Calculating the Internal Economic Rate of return for the Quirimbas National Park

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Calculating the EIRR

An exercise was conducted to evaluate the economic efficacy of financial interventions, in terms of their contribution to local development and conservation. This exercise followed a rational logic consistent with the need for optimal use of public funds with high opportunity costs, but it is also a high-risk exercise given the lack of references and stable methodologies in an area which is still new to economists. The economic analysis required by the AFD and the FGEF is given in detail in the methodology note attached to this report. This appendix describes, in a naïve and transparent manner, the sources of information and assumptions used, the scenarios developed for the future and the results obtained with the central scenario and reasonable variants. The formal and seemingly sophisticated presentation of the approach and results should not lead readers astray: the point is not to make an issue of every figure that might follow a decimal point, but to use the results as a source of information and input to discussions on the effectiveness of the public money used for this project.

The main tasks to be assessed and the main indicators to be measured are described in the methodological note (see annex), along with the sources of information and hypotheses used to calculate the Quirimbas project Economic Internal Rate of Return. The results of this calculation are described and discussed. The Note is one of the evaluation documents for the Quirimbas project in Mozambique.

The assumptions and parameters described in annexe were incorporated into an Excel spreadsheet to make the various calculations:

- calculation of the base EIRR using the above assumptions and parameters
- analysis of EIRR sensitivity to variations in the parameters described above.

Taking a calculation period of 15 years (2001-2015), which is reasonable given the scale of investments at the point of interface between nature conservation and land and marine resource management, and according to the central scenario, the investments made between 2001 and 2008 and planned for 2009-2015 would, based on the assumptions described, produce a Net Present Value of 7.5 million Euros and an Economic Internal Rate of Return (EIRR) of 52.4%. This is very high indeed compared to alternative investments in local development and requires comment (see below)
With the central scenario, the economic benefits from the different areas are as follows:

Alternative livelihood options	45%
Recovery of fish stocks	18%
Recovery of biodiversity	15%
Tourism	13%
Improved technical capacities	8%
Shellfish	less than 1%

The variants analysed produce the following variations in the EIRR:

Variant 1: central scenario with no economic value set on biodiversity benefits:
Current added value of 5% per year: 5.6 Million Euros
Economic internal rate of return: 43.7%

Variant 2: central scenario with no economic value set on tourism benefits
Current added value of 5% per year: 5.8 Million Euros

Economic internal rate of return: 45.9%

Variant 3: central scenario with no economic value set on alternative livelihood benefits
Current added value 5% per year: 1.6 Million Euros
Economic internal rate of return: 18.5%

Variant 4: central scenario with no fishing benefits
Current added value 5% per year: 5.1 Million Euros
Economic internal rate of return: 34.6%

It is clear that economic returns from the creation and operation of the PNQ are very high and that they depend a great deal on alternative livelihoods established. If these are not take into consideration, the EIRR drops sharply to about 18%. The share of fishing in the EIRR of the PNQ is only about 18%, which can be accounted for partly by the very large area of the inland part of the PNQ and partly by the relatively low added value of primary production activities compared to that of tertiary activities like tourism.

As mentioned repeatedly in this methodological note, the quantified development targets set out in the Envirotrade reports introduce an unusual dimension into our calculations. Despite our arbitrary and very considerable 80% reduction of these targets, the carbon sequestration operation still supplies more than 40% of net present income in the Park zone. One research topic which would be of particular interest as a follow-up to this EIRR estimation would be to check the figures given by Envirotrade against the situation in the field.

Overall, it is interesting to note that, despite the high administrative costs involved and subject to verification of the assumptions made during this exercise, public management of the PNQ supplies only a very small portion of the zone's current added value. Private activities (tourism, Envirotrade) alone represent almost 60% of the total current added value. In the above estimations, biodiversity recovery represents most of the current added value of activities conducted under public sector supervision (biodiversity, fish stocks, oyster farming, improved technical capacities among producers).

Clearly, there would be at least as much value in being able to use a calibrated EIRR calculation model to simulate different variations in parameters than in dissecting the above results *ad nauseam* in an attempt to extract more from the results than they can offer, given the considerable amount of uncertainty as to the real value of many of the variables and parameters use (mainly because of the regrettable lack of sound background studies). The AFD/FGEF directors and any other authorised users have the option of using this model for other simulations.

To conclude, it is no doubt important to repeat that the conclusions drawn from this exercise are only as valid as the – numerous – assumptions made to produce input for the calculations. In other words, other than for general trends and large scales, it would be misleading, if not downright dangerous, to treat these results as having more scientific value than they actually have. Nevertheless, the authors who conducted this exercise believe that, bearing theoretical precautions in mind, it would be of interest, especially for inter-MPA comparisons, to take the time to understand and analyse alternative livelihood options in MPAs and especially in the Quirimbas.

Appendix 8: Methodological note to determine the EIRR

Conversion rates:

Euro	1.30	US Dollar
Euro	33	Meticais
Dollar	25	Meticais

Objectives of the EIRR study

The study to determine the EIRR of funds invested in the creation and development of the Quirimbas Park, with AFD/FFEM co-financing, meets four complementary objectives:

- Feedback to financial partners of the operation on the economic efficacy of the grants and subsidies awarded,
- Contribution to the organisation of information to ensure better monitoring and evaluation in the future of ongoing PNQ operations,
- Support to the formulation of national and local policies in the areas of environmental management and fisheries development,
- Participation in the build-up of a knowledge base on the economics of the PNQ and other MPAs, and in the development of a new discipline.

Finally, it should be remembered that determining the EIRR also helps to develop a federative approach to the very broad range of activities conducted in MPAs. These areas are by no means strictly confined to nature conservation operations as they cover a complex system of economic and social development activities in which biodiversity protection is - or should be - fully integrated.

Reference framework for estimating the EIRR

it should be noted, by way of an introduction, that estimating the EIRR is a very different exercise to the preparation of the PNQ business plan. Much of the data are obviously common to the two analyses, but the difference between the two approaches lies in the reference framework. For the business plan, the reference framework is financial and defined by the PNQ itself as a stakeholder. For example, funds from the AFD/FFEM, WWF and the government of Mozambique are - as they should be – treated as inputs for business plan purposes. In estimating the EIRR, however, the method of financing is neutral in terms of the reference framework. There are investments, operating expenses and value added by the activities in the Park zone. For the EIRR, transfers between the government and private stakeholders to populations are not taken into account since the aim is to determine the total economic value generated in the zone by the creation and operation of the PNQ. What is important here is the economic efficacy of all the investments made and, ultimately, how this compares with the efficacy of alternative investment choices.

We therefore made an analysis to (i) determine the Total Economic Value (TEV) of the PNQ, year by year as from the start of preliminary activities financed first by the government and then by the WWF and the AFD/FGEF, (ii) compare TEV flows "with the project" to TEV flows "without the project" and, finally (iii) compare the net profits generated by the project from the investment and operating expenses required to implement and run the project.

For the VET estimation, the goods and services produced by the PNQ would include:

Direct value with market value

Fisheries production
Shellfish production
Tourism
Diversification of economic activities
Additional net income from existing activities
Carbon sequestration and reduction in carbon emissions

Indirect value with no market price

Biodiversity protection
Coastal zone protection
Increased technical capacity among local producers

However, for lack of relevant data, no value has been given to coastal zone protection, which can be valued quite easily when there is a built-up heritage but not in the case of natural environment, or to increased knowledge and awareness among tourists.

Concerning tourism, only net direct gains have been taken into account, but a more detailed study of the longer duration would probably have produced an estimate of willingness to pay (WTP) and therefore of consumer surplus .
Given the limited time and resources available for this assessment, it was decided not to consider values that are more difficult to determine, such as values of existence, other than the value of biodiversity conservation.

Assumptions
The following assumptions were used:

- Bringing the PNQ under protection will have a beneficial effect on fish resources for several years, allowing steady recovery of stocks and their stabilisation at levels where fishing is sustainable and which existed before overfishing began to occur,
- Activities initiated at the time of the PNQ's creation and during its first years of operation will continue thanks to public financing, which has not yet begun but will consolidate the benefits acquired. Therefore, trends "with the project" will include, regardless of origin, additional financing that will continue throughout the EIRR calculation period;
- The section on "details" in this methodology note describes the other more technical assumptions used.
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Sources of information
The main sources of information used were the documents supplied by the PNQ, particularly the Tourism Development Plan, the Business Plan and various statistics and technical studies. Additional information was kindly supplied by Park managers via electronic exchanges.

Details on the parameters chosen and tested and on the formulae and coefficients used in the model
The EIRR was calculated by seeking the rate of capitalisation at which total investments at current rates become equal to total added value at current rates, with investments and added value calculated as the difference between situations "with" and "without" a project. The EIRR calculation thus corresponds to the of the following equation:

Sum (n=1 at n=calculation period) (GAVn- In)/(1+CR)^n=0
Where GAV= Gross Added Value (annual)
I= Investment
CR=Capitalisation rate
As the panoply of Excel tools includes the necessary functions, we simply integrated these functions into the EIRR calculation table.

Assumptions used for the Quirimba operation

Boundaries in time and space

As a central assumption, it was decided to use a calculation period of 15 years beginning two years before the park's creation. The benchmark situation is therefore one with no protection. The 15-year duration is justified by the long period of time devoted to protective actions, which, it is to be hoped, will last for longer still. The effects of a longer duration, 20 years for example, can also be tested along with its impact on the EIRR value. However, the assumptions as to how the zone will evolve in the very long term will become less robust as the capitalisation period lengthens. The central scenario for the EIRR calculation is therefore based on the 2001-2015 period.

The project's zone of influence covers the geographical extent of the protected area, including the buffer zone. The project's influence obviously extends beyond this because of the mobility of both fish and fishers. However, using this arbitrary boundary is a practical way of identifying the direct and indirect effects of the PNQ.

Monetary units

Depending on the sources of information used, the financial data were expressed in Meticais, US Dollars or Euros. For the economic calculations, all the data were converted to 2008 values at uniform

exchange rates (see above), a convention which is essential in this context. It should be noted, however, that the current variability in exchange rates has blurred the picture for medium and long-term projections. Variations in exchange rates, whether for the national currency or US dollars and even during 2008 alone, could well reverse the profitability results for purely monetary rather than economic reasons.

Investments

Public investments prior to the creation of the PNQ are minimal. The government and the NGOs involved placed a much greater emphasis - and rightly so – on consultations with local populations than on preparatory studies. On the other hand, private operators from the tourism sector had agreed to substantial investments, although their motivations had more to do with the attractiveness of the coastal area for tourism than with the ecological value of the sites. These investments were not taken into account, as we considered that they would have been made whether the park was created or not.

The investments for the Park's creation and initial launch are counted as net investments, and do not include either taxes or salaries for unskilled staff.

Concerning investments for the 2009-2015 period, we used the main data from the Business Plan and the Tourism Development Plan.

Valuing fish stocks

The main benefits of the PNQ are assessed on the basis of its current and future impact on the recovery of fish stocks. The impact of the MPA was assessed on the basis of figures found in the literature and especially in the excellent study made by JF Rousselot. The figures were then incorporated into the conceptual model detailed below.

The benefits of the PNQ were taken as the difference between net income from fishing in the zone evolving "with the project" minus that income in the "no project" scenario. The following formulae were used:
Annual net income = (total catch – home consumption) * sale price of catches – direct expenses (other than salaries) required for fishing.

Annual PNQ benefits to fishing = annual net income "with the project" – annual net income "with no project".

Capitalised benefits for fishing = sum – of n=1 to 15 - (annual benefits/(1+ CR)^n
where CR= capitalisation rate

Income from fishing activities depends on actual catch volumes and on the prices paid to producers.
We will deal first with catch volumes.

The total catch is the product of multiplying individual catches by the number of people fishing.

The assumption of a steady decline in catches in the Park zone is confirmed by all the sources used: research reports and scientific monitoring results both show declining diversity and smaller average catch sizes, as do field surveys and impressions reported by local people. Whether or not fish stocks have been recovering since the creation of the Park is central to this assessment. The reports mentioned above show that several indicators of diversity and abundance are tending towards an improvement in fish stocks, both in quantity and quality. It is nevertheless essential to insert this reconstitution into a theoretical model based on parameters that are not measurable at present but which may be validated over time.

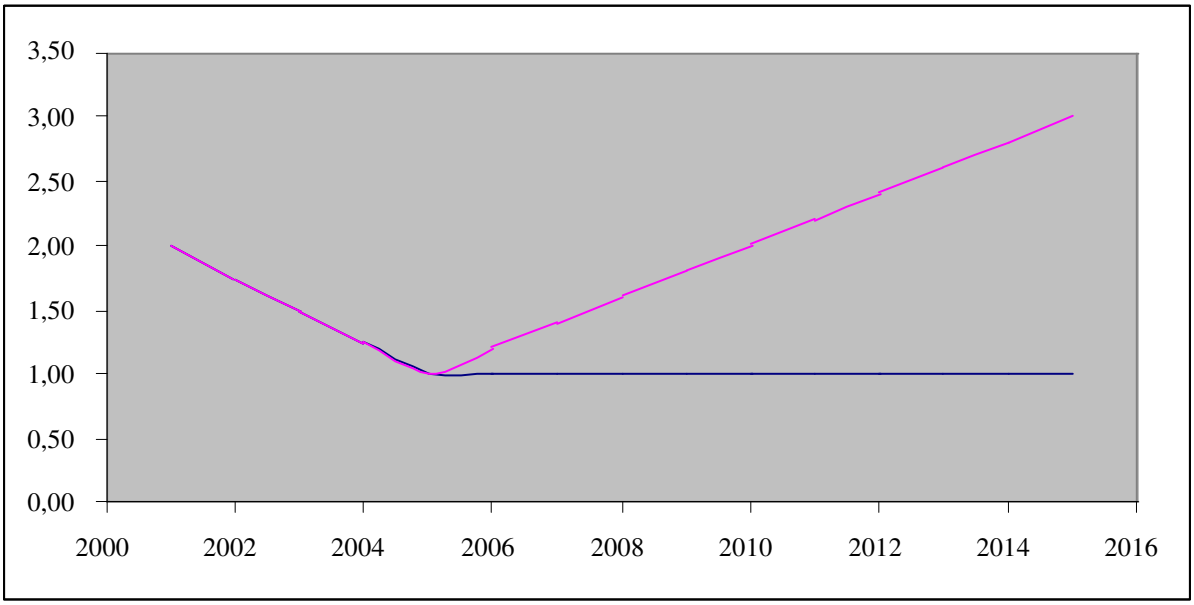
According to the Rousselot study mentioned above, catch volumes declined by a factor of three from 1997 to 2005, while sale prices at landing points increased by 100%.

The Rousselot study details the fishing methods and gear used by about 380 fishers and equipment owners. On the basis of an overall socio-demographic assessment which estimates that 20% of PNQ inhabitants practice fishing, i.e. about 20 000 people and 3 500 families, we applied a ratio of 10 (3500/380) to the results of the Rousselot study.

It should be noted that the Rousselot study does not report fuel costs in the fishermen's simplified operating accounts. Our calculations do not include fuel costs, which may mean that costs are underestimated and net income overestimated, thus overemphasising the recovery of fish stocks in the overall balance.

It was assumed that with no project (i.e. if the MPA had not been created), average catch volumes would have remained stable.

With the project, we estimated that average catch volumes would increase by 2015 to the 2001 (pre-Park) level, using an arbitrary formula showing a steadily rising trend from 2008. Because of the arbitrary nature of these assumptions, we conducted a sensitivity study by varying the amount of time up to stock recovery and the speed with which recovery occurred (see results).



To calculate the EIRR, we calculated the added value of catches; consequently, salaries and other transfers of cash between local stakeholders (canoe hire) were not taken into account as costs incurred for some economic agents are benefits for others. We also considered that fishers did not pay tax, which actually does not matter either way since even if they did, the calculation would be the same.

Net income from tourism

Benefits from tourism were assessed on the basis of data from the literature. Although an ambitious tourism development plan has been published, we unfortunately have few detailed economic data on each tourist facility, so that the data were assessed on a statistical level and aggregated.

As indicated in the main report, the overview of tourism in the PNQ may be summarised as follows.

It is estimated that the number of tourists "with no project" would have remained constant at 1 265 tourists than a year.

Current hotel capacity amounts to 142 beds in hotels of three categories: luxury (Matemo, Guludo and Quilalea); mid-range (Ibo Island Lodge, Portas Ibo) to budget (TDM Ibo) and community tourism. In 2006, 3 300 tourists visited the park (PNQ estimation). The current average occupancy rate is very low, at 30% on average over the year. The main seagoing activities are boat trips and diving. At present, tourism has few adverse impacts on the environment.

The objectives of the PNQ are ambitious and aggressive and aimed at a significant increase in tourism capacity and occupancy rate, and therefore in the total number of tourists and the average duration of visits in the zone (currently 2 nights per tourist).

The main assumptions made for the central scenario for 2008-2015 in our calculations are as follows:

- average annual increase in hotel capacity of 12 beds per year,
- average overall investment per additional bed: 130 000 US$
- average overall price of one hotel night: 180 US$

	Beds	Price / bed	Full capacity per day	Average
Matemo Island Resort	48	220	10.560	
Guludo Beach Lodge	14	200	2.800	
Ibo Island Lodge	18	280	5,040	
Portas Ibo	10	50	500	
TDM Ibo	12	10	120	
Community tourism Ibo	6	8	48	
Quilálea	18	300	5.400	
Taratibu	6	100	600	
Mareja	10	30	300	
TOTAL	142	1.198	25.368	178.6

Activity	Cost (Meticais)
a. Sports fishing	500
b. Diving, submarine nature observation (diving)	200
c. Camping, per night	100
d. Caravaning, per night	150
e. Research	12 000
f. Photography (for commercial/public purposes)	12 000
g. Filming (for commercial/public purposes)	24 000

Source: Business Plan - 2003

Unfortunately, accounts for tourist accommodation were not available and the amount of private investment required to increase hotel capacity had to be estimated. Based on information supplied by the Park on two current projects, investment per bed ranged from about 40 to 220 k US$. We used an average figure of 130 k US$, with a target of 268 beds by 2017.

Income and added value from community-run facilities, although their net contribution is marginal, were added to the data on private operators.

Following advice from experts in the field, we used scenario 3 in the Tourism Development Plan, which predicts an annual increase of 12.5%8 in the number of tourists for 2009-2015 and 6.2% per year in the number of hotel nights per tourist, a rate of increase that would result in 3.65 hotel nights per tourist in 2017.

A more detailed and in-depth approach could, in future, also incorporate economic aspects that are more difficult to measure, such as tourists' WTP, net expenses made by tourists to buy local crafts or expenses on food by tourist facilities buying local farm produce.

Shellfish harvesting

A great many inhabitants in the zone are involved in shellfish harvesting and we assumed that there would be only a modest increase - which, moreover, would be compatible with protection of the local environment. In order to set an economic value on col ecting, processing and selling oysters, we used an example analysed in 2007, where 14 people, including 4 women, worked for 10 days and earned

8 In the Tourism Development Plan, the average number of tourists by 2017 would rise to 12 056, based on projections for 2006-2017. However, when actual data for 2007 are used (observed after publication of the TDP), the projected number for 2017, which we have used here, is 10 716, which is still within the range of TDP projections and seems more realistic than the12 056 figure.

200 US$ for 260 kg of fresh produce. We assumed that 30 additional people for a year would engage in this activity up to 2015, and that gains would be net income, given that the only significant input to the activity is the work done by local people.

Diversification of local economic activities

According to our sources, agriculture in the Park area has improved since its creation, partly with intensification thanks to guidance from Park Management and partly because of the net decrease in crop losses due to elephant damage.

The principal form of diversification, by far, is the carbon sequestration operation under Envirotrade. As a precaution, we decided to use only the economic value of this operation, which in itself is very high. The "term sheet" for this operation reports its launch in 2007 and the presence of about 200 producers by 2008. The only quantified targets found in the term sheet are for Years 5 (2012) and 10 (2017) of the project, with about 11.000.000 VER (Verifiable Emission Reductions) accumulated by Year 5 and about twice as many by Year 10. For the purposes of our calculation here, we estimated that progress towards these targets would be linear.

The term sheet gives a value of 10 US$/VER, with one third of profits going to local producers and the remaining two thirds assumed to be shared 50-50 between the costs of building and maintaining the required local infrastructure on the one hand, and remuneration for Envirotrade departments on the one hand.

When applied as such to our calculations, these assumptions produce colossal gains for local producers, well above benefits from fishing (by one order of magnitude) and tourism.

Given the lack of field observations, in the PNQ as elsewhere in the world, on operations of this type, we decided to lower the VER targets and remuneration for producers arbitrarily, by using as a central assumption that benefits to local producers would amount to 20% of the targets set out in the "term sheet", i.e., an 80% reduction in the targets.

Protection/recovery of biodiversity

To assess the economic value of the biodiversity recovered thanks to PNQ management, we proceeded as follows:

- local biodiversity will gradually return to its status prior to implementation of the Park,
- as a proxy for the economic value of this biodiversity, we used an average value for biodiversity conservation costs in the GEF's marine biodiversity protection operations. We divided this figure by the number of protected area units and multiplied the result by the number of units protected in the PNQ. This produced an assumption that the economic benefit of protecting marine biodiversity is at least equal to the amounts spent on doing so. This economic value is considered as an instantaneous benefit which is arbitrarily attributed to the year in which biodiversity recovered.

In a paper published in 20049, Balmford et al. review 80 Marine Protected Areas across the world and analyse the relevant conservation costs. As a first approximation of the value of the biodiversity conserved, we used the average figure calculated by Balmford et al., updated to 2008, of 775 US$/km2/year in 2000 values. After completing all the calculations, this produces an annual economic value of about 1.300.000 US$ per year by 2017, once all the biodiversity has recovered. As a precaution, because the recovery rates of the said biodiversity are not known exactly, we estimated that, "with no project", biodiversity would not recover and that "with a project", it would recover at a rate of 10% a year as from 2007.
Amongst all the calculations made to estimate the EIRR for Quirimbas, this estimate of biodiversity value is the only one that relies on "consent to pay". As recovered biodiversity does not have any market value in itself, we assumed that the figure of 1.3 million US$ per year represents the sum that the international community consents to pay for the existence of that biodiversity in the PNQ.

9 The worldwide costs of marine protected areas, Andrew Balmford, Pippa Gravestock, Neal Hockley, Colin J. McClean, and Callum M. Roberts

Increase in technical capacities among producers

Assessments of the impacts of agricultural extension projects in Kenya in 1999 (OED World Bank) have produced a mean value for the WTP of agricultural extension councils of about 6 US$ (1991 value) per producer and per year. Updating this to 2007 values produces a WTP of 3 600 FCFA/ producer/year. We decided to apply this WTP to the producers working within the study area, assuming that the awareness extensively generated by the PNQ will have reached a very large number of them.

More specifically, we estimated that 1 000 producers, whatever the production systems used, were monitored and advised in 2008 and that the Park would monitor and advise 100 more producers each year up to 2015.

The assumptions and parameters described above were incorporated into an Excel spreadsheet to make the various calculations (see in the report) :

- calculation of the base EIRR using the above assumptions and parameters
- analysis of EIRR sensitivity to variations in the parameters described above.