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The contribution of economic analysis to the design of sustainable irrigation projects

Widely used until the 1980s to assess the viability of rural development projects, *ex ante* economic analysis is less common today. When it is carried out at all, it is predominantly used *a posteriori* to justify investment decisions based on the profitability indicators expected by decision-makers. Yet, when properly applied, economic analysis is a powerful tool for designing viable and sustainable projects that meet specific economic, political, social, and environmental objectives.

Irrigation projects can take a variety of forms, but they often require substantial investment and bring together stakeholders with differing resources and interests in the shared management of an increasingly scarce common good: water. In a recent publication,[1] the Comité scientifique et technique pour l'eau agricole (COSTEA) (Scientific and Technical Committee on Agricultural Water)[2] proposed an economic analysis process for each type of irrigation project, focusing on the main project stakeholders, namely farmers and irrigation scheme managers (operators). A few methodological principles are summarized here.

[1] "Pour des projets d'irrigation viables et durables : L'analyse économique, mode d'emploi",2022, available at https://www.comite-costea.fr/actions/analyses-economiques/

[2] A working group involving researchers, research organizations, backers, and project owners from the Global South.

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Taking every type of stakeholder into account

When carried out *ex ante*, economic analysis must consider the interests of all the stakeholders who will be involved and should benefit from the irrigation project. It must answer four types of questions with regard to farmers, operators, local and national authorities, and Society as a whole (see Figure 1).

1. **Under what conditions will the farmers benefit from the project and therefore want to get involved?** *Expost* evaluations of many irrigation projects have shown that farmers did not in the end cultivate the planned areas. Reasons for this may have been a lack of financial means or labor; farmers deriving greater benefit from other activities; incorrect initial assumptions about the number of crop cycles on irrigated plots; technical or crop finance constraints that were incompatible with the project's assumptions, etc. While theoretically possible, the intensive cropping systems that were supposed to make the irrigation infrastructure financially viable in the initial studies rarely matched up with farmers' means and interests.

2. **In the case of collective irrigation systems, under what conditions can the operator reach financial sustainability?** Many *ex ante* evaluations ignore this question, assuming that irrigators organized into associations will cover all the costs, or that the costs will be fully recovered through irrigation service fees. However, this is very rarely the case, which leads to the infrastructure being poorly maintained and impairing irrigators' ability to achieve the expected performance and financial returns, thereby limiting their ability to cover the maintenance costs. A vicious circle ensues, which can sometimes lead to the irrigation scheme being totally abandoned.

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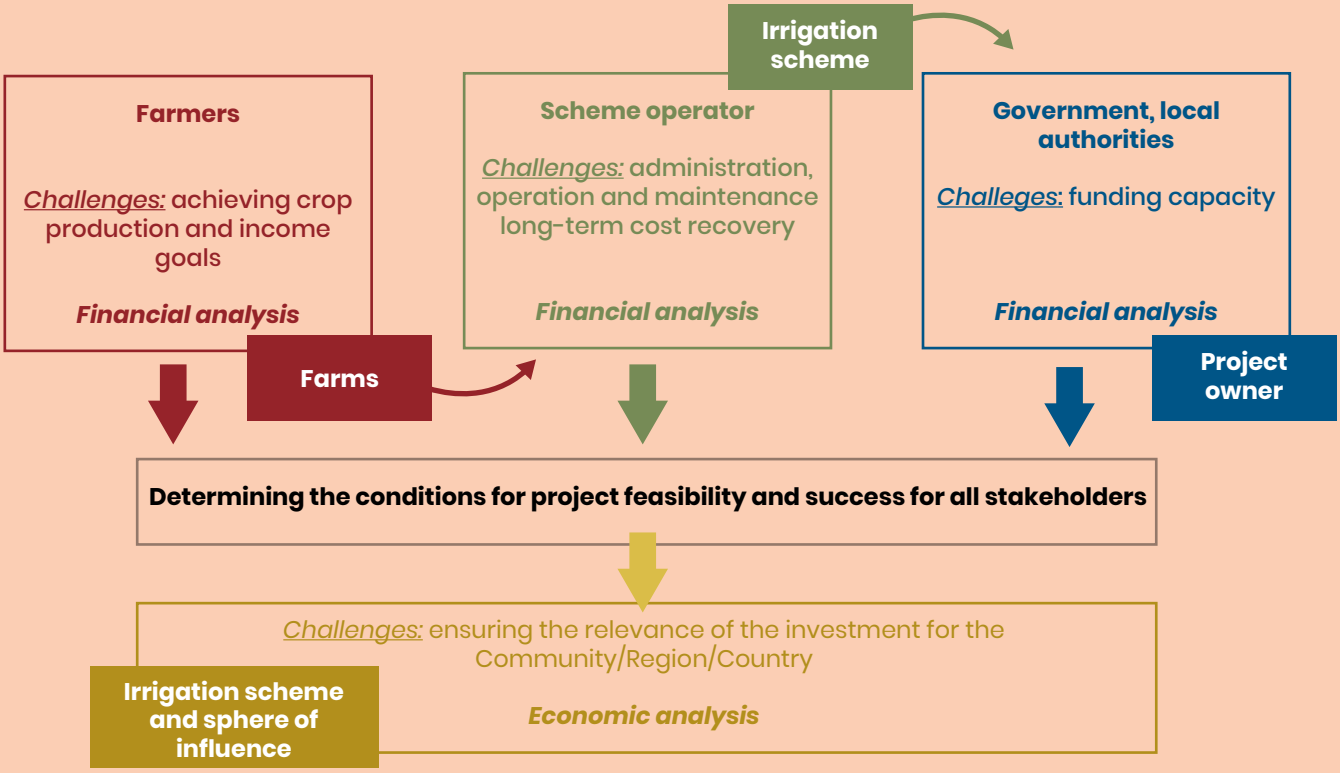
Figure 1 - The three levels of *ex ante* economic analysis of an irrigation project



3. **What are the government's funding requirements over the life of the project, and what revenue will it be able to generate from direct and indirect taxes?**

4. **Lastly, what is the relevance of the investment from the point of view not of the individual stakeholder but of Society as a whole?** This is what distinguishes economic analysis from financial analysis. It includes and goes beyond the individual point of view to take public interest into account and compare the expected outcome with what would be the case if the project did not go ahead. Furthermore, this global assessment must include indicators that have often been overlooked but which are nonetheless essential, such as environmental and social impacts.

Taking the diversity of producers into account and checking the conditions for their involvement

To meet producers' needs, it is essential to have a thorough knowledge of the various production systems and the rationales of the different types of producers within the project area. It is important to note that not all producers in the irrigated area will be in the same situation: some may be landowners, while others operate on a tenant or sharecropping basis; some may have plots of land outside the irrigated area, or livestock; some may use only family labor, while others have paid workers; and so on.

It will be in the farmers' interest to commit to a project if it can provide them with a higher income (or more resources overall) than if they were to use their means of production for other activities. So, it is not merely a matter of checking that farmers will generate a positive income, or enough to feed their family, for example, but also of ensuring that other production options or activities might not be preferable. For example, farmers seeking to ensure their family's food security may prefer crops that are less profitable but less risky over the cash crops proposed by the project. For others, it may be in their interests to sell their labor or to work on rain-fed crops rather than on the irrigation scheme.

Regardless of these individual strategies, irrigating farmers may not have the material and financial resources to implement the project's cropping plans. The analysis then needs to focus on ensuring that they have (1) the technical means (and an appropriate economic environment) to implement the planned crops and obtain the expected results; (2) the necessary family or hired labor; and (3) the financial means to cover their own operating and investment expenses throughout the project and beyond. Farmers who do not have the necessary resources to invest in the project may not benefit from committing to it, or may not have the capacity to do so, unless appropriate support measures—credit, subsidies, technical support, mechanization, and so forth—are provided. This analysis at the farmer level therefore helps to identify the support measures required for the project to work.

Determining the conditions for irrigation infrastructure management stability

Many irrigation projects perform very poorly because collective infrastructure is not operated and maintained effectively. Irrigation schemes operators are an essential component of a project's viability. They can be of different types: farmers' organizations (associations, groups, or

federations), administrations, publicly owned companies, private corporations, or even semi-public companies. Complex systems may also divide responsibility for system operation and maintenance between several stakeholders. For operators to be able to provide satisfactory services to their users over the long term, their financial stability must be ensured. This stability depends, on the one hand, on the cost of operating and maintaining the infrastructure and, on the other, on the ability of the various stakeholders to contribute to its funding. When responsibility for the management of the irrigation system is shared between several distinct operators, it is necessary to carry out a separate financial analysis for each operator. As in the case of farmers, the specific economic rationale of each party involved must be considered.

The larger the irrigation scheme and the more complex the infrastructure, the less likely it is that irrigation service fees will be sufficient to cover operating and maintenance costs, let alone the long-term renewal. If charging farmers for water service does not cover the "sustainability cost" (see Figure 2), then achieving financial stability for the the operator and the irrigation scheme means identifying and securing other sources of funding, in particular public subsidies when these are justified by the overall benefits of the project for the community. The project's sustainability depends on ensuring that the "full cost" is funded and that the "total cost" is covered by the expected benefits of all kinds, not only agriculture.

Carrying out better evaluations of projects' impacts on the community/region/country[3]

Analysis at the community/region/country level makes it possible to evaluate and compare the advantages and disadvantages of implementing the planned irrigation project for Society as a whole and for its various components. Economic evaluation can thus help justify the requirement for public support beyond investment, by demonstrating the benefits of supporting projects with a high positive overall impact even when profitability is low for part of the stakeholders. Public support can also compensate for losses incurred by stakeholders who are disadvantaged by the project. It may take the form of differentiated trade policies, facilitating access to credit, product or input subsidies, income support, and so on. It can also be used for repairing/compensating potential environmental damage.

One of the major difficulties in economic analysis is how to compare advantages and disadvantages across a wide range of areas. Beyond generating value, developing irrigation can have multiple impacts; positive or negative, for example on employment, social differentiation, health, nutrition, and ecosystems. How can a project that creates greater wealth be compared with one that creates more jobs? How can one compare advantages in terms of human nutrition with disadvantages such as loss of biodiversity?

One solution is to convert all the advantages and disadvantages into monetary units, so that the sum of the advantages can then be compared with the sum of the disadvantages over a defined reference period: this is the basis of **cost-benefit analysis (CBA).** This method is very effective when the expected advantages and disadvantages, including environmental ones, can be monetarized: the added value produced by irrigated crops, the costs of creating irrigation infrastructure, indirect impacts on other activities or resources, etc. But some advantages and disadvantages are difficult to express in monetary terms.

In these situations, **multi-criteria analysis (MCA)** offers an alternative to assessing non-monetary costs by considering aspects such as human health, the environment, social issues and heritage, in addition to economics. It makes it possible to assess the relevance of a project on the basis of both non-monetary and monetary factors, through criteria that must be determined and weighted. It is particularly beneficial when it adopts a participatory approach and facilitates dialogue between project stakeholders.

[3] Depending on the scope of the project and its sphere of influence.

Figure 2 - Costs of irrigation services and water resource use

<table>
<tr><th colspan="2">Type of cost</th><th></th><th></th><th></th></tr>
<tr><td rowspan="4">Technical and administrative operation of the system</td><td>Infrastructure operation</td><td rowspan="6">Sustainability cost</td><td rowspan="8">Full cost
(technical and financial)</td><td rowspan="10">Total cost
(economic)</td></tr>
<tr><td>Water policing</td></tr>
<tr><td>Management administration or Administrative and financial management</td></tr>
<tr><td>Routine infrastructure maintenance (upkeep)</td></tr>
<tr><td rowspan="2">Maintenance (non-routine)</td><td>Preventive maintenance</td></tr>
<tr><td>Corrective maintenance</td></tr>
<tr><td>Long-term renewal</td><td>Replacing equipment and works</td></tr>
<tr><td rowspan="2">Initial investment</td><td>Capital repayment</td><td></td></tr>
<tr><td>Financial expenses (LT debts)</td><td></td></tr>
<tr><td>Water resources</td><td>Opportunity cost</td><td colspan="2">Opportunity cost of the resource</td></tr>
<tr><td>Environment</td><td>Impacts and externalities</td><td colspan="2">Environmental cost</td></tr>
</table>

Source: adapted from Tardieu and Préfol (2002)

What kind of analysis should be carried out at each stage of the appraisal of an irrigation project?

The COSTEA guide proposes a specific approach to four types of irrigation project: the development, modernization, or rehabilitation of a single irrigation scheme;[4] irrigation development programs (multiple schemes); large-scale multi-use infrastructure; and projects supporting public irrigation policies. It specifies when economic analysis should be carried out and the role it should play in each case. For example, when developing an irrigation scheme, financial and economic analysis should be carried out at every stage of the project:

- At the identification stage, a summary analysis must specify the economic benefits expected and thus feed into selecting the main project guidelines and its location.
- In feasibility studies, economic analysis must be carried out at the very least with regard to the farmers and the scheme operator (and at the level of the region or country, when this is justified by the project scope) so as to feed into decisions on technical options, management, and agricultural development. At this stage, economic analysis can be used to specify the measures that will be required to support the key stakeholders.
- Lastly, when carrying out the detailed technical studies, it is important to check that the hypotheses put forward in the feasibility study are still valid and to carry out a more thorough economic evaluation, by completing studies on irrigation service pricing and the financing conditions for each stakeholder involved and, when necessary and relevant, estimating government subsidies.

[4] Projects to create new irrigation schemes are uncommon at present; most projects aim to rehabilitate, update, or extend existing schemes.

Resources

The resources and the time required for economic studies during the appraisal process and subsequent studies should not be underestimated. They will depend on a number of factors, including:

- the complexity of the project (whether it involves multiple infrastructures, diversified cropping systems, numerous indirect impacts, etc.);
- the size of the scheme and its impact on local resources.
- the availability of data;
- the size of the project and the number of farms/communities affected;
- the diversity of the farms and the level of organization of supply chains.

Using four cases based on real projects, the guide suggests an estimate of the number of days required for each stage and each task. This is not intended to be prescriptive; rather, the suggestions are meant to provide a basis for reflection for anyone (project owner, backer, etc.) who needs to specify the requirement for economic analysis in order to carry out an appraisal of an irrigation project.

Some classic mistakes

- Only considering the financial dimension of the project, focusing on the internal rate of return (IRR) and forgetting to check feasibility for all stakeholders.
- Considering a project with high IRR as necessarily being a good project.
- Considering the area covered by a scheme to be homogeneous and estimating agricultural income without taking into account the diversity of farms and farmers.
- Forgetting that family farmers may have priorities other than the project and that financial profitability is not necessarily their top priority.
- Failing to consider the financial balance of the scheme operator.
- Not taking into account the social dimension of irrigation management and confining oneself to calculating costs—which, in any case, are often underestimated by a wide margin.

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