



Validation Report

Reference Number: PVR–186

Project Number: 33443

Loan Number: 1924

November 2012

People's Republic of China: Efficient Utilization of Agricultural Wastes Project

Independent Evaluation Department
Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
DMF	–	design and monitoring framework
EEMP	–	energy and environmental monitoring plan
GEF	–	Global Environment Facility
PCR	–	project completion report
PIO	–	project implementation office
PMO	–	project management office
PRC	–	People's Republic of China

NOTE

In this report, "\$" refers to US dollars.

Key Words

agricultural waste, agriculture, asian development bank, evaluation, lessons, people's republic of china, technology, utilization, validation

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PROJECT BASIC DATA

Project Number:	33443	PCR Circulation Date:	16 Dec 2010	
Loan Number:	1924	PCR Validation Date:	Nov 2012	
Project Name:	Efficient Utilization of Agricultural Wastes Project			
Country:	People's Republic of China (PRC)		Approved (\$ million)	Actual (\$ million)
Sector:	Agriculture	Total Project Costs:	77.27	83.55
ADB Financing (\$ million)	ADF: 0	Loan:	33.12	32.78
	OCR: 33.12	Borrower:	37.79	44.20
		Beneficiaries:		
		Others:		
Cofinancier:	Global Environment Facility (GEF)	Total Cofinancing:	6.36	6.25
Approval Date:	22 Oct 2002	Effectiveness Date:	16 Jun 2003	16 Jun 2003
Signing Date:	18 Mar 2003	Closing Date:	30 Jun 2008	23 Aug 2010
Project Officers:	T. Qadri L. Adriano B. Wilkinson Q. Zhang Y. L. Feng	Location:	ADB headquarters ADB headquarters ADB headquarters ADB headquarters	
Validators:	C. Dingcong, Consultant F. De Guzman, Evaluation Officer, IED2	Peer Reviewer:	A. Brubaker, Evaluation Specialist, IED1	
Quality Reviewer:	R. Sabirova, Evaluation Specialist, IED1	Director:	W. Kolkma, IED1	

ADB = Asian Development Bank, ADF = Asian Development Fund, IED1/2 = Independent Evaluation Department (Division 1/2), PCR = project completion report, OCR = ordinary capital resources.

I. PROJECT DESCRIPTION

A. Rationale

1. Large quantities of agricultural waste were being disposed of inappropriately in the People's Republic of China (PRC). This energy and nutrient resource could have added value to integrated farming systems, reduced farm input costs, and provided opportunities for integrated pest management and organic farming techniques. Also, a clean energy source like biogas digesters was developed to reduce the farm households' dependence on coal, straw, and firewood for heating and cooking, thus promoting a cleaner environment, improved health from reduced air pollution, and lesser stress on forest resources. Integrated agricultural production systems with biomass technology have proven effective in generating cleaner and renewable energy that improves the environment and the quantity and quality of farm outputs.

2. However, biomass technology faced numerous constraints and barriers, for mass adoption, particularly in rural areas. These barriers included a shortage of credit facilities, weak institutional and technical expertise, inadequate service infrastructure, lack of environmental awareness, and very few incentives. Farmers were facing constraints in obtaining access to credit for the adoption of biomass-based renewable energy systems that could be integrated with existing farming practices. Interest rates in the PRC at that time were set below market rate

levels, creating excess demand within which rural investments received low priority. As a consequence, farmers were not able to access longer term loans for rural capital investments with the grace period that would have given them the time required to generate a positive cash flow. The commercial financial institutions and banks were not certain about the viability of biogas systems and did not provide longer term credit to many small farmers.

B. Expected Impact

3. The project¹ design and monitoring framework (DMF) indicated the following project expected goals and/or impacts: (i) environmental improvement, and (ii) promotion of sustainable agricultural production to enhance economic growth and to improve welfare and living conditions in disadvantaged areas in Henan, Hubei, Jiangxi, and Shanxi provinces. The performance indicator for the first targeted impact was improved quality of air, soil, and water. For the second expected impact, performance targets were: (i) increased supply of clean renewable energy and improved quality of agricultural inputs, and (ii) expanded rural production and decreased number of households living below the poverty line.

C. Objectives or Expected Outcomes

4. Intended outcomes as indicated in the DMF were as follows: (i) demonstration of economic viability of sustainable biomass technology for efficient utilization of agriculture waste to generate clean, renewable energy and private sector participation; and (ii) enhanced agricultural productivity and rural income through recycling of biomass resources and reduced poverty. However, during the midterm review, performance targets and/or indicators for these outcomes were revised. For outcome (i), sustainable incremental annual production of: (a) 41 million cubic meters (m³) of biogas per producer of renewable energy revised to 13.1 m³ of biogas renewable energy; (b) 289,780 pigs to 355,150 swine; (c) 882 tons of green vegetables to 2,291 tons; (d) 209,280 tons of citrus fruit to 173,278 tons; and (e) 645,952 tons of digested effluent/sludge (organic fertilizer) to 738,712 tons. For outcome (ii), the indicators were as follows: (a) sustainable annual incremental environmental benefits estimated in reducing 78,338 tons of carbon dioxide (CO₂) to 84,429 tons, and annual treatment of over a million tons of agricultural wastes (pig manure, crop residues, vegetable waste, etc.) to over 738,712 tons resulting in improved air and groundwater quality; and (b) increased incomes and quality of life for about 34,080 households including about 9,000 poor household families, to 21,425 households.

D. Components and Outputs

5. The project had six components: (A) funding for renewable energy generation and eco-environment development, (B) improvement in mechanisms for biomass technology transfer, (C) rehabilitation of farmers' selected farm-to-market facilities; (D) improvement in environment policy implementation and awareness, (E) pilot poverty-focused approaches for biomass development, and (F) improvement in project implementation and capacity development.

6. Component A was to develop a viable, sustainable, and replicable financing model and organize and provide credit through subloans to rural households and medium-scale enterprises

¹ ADB. 2002. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Efficient Utilization of Agricultural Wastes Project*. Manila.

for integrating biomass-based renewable energy systems into existing farming practices.² Component B was to address technical barriers to adopting biomass technology by training biogas contractors, technicians, and project beneficiaries in applying the technology for biogas production. Component C was to rehabilitate rural roads and bridges to link agricultural production areas to the urban markets. Component D was to help remove institutional barriers to promoting and expanding biomass technology adoption for environmental improvement and public awareness. Component E was to remove constraints to participation by large numbers of poor farmers in rural areas, while component F was to provide consulting services to strengthen technical support and coordination, and improve the capability of the implementing agencies.

E. Provision of Inputs

7. The Asian Development Bank (ADB) provided a loan of \$33.1 million to finance component A. The Global Environment Facility (GEF) grant of \$6.361 million financed components B, D, E, and F, while the government financed component C. Project expenditures were \$83.23 million, exceeding the estimated amount of \$77.27 million at appraisal, largely due to cost increases under component A and additional activities undertaken under components B and C. Planned inputs and/or activities were (i) funding for renewable energy generation and eco-environment development; (ii) improvement in mechanisms for biomass technology transfer; (iii) rehabilitation of farm-to-market facilities; (iv) improvement in environmental policy implementation and awareness; (v) introduction of pilot poverty-focused approaches to biomass development; and (vi) improvements in project implementation and capacity development.

F. Implementation Arrangements

8. The executing agency for the project was the Ministry of Agriculture through its Foreign Economic Cooperation Center at the national level, and the provincial governments of Henan, Hubei, Jiangxi, and Shanxi, through their departments of agriculture at the provincial level. The project management office (PMO) was established in the Ministry of Agriculture and the project implementation offices (PIOs) set up in the four project provinces. The implementation arrangements at appraisal were followed throughout project implementation. Most of the loan covenants were complied with on time. One covenant yet to be complied with was the PIO's submission of environmental assessment reports 1 year after project completion. The project completion report (PCR) indicated that no major problems were encountered in the recruitment of consultants and procurement. This validation endorses the PCR findings and observes that the overall performance of the consulting firm, research institutions, and individuals was generally satisfactory despite a few delays (para. 16).

II. EVALUATION OF PERFORMANCE AND RATINGS

A. Relevance of Design and Formulation

9. The PCR³ considered the project *highly relevant* because of its support for the government's rural development strategies, especially on increasing agricultural productivity,

² Component A biogas technologies: The type I system, a 4-in-1 model eco-farm, combined a greenhouse and pig raising in an integrated system comprising a pigpen, greenhouse, vegetable crops, and a biogas digester. The type II system, a 3-in-1 model eco-farm, combined pig raising and a biogas digester with an orchard, crops, or fish pond. The type III system was to pilot medium-scale plants in commercial livestock farms. The type IV system was the straw gasification plants.

³ ADB. 2010. *Project Completion Report: Efficient Utilization of Agricultural Wastes in People's Republic of China*. Manila.

reducing poverty in rural areas, and reversing environmental degradation. In particular, the Renewable Energy Law of the People's Republic of China and its amendments in 2009 addressed the need for developing rural household biodigesters. The Circular Economy Promotion Law of PRC adopted on 1 January 2009 encouraged the use of agricultural waste in eco-farming to produce green energy. The project was strongly aligned with the government's environmental policy. The project financed the construction of household biodigesters and the integration of biogas generation with farmers' livelihoods, and piloted medium-scale biogas plants, which were highly relevant to rural biogas development in the PRC. The government's preparation of a national strategy on rural biomass energy development further underscored the relevance of the project. The project was also in line with ADB's Country Partnership Strategy 2008–2010 for the PRC, which had an overarching poverty reduction objective and an agriculture sector strategy emphasizing increased productivity and incomes in rural areas while conserving the environment.

10. Changes made during the midterm review were appropriate and helped to ensure that the project remained relevant. However, a few assumptions made during appraisal, which formed the bases of project design did not hold true. This resulted in changes of some planned project activities. For instance, the target for the type I system was reduced because it was less convenient and popular among households. Also, the use of the type III system in Hubei province was not pursued because enterprises were no longer interested. Furthermore, financing of gasification plants was canceled because the gasification technology was not mature enough and some technical problems remained unsolved (para. 12). While the cancellation avoided project failure, the risks and applicability of the technology should have been identified at appraisal. These changes in scope as a result of a few unrealistic assumptions did not justify a *highly relevant* rating. During the midterm review, a minor change in the scope of the GEF grant was made, which added a study on the preparation of project design for livestock farms for carbon financing from the Clean Development Mechanism. This addition furthered the project's aim of improving design preparation to help reduce greenhouse gases and promote the adoption of renewable energy. These major changes in scope (especially the cancellation of gasification plants) led to corresponding reduction in the annual production of outputs (agricultural waste) which, in turn, affected the targeted project outcome of demonstrating the economic viability of biogas technology. The changes indicate weaknesses in the project design, which were not anticipated or identified at appraisal. Thus, this validation considers the project *relevant*.

B. Effectiveness in Achieving Program Outcomes

11. As formally modified during project implementation following the midterm review, the targets for type I and type III systems under component A were reduced, while the construction of type IV systems was canceled. Specifically, the target in component A for the rehabilitation of old or building of new greenhouses for the type I system was reduced from 4,700 to 2,545 because the type I was less popular than the type II. Hence, the target for the type II system was increased from 12,500 to 16,970 greenhouses. The project achieved 99% of the target for type I, and 98% for type II.

12. The target of constructing 28 biomass gasification plants (type IV) was canceled because the gasification technology was not mature enough and associated technical concerns were encountered. Of the 13 medium-scale type III plants envisaged at appraisal, only 2 (one each for Shanxi and Henan) provided gas reticulation to rural households. The other 11 plants produced gas for their own use within the enterprises' operations (e.g., slaughterhouse and

dairy factory operations). The PCR attributed this to commercial risks involved in recovering investment and operating costs from households through the sale of biogas.

13. Other output indicators (formally modified during project implementation) were generally achieved. Vegetable production reached 21,862 tons, exceeding the targets at midterm review; and citrus fruits production was 156,114 tons or about 10% less than the target set at midterm review. The project exceeded its component B targets for both trainees and workshops. In component C, the government constructed 526.7 kilometers (km) of farm-to-market roads, well exceeding the appraisal target of 60 km. In addition, 18 agroproduce markets were constructed and 113 mechanized wells were drilled. For component D, the Renewable Energy Law of 2007, amended in 2009, has set for local governments the strategies for rural biogas development. The communication strategies improved the farmers' knowledge and awareness of biomass renewable energy. The results recorded by the equipment purchased to monitor emissions and to reduce environmental pollution, were used in preparing the energy and environmental monitoring plan (EEMP). In Component E, of the 9,000 poorer rural villagers, 8,528 received GEF grants to set up biodigesters. Of 9,746 low-skilled poor households trained, 9,182 were reported to have been lifted from poverty.

14. Overall, the project partially achieved its envisaged outcomes at appraisal. The PCR considered that the project was *highly satisfactory* (or *highly effective*) in achieving its outcome indicators (as formally modified during midterm review). The marked reductions in major outputs (especially the cancellation of gasification technology) affected the targeted outcome of demonstrating the economic viability of sustainable biomass technology. However, the other targeted outcome of enhancing agricultural productivity and rural income has been largely achieved. Thus, this validation rates the project *effective*.

C. Efficiency of Resource Use in Achieving Outputs and Outcomes

15. The PCR rated the project as *efficient*. The economic internal rate of return (EIRR) for the project as a whole was re-estimated at 19.9%, based on the benefits from biogas and agricultural production. This was higher than the 18% estimated during appraisal. If the benefits from reduction in cooking time, medical expenses and carbon dioxide emissions were included, the estimated EIRR increase would be 25.8%. This validation finds the assumptions used in the economic analysis, as presented in Appendix 8 of the PCR, plausible and appropriate.

16. Project activities financed by ADB started on time. However, implementation of the GEF components was delayed by 16 months due to the slow flow of GEF funds arising from: (i) the lack of an imprest account in the provinces; (ii) delays in the implementation of components, aimed at improving mechanisms for biomass technology transfer and pilot testing poverty-focused approaches to biomass development, until after the midterm review; (iii) the lack of knowledge by PMOs and PIOs of ADB administrative procedures for implementing GEF components; and (iv) difficulties faced by PIOs in advancing their own funds to implement GEF activities while waiting for GEF funds to become available. Consequently, the loan closing date was extended by 1.5 years. This validation concurs with the PCR's *efficient* rating of the project. While there were delays in implementing the GEF components, cancellation of type IV systems, reduced targets of type I and III systems, and changes in scope, the activities financed by ADB were implemented on time and project resources were efficiently used as reflected in the EIRR of 19.9%.

D. Preliminary Assessment of Sustainability

17. The PCR rated the project *most likely sustainable*. The project was able to train and develop a pool of technicians. Interest in biogas technology remains and financial incentives to expand its use in the PRC are being provided. Ongoing government programs encourage the use of small- and medium-scale biogas technology, and provincial and county governments will most likely retain a network of support systems. More than 100 organized community groups participated in the construction and maintenance of rural infrastructure facilities, providing the ownership base and incentive to maintain the rehabilitated farm-to-market facilities. The government's increased contribution for this component indicates its commitment to invest in rural development. Existing government regulation and policies on renewable energy support the project's goals and will contribute to the sustainability of project outcomes.

18. The PCR recalculated the financial internal rates of return (FIRRs) for the biogas systems. For type I and II systems, the FIRRs were estimated between 10% and 40%. The FIRRs for the type III medium-scale models ranged between 9.0% and 23.2%, well above the loans' prevailing interest rate of 7.2%. Overall, this validation concurs with the *most likely sustainable* rating in the PCR.

E. Impact

19. The project had positive overall impact on the environment. The EEMP surveyed extensively the "before" project, the "with" project, and the "without" project environmental conditions across a wide range of environmental monitoring variables (Appendix 10, PCR). The main findings included significant reductions in the use of traditional rural energy sources (coal and firewood) and chemical fertilizer, and a decline in emissions of carbon dioxide, sulfur dioxide, and nitrogen dioxide. Soil samples showed that project farm soils contained higher qualities of the minerals and metals that crops need than non-project farm soils. Compared with non-project residences, the indoor air quality of project households were of better quality, indicating better living conditions for project farm families.

20. A beneficiary impact assessment and socioeconomic analysis of the project were carried out with still 2 years to go on project implementation. The report on these studies therefore presented only preliminary findings on the social impacts. The assessment covered a "without" project baseline survey in 2006, and collected information about pre-project socioeconomic conditions in 2003 and project benefits realized by late 2006 and late 2007 (Appendix 9, PCR). Based on data from the beneficiary impact assessment, the incomes of project beneficiaries indicated that the project contributed to a decline in poverty. The percentage of beneficiaries described as among the absolute poor⁴ declined from 15% in 2003, to 11.25% in 2006, and further to 6% in 2007. The percentage of those categorized as poor⁵ were 9.25% in 2003, 6.75% in 2006, and 2.5% in 2007. The percentage of beneficiaries defined as the vulnerable poor⁶ were 15% in 2003, 11.25% in 2006, and 6% in 2007. This steady trend across categories indicates early project success in reducing poverty. However, this validation interprets the data with caution since other factors such as remittances and other government programs may have contributed to the increase in incomes.

⁴ Those with net per capita income below CNY700 per year.

⁵ Those with per capita net income between CNY700 and CNY1,000 per year.

⁶ Those with per capita net income between CNY1,000 and CNY2,000 per year.

21. The project strengthened the institutional capacity of implementing agencies in biomass technology adoption and efficient use of agricultural wastes. It provided environmental monitoring and training stations in the four provinces with monitoring equipment and technical training. The extension and training stations continue to be staffed by trained technicians after project completion.

22. The comparisons made by the PCR between the baseline conditions (of beneficiaries and environment) and actual benefits realized comply with GEF guidelines in conducting terminal evaluations. On the whole, the expected impacts of the project were realized. Better quality of air, soil, and water signified an improvement of the environment. Sustainable agriculture was promoted as rural households reduced significantly the use of traditional sources of energy. Survey data also indicate a general decline in poverty among beneficiaries. Based on the preliminary results of studies conducted, project impact appears to be *moderate*.

III. OTHER PERFORMANCE ASSESSMENTS

A. Performance of the Borrower and Executing Agency

23. The performance of the borrower and the executing agency was *satisfactory*. The increased government funding for infrastructure was not anticipated at appraisal but nonetheless boosted the project's impact. The executing and implementing agencies provided adequate counterpart funds and human resource support, and timely recommendations on changes in project scope to maintain the project's relevance and efficiency. The PMO, the four PIOs, and the provincial finance bureaus demonstrated competence and ability to meet ADB requirements.

B. Performance of the Asian Development Bank

24. ADB's performance was *satisfactory*. It carried out one inception mission, seven review missions, one midterm review mission, one special project administration mission, and one project completion review mission. ADB was responsive to government requests for adjustments in project scope and reallocation of funds. ADB demonstrated flexibility in adapting to changing commercial environment and technical issues through the cancellation of gasification plants. However, there seemed to be lack of clarity in a few ADB procedures. Delays in administering the GEF components were caused partly by lack of information about ADB administrative procedures regarding GEF funds.

C. Others

25. There was no recorded adverse effect on the environment. The PCR did not indicate any resettlement-related issue.

IV. OVERALL ASSESSMENT, LESSONS, AND RECOMMENDATIONS

A. Overall Assessment and Ratings

26. The PCR rated the project *successful*. This validation concurs with the PCR's rating (see table). The project was relevant to the government's strategies and policy and to ADB's strategy for the PRC. It also followed the GEF guidelines for assessing the relevance, effectiveness, and efficiency of GEF supported projects. The cancellation of the gasification plants (type IV) avoided potential failure of the technology but should have been anticipated at appraisal. The

reallocation of resources from type 1 to type 2 biogas systems was appropriate in view of the changing commercial environment. The reduction in the number of households provided with reticulated biogas supply from type III plants was a move in the right direction in view of the commercial risks private operators faced in investing in gas distribution networks without financial support. The project catalyzed an increase in government funding and support for biogas technology in rural areas.

Overall Ratings

Criteria	PCR	IED Review	Reason for Disagreement/Comments
Relevance	Highly relevant	Relevant	The three changes in scope were not anticipated and identified at appraisal, indicating weaknesses in project design (para. 10). No exceptionally value-adding design features are found to justify the claimed highly relevant rating.
Effectiveness in achieving outcome	Highly effective	Effective	Reductions in major outputs (especially the cancellation of gasification technology) affected targeted outcome of demonstrating economic viability of biomass technology, although enhancing agricultural productivity and rural income were largely achieved (para. 14).
Efficiency in achieving outcome and outputs	Efficient	Efficient	
Preliminary assessment of sustainability	Most likely	Most likely	
Overall assessment	Successful	Successful	
Borrower and executing agency	Satisfactory	Satisfactory	
Performance of ADB	Satisfactory	Satisfactory	
Impact	Not rated	Moderate	While survey data shows positive impact on beneficiaries, this validation interprets the data with caution since there were other factors that may have contributed to the increase in incomes such as remittances and other government programs (para. 22).
Quality of PCR		Satisfactory	

ADB = Asian Development Bank, GEF = Global Environment Facility, IED = Independent Evaluation Department, PCR = project completion report.

Source: ADB Independent Evaluation Department.

B. Lessons

27. The PCR drew out valuable lessons to ADB operations. Strong government ownership and commitment to a project's success and sustainability is important. The project's training programs were effective. These taught farmers to use new technology, knowledge, and ideas to improve their income and living conditions. Training was flexible in allowing family members, who are often the final users of the biogas, to take part. This ensured that type I and type II systems would remain operational after project completion. This validation agrees with the PCR that proper due diligence on new technology such as the type IV gasification plant should have been undertaken at appraisal to determine the risks and sustainability of the technology.

C. Recommendations for Follow-Up

28. This validation agrees with the recommendations of the PCR. The use of project farm systems must continue to be monitored in view of their sensitivity to prices of pork, weather conditions, and rural economic growth. Furthermore, the government needs to continue training biogas technicians and farmers in the project provinces and also share the training materials with other provinces.

V. OTHER CONSIDERATIONS AND FOLLOW-UP

A. Monitoring and Evaluation Design, Implementation, and Utilization

29. Following the project design, the PMO in coordination with the PIO established a project performance management system (PPMS) to monitor and assess project impact and the achievement of project objectives. Surveys were undertaken to generate socioeconomic data for the PPMS. The impact on target beneficiaries, particularly on the poor and vulnerable poor was estimated using beneficiary impact assessment surveys that included non-project survey baseline and pre-project conditions. The EEMP also surveyed extensively the “before project”, “with project”, and “without project” environmental conditions across a wide range of environmental monitoring variables (para. 18).

B. Comments on Project Completion Report Quality

30. This validation rates the quality of the PCR as *satisfactory*. The PCR is consistent with the PCR Guidelines (Project Administration Instructions 6.07). It is also generally consistent with the GEF guidelines in conducting terminal evaluations particularly in assessing outcomes, impact, relevance, effectiveness, and efficiency. The lessons and recommendations are sound and drawn from the findings of the report. The report has a clear presentation and analysis of the issues, outputs, and outcomes. The DMF is clear in presenting the appraisal and revised midterm targets and actual performance. The impact analyses in Appendix 9 and 10 were very informative, while the survey design and methods used were acceptable.

C. Data Sources for Validation

31. The data sources for this validation comprised the report and recommendation of the President (RRP), PCR, back-to-office mission reports, government PCR, midterm review report, and project processing documents.

D. Recommendation for Independent Evaluation Department Follow-Up

32. The Independent Evaluation Department may consider conducting a project performance evaluation report (PPER) to reassess the economic viability of the project. Also, additional information required by the GEF for terminal evaluations of joint ADB-GEF projects could be assessed during the course of PPER preparation.