss the solution. Therefore, the sustainability of the effects generated by this project is fair.

In light of the above, this project is evaluated to be partially satisfactory.

1. Project Description



Project location



Pellet boiler introduced by this project

1.1 Background

Moldova is poor in mineral resources such as oil and coal and relies on imports from neighboring countries, namely, Russia and Ukraine, for most of its energy sources such as natural gas and coal. Energy used to be provided cheaply by the former Soviet Union before independence in 1991. However, since independence, Moldova has been purchasing fuel based on international market prices. From 2006 to 2010, before the start of this project, the price of natural gas more than tripled and fuel purchase costs were putting pressure on national finances. Especially in rural areas, because of financial difficulties of the government, it was not possible to purchase a sufficient amount of fuel (natural gas) in the midwinter. Particularly in rural areas where heating could not be supplied, there were cases where schools had to temporarily close in winter. Therefore, securing a stable heating supply was an urgent issue. Under such circumstances, expectations were rising for improving the energy situation by utilizing straw, etc. that can be obtained domestically in large quantities from rural areas as biomass resources and by introducing pellet boilers.

1.2 Project Outline

The objective of this project is to reduce energy cost and secure heating facilities at public facilities (mainly education facilities such as primary schools) in Moldova by introducing pellet boilers that use biomass (pellet) as fuel and pellet plant, thereby contributing to the improvement in the living environment of the residents in the target areas.

Grant Limit / Actual Grant Amount	1,154 million yen / 1,025 million yen
Exchange of Notes Date / Grant Agreement Date	June 2013 / June 2013
Executing Agency(ies)	(At the time of Planning) 2KR-PIU, Minister of Agriculture and Food Industry (At the time of Ex-Post Evaluation) Agency for Development and Modernization of Agriculture (ADMA): hereinafter referred to as “executing agency”
Project Completion	January 2016
Target Area	All over Moldova (25 locations for the pellet boilers, 1 location for the pellet plant)
Main Contractor	None
Main Consultant	Mitsui Consultants Co., Ltd., UNICO INTERNATIONAL CORPORATION (JV)
Procurement Agency	Toyota Tsusho Corporation
Preparatory Survey	December 2011–March 2013
Related Projects	(Grant Aid) - Grant Assistance for Grassroots Human Security Projects “Improvement of Heating System for the Kindergarten and School in Hirtopul Mare Village” (2008) (Other International Organizations and Aid Agencies) - “Moldova Energy and Biomass Project” (2011–2014, United Nations Development Programme (UNDP) - “Moldova Energy and Biomass Project Phase 2” (2014–2018, United Nations Development Programme

	<p>(UNDP)</p> <ul style="list-style-type: none"> - “Energy II Project” (2004–2011, World Bank) - “Renewable Energy from Agricultural Waste Biomass Project” (2005–2008, World Bank) - “Social Investment Fund II Project” (2004–2013, World Bank)
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2. Outline of the Evaluation Study

2.1 External Evaluator

Miyuki Koga, Octavia Japan, Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: December 2020–December 2021

Duration of the Field Study: The project involved a field survey with no international travel; it was conducted remotely using a local survey assistant.

2.3 Constraints during the Evaluation Study

(Conducting Remote Field Surveys Using Local Survey Assistant)

Two international visits to Moldova were planned for this evaluation study before it commenced. Due to the spread of COVID-19 after the study began, the external evaluator did not travel internationally. Using the local survey assistant, the external evaluator conducted the site visits, collected information and data and conducted interviews with the individuals concerned remotely. The external evaluator analyzed the information collated to conduct the evaluation and make a judgment.

3. Results of the Evaluation (Overall Rating: C¹)

3.1 Relevance (Rating: ③²)

3.1.1 Consistency with the Development Plan of Moldova

Prior to the start of this project, the government of Moldova formulated the *National*

¹ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

² ③: High, ②: Fair, ①: Low

Development Plan in 2012, in which “education,” “improvement of road network,” “fund access,” “business environment,” “efficient energy use,” “pension reform” and “governance by law” were listed as seven national priorities. Of these, concerning energy, the aim was to improve the efficiency of energy utilization and reduce energy consumption through the use of renewable energy. The government also formulated the *Energy Strategy of the Republic of Moldova until 2020* and the *Government Action Plan (2011–2014)*, in which energy efficiency, promotion of renewable energy utilization and biomass utilization were emphasized as specific goals.

At the time of the ex-post evaluation, the government of Moldova formulated the *National Action Plan (2019–2021)* and the *National Development Strategy Moldova 2030*, in which promotion of renewable energy usage is placed as an important aspect of the main energy strategy action plans. The government also plans to promote the reduction of greenhouse gas emissions domestically and improve the efficiency of energy utilization. In addition, the government continues to place importance on biomass used for heating public facilities and homes. Specifically, biomass utilization is positioned as a means to diversify energy sources, which can reduce the country’s dependency on natural gas imports and strengthen the national energy security system.

The above shows that promotion of the use of renewable energy was positioned as a main action plan of the energy strategy before the start of this project and at the time of the ex-post evaluation. The utilization of biomass fuel is also regarded as important. Therefore, the project’s relevance is recognized in terms of policy and measures.

3.1.2 Consistency with the Development Needs of Moldova

Before the project began, the price of natural gas in Moldova more than tripled from 2006 to 2010 and fuel purchase costs were putting pressure on national finances. Especially in rural areas, because of financial difficulties of the government, it was not possible to purchase a sufficient amount of fuel (natural gas) for heating in the midwinter. Particularly in rural areas where heating could not be supplied, there were cases where schools had to temporarily close in winter. Therefore, securing a stable heating supply was an urgent issue. Under such circumstances, expectations were rising for improving the energy situation by utilizing straw, etc. that can be obtained in large quantities domestically from rural areas as biomass resources and by introducing pellet boilers.

At the time of the ex-post evaluation, biomass resource utilization continues to hold national importance in Moldova. Its advantages are numerous: it can replace natural gas, which is the main

heating source³; a heating system using pellet boilers is cheaper to operate and maintain than a system that uses coal, firewood and electricity; it can prevent outflow of funds previously used for fossil fuel purchases; it can form a new industry through local production for local consumption of biomass fuel; and it can create new employment opportunities. Since 2018, the selling price of natural gas in Moldova has been relatively stable⁴. However, even if the price rises sharply again and it becomes scarce in the future, public facilities such as schools can switch to biomass fuel and thereby avoid the situation where heating is not available⁵. In other words, installing a heating system using pellet boilers in addition to the existing heating system (gas, coal, electricity, firewood, etc.) will increase stability in the energy supply. From that point of view, it can be judged that the needs of this project continue to be high.

Based on the above, biomass fuel contributes to strengthening the stable energy supply system in Moldova before the start of this project and continues to do so at the time of ex-post evaluation, and therefore, this project is consistent with development needs.

3.1.3 Consistency with Japan's ODA Policy

The 2013 Official Development Assistance (ODA) Country Databook concerning Moldova indicated the direction that Japan would “aim to improve the living standards of the citizens and give consideration to building a foundation for economic development through the improvement of socio-economic infrastructures.”

Considering that this project was designed to promote the utilization of biomass fuel, a renewable energy, to reduce energy costs, and to contribute to the improvement of the living environment of the residents in Moldova, it is consistent with Japan's ODA policy.

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

³ According to the law of Moldova (Art. 13 and 14 of Law no. 128 of 11.07.2014 on the energy performance of buildings), it is highly recommended to consider high efficiency alternative systems utilizing renewable energy sources, etc. when constructing or renovating buildings.

⁴ In the fourth quarter of 2020, the price of natural gas supplied by a major natural gas producer and supplier (Gazprom) in Moldova was 114.5 USD per 1,000 m³. This is cheap—about half of the price of what is distributed in European countries. In addition, the average price of natural gas imported by the country in 2020 is 149 USD per 1,000 m³, which is lower than the average import price of European countries of 186 USD per 1,000 m³ (the source of above data is the executing agency). At the time of the ex-post evaluation, the current domestic price of natural gas is cheaper than that of 2015. Moldova has been dependent upon the former Soviet Union and Russia to procure natural gas for decades. With the completion of the gas pipeline from neighboring Romania in 2020, Moldova's price bargaining power and gas procurement capacity have increased, which has an impact on the purchasing price. Nevertheless, it is difficult to predict future prices of natural gas.

⁵ According to the executing agency, it is estimated that sufficient biomass resources such as straw can be secured in Moldova and that approximately 1.8 million Gcal per year of thermal energy can be generated.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Table 1 shows the planned and actual outputs of this project.

Table 1: Plan and Actual Outputs of This Project

At the Time of Planning (2013)	Actual (2020)
<p>[Planned Inputs from the Japanese Side]</p> <p>1) Equipment Procurement, etc. [Equipment] 1 pellet plant, 25 pellet boilers (including one demonstration boiler⁶), 25 prefabricated buildings for the pellet boilers (including, transportation, delivery, assembly, installation, test run, initial operation guidance of procured equipment)</p> <p>2) Consulting Service Design confirmation, preparation of bidding documents, supervision of the bid and procurement</p> <p>3) Soft Component Build a maintenance management system by providing the following: (1) training on pellet boiler maintenance (2) training on pellet plant maintenance (3) support for public relation activities to increase the number of pellet boiler users in Moldova</p>	<p>[Actual Inputs from the Japanese Side]</p> <p>1) Equipment Procurement, etc. [Equipment] 1 pellet plant, 25 pellet boilers (including one demonstration boiler), 25 prefabricated buildings for the pellet boilers: <u>as planned</u>⁷</p> <p>2) Consulting Service: <u>as planned</u></p> <p>3) Soft Component: <u>mostly as planned</u></p>
<p>[Planned Inputs from the Moldovan Side] (Concerning Pellet Boilers)</p> <ul style="list-style-type: none"> - Construction of an appropriate foundation for the module (including construction materials) - Works to make electricity and water available to the modules - Fire prevention and extinguishing system - Containers to store ash temporarily - Facilities for boiler operators (e.g., showers, toilets) - Recruitment of boiler operators <p>(Concerning Pellet Plant)</p> <ul style="list-style-type: none"> - Building for the pellet plant 	<p>[Actual Inputs from the Moldovan Side] (Concerning Pellet Boilers)</p> <p>Almost as planned. The differences in the plan are as follows:</p> <ul style="list-style-type: none"> - recruitment of boiler operators: <u>operators were recruited at seven of the nine operating sites</u> <p>(Concerning Pellet Plant)</p> <p>Almost as planned. The differences in the plan are as follows:</p>

⁶ It was set up to present an example of the effective use of domestic resources and to give demonstrations.

⁷ (Reference) The introduction cost of the pellet plant (1 unit) was 289 million yen. The total installation cost of the pellet boilers (25 units) was approximately 617 million yen, and the average installation cost per unit was approximately 24.7 million yen.

<ul style="list-style-type: none"> - Pellet transportation equipment (crane, forklift, etc.) - Constructions related to electricity and water supply - Fire prevention/extinguishing equipment - Facilities for operators (showers, toilets, etc.) - Recruitment of operators 	<ul style="list-style-type: none"> - Pellet transportation equipment (crane, forklift, etc.): <u>not implemented</u> - Recruitment of operators: <u>not implemented</u>
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Source: documents provided by JICA, answers to the questionnaire

The actual outputs from the Japanese side and the Moldovan side were generally implemented as planned, although some site changes and delays occurred. The differences between the plan and the actual results will be explained below.

(Inputs from the Japanese Side)

One change from the time of planning is that three local sites (Bubuieci, Pilrita, Siscani) that had planned to introduce pellet boilers became unable to cover the costs required for equipment installation, etc., and these three sites expressed that they would like to decline the offer of introducing the boilers. For this reason, alternative sites (Larga, Cotova, Burlacu) were selected by the executing agency, and JICA approved this decision after confirming the situation. Since the selection was made from the 100 priority sites that were initially listed as candidates at the planning stage, there were no major problems in the reselection or decision-making process⁸.

Regarding the pellet plant, the initial plan was to install it at the National Training Center (hereinafter referred to as “NTC”) in the capital city of Chişinău, however, it was installed at another NTC site, located in Porumbeni village, Criuleni district, about 15 km away. Although the building design permit was granted by the city government of Chişinău, this permit was not subsequently granted, due to the fact that it would violate the Water Area Conservation Law⁹ for rivers, etc. at the stage of applying for the construction permit¹⁰. At the time of the ex-post evaluation, this facility is not operating. The reasons for this, as will be discussed in 3.2.2.2 Project Period, are that it became difficult to secure the required budget for which Moldova was responsible, as a result of the pellet plant construction being delayed; consequently, the plant was

⁸ As will be explained in 3.3.1.1 Quantitative Effects (Operation and Effect Indicators), the baseline and target shown in Table 2 were amended slightly.

⁹ Law No. 440 of the Republic of Moldova (revised in July 2012)

¹⁰ It is worth noting that the authority of the capital city of Chişinău was also not aware that it violated the Water Conservation Law for rivers, etc., and because this was a transition period from the former Soviet Union system, the law was revised repeatedly and its contents were not properly made known to the general public of Moldova. As for the criteria for the site selection, the following factors were considered: having a water supply, drainage and electrical facilities for the pellet plant, being close (about 15 km) to the center of the capital city, Chişinău, being surrounded by corn fields thereby facilitating the securing of raw materials and the fact that various regulations regarding fire-related laws were not particularly strict.

transferred to the NTC. According to the executing agency, the plant has been an asset of the NTC since October 2016 and, as a result, the executing agency cannot be directly involved in the operational policy of a separate entity subordinated to the same Ministry. In addition, according to NTC, there has been no instruction from the Ministry of Agriculture, Regional Development and Environment, which is a higher government agency, to make the plant operational, and the budget for equipment and machinery inputs (around 500,000 euros¹¹), required for starting the operation, had not been allocated at the time of the ex-post evaluation. The NTC also sought a joint venture with a private company, but this was not realized, due to the high input cost. It was also because coordination with related governmental organizations did not materialize. On the other hand, the executing agency has suggested the possibility of budget allocation by patiently working with the Ministry of Agriculture, Regional Development and the Environment and its related organizations; further consultation with each related organization is necessary.

The soft component was planned after the provision of materials and equipment in this project. However, since neither the boiler nor the pellet plant was in operation when the project was completed (January 2016), the staff of the executing agency could not acquire knowledge (promoting understanding of the environmental aspect), and activities, such as pellet boiler management and monitoring, supply chain planning, hands-on training on pellet manufacturing, were not implemented. On the other hand, during the training in Japan, exercise training was conducted by visiting the facility that was actually in operation, and briefing sessions were held for boiler managers.

(Inputs from the Moldovan Side)

Regarding the “recruitment of boiler operators,” we were able to confirm that recruitment was carried out at 7 of the 9 sites where the pellet boiler was in operation, however, we were unable to establish the actual situation in the remaining 2 sites. According to the interviews with the staff of the executing agency and rural sites (target public facilities), the outflow of technology-related human resources from rural to urban areas has been a remarkable social problem in recent years, and it is difficult to secure human resources in Moldova. With regard to “pellet transportation equipment (crane, forklift, etc.)” and the “recruitment of operators,” as discussed above, the pellet plant is not operating, therefore, no procurement or recruitment has been conducted to date.

¹¹ Approximately 67 million yen, based on the exchange rate at the time of the ex-post evaluation



Photo 1: Heating system utilizing pellet boiler (Kindergarten/cultural facility in Furceni)



Photo 2: Exterior of pellet boiler building (Branesti)



Photo 3: (left) Pellet plant building, (center) Pellet manufacturing equipment, (right) Inside the pellet plant

3.2.2 Project Inputs

3.2.2.1 Project Cost

Regarding the total cost of this project, the initial plan was approximately 1,276 million yen (of which 1,159 million yen was to come from the Japanese side and approximately 117 million from the Moldovan side). The actual total cost is approximately 1,181 million yen (of which approximately 1,025 million came from the Japanese side and approximately 156 million yen from the Moldovan side), which was within the plan (approximately 93%). The cost actually borne by the Moldovan side exceeded the initial plan, as 11 of the 24 rural public facilities, targeted by this project, refused to pay the incidental cost¹² (mainly the cost relating to the

¹² The reason why the rural sites could not secure the budget for the construction work they were supposed to cover is that law was revised during the project implementation; the Ministry of Education instead of the village became the

connection between the boiler and the heat source facility) and, as a result of the coordination, it was decided that the executing agency bear the cost¹³. Although there was a rough agreement on the cost burden between the target public facilities in rural areas and the executing agency before the start of this project, the amount to be borne by the target public facilities was not clear. Regarding the cost burden, it was desirable to establish an agreement between the concerned parties before the start of the project.

3.2.2.2 Project Period

This project was planned to be implemented between June 2013 and March 2015 (22 months). The actual project period was June 2013–January 2016 (32 months), which was longer than planned (approximately 145% of the plan). The main reason for this was the delay in procurement and installation of some of the pellet boilers. As previously discussed, it took time to coordinate with the executing agency in relation to the incidental cost (mainly the cost relating to the connection between the boiler and the heat source facility) at 11 of the 24 rural sites¹⁴. Nevertheless, overall, it cannot be said that there was a significant delay; the outputs were implemented generally as planned. Therefore, this does not significantly impair the efficiency aspect of this project.

Based on the above, although the project outputs were generally as planned and the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair.

one to allocate budgets for elementary school facilities. To be more specific, in the original plan, boilers were installed at elementary schools and kindergartens with the village budgets, thus as of 2013 when the bid for this project was made, the village mayors were the contractors. However, due to the law revision in 2014, it became the Ministry of Education that would allocate budgets for elementary schools. For this reason, in areas where elementary school and the village mayor were not on good terms or support for the pellet boiler diminished due to change of village mayors (where mayors preferred gas boilers due to the decrease in gas price), the sites were less motivated to allocate budgets for the construction work that they were supposed to bear. In addition, according to the executing agency, some rural sites (target public facilities) were financially unable to bear the cost.

¹³ JICA has approved the use of the 2KR counterpart fund and the executing agency spent a total of approximately 3.58 million Moldovan leu (hereinafter referred to as “MDL”) (approximately 23.7 million yen, converted by 1 MDL = 6.63 yen, an average exchange rate during the project implementation period).

¹⁴ JICA monitored the situation regularly and was in agreement each time.



- | | | |
|---------------|---------------|-------------|
| 1. Furceni | 4. Cricova | 7. Copaceni |
| 2. Branesti | 5. Varzaresti | 8. Mateuti |
| 3. Chiperceni | 6. Cimislia | 9. Larga |

Figure 1: Locations of project sites
 (Locations of the pellet boilers that were operational at the time of the ex-post evaluation and the pellet plant)

3.3 Effectiveness and Impacts¹⁵ (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Table 2 shows the quantitative effect indicators (baseline, target, actual) of this project.

Table 2: Quantitative Effect Indicator of This Project (Baseline, Target, Actual)

Indicator	Baseline 2012	Target 2018 3 Years After Completion	Actual		
			2018 2 Years After Completion	2019 3 Years After Completion	2020 4 Years After Completion
1) Heating Cost of Target Facilities	6,753,361 MDL → After the site change 6,858,160 MDL *7 sites that were operational at the time of the ex-post evaluation (calculated): 1,354,607 MDL*Note 1	5,602,845 MDL → After the site change 5,666,313 MDL (-17% of the Baseline) *7 sites that were operational at the time of the ex-post evaluation (calculated): N/A	- *7 sites that were operational at the time of the ex-post evaluation: 1,087,355 MDL (approx. 20% less than the baseline)	- *7 sites that were operational at the time of the ex-post evaluation: 1,113,739 MDL (approx. 18% less than the baseline)	- *7 sites that were operational at the time of the ex-post evaluation: N/A*Note 2
2) Job Creation	Total 24 people → After the site change 27 people in total *7 sites that are operational at the time of the ex-post evaluation (calculated): total 9 people * Note 1	Total 50 people (On average 0.96 persons per site increase from the baseline) *7 sites that are operational at the time of the ex-post evaluation (calculated): N/A	- N/A	- N/A	- *7 sites that are operational at the time of the ex-post evaluation: total 14 people (On average 0.71 persons per site increase from the baseline)

Source: documents provided by JICA (baseline, target), answers to the questionnaire (actual)

Note 1: as at the time of the ex-post evaluation (June 2021), we have acquired data for seven of the nine operational sites. The plan figures were calculated from these data.

Note 2: the heating cost for 2020 was not included, as it had not been calculated by the Moldovan side at the time of ex-post evaluation (June 2021).

¹⁵ Sub-rating for Effectiveness is to be put with consideration of Impacts.

The effectiveness/quantitative indicators set at the time of planning were: 1) heating cost of the target facilities and 2) job creation. The target year was set at three years after the project completion. As explained in 3.2.1 Project Outputs under Efficiency, the baseline and target of the heating cost changed because the three target sites were changed after commencement of the project.

In this evaluation study, we aimed to acquire actual data for the recent three years (2018–2020) through the questionnaire and field surveys. We subsequently discovered that the boilers were operational at 9 (kindergarten/school, etc.) of the total 24 sites, excluding the demonstration boiler at the time of the ex-post evaluation. According to the executing agency, this is because the price of natural gas declined in 2018 and since then, gas heating facilities have become cheaper to operate and maintain than biomass, as a result of which pellet boiler use did not begin immediately, consequently delaying the start of the operation. Another reason is that 11 of the total 24 sites (each target public facility) could not bear the cost of switching from the existing heating system, therefore, coordination took time¹⁶. The pellet boilers at these 11 sites had been prepared for operation during the period December 2020–March 2021 and are expected to be used this winter (2021/2022). The remaining 4 sites are refraining from using pellet boilers, due to the cost advantage of using natural gas. On the other hand, it was confirmed through the questionnaire and field surveys that the executing agency and the target public facilities, other than the 4 sites, understood the need to establish an alternative means of heating in preparation for situations, such as soaring natural gas prices, and had, therefore, not postponed the situation, meaning that they were preparing for the operation.

With regard to the quantitative effects, it is necessary to verify these effects, based on the operation results of all 24 sites. However, as previously discussed, most of the sites are “under preparation” at the time of the ex-post evaluation, hence it is necessary to note the constraint that the verification of actual data is not easy at the time of the evaluation work. Therefore, it was judged to be appropriate to verify the effects by limiting these to the sites where the actual data were recorded (boilers that are operational at the time of the ex-post evaluation), and by comparing the actual data with the baseline and target values of these sites. Although 9 sites were operational, only 7 sites actually measured and recorded the data relating to the quantitative effects. Therefore, this evaluation study verified the values of these 7 sites.

¹⁶ Eventually, it was decided that the executing agency would bear the entire cost.

Regarding the 1) heating cost of the target facilities, as shown in Table 2, the target value set at the time of planning was the sum of all sites, and it was expected that the cost would be 17% less than the baseline value. As for the 7 sites where the data are available, the actual cost was 20% less (2018) and 18% less (2019) than the baseline; the reduction rate exceeded the target. Although data acquisition was limited, it can be said that the expected effect was achieved at the facilities where the pellet boilers are operational. The reason for this reduction is that the sites that previously used coal, firewood and electric heating had introduced the pellet boilers, that are advantageous in terms of cost effectiveness.

With regard to 2) job creation, the total baseline value for the 24 regional sites was 27 people; the target was 50 people, meaning that the number of people was expected to increase by approximately 0.96 persons per site. According to the questionnaire and interviews with the executing agency, etc., the total baseline value for the 7 sites, where data were available, was 9 people and the actual value at the time of the ex-post evaluation was 14 people or an increase of 5 people. In other words, the number increased by 0.71 persons per site on average, which is slightly below the target¹⁷. According to the executing agency, the main reason is the difficulty of securing human resources in rural areas. Another factor was pointed out that the work of heating system operators is limited to winter, and that their income is not stable throughout the year. In addition, it was suggested that the more skilled the person is, the more likely he/she is to migrate to the cities or even outside Moldova. Comparing the initial plan with the actual results, one cannot say that the target has been achieved as described above, however, the number of staff has increased. Nevertheless, each target public facility should continue to devise and make efforts to secure human resources.

3.3.1.2 Qualitative Effects (Other Effects)

By introducing facilities and equipment such as pellet boilers through this project, an alternative to coal/wood/gas/electricity has been established in Moldova. Pellet boilers are utilized at facilities, such as kindergartens and schools, as a means of securing heating during winter, without being affected by trends in natural gas prices, etc. Although there are certain sites where gas boilers are given priority at the time of the ex-post evaluation due to the reduction in the

¹⁷ At the time of planning, the number of staff was expected to increase (by 2 people per site) at the rural sites (target public facilities) which were switching from gas to pellet boilers, while staff numbers were expected to decrease (by one person per site) at the sites switching from coal to pellet boilers. In reality, 5 of the 7 sites switched from electricity/gas to pellet boilers; staff numbers increased by 3 people at one site, that switched from electricity, while the numbers increased by one person per site at the 4 sites which switched from gas boilers.

natural gas price in 2018, there was also a comment from on-site staff that they were convinced that the pellet boiler was safer¹⁸. As explained in 3.3.1.1 Quantitative Effects, heating costs have reduced at each target public facility, where coal/wood/electricity had previously been used. Considering the safety aspect, it can be said that this project has played a role in improving the heating environment within public facilities in rural areas.



Photo 4: Connection pipes of pellet boiler (Kindergarten in Cricova)



Photo 5: Pellet fuel before use (Primary school in Chiperceni)

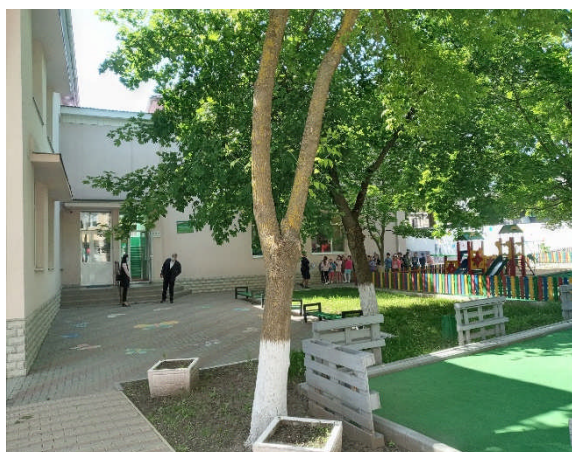


Photo 6: Kindergarten where pellet boiler has been installed (Cricova Kindergarten)



Photo 7: Learning room where pellet boiler heating equipment is installed (Mateuti Kindergarten)

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impact observed at the time of the ex-post evaluation will be explained from the following

¹⁸ There was a comment, “In the gas boiler room there are many dead insects, whereas they are alive in the pellet boiler room. For this reason, I feel the pellet boiler is a safer and more environmentally friendly system than gas.” According to the executing agency, after 2020, public institutions have increasingly faced financial constraints, due to the influence of COVID-19 in Moldova, and facilities tend to operate by giving more weight to cost advantage than environmental/social benefits. At facilities where both pellet and gas boilers are available for use, the latter tends to be prioritized, and one cannot exclude the possibility that the operation of pellet boilers depends on the trends of gas prices.

four perspectives.

Improving the Living and Learning Environment in Rural Communities

Before the implementation of this project, inefficient/non-practical means of heating¹⁹ were observed in at least 7 sites. However, it was confirmed through the questionnaire and interviews with the executing agency and the rural sites (each target public facility) that the use of efficient and safe heating systems became possible by introducing pellet boilers through this project, and as a result, the learning environment has improved²⁰.

Diversifying Energy Sources

It was confirmed that the introduction of pellet boilers is contributing to the diversification of energy sources and is reducing the risk of dependence on imported energy in Moldova.

Greenhouse Gas (CO₂) Reduction

At the time of planning and based on the assumption that all 24 boilers would be operational, excluding one demonstration boiler, it was estimated that 5,629.2 tons of CO₂ emissions would be reduced annually. At the time of the ex-post evaluation, considering that only 9 of the 24 boilers are operational, the annual CO₂ emission reduction is estimated to be approximately 2,111 tons²¹. On the other hand, 11 sites are scheduled to become operational this winter (2021/2022), after which the annual CO₂ emission reduction is estimated to be approximately 4,691 tons²² (more than 80% of the initial plan is expected to be achieved).

Awareness of Renewable Energy and Biomass

In the interviews with each target public facility, it was observed that they were familiar with the existence of renewable energy, the raw materials for biomass and how to use them. Specifically, those interviewed were aware of the situation and the risks of Moldova being over-dependent on gas, coal and oil, the existence of biomass as an abundant natural resource in the country and the fact that its utilization would be beneficial to the nation.

From the above, it can be said that this project is playing a role in improving the learning

¹⁹ Wood-burning fireplaces, very expensive electricity, gas equipment from the 1970s and 1980s, aging coal heating, etc.

²⁰ In this evaluation study, interviews were conducted at the target sites of this project (sites in operation at the time of the ex-post evaluation: eight sites, total 14 people) to capture the following: “changes in knowledge and awareness regarding renewable energy and biomass utilization,” “changes in the spread and promotion of pellet production and pellet boilers in Moldova,” the “improvement status of living and learning environments in rural communities as a result of this project,” “the negative impact on the natural environment, voices of residents regarding resettlement and land acquisition, etc.”

²¹ The formula is $5,629.2 \text{ tons} \div 24 \times 9$

²² The formula is $5,629.2 \text{ tons} \div 24 \times 20$

environment in rural areas, strengthening the energy supply system, raising awareness of renewable energy and biomass, and ultimately raising the environmental awareness of the residents.

3.3.2.2 Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project was classified as Category C, as it did not fall under the vulnerable sectors/characteristics or vulnerable areas listed in *JICA's Guidelines for Environmental and Social Considerations* (promulgated in April 2010), and the undesired impact on the environment was judged to be minimal. In addition, according to Moldova's Environmental Impact Assessment (hereinafter referred to as "EIA") law and European Union standards, heat supply plants (or pellet boilers), with a calorific value of less than 300 MW, were not subject to EIA implementation and EIA was not required for this project.

Through the questionnaire and interviews with the executing agency and the target public facilities (9 sites) visited, it was confirmed that there was no particular impact on the natural environment (air pollution, noise/vibration, impact on the ecosystem, etc.) during project implementation and after completion. It was also confirmed that there were no claims or complaints regarding noise, vibration, etc. from the residents around the pellet boiler facilities.

The environmental monitoring of this project was the responsibility of the construction supervision consultant during the project implementation. After completion, it is carried out according to the law in Moldova; based on the Moldova Government Decree No. 548 and 549, the Environmental Protection Inspectorate and the Environmental Agency are responsible for environmental monitoring. Should there be any negative environmental impact (impact on the surrounding environment), it is the responsibility of the executing agency to report this immediately to both organizations. However, no serious incidences of this had been reported at the time of the ex-post evaluation.

2) Resettlement and Land Acquisition

It was confirmed through the questionnaire and interviews with the executing agency that there was no resettlement or land acquisition related to this project in any of the rural sites.

[Summary of Effectiveness and Impacts]

In Moldova, the natural gas price declined in 2018, and gas boilers become more cost effective

than biomass. For this reason, gas boilers tend to be prioritized at the time of the ex-post evaluation. While a total of 20 pellet boilers are planned to be operational this winter (2021/2022), only 9 boilers (9 sites) are operational at the time of the ex-post evaluation. As a result, it can be said that there are constraints with regard to reviewing the results of effectiveness/quantitative effects. However, 1) the reduction in heating costs exceeded the target and 2) job creation slightly underachieved the target. The project began on the assumption that dependence on pellet boilers would increase, due to soaring natural gas prices at the time of planning. At the target sites of this project, an environment was established in which a means of heating, cheaper than coal/wood/electricity, could be used during winter, without being influenced by the trends of imported energy prices. Although the reduction in greenhouse gas emissions (estimated value) is limited, the fact that the benefits of using renewable energy that makes effective use of agricultural waste is well known and promoted, and that it is also contributing to the country's energy security, demonstrates the impact is not necessarily low. Based on the above, this project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

3.4 Sustainability (Rating: ②)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

At the time of planning, the executing agency was the 2KR Project Implementation Unit (hereinafter referred to as "2KR-PIU") of the Ministry of Agriculture and Food Industry. However, based on the Government Decision No. 594 of July 2017, it was restructured and the Ministry of Agriculture, Regional Development and Environment²³ was created. Subsequently, the 2KR-PIU was reorganized as the Agency for Development and Modernization of Agriculture (ADMA), a governmental body, based on the Government Decision No. 536 of June 2020. Therefore, the executing agency at the time of the ex-post evaluation is ADMA. The staff engaged in the planning and implementation of this project at 2KR-PIU are not working in ADMA at the time of the ex-post evaluation.

It is the representative of the local authority (e.g., the mayor) that is responsible for the operation and maintenance of the facility and equipment, introduced at each target public facility (rural sites). On the other hand, as discussed in 3.2.1 Project Outputs under Efficiency, the NTC is responsible for the operation and maintenance of the demonstration pellet boiler and the pellet

²³ As supplementary information, the ministries and agencies were reorganized on August 12, 2021, and the Ministry of Agriculture, Regional Development and Environment was reorganized to become the Ministry of Agriculture and Food Industry.

plant at the time of the ex-post evaluation. Table 3 shows the organizational structure of each operation and maintenance.

Table 3: Organizational Structure of Each Operation and Maintenance at the Time of the Ex-Post Evaluation

	Pellet Boiler	Pellet Plant
Who is Responsible for the Operation and Maintenance	- 24 boilers: representative of the local authority (e.g., the mayor) - Demonstration boiler: NTC	- NTC
Who owns the Facility	- 24 boilers: each target public facility (facility manager, such as school director) - Demonstration boiler: NTC	- NTC
Who Actually Operates	- 24 boilers: operators hired by each target public facility - Demonstration boiler: operators of an organization, commissioned by NTC	- NTC
Who Bears the Cost of the Operation and Maintenance After Completion	- 24 boilers: budget of each target public facility - Demonstration boiler: NTC	- NTC

Source: answers to the questionnaire

At the time of the ex-post evaluation, 9 of the pellet boilers introduced by this project are operational. In this evaluation study, through the questionnaire with the executing agency, interviews at each target public facility and site visits, it was confirmed that the number of operators working at the sites where the boilers had been installed, was mostly sufficient. Operators are engaged in daily maintenance work, such as cleaning, inspection and maintenance, while technically specialized companies attend to more specialized maintenance work. As discussed in 3.3.1.1 Quantitative Effects under Effectiveness, preparations for operating the boilers, that were not yet operational at the time of the ex-post evaluation have been completed, including the inspection, operation structure and personnel aspect; operation of the boilers is planned to commence this winter (2021/2022).

With respect to the pellet plant, NTC, the owner of the plant, has not recruited any operation or maintenance staff. As discussed in 3.2.1 Project Outputs under Efficiency, this is because the budget required for operating the plant has not been secured. After the restructuring of Moldova's governmental organizations, the non-operational situation has not been resolved at the time of the ex-post evaluation. Although the NTC attempted to find a solution by collaborating with a private company, this did not materialize, as the plant has been constructed on a large scale and the cost

aspect was viewed as prohibitive²⁴.

Based on the above, it can be said that certain issues exist in relation to the institutional/organizational aspect of the operation and maintenance of this project.

Conversely, it was confirmed by the questionnaire and the interviews that the pellets used as fuel for the pellet boilers have no issues in terms of quality and that the supply system in Moldova is in place. According to the executing agency, pellets are sold at around 3,000 to 4,000 MDL per ton (around 19,800 to 26,400 yen), and these have been sold at a generally stable price over the last 4 to 5 years; moreover, there is no problem with the supply system. On the other hand, the natural gas in circulation is easily affected by international prices, and the possibility of soaring prices cannot be ruled out in the future. From that point of view, one can say that boilers fueled by pellets that can be procured domestically, the prices of which are relatively stable, are important as an alternative means of heating for gas boilers and are indispensable in terms of maintaining the heating supply system in the country. If the pellet plant becomes operational, the stability of the pellet supply system will increase, and its price may decrease further.

3.4.2 Technical Aspect of Operation and Maintenance

By the time this project was completed, the contractor had distributed 2 copies of the maintenance manual for pellet boilers to each target public facility, 3 copies to the executing agency and 5 copies to the pellet plant. The manual is used at each site as required for maintenance.

During the implementation of this project, operation and maintenance training (soft component training) was conducted at each target public facility when the pellet boiler was introduced. According to the executing agency, it was beneficial for each person to be involved in the preparation of the operation and to deepen their level of knowledge accordingly. At each facility where pellet boilers have been introduced, on-the-job training (OJT) related to the operation and maintenance work is conducted when new staff are hired.

Regarding the above, it is considered that there are no particular problems in relation to the technical aspects of the operation and maintenance of this project.

3.4.3 Financial Aspect of Operation and Maintenance

Table 4 shows the maintenance costs for the non-operating pellet plant and demonstration boiler.

²⁴ According to the NTC, it is difficult to solve this problem without instructions or budgetary measures from the Ministry of Agriculture, Regional Development and the Environment.

The expense is limited to maintenance, inspection and electricity bills, necessary to prevent the facilities from aging. The NTC allocates a budget and spends it every year. The electricity bill in 2020 decreased from the previous year, as the winter of 2020 was relatively warm.

Table 4: Maintenance Costs for the Pellet Plant and Demonstration Boiler

(Unit: MDL)

	2018	2019	2020
Raw Material	0	0	0
Marketing Cost	0	0	0
Salary/Labor	0	0	0
Electricity	22,469	25,468	14,128
Spare Parts	0	0	0
Maintenance Service	171,000	180,000	180,000

Source: document provided by the executing agency

Table 5 shows the maintenance cost of each target public facility that manages the pellet boiler (cost per boiler).

Table 5: Maintenance Cost of Each Pellet Boiler*Note

(Unit: MDL)

	2018	2019	2020
Pellet Purchasing Cost	30,000–135,370	30,000–115,571	30,000–78,036
Electricity	2,465–24,000	2,465–39,000	2,465–24,000
Maintenance (average)	500	800	1,300
Salary	15,126–16,930	14,981–17,038	13,170–19,248

Source: documents provided by the executing agency

Note: there is a range depending on the expense item. This is because the output was selected according to various conditions, such as the number of users in each facility and the floor area, and the boiler capacity differs accordingly.

Regarding each expense item, the executing agency commented, “the operation and maintenance costs required for the last 3 years may not be large, but we think we have secured the minimum necessary level.” The maintenance cost (average cost) exhibits an increasing trend towards 2020, but this amount is small compared to the overall maintenance cost. While there were 3 sites that did not spend maintenance costs, we confirmed that the minimum amount required for problems and their related repairs was spent. As previously mentioned, after 2020, COVID-19 caused financial concerns in Moldova, and the executing agency has suggested that it may not be easy to secure budgets in the future. Nevertheless, there are no particular concerns at the time of the ex-post evaluation.

Based on the above, there are no major concerns regarding the operation and maintenance costs of the facility and equipment currently in use. On the other hand, it will be necessary to monitor

the financial changes affected by COVID-19 in the future.

3.4.4 Status of Operation and Maintenance

Regarding the operating status of 9 pellet boilers, it was confirmed by the questionnaire and site inspections that there were no problems at the time of the ex-post evaluation. Some boilers experienced operational problems after the project was completed, however, quick fixes and repairs were carried out promptly. If necessary, facilities and equipment are repaired and replaced by specialized companies. Although the pellet plant is not in operation, maintenance and inspections are conducted to prevent aging.

Regarding spare parts, there are no cases where boilers are non-operational due to shortage of spare parts at the time of the ex-post evaluation. However, it is necessary to maintain a system that will enable smooth procurement in the future.

Therefore, it would appear that there are no particular problems as regards the operation and maintenance status of the pellet boilers in operation. At the same time, the pellet boilers that are scheduled to start operating from this winter (2021/2022) need thorough maintenance and inspections, as well as continuous operation checks to ensure a steady operation²⁵.

Some minor problems have been observed in terms of the institutional/organizational aspects. Therefore, sustainability of the project effects is fair.



Photo 8: Poster regarding biomass fuel utilization (Kindergarten/culture facility in Branesti)



Photo 9: Stored pellet fuel (Vazaresti Kindergarten)

²⁵ It was confirmed via the questionnaire and interviews, held at the relevant public facilities, that the pellet boilers are maintained in such a way that they could be rolled out smoothly, should the need arise to switch from gas boilers.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to reduce energy cost and enable sustainable operation of heating facilities at public facilities (mainly education facilities such as primary schools) in Moldova by introducing pellet boilers and pellet plant, thereby contributing to the improvement in the living environment of the residents. The *Energy Strategy of the Republic of Moldova until 2020* and the *National Development Strategy Moldova 2030*, formulated by the government of Moldova, advocate improving energy utilization efficiency and reducing energy consumption through biomass fuel and renewable energy. They recognize biomass fuel as a beneficial alternative to natural gas and indispensable for the country's stable energy supply. The project is also in line with Japan's assistance policy and is therefore highly relevant. Regarding efficiency, although the output was generally as planned and the project cost was within the planned budget, the project period was slightly longer than planned as it took time to agree on the pellet boiler connection cost between the executing agency and some local target sites. Therefore, efficiency is fair. With regard to effectiveness, as a result of the decline in natural gas prices since 2018, gas heating tends to be prioritized in the country. As a result, only 9 of the 24 pellet boilers installed in rural areas are in operation at the time of ex-post evaluation. For this evaluation study, targets and actual results were available at 7 of the 9 operating sites; data required to analyze quantitative effects were limited. Keeping this in mind, 1) the heating cost reduction is above the target and 2) job creation was slightly below the target. On the other hand, a means of heating that is cheaper than coal, firewood and electricity, and safer and more environmentally friendly than natural gas, is secured, and heating can be used in winter regardless of the price trend of imported energy in the target areas of this project. The non-operational pellet boilers are scheduled to operate in the future, while the fact that renewable energy makes effective use of agricultural waste is widely known and promoted, and the project is contributing to the diversification of energy sources (energy security) in the country. Therefore, overall, the effectiveness and impacts are judged to be fair. Regarding sustainability, 9 operational pellet boilers have no breakage or malfunctions and 11 non-operational pellet boilers have been connected and are ready for operation from this winter (2021/2022). Thus, no problems are observed in the institutional, technical or financial aspects of operation and maintenance. However, there is no prospect for the operation and utilization of the pellet plant and the demonstration pellet boiler, and concerned parties need to discuss the solution. Therefore, the sustainability of the effects generated by this project is fair.

In light of the above, this project is evaluated to be partially satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- In October 2016, the then Ministry of Agriculture and Food Industry transferred the ownership of the pellet plant from the executing agency, and as a result, NTC became responsible for the operation and maintenance of the introduced pellet plant and the demonstration pellet boiler. The facilities have not been made operational because there is no clear instruction or budget allocation from the Ministry of Agriculture, Regional Development and Environment, the upper supervisory authority. It is recommended that the executing agency, NTC and the Ministry of Agriculture, Regional Development and Environment discuss patiently and develop specific measures to be taken so that the facilities become operational. This is because the introduction and steady operation of these facilities will not only improve the heating environment but will also accelerate the effects of CO₂ reduction, diversification of energy sources and use of renewable energy.
- Regarding the 11 pellet boilers that are expected to become operational from this winter (2021/2022), it is recommended that the executing agency and the local sites responsible for operation and maintenance (each public facility) coordinate closely to ensure regular maintenance inspections are performed and the operation status is checked.
- At the time of the ex-post evaluation, gas boilers are in use at 4 sites, because gas boilers are more cost effective than pellet boilers. However, assuming that the price of natural gas may rise and the pellet boiler may have an advantage in the future, it is recommended that the executing agency and local sites (each public facility) make the necessary preparation so that the pellet boilers can be operational as soon as the need arises.

4.2.2 Recommendations to JICA

- With regard to the non-operating pellet plant and the pellet boilers that are expected to be operational in the future, JICA is advised to regularly check the situation with the executing agency and make a formal request as necessary, in order to prevent the loss of project benefits.

4.3 Lessons Learned

Need for Clarification on Cost Bearings Regarding the Facility Operation and Consensus Building Between Both Parties

- At 11 locations of the pellet boilers introduced, local sites (each public facility covered by this

project) refused to pay the incidental cost (mainly the cost related to the connection between the boiler and heat source facility). As a result, it took considerable time to coordinate and the project's progress was affected. This was because agreements were initially reached without clearly indicating the cost to be borne by each public facility. It was also affected by the fact that there was a system reform which changed the responsibilities of bearing the project fund in 2014, after this project began. The executing agency and the local sites should have clearly agreed on the approximate amount of cost to be borne and the project implementation schedule before the start of the project. For future similar projects, if there are multiple project sites and parties responsible for operation and maintenance, mutual understanding and clear agreements should be exchanged among the concerned parties. In case of system changes, a thorough measure such as reviewing the contents of the agreement and re-agreement should be taken promptly.

Need to Minimize the Risk of Unused Facilities and Equipment Due to Changes in the Operation and Maintenance System

- At the time of planning, the idea was to install a pellet plant on the premises of the executing agency and manufacture pellets that would be used as fuel by the pellet boilers to be installed. However, as discussed above, the responsibility for operation and maintenance changed from the executing agency to NTC. The budget required for operation has not been allocated and the facility has not been utilized until the time of the ex-post evaluation. For future similar projects, if it is anticipated that the introduced output may not be used, it is advisable that the assistance provider continues to collect information on a regular basis without waiting for a formal ex-post evaluation. At the same time, in the event of a major change in ownership or the operation and maintenance system of the introduced output, the recipient country should immediately notify the assistance provider of the change, even after the project is completed. It is desirable for both sides to work diligently to build such a system.