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Is the EIRR, the Economic Internal Rate of Return of Projects to Combat Desertification and Land Degradation Evaluation a Relevant Tool for Evaluation?[1]

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Abstract – The economic internal rate of return (EIRR) is considered as a useful tool, both for advocating investments in the areas of land rehabilitation and poverty alleviation and for economic evaluation. This communication reviews the main literature on EIRR and discusses its relevance, particularly with respect to short-term and small size projects. It highlights the many constraints associated with its calculation and underlines its usefulness and limits in relation to local perspectives, local societies and their natural environment.

Keywords – *Economic internal rate of return, projects to combat desertification, economic evaluation.*

1. Introduction and background

Evaluation in economics implies the measurement of impacts of specific actions, by comparing beneficiaries' situation after the actions to control situations there have been no action (Garrabé et al, 2012). Originally, the internal rate of return is a financial and management tool, defined as the interest rate at which the cost and benefit of a project discounted over its lifetime are equal. As a percentage, it compares the average annual profits discounted to the amount invested over a precise period of time. It is referred to as the most common measure of profitability of an investment. The IRR informs on the internal profitability structure of a given investment [2]. Therefore, it can be used to demonstrate the profitability of investments in development projects as compared to the profitability of financial investments in the same amounts of money. Development sector and international cooperation institutions usually distinguish between the *ex ante* IRR that is used to guide decision-making on future investment and the *ex post* IRR that is more used to support advocacies towards decision-makers and funders. *Ex ante* IRR is required in most project documents as one key indicator to be analyzed prior to making final decisions about funding or implementing a project. This is particularly a practice at FAO and IFAD with most agricultural development projects. *Ex post* IRR has been promoted mostly by C. Reij through his various works and studies, and it is used to demonstrate how actions to combat desertification reveal profitability in difficult environments such as dry zones (Reij and Steed, 2003 ; Reij and Smaling, 2008 ; Botoni and Reij, 2009). The idea is to show that in regions where high rates of rural poverty exist, and where resources are limited, like in arid zones, investing may be profitable. C. Reij calls this *ex post* IRR the economic internal rate of return (EIRR) because it is based upon real data by contrast of the *ex ante* internal rate of return which is only based on assumptions about the benefits of the project. The communication presents the EIRR and discusses its relevance for evaluating short-term actions and projects to combat desertification and land degradation mostly implemented by civil society organizations in Western Africa. It relies first, on a literature review focused on the Sahel Studies (Botoni and Reij, 2009) and second, on the evaluation of a specific project, e.g., the Regional Initiative for Global Environment/Combating Desertification (IREM/LCD) in the Sahel, co-funded by the French Global Environmental Funds, French Ministry of Foreign Affairs and the Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS) between

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[2] The internal rate of return is an indicator of the internal structure of profitability of a given project: per se, it does not inform on the comparison between several projects outputs. For such a comparison, investors use the net present values of projects

[3] Nine countries are concerned :Burkina Faso, Cap-Vert, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, Chad

2000 and 2008. That project funded small size projects from civil society organizations in the CILSS region [3] .

2. Lessons learned from the Sahel studies and remaining challenges

The most known studies using *ex post* EIRR for advocating investments towards actions to combat desertification and land degradation in poverty contexts are the CILSS coordinated Sahel Studies (Botoni et Reij, 2009). An earlier study commissioned by the Global Mechanism of the UNCCD convention (Reij and Steeds 2003) evaluated projects impacts, 20 years after their implementation; a time long enough for assessing the impacts of actions like forest plantations and for collecting relevant data on changes. It also permits to minimize the impact of annual rainfall variation on projects outputs. Finally, it allows more precise evaluation of average annual benefits, and enables the measuring of ecological changes (Requier-Desjardins et al, 2011). Over this period of time (1980-2000), roughly, ten dry and ten humid years have been experienced; but this trend varied from site to site. This literature review presents the main results of EIRR calculations with respect to naturally assisted regeneration of trees, forestry and agro-forestry park plantation, and soil and water conservation on cultivated lands. The main impacts of interest concern timber and non-timber production, and pastoral and agricultural activities. Only provisioning services are quantified and valued in monetary terms.

2.1. Main results of the Sahel studies

In the Sahel studies, EIRR are calculated for only long term projects and the work is based on information collected after twenty years of implementation. In addition to project reports, the data are collected through stakeholders analysis. Moreover, in order to evaluate project impacts in terms of service provision, especially for the Niger sites, comparisons are made between project sites and non-project (control) sites where no action was taken (Abdoulaye and Ibro, 2006). In this process, the project length fits the temporal scale of EIRR evaluation, allowing more precise evaluation of average annual benefits, on one hand, and on the other hand, enabling the measuring of ecological changes (Requier-Desjardins et al, 2011).

The types of benefits that are valorized comprise of wood production, and improved yields for agriculture and pastures. The project costs comprise of all implementation costs, from plantation costs (seeds, plants, labor, equipments), to maintenance costs (such as watering, tenure, surveillance and supervision, etc.). The calculation of the average annual benefit, as based on a series of field data shows that at least six years are necessary for projects to yield returns in terms of timber production. Annual yield increase on project sites averages 5% for crops and pastures and is used for annual benefit calculation, as based on local prices (Botoni and Reij, 2009). Best and most striking results are observed on assisted natural regeneration (ANR) sites where diverse plant species are spared on cultivated lands to grow naturally under farmers' protection. These strategies may be later supported by specific projects and national policies (Sendzimir et al., 2011; Garrity et al., 2010 ; WRI-PNUD-PNUE, 2008). In the Sahel studies, these practices show EIRRs of 31% in Niger and 24% in Burkina Faso (Botoni and Reij, 2009). Other EIRR are calculated in more generic terms, on same time length, comparing the return between forest plantation and fruit forestry in Niger. Figures are obtained based on theoretical analysis and field investigations. In the first case, 6 steres of timber and a surplus of 15.5 kg of forage are produced after a period of 6 years with associated EIRR averaging 13%. In the second case, acacia gum production is to be also included in the return from the sixth year, estimated returned of 1.5 kg acacia gum per tree must be added at the end of the sixth year; which increases EIRR to 31% over twenty years. This calculation is based on a very optimistic rate of 100% trees survival, which is unrealistic given the field constraints. Other studies on tree survival rate in Niger show that only 25% of trees would survive after plantation (Boubacar et al, 2005), clearly showing that the actual rates of return are lower. Another case study concerns filao tree plantations for sand dune fixation in Senegal littoral. By enabling the cultivation of vegetables in neighboring pits, planting holes filled with organic matter, as they enabled the cultivation of vegetables through the practice of "zaï" (a traditional land rehabilitation practice that uses planting pits), these investments proved to be indirectly beneficial to the local populations. There, in such situation, the consideration of the income generated by selling the crops produced into the calculations, increases the EIRR to 20% over the period of twenty years. However, specific rules must be set to respect a threshold for the forest exploitation in order for the system to remain sustainable through time. Finally, the rapid changes in the yields production with associated returns as induced by soil and water conservation practices on cultivated lands have been extensively studied and documented (Reij et al, 2005 ; Hien et al, 2004; Hassane et al, 2000; Somé et al, 2000) . In effect, Reij and Steeds (2003) report a EIRR of 20% for a small-project in Illela district, Niger after seven years (1988-1995) where soil management techniques including bunds, half-moons and zaï were applied (Hassane et al, cited in Reij and Steeds, 2003). These studies showed how worth it is to invest on natural resources rehabilitation in dry rural areas. From ecosystems services stand point, it must be noted that EIRR calculations only consider provisioning services, meaning services for which a local market does exist [4].

2.2. The challenges

EIRR being based on project logical framework information, it helps to define and measure project outcomes. However, it tends to be solely concerned with expected costs and benefits, ignoring some others. Many projects would generate social and environmental costs on neigh-

[4]C. Reij and his team do not only use EIRR for advocating investment towards land rehabilitation, but also consider qualitative outcomes such as environmental, social, and institutional impacts.

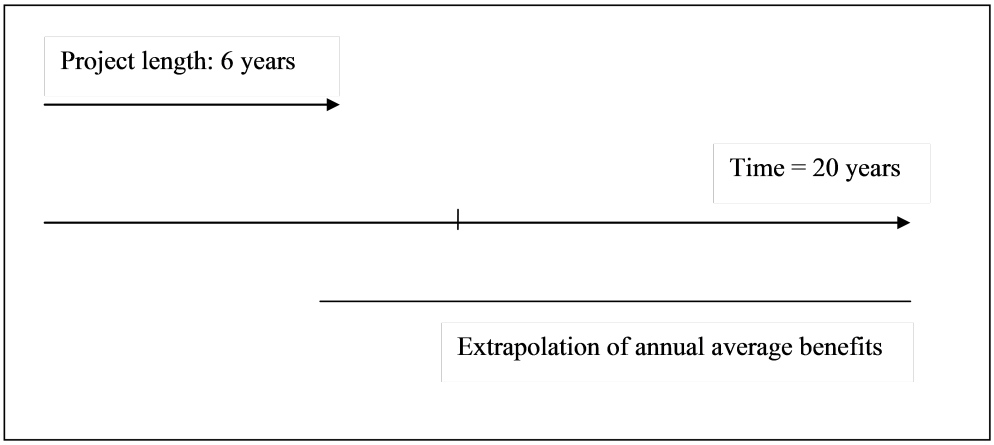

Figure 1: Data extrapolation for the calculation of a short-term project EIRR

bor areas which are ignored in the EIRR calculation because this calculation only refers to the space occupied by the project and not to a coherent local land unit. The institutional and organizational aspects (action coordination level) have quantifiable costs, but are hard to valorize in monetary terms and therefore, are hardly integrated into the calculation of benefits, even when they are mentioned in the logical framework as expected results. Though, they are necessary for ensuring sustainability. These aspects are fundamental when evaluating and calculating EIRRs for short and medium term projects, as the expected environmental results may not appear during the project, but eventually after the project duration because ecological cycles do take place over longer period of time (see fig.1). This is the same with projects such as forest plantations where ecological benefits take time to be observed. Extrapolating annual benefits calculated during or at the end of a project over a larger period of time is also a challenge as a result of rainfall variability in dry regions. However, the latter two limitations have been overcome in the Sahel studies because these studies only consider long-term projects; e.g. exceeding twenty years. The reality remains that overseas development projects are generally of short-term durations. Another challenge relates to the documentation of and access to project results pertaining to the effects on production. In clear, it is necessary to use a monitoring system in order to collect relevant data for quantifying annual benefits, not to rely solely on experts' judgments and generic knowledge from national agro-economic research institutions that are based on a diversity of contexts.

A last challenge is that EIRR is often calculated assuming a discount rate of 10%, which is too high for natural resources (Martinez-Allier in TEEB, 2009) because, by contrast to financial capitals, the latter do not forcedly increase with time. With respect to actions and projects to combat desertification, the literature is poor on comparative data on discounting rates for EIRR. After overviewing the constraints for calculating a robust EIRR, we can now reflect on the complexity of the approach as compared to the use and utility of its quantification. To be short, the EIRR is not informative on how beneficiaries and local populations share the project benefits. It is a tool designed for advocacy makers, investors and projects contractors that has been promoted by some civil society organizations at various levels and which help to promote specific actions like the practice of assisted natural regeneration. The level of constraints compared to the comprehensive dimension of the indicator remains unclear.

3. Case study: regional initiative for global environment / combating desertification in the Sahel (2000-2008)

To better illustrate the constraints for calculating EIRR, we present and discuss the calculation of EIRR for a set of micro-projects developed by the French fund for global environment between 2000 and 2008. This economic approach is part of the overall external evaluation, which encompasses the evaluation of the design and governance of micro-projects and institutional projects.

3.1. Major features of the project

The project called Regional initiative and Global Environment for combatting desertification in the Sahel (Africa) (IREM/LCD) was coordinated and monitored at the regional level by CILSS. It funded 33 micro-projects for less than 100 000 Euros each, presented by civil society organizations and rural collectivities. The latter contribute 50% of project costs. These micro projects are short term (two years on average), and aimed to improve both, the natural environment and the income of local people. In the *ex post* evaluation, some EIRR calculations are made on specific micro-project axes using data obtained from the projects reports and from the scientific literature on the region. Management costs at regional level are not included in the calculations. Only investments provided by the donor (50% of overall cost) are considered. Also, only the provisioning services defined in project logical frameworks are taken into account. In fact three micro-projects allowed the calculation of EIRR for specific activities only, filling the gap of information collected at local level and revealing the needs for capacity building for the local administration in the context of the decentralization of natural resource management. Table 1 shows results for tree

Table 1: Examples of ERR – IREM/ LCD for three micro-projects (Source : Deygout and Requier-Desjardins, 2007)

Project / Country	Activities measured/objectives	Activities measured/objectives	Minimum time to recover investment
Dune pastures restoration and timber production (2005-2007) Mali	plantation of *Eucalyptus* / avoiding deforestation	28% / 3 years	3 years
Rehabilitation of a common zone in Bareina (2004-2006) Mauritania	Plantation *Acacia Senegal* / Arabic gum production and Avoiding sand silting	4% / 8 years	7 years
Environment restoration and soil and water conservation (2003-2005) Burkina Faso	Infrastructures against erosion on cultivated land	16% / 3 years	3 years

planting and soil and water conservation projects. Several assumptions were made about the sustainability of the projects with respect to their ability to maintain or to create annual benefits after their respective ends. These assumptions appear audacious given that only few projects are sustainable after they end. With lack of control sites and appropriate project monitoring system, many extrapolations were also made using data from the literature to define annual average benefits.

3.2. The results

The attempt to calculate EIRR has revealed an acute scarcity of relevant information; which is logical because the project was first designed for capacity building of civil society organizations in project administrative, financial, and technical management. Impact driven monitoring activities were not a priority. However, it has been observed that these micro-projects are potentially profitable. Unsurprisingly, commercial plantation of *Eucalyptus* and soil and water conservation infrastructures showed the highest rates of return.

Five women and youth associations have benefited from land use contracts from local authorities, and support from a 2-year project (2005-2007) for tree planting over land areas of 5 ha each plantation under the supervision of an NGO based in Bamako and which is the principal investigator. Four of them planted *Eucalyptus* and one chose *Acacia Senegal*, in an attempt to develop a green belt around Timbuktu and to improve beneficiaries' income by the selling of timber [5]. Wells and motor pumps were provided for supply of water for human use and for watering the trees. At the end of the projects, a first evaluation showed that among the four *Eucalyptus* micro-projects, the plantation rate for each of the four targeted zones varied from 0% (one case), to 50% (two cases) and 95% (one case). At the end, only 9,75 ha are effectively planted in *Eucalyptus* e.g. 48,75% compared to the expected 20 ha. The short duration of the project (2 years) did not allow significant production for commercialization nor valorization of the trees planted. Therefore, projects reports and available literature (Bazin et al, 2007; Deygout and Requier-Desjardins, 2007; USAID, 2006) were used to do the financial evaluation, following certain assumptions. *Eucalyptus* trees produce marketable timber after 3 years (USAID, 2006). While annual costs and benefits were derived from projects budgets and accountability in the AMEN reports sent to CILSS and FFEM, commercialization data were drawn from USAID study on *Eucalyptus* value chains. Three years after the plantation, a first commercial exploitation results in a EIRR of 28%. Considering 25% of initial expectations are met (5 ha are effectively planted instead of 20 ha) the EIRR over three years would drop to -1%.

Such results reveal first the sensitivity of project output to climatic stress and to beneficiaries' organization and coordination, two elements that impact strongly on trees survival. Second, if positive EIRR can be reached after three years, this is not telling much about environmental benefits after the trees are cut, nor on the use of economic benefits.

Regarding soil and water conservation techniques, the Tind Yalgré Association in Burkina Faso submitted a project aiming at increasing land fertility in five villages over two years (2003-2005) through the building of stone bunds across cultivated lands and the use of compost. These techniques are well-known since the 1980s and have been extensively documented by the Institut National de l'Environnement et de la Recherche Agronomique (INERA), and by international partners (Requier-Desjardins, 2007; Dabiré, 2004). As the project reports give too little data on the impacts on the provisioning services (e.g. the variations of yields), the calculation of the EIRR relies on precise figures about the increase of yields derived from same techniques implementation (Kabore and Reij, 2004 ; Hien et al, 2004 ; FAO, 2001 ; Mazzucato and Neimeijer, 2000 ; Some et al 2000) in similar agro-climatic zones of Burkina Faso.

Over 100 ha of cultivated land initially planned, 93 ha were treated with soil and water conservation techniques. Moreover, 10 ha of land were also reforested. Cultivated land on which infrastructures were implemented are individually appropriated and final project evaluation reports reveal that trees were also individually managed on reforested areas with good results for *Eucalyptus*. The EIRR evaluation on treated cultivated lands relied on two scenarios regarding the level of benefits that can be obtained from the bunds and from the use of compost when African

[5]The association that chose to plan *Acacia Senegal* resulted in less than 5% planting on the 5 ha; it will be left out of our calculation

Table 2: Economic benefits and cost associated to a project implementation

Benefits	Costs
Job creation	Job loss
Creation of income generating activities (products, services)	Loss of activities
Creation of environmental services (positive externalities)	Loss of environmental services (negative externalities)
Creation of social networks and collective organization	Loss of social networks and collective organization

millet production is grown (Hien et al, 2004; Some et al 2000). When agroclimatic conditions are fair, yields may increase from 0,7 tons per ha to 1,7 tons per ha; when the rainy season is normal, yields increase only from 0,7 tons to 1 tons per ha. No prices being available in project reports, average producers prices were drawn from FAO documents for the period 1995-2005 for calculating the EIRR. With optimistic scenario on yield change, a positive EIRR was found over three years, three years being the minimum to recover the amount invested. In the second scenario, the EIRR on the same period is negative and ten years are needed to get positive return under this trend. These results show that climate and rainfall variability do impact strongly on the results of actions to combat desertification. This makes projects profitability rates highly variable.

For *Eucalyptus* plantations, no calculation was made because of the lack of information on final results, and also because the evaluators underlined the absence of local markets for timber.

In Baraina (rural Mauritania), a local association named ADD (Association for sustainable development) has developed a 2-year (2004-2006) *Acacia Senegal* plantation project under IREM/LCD. Through a logical framework the project planned for a global and dynamic development of the village, advocating an enhanced protection of the houses and infrastructures against sand silting in order to avoid associated collective costs and to create spaces for cultivation. EIRR calculation only focused on income making by women and youth who are the most vulnerable and who provide free labor for project implementation. Mature plantations yield arabic gum for market and other directly provisioning services, just as was the case with a similar project implemented between 1989 and 1994. In this case, the association had chosen to plant the trees before the rainy season in order to benefit from longer rain watering periods and to allow the trees to growth within a short time. Unfortunately, the location of most of treated dunes above the water dams (funded by the project) did not facilitate their watering, resulting in only 22% survival. The evaluation was solely concerned with arabic gum valorization and so, ignored the avoidance of collective costs. As a result, the EIRR is low, and seven years may be necessary to recover the initial investment. With 50% of tree survival rate, provisioning services and improve income would have raised the EIRR to 15% after seven years". In effect, considering that the cost for building a single house for a family removed by sand silting is much higher than the overall project cost, the project benefit would have exceeded the investment for year I. Unfortunately, EIRR methodology does not take avoided costs or opportunity cost into consideration (see table 2).

Regarding the ADD projects, result suggests that such kind of investment looks more like local public good creation and need a different approach for evaluation, the returns in terms of Arabic gum yield should not be seen as most important point.

4. Conclusion

The analyses of the literature and of the three microprojects results show that EIRR is most based on the valorization of provisioning services. This weakness results from the fact that the primary objective in reducing desertification is to generate income for alleviating poverty. There is a contradiction resulting from the fact that no data are available on profit sharing between community members, except for actions on cultivated private lands. This supports the suggestion that more attention should be given to the selection strategy of IREM/LCD project beneficiaries. EIRRs were high when some socioeconomic aspects were considered in the calculations; suggesting that project-induced problems, such as the sharing of efforts and benefits and land property rights which create important social costs, must be solved so as to facilitate the consideration of associated costs in EIRR calculation. IREM/LCD selection criteria took into account this issue of property rights in an attempt to secure the investments and to ensure a long-term sustainability for the natural resources. Another limitation is associated with project site selection. Site selection must be in line with local regulations, not to induce adverse effects on neighboring areas. In effect, not all positive EIRRs should raise high expectations of local administrations, natural resources managers and institutions, as a high EIRR observed on one land can hide important processes of land degradation on another land. In other words, EIRRs tend to ignore the risks associated with the local landscape or with the management envisioned on selected sites. Therefore, a landscape approach would be advisable. Another approach would be to privilege avoided costs over provisioning services in order to demonstrate the benefit of invested resources for community sustainability; hoping that the investor will consider this as an internal rate of return. Alternative economic evaluation also suggests an inventory of all the costs and benefits associated to the project. This would necessitate that said costs be valorized in monetary terms under specific assumptions and that project induced changes be well identified and quantified.

Also, the implementation of EIRR approach with local collaboration can generate positive local externalities in

terms of local capacity building such as through collective learning through evaluation processes, contribution to local and territorial development processes and governance by improving monitoring systems. Yet, these advantages remain unconsidered in the EIRR calculation, limiting the use of EIRR only to experts and investors. The procedure leading to the calculation of EIRR must be reviewed to take into account the above important aspects so as to make EIRR a more inclusive environmental evaluation tool for a wider range of users.

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