Tanzania: Lower Kihansi Hydropower Station

Ex post evaluation

OECD sector	23065 / Hydropower plants	
BMZ project ID	1996 66 108	
Project-executing agency	Tanzanian Electricity Supply Company (TANESCO)	
Consultant	**-**	
Year of ex-post evaluation	**2006**	
	Project appraisal (planned)	**Ex post evaluation (actual)**
Start of implementation	3rd quarter 1994	3rd quarter 1994
Period of implementation	63 months	70 months
Investment costs	EUR 185.0 million	EUR 212.1 million
Counterpart contribution	EUR 23.4 million	EUR 11.8 million
Financing, of which Financial Cooperation (FC) funds	EUR 14.3 million	EUR 15.1 million
Other institutions/donors involved	EIB, NORAD, SIDA, World Bank	EIB, NORAD, SIDA, World Bank
Performance rating	4	
• Significance / relevance	5	
• Effectiveness	3	
• Efficiency	4	

Brief description, overall objectives and project objectives with indicators

The project comprises the construction of the Lower Kihansi hydropower station (3x60 MW) including the required infrastructure (access road, residential buildings) and the connection to the national interconnected grid. The project was implemented as a parallel financing with the World Bank, the European Investment Bank (EIB), the Norwegian Agency for Development (NORAD) and the Swedish International Development Agency (SIDA).

The overall objective of the project was to ensure the sustainable, reliable, stable and macro-economically efficient power supply for the customers in the interconnected grid of TANESCO. The project was mainly intended to benefit industry, trade and commerce (immediate target group). The indicators defined for the achievement of the objectives were the available capacity (687 MW), the ensured energy potential (2,997 GWh), achievement of an average tariff of US cents 9/kWh or at least 90% of long-run marginal costs (LRMC) and the reduction of outstanding accounts to 60 times the daily revenue. At the time of the final evaluation the third indicator was replaced by the indicator “effective cost coverage”. The project objective was the provision of additional capacity to cover peak loads and the feeding of this electrical energy into the national interconnected grid in accordance with the requirements of an optimal system operation. The indicators defined were a capacity of 180 MW of the hydropower plant units and a power production of 935 GWh in a normal year.

In addition to the target indicators, the guidelines of the World Commission on Dams, which had not existed at project appraisal, were also applied at the time of the final evaluation. According to these guidelines the people living in the project area would have had to be informed about the project and to be included into the planning. The population in the project area would have had to be given an adequate share in the benefit of the project and negative environmental impacts would have had to be minimised. This includes compliance with the Convention on Biological Diversity, in particular the protection of endemic species.

Project design / major deviations from the original project planning and their main causes

The Lower Kihansi power plant is located on the Kihansi river, a tributary of the Kilombero, about 460 km south-west of the capital of Dar es Salaam. The power station was designed as the first expansion stage to exploit the water power of the Kihansi river. For reasons of adjustment to the machine sizes of the interconnected grid already existing in Tanzania 3 hydro-power units with 60 MW each were planned. To transport the electrical energy produced in the power plant 220 kilovolt high-voltage single lines were constructed, which feed the energy into the interconnected grid of TANESCO. In addition to the construction works for the power plant and the transmission lines financing was provided for the construction of an access road, possible expansion measures and accompanying consulting services and training measures. FC funds were provided for the 220 kV high-voltage cables and the 220 kV switchboard plants, and for a monitoring study on the spread of malaria caused by the construction measures.

All components/measures to construct the hydro-power station were implemented largely as planned. During the execution of the construction works geological conditions turned out to be so difficult that the powerhouse cavern had to be relocated and it was necessary to prolong the fall shaft and the access, cable and underwater galleries. In the other hand, it was possible to shorten the pressure tunnel and, thus, the additional costs could be compensated for. The decision about the final lining/reinforcement of the tunnel was taken on the basis of the geological findings produced during the tunnel drilling works. The water losses of approx. 0.3 m3/s are in line with expectations. However, since the losses are stable over time they are still tolerable. Deficiencies were identified on the turbines and generators. These were, however, successively remedied and in individual cases lead to the extension of warranties by up to four years.

In 1990 around 16,000 people were living in the project area. 380 families had to be relocated. Due to the remoteness of their villages the population of the highlands (3,000) was not so much affected by HIV and malaria. Until 1995 the number of inhabitants in the project region had increasesd by more than a third to 22,000 and has today reached 63,000. Social mitigation measures and measures on the health sector (e.g. containing HIV/AIDS and the establishment and maintenance of health stations) were implemented but should have been designed on a more sustainable basis and been embedded locally. After the donor-financed accompanying measures have been concluded the continuation of these social mitigation measures was heavily jeopardized and was already scaled down. Some measures, such as malaria protection for the population living in the highlands, were introduced too late and were not pursued vigorously enough. If accompanying low-cost health measures had been introduced in time (education, mosquito nets, drugs for treating persons who have contracted the disease, etc.) the spread of malaria in the highlands could at least have been considerably slowed.

During the construction phase the ecological quality and importance of the gorge below the dam was recognised. Since then extensive measures have been taken to protect the gorge. The measures comprise the breeding of the Kihansi spray toad in the United States, the construction of a sprinkler system to irrigate the gorge and the undertaking to have 1.5m^3/s flow off the

reservoir into the gorge. Despite these mitigation measures, which reduce the annual quantity of electricity produced by the power plant by 116 GW (which means revenue losses of approx. EUR 6.6 million annually) it was not possible to restore the original state of the gorge. Due to the diversion of the river the ecosystem in the Kihansi gorge suffered lasting and irreversible damage and it is as yet unclear whether the Kihansi spray toad can be resettled in the gorge.

Key results of the impact analysis and performance rating

The performance rating of the project is based mainly on two target dimensions: On the one hand the hydropower plant can, from a mere energy perspective, be called a still successful project, which helped to avoid the capacity-related network failures that existed at the time of project appraisal. On the other hand, in spite of considerable progress made in the last three years, the situation in the energy sector as such deteriorated in some major areas as compared with project appraisal. In addition, the project had clearly negative impacts on nature and the ecology, which could not be remedied though considerable efforts were made in this respect. The socio-economic impacts were equally not compensated for, as would have been required in accordance with the guidelines of the World Commission on Dams, which were agreed, however, only after the conclusion of the project.

Due to the fact that neither the loss of the ecosystem in the Kihansi gorge nor the effects of the occurrence of malaria in the highlands can by quantified in monetary terms, it is even more difficult to assess and weight the intended and non-intended impacts of the project. It even has to be questioned whether the funds provided for ecological compensation measures (approximately USD 15 million spent on compensation measures and another USD 8.2 million annually in the future in terms of revenue losses) can still be justified in view the wide-spread poverty in Tanzania. We consider these impact as so severe that they will be given specific attention in the context of a summary evaluation of all impacts and risks.

Effectiveness

The project objectives were (i) to provide additional capacity to cover peak loads and (ii) to feed electrical energy into the interconnected grid. Measured against the indicators, the project objective (i) was achieved, while project objective (ii) was slightly missed. The expected quantity of energy provided was missed by around 12%, but due to the good technical starting conditions this result is still acceplable. We rate the programme's overall effectiveness as sufficient (sub-rating 3).

Relevance/Significance

The overall objective of the project was to contribute to maintaining/improving the macro-economic efficiency of the integrated grid of TANESCO. The indicators set to measure the achievement of the overall objective of the follow-up project were: (i) the available capacity, (ii) the ensured energy potential, (iii) the achievement of an average tariff of US cents 9/kWh or at least 90% of long-run marginal costs (LRMC) and (iv) the reduction of outstanding accounts. In addition, compliance with the guidelines of the World Commission on Dams (WCD), which had not been agreed at project appraisal, and non-intended effects were also taken into consideration. Objectives (i) and (ii) were achieved, though at a later stage than planned. Though, on the face of it, target (iii) was reached in the context of the definition developed at the time of the project appraisal, the intended objective of ensuring adequate cost recovery was missed. Target (iv) was missed entirely. These impacts have to be assessed in connection with the implementation of the WCD guidelines. Despite the extensive and expensive measures implemented, it was not possible to preserve the ecosystem in the Kihansi gorge. Though it was possible to protect the spray toad through appropriate breeding measures the ecosystem in the gorge suffered irreversible damage. The participation of the population in the project benefits was not achieved to the desired extent. Due to the accelerated spread of malaria individual population groups even suffered significant disadvantages. Taking into consideration these side effects we rate the **relevance/significance** of the project as **clearly inadequate** (sub-rating: 5).

Efficiency

Given an installed capacity of 1.251 EUR/kW the specific costs of the hydropower station are acceptable. However, due to the above-mentioned utilisation restrictions dynamic production costs rose by approximately 40% to 5.0 US cent per KWh (discount factor: 8%). Thus, the attractiveness of the power plant is limited. Nevertheless, in comparison with the existing thermal power stations the Lower Kihansi hydropower plant offers a favourable alternative. The production efficiency (system losses) and the allocation efficiency do not fulfil the operational evaluation criteria. Due to the conversion to gas and an improvement in the collection efficiency it was possible to improve marginal cost recovery to around 70%. However, it is not foreseeable for the time being how this rate can be further improved in the future. Overall, we rate the projects' efficiency as slightly insufficient (sub-rating: 4).

Overall, in consideration of the sub-criteria mentioned above, we rate the developmental effectiveness of the project as slightly insufficient (**overall rating 4**).

General conclusions and recommendations

Projects, which may have potentially strong environmental impacts, have to be included in the risk analysis conducted at the time of the project appraisal and to be further reviewed in the framework of the project monitoring to find out whether they might have any secondary or remote impacts on the project region and the population living in this region (damage to the ecosystem or to the health of the population). If risks are detected the required counter measures have to be introduced consistently and comprehensively.

All necessary environmental impact analyses have to be concluded and evaluated before the start of project implementation. Moreover, it has to be ensured that the recommendations given can actually be translated into practice. In the case of the project "Lower Kihansi Hydropower Station" the environmental impact studies were obviously conducted too late. At the time of presentation of the environmental studies it was too late to implement the recommendations made to prevent irreversible damage.

Equally, it would have been required prior to the start of the project measures to work out a comprehensive catalogue of instructions for social compensation measures to be taken with regard to HIV and malaria, among others. Remedial action introduced once the project implementation is under way will in many instances not be sufficient to prevent or effectively influence adverse developments.

Accompanying studies have to be designed so as to ensure that continuous time series that cover the entire project period and comparable data on the development in other regions of the respective country are available.

All mitigation measures have to be designed so as to ensure that they are truly sustainable. This includes in particular the early conclusion of agreements on the volume and length of payment obligations. The target groups of the project measures should be included in the process of designing of the project measures from the very beginning.

Even if several donors combine their activities in the context of large-volume project it is possible only on a limited scale to bring about sectoral changes. The implementation of the required changes (e.g. a tariff reform) should be agreed as a prerequisite for the first disbursements of funds; it is not sufficient to request the implementation of such changes only in the medium term.

When calculating the profitability of hydropower stations it should be examined whether the earnings calculated on the basis of historic precipitation records might be supplemented and improved by means of scenario calculations in the context of climate models.

Legend

Developmentally successful: Ratings 1 to 3	
Rating 1	**Very high or high degree of developmental effectiveness**
Rating 2	**Satisfactory developmental effectiveness**
Rating 3	**Overall sufficient degree of developmental effectiveness**
Developmental failures: Ratings 4 to 6	
Rating 4	**Overall slightly insufficient degree of developmental effectiveness**
Rating 5	**Clearly insufficient degree of developmental effectiveness**
Rating 6	**The project is a total failure**

Criteria for the Evaluation of Project Success

The evaluation of the "developmental effectiveness" of a project and its classification during the ex-post evaluation into one of the various levels of success described in more detail below concentrate on the following fundamental questions:

- Are the **project objectives** reached to a sufficient degree (aspect of project **effectiveness**)?
- Does the project generate sufficient **significant developmental effects** (project **relevance** and **significance** measured by the achievement of the overall development-policy objective defined beforehand and its effects in political, institutional, socio-economic and socio-cultural as well as ecological terms)?
- Are the **funds/expenses** that were and are being employed/incurred to reach the objectives **appropriate** and how can the project's microeconomic and macroeconomic impact be measured (aspect of **efficiency** of the project conception)?
- To the extent that undesired **(side) effects** occur, are these tolerable?

We do not treat **sustainability**, a key aspect to consider for project evaluation, as a separate category of evaluation but instead as a cross-cutting element of all four fundamental questions on project success. A project is sustainable if the project-executing agency and/or the target group are able to continue to use the project facilities that have been built for a period of time that is, overall, adequate in economic terms, or to carry on with the project activities on their own and generate positive results after the financial, organisational and/or technical support has come to an end.