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## **Investment project evaluation : social and economic indicators for sustainable development**

Francois Bonnieux, Jean Christophe Paoli

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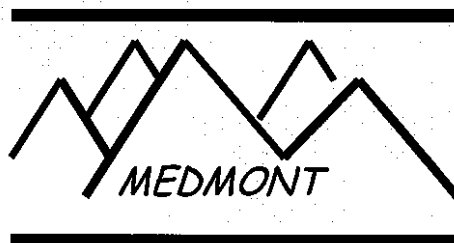
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## MEDMONT WP6 Final Report

June 2004

### Investment Project Evaluation: social and economic indicators for sustainable development

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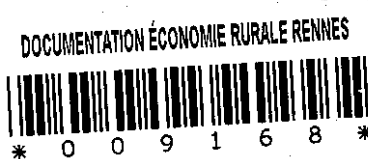
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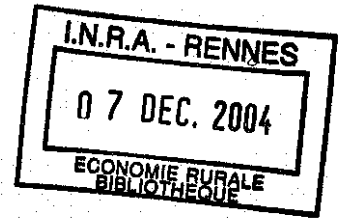
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## Abstract

*This is the last version of the work package 6 final report. It is based on the third draft which has been presented at the Sixth Medmont Meeting in April 2004. Thus, this last version benefits discussions among Medmont Partners and integrates a number of recommendations they made. This final report is a self content paper which both includes theoretical and empirical contributions. The theoretical part relies on the discussion documents which were produced before, as well as some new developments. The outcome of the empirical part contrasts with the methodological one. It is based on a databank, derived from the consolidated questionnaires. Its main objective was to demonstrate that the proposed methodology can be applied on real world data and leads an operational outcome for policy-makers.*

*This report is organised into five sections, plus a short introduction and some recommendations for making an evaluation. There are two theoretical sections and two empirical ones, which are bridged by a methodological section in which the integrated framework supporting economic and social indicators is developed. The theoretical sections are devoted to the concept of sustainable development and to a discussion of evaluation tools with a special emphasis on cost-benefit analysis and its limitations. Integrating sustainability requirements into an extended cost-benefit analysis is a difficult challenge which is considered in some details. Based on this critical analysis, an approach relying on indicators is proposed. Important issues to define indicators are discussed and then the consolidated questionnaire is elaborated. Empirical sections provides a simple statistical analysis and a multi-criteria analysis leading to a selection of key indicators and to a typology of the projects.*

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## 1. Introduction

According to the Evaluation Unit of the DG Regional Policy (European Commission, 2002): 'A project refers to an investment activity upon which resources (costs) are expected to create capital assets that will produce benefits over an extended period of time, and that logically lends itself to planning, financing, and implementing as a unit. A project is thus a specific activity, with a specific starting point and a specific ending point, that is intended to accomplish a specific objective. It can also be thought of as the smallest operational element prepared and implemented as a separate entity in a national plan or programme. A project may produce benefits that can be valued in money terms or it may produce benefits that are intangible'. This definition makes a clear delimitation between a project and a programme or a plan, a project corresponding to the lowest level. In addition, by emphasising monetary and non-monetary benefits, it takes into account the main issues of interest in the Medmont context.

The central issue of project evaluation is concerned with the change in the state of the environment, and in the economic and social conditions due to the project. Evaluation refers to a baseline which is used as a benchmark for assessing the expected outcome of the project (*ex ante* perspective) or its actual outcome (*ex post* perspective). Indicators for evaluating a project will be therefore expressed in relative terms. *Ex ante* analysis can be seen as the comparison of a potentially wide range of options, all of which are hypothetical. It is used to describe the analysis of the costs and benefits which should underlie the final project. It should always include an examination of the risks and uncertainties. Analysis can show how alternative choices compare in many ways. *Ex post* analysis compares a likely narrower range of options. It mainly examines the outcome of a real project which has been carried out. It will include an assessment of what happened and a comparison with what would have happened if the project under consideration had not been implemented.

There are many techniques for evaluating projects which impact on the environment, among which Cost-Benefit Analysis (CBA) and the closely related technique of Cost-Effectiveness Analysis (CEA) play a prominent role. The need to balance the costs of an action against its benefits is intuitively appealing. One of the claim strengths of CBA is the fact that is grounded in a strong theoretical basis relative to human behaviour and preferences. Basically, CBA involves the monetization of all the costs and benefits of a proposed project, including the alternatives, and the assessment of the resultant net benefits over a given time horizon. Where monetization cannot be achieved, CEA is used to select the lower cost project of satisfying a given objective. Throughout the past decades, CBA became the predominant tool for project evaluation (Hanley and Spash, 1993). We should be fully aware that there are many methods of expressing impact on the environment that a decision-maker can consider singly or jointly. Other methods include Environmental Impact Assessment (EIA) and risk effectiveness analysis. Indeed, in all case studies, physical information about environmental impacts is shown to be an essential prerequisite to CBA and CEA.

Despite the current sustainable development rhetoric there is no doubt that the frequently antagonistic relationship between economic development remains. So traditional environmental decision-making is being questioned because it does not integrate environmental objectives with economic and social issues. Strategic environmental assessment has been emerging in this context and can be defined as follows: 'Strategic

environmental assessment is a systematic, on-going process for evaluating, at the earliest appropriate stage of publicly accountable decision-making, the environmental quality, and consequences, of alternative visions and development intentions incorporated in policy, planning or programme initiatives, ensuring full integration of relevant biophysical, economic social and political considerations' (Partidário, 1999). It aims to provide the competent authority with a tool which enables it to be fully aware of the environmental and sustainability issues associated with a particular policy, programme or project. The objective is therefore to expand the competent authority's focus by providing a mechanism by which its goals will include cross-cutting environmental and sustainability perspectives. Thus strategic environmental assessment does not refer to a precise technique but to a general methodology which relies on a range of methods (Thérivel and Brown, 1999). Under the Medmont research programme, we are developing a similar procedure to evaluate investment projects only, but with a more ambitious theoretical objective as it concerns both *ex ante* and *ex post* evaluation. With respect to on going projects both perspectives, *ex ante* and *ex post*, will be considered. The technical methodologies used for *ex ante*, *ex post* and on going evaluation are similar. Each should identified, and quantified where possible, both the direct and indirect costs and benefits of the project. However, *ex post* evaluation tends to be based on actual data while *ex ante* evaluation relies on forecasts and projections. In any case five steps can be defined (Table 1).

Table 1. Evaluation steps.

<i>Ex post</i> evaluation	<i>Ex ante</i> evaluation
Establish exactly what is to be evaluated	Define the project
Define alternative projects	Consider the options
Compare the real outcome with the target outcome and with the effects of the selected alternative projects	Identify, and where possible quantify and value the benefits, costs, risks and uncertainties associated with each option
Analyse the information	Analyse the information
Present the results	Present the results

In each country, there is a diversity of investment projects which are located in the same small area. However they are not part of a general plan and they are not supervised by the same agency that would be responsible for co-ordination and monitoring. They are not making a group of projects and are evaluated one by one (European Commission, 2002). However, there is a limit to evaluation of a project alone, because several small projects taken together may give rise to substantial externalities and may justify much greater assessment collectively than individually (Tisdell, 1993).

Investment Project Evaluation

Table 2. Identification of the projects

1:pre-installation  
2:installation  
3:operating

	Acronym	Name	Pre-installation period (years)	Installation period (years)	Operating period (years)	Life of the Project (years)	Present stage of the project	First year of installation period	Total investment (1000 €)
Spain	E1	Cork oak natural regeneration	0.2	4.9	170.0	174.9	1	2003	745.0
	E2	Forest-fire regional prevention program Cadiz	0.3	8.8	33.5	42.3	3	1993	4249.4
	E3	Rojitan country house and path	0.4	5.0	30.0	35.0	3	1997	975.6
	E4	Hurones recreative area	0.3	1.5	30.0	31.5	3	1996	147.3
	E5	Visitor's center del Barbate	2.0	4.0	30.0	34.0	2	1999	1879.6
France	F1	Balagna oil co-operative reconstruction	0.7	0.2	15.0	15.0	3	1994	599.9
	F2	Wastewater network transfer of Belgodère	2.0	0.5	50.0	50.0	3	2002	1008.1
	F3	Rehabilitation of an habitation for tourists	3.0	2.0	25.0	27.0	1	2003	1349.6
	F4	Construction of Codole dam in Balagna region	4.0	4.0	80.0	84.0	3	1980	9937.0
	F5	Frassigna forest road	0.6	2.0	13.0	15.0	3	1988	297.5
Greece	G1	Making & selling traditional Holomontas sausage	3.5	1.2	5.0	6.2	3	1999	117.4
	G2	Agrotourist lodgings Estate of Arnea	1.5	3.5	5.0	8.5	2	1999	1400.0
	G3	Timber quality improvement degraded forests in Halkidiki	1.0	90.0	na	na	2	1990	40116.1
	G4	Restoration of the Agia Paraskevi-Pefkohori burnt	0.3	0.5	80.0	80.5	3	1998	1014.7
	G5	The Bizirgianni old bridge Megali Panagia	1.5	0.5	30.0	30.5	1	2003	230.9
Italy	I1	Dairy processing farm & agritouristic activity Tambre d'Alpago	6.0	1.5	20.0	21.5	3	2001	788.0
	I2	Ethnographic museum of Seravella	14.0	4.0	35.0	39.0	3	1993	1574.0
	I3	Forest road Praducchio-Salacè in Comelico	12.0	2.0	29.0	31.0	3	2001	110.0
	I4	Frassati footpath	3.0	0.4	50.0	50.3	3	2001	50.0
	I5	Private slaughter house in Alpago	1.0	0.5	10.0	10.5	3	2002	125.0
Slovenia	S1	Forest learning-trail Panovec	1.0	2.0	118.0	120.0	3	1981	147.8
	S2	Forest road Ojstrovica	10.0	1.0	159.0	160.0	2	2003	264.0
	S3	The irrigation project Dragonja	6.0	5.0	20.0	25.0	1	2003	7385.0
	S4	The improvement of infrastructure (Soca Valley)	3.0	1.0	6.0	7.0	3	2000	6.0
	S5	Reactivation of the abandoned karst grassland	1.0	0.5	14.5	15.0	3	2001	47.8

Table 2 provides a brief description of the twenty-five projects which have been considered in the Medmont programme. First of all the variety of projects related to the duration of the pre-installation period, the installation period as well as the operating period must be emphasised. The pre-installation can be very short, it is under one year for twelve projects, can also extend over a long period of time, it is over five years for five projects with a maximum of fourteen years for I2. Apart the extreme case of G3 (timber quality improvement in Halkidiki), the range of the duration of the installation period is smaller: eight projects are under one year, while twenty-three are under five years. In addition there is no correlation between the duration of these two periods.

The duration of the operating period ranges from five years for G1 (traditional Holomotas sausage) and G2 (lodging estate of Arnea), up to 170 years for E1 (cork oak natural regeneration). Here there is a relationship between the type of project and the operating period duration. However, there are differences among countries for the same type of projects. As mentioned five years are reported for G1, fifteen for F1 (oil co-operative) and twenty for I1 (dairy farm). The same remark applies for forest roads: thirteen years for F5 (Frassigna forest road), twenty-nine for I3 (Comelico forest road) and 159 for S2 (Ojstrovica forest road).

A series of five projects are starting in 2003 (E1, F3, G5, S2 and S3) and two others started in 2002 (F2 and I5). In contrast, six projects are operating for more than ten years: E2 and I2 started in 1993, G3 in 1990; F5 in 1988, S1 in 1981 and F4 in 1980.

According to their present stage, only four projects are in the pre-installation or at the end of this phase (E1, F2, G5 and S3), while four are in the installation period (E5, G2, G3 and S2). Most of them (17 among 25) are in operation, and none is ended. The evaluation is therefore run in the context of *ex ante* projects and on ongoing projects only.

The range of total investment is very large since the minimum equals 6000 € (S4) and the maximum is over 40 million € (G3). The distribution of total investment includes a variety of situations. Projects can be classified as follows:

- Large projects (over two millions €): E2, F4, G3 and S3;
- Medium projects (over half-million €): E1, E3, E5, F1, F2, F3, G2, G4, I1 and I2;
- Small projects (over fifty thousand €): E4, F5, G1, G5, I3, I5, S1 and S2;
- Very small projects (under fifty thousand €): I4, S4, and S5.

This report is limited to the work package 6 (WP6) which deals with the economic and social component of the whole research programme. It is structured into five sections. The two first sections give insights on sustainable development and evaluation tools with an emphasis on EIA and CBA. Theoretical bases as well as limitations are considered, with a specific discussion devoted to the integration of sustainability requirements into CBA. The next section is then elaborated on this firm background and proposed an integrated framework for investment project evaluation. The two last sections are devoted to the application of this framework to the sample of case-studies. First there is a simple statistical analysis of the projects and then a multi-criteria analysis.

## 2. Sustainable development

### 2.1. Emergence of sustainability

Sustainability became a central issue of our time during the eighties with the Bruntland Report (WCED, 1987). It firmly establishes the concept of sustainable development as the basis for an integrative approach to economic policy in the coming decades. Sustainability has been an exceedingly popular word over the past few years when it comes to human interactions with the environment. Probably one reason for its popularity is that it sounds good but it is difficult to define precisely (Kolstad, 2000). A number of economists have embraced the notion as a concept that they have been talking about for decades, in the context of economic growth and the environment. Ecologists and the green lobby have embraced sustainability as fresh alternative to blind economic growth (Costanza, 1991).

The 1972 United Nation Conference in Stockholm represented a landmark in the development of global environment awareness and the World Conservation Strategy (IUCN, 1980) expressed concern about irreversible damage that man is doing to the biosphere. It suggested that if this damage continued at recent rates, the economic welfare of mankind will be undermined. Therefore, the need for integrating conservation and economic development had already advanced: 'Development and conservation are equally necessary for our survival and for the discharge of our responsibilities as trustees of natural resources for the generations to come'. In fact, the importance of sustainable development has been acknowledged for decades, specially in the context of forestry economics and more recently in fisheries economics. The term *nachhaltig* was first used by Carlowitz in 1713 and later by Moser in 1757 in a book on forest economics (Killian, 1993). By the mid 19<sup>th</sup> century, a German landowner, Martin Faustman (1968) solved the sustained-yield forestry problem. The concept of sustainability of forest production in the Habsburg empire was first established in the imperial forest law of 1852. In this law the term *nachhaltig* is not used but the requirement for afforestation after harvesting forests was introduced there among others. This law established homogeneous management practices and monitoring authorities. Before this law there were many legal prescriptions under which long term forest management was regulated (some of them dating back to 1500), but poorly enforced.

The Treaties establishing the EC were written in a period before concerns about pollution and the depletion of resources had come to prominence. This was reflected in Article 2 of the 1957 Treaty of Rome, which included among the tasks of the Community: 'A continuous and balance expansion' and 'an accelerated raising of the standard of living' of the Member States. No concern was expressed for the quality of that expansion, nor the conservation of resources, nor the needs of future generations (Wilkinson, 2002). With the adoption of the Maastricht Treaty, environmental action was granted the status of an EU policy. Indeed, Article 2 has been amended to include the promotion of 'sustainable and non-inflationary growth respecting the environment'. Article B of the Common Provisions of the Treaty similarly refers to 'economic and social progress which is balanced and sustainable'. This greening of the Treaty was reinforced with the Treaty of Amsterdam, which entered into force in 1999 and enshrines the principle of sustainable development as one of the EU aim.

Since 1973, every few years, the Commission has drafted an Action Programme on the environment, outlining its intentions for legislation and other activities in the years ahead. The

Fifth Action Programme 1993-2000 'Towards sustainability' constituted the Community's first commitment to sustainable development. The global assessment of the programme concluded that while progress was being made in cutting pollution levels in some areas, problems remained and the environment would continue to deteriorate unless a series of actions were made (European Commission, 2001a). Among those, the integration of environment into the economic and social policies driving the pressures on the environment is emphasized. Rather than fixing specific environmental targets for the coming decade, the Commission has opted to define actions in thematic strategies, aiming at the four priorities of its Sixth Action Programme 2001-2010 'Environment 2010: our future, our choice' (European Commission, 2001a):

Tackling climate change.

1. Nature and biodiversity.
2. Environment and health.
3. Sustainable use of natural resources and management of wastes.

Broad involvement of stakeholders, citizens and business will be central to the successful implementation of measures to protect the environment. 'Sound scientific knowledge and economic assessments, reliable and up-to-date environmental data and information and the use of indicators will underpin the drawing-up, implementation and evaluation of environmental policy' (European Commission, 2001a).

## **2.2. Definition of sustainability**

Sustainable development is an evolving concept, one that is being redefined and reinterpreted in what is now a massive literature on the subject. One of the best known definition was published in the Bruntland Report (WCED, 1987). Sustainable development is simply defined in as: 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. But the Report goes further by stating that it is possible to achieve a path of sustainable development for the global economy. This definition was extended significantly (Solow, 1992). 'The duty imposed by sustainability is to bequeath to posterity not any particular thing - with rare exceptions such as Yosemite, for example - but rather to endow them with whatever it takes to achieve a standard of living at least as good as our own and to look after their next generation similarly. We are not to consume humanity's capital in the broadest sense'. Humanity's capital includes environmental assets, human-made capital as well as human capital. Key to this view is that man-made capital (machines, buildings) and knowledge are substitutes for natural capital, particularly natural resources. The prescription is to leave to future generations a generalised capacity of producing social utility. Thus removing distortions stemming from public policies and market failures which involve an inefficient use of natural resources may improve the prospects for sustainable development but will not guarantee it. Efficiency is a necessary condition but it is not sufficient. Achieving sustainability involves achieving equity across generations.

The underlying logic is that future generations should be compensated for reductions in the endowments of resources brought about by the actions of present generations. So the way in which compensation should take place is the crucial issue. It poses the problem of substitution between man-made capital and natural capital. The distinction is not always clear between these two types of capital but it is helpful to understand linkages between the environment and

the economy. Natural capital includes assets such as soil, water and wildlife whereas man-made capital includes things such as infrastructures as well as knowledge and technology. Indeed assets such as breed animals or crops cannot be classified according to this oversimplified typology. If resource scarcity and environmental degradation posed no significant threat to the well-being of future generations, both types of capital are substitutes, then compensation can take place. So achieving a sustainable development restricts to achieving an efficient resource allocation across periods of time. The concept moved away from a model of development that was almost exclusively based on economic growth and pointed out the need to integrate fully environmental protection and the sound management of natural resources into all economic and social activity.

The debate over sustainability has focused on two key aspects:

The degree to which natural capital can be viably replaced by human capital.  
The obligation the present owes to future generations.

### **2.3. Types of capital and safe minimum standard**

The general prescription for sustainability is to leave to future generations a generalised capacity of producing social utility allowing to achieve a standard of living as good as our own and to look after their next generation similarly. Various authors have established a relationship between sustainability defined as non declining utility and the underlying capital stock (Pearce and Atkinson, 1995). The concept of capital has widened from the classical approach, with its focus on produced goods to embrace other assets. Capital assets take four forms (Pearce and Atkinson, 1998):

- Reproducible capital (or man-made capital) includes machines, buildings and roads, and is denoted by  $K_R$ .
- Human capital is the stock of knowledge and skills, denoted by  $K_H$ .
- Natural capital  $K_N$ , includes assets such as soil, water, forest and wildlife, as well as mineral assets.
- Social capital  $K_S$ , concerns the relationships between individuals, between institutions, and between individuals and institutions.

The distinction is not always clear between these types of assets but it is helpful to understand linkages between the environment, the economy and the organisation of the society. Social capital is not easy to measure in a manner consistent with how over assets are quantified. Nevertheless, there is evidence that different societies can have broadly equal endowments of other forms of capital, but perform differently in terms of economic and social development. This is related to the issue of governance which is found to be a crucial one in the context of mountainous Mediterranean regions.

The condition for sustainable development, therefore, amounts to each generation leaving a stock of capital that is capable of providing utility per capita than that enjoyed by the current generation. This line of analysis leads to the 'constant capital' rule. The value of the net change in the total capital must be positive:

$$dK/dt = d(K_R + K_H + K_N + K_S)/dt \geq 0$$

where  $K = K_R + K_H + K_N + K_S$

Defining gross savings  $S(t)$  and the rates of depreciation  $\delta_R$ ,  $\delta_H$ ,  $\delta_N$  and  $\delta_S$  of the four types of capital, this becomes:

$$S(t) - \delta_R K_R - \delta_H K_H - \delta_N K_N - \delta_S K_S \geq 0$$

For simplicity, we assume that knowledge and skills, as well the organisation of the society do not depreciate, the condition for weak sustainability is:

$$S/Y \geq \delta_R K_R/Y + \delta_N K_N/Y$$

where  $Y$  is income.

If  $\delta_H \neq 0$  or  $\delta_S \neq 0$  this condition will alter. Nevertheless, weak sustainability is consistent with running down the stock of natural capital providing sufficient investments in reproducible capital. On this basis compensation to future generations are expressed in terms of a savings rule. The underlying logic is that future generations should be compensated for reductions in the endowments of natural resources brought about by the actions of present generations. So the way in which compensation should take place is the crucial issue. It poses the problem of substitution between natural capital and reproducible capital.

Under the constant capital rule, all forms of capital are substitutable for each other. Much of the ecological literature denies this substitutability, at least across some classes of natural capital. Of particular interest are the life support of the ecosystems such as hydrologic and nutrient cycles. Indeed there are asymmetries between  $K_R$  and  $K_N$  as far as irreversibility and uncertainty are concerned. Thus  $K_R$  is reversible since the capital stock can be increased or decreased within limits whereas some natural assets are technically irreversible, extinct species cannot be recreated. The non substitutability of natural capital supports strong sustainability. That does not imply that weak sustainability is irrelevant, but in addition strong sustainability requires that the stock of  $K_N$  should not decline. There may be reason to suggest that social capital should be constrained to be non-declining, because its decline leads to a disruption of the social links. Strong social sustainability is then defined along the same line than strong environmental sustainability (Pearce and Atkinson, 1998): both total assets and social capital do not decline. Depending upon the relationships between capita assets four levels of sustainability can identified (Sadler, 1999):

1. Weak sustainability involves maintaining total capital intake without regard to its composition.
2. Moderate sustainability requires that some attention is given to the relative levels of capital as well.
3. Strong sustainability means maintaining natural capital at current levels (no net loss). The resource losses and ecological damages resulting from development must be replaced or offset.
4. Absolute sustainability means non-depleting and non-damaging use of natural resources. Only the net increment of renewable resources can be used.

Knowledge about current man-made capital tends to be complete, while the precise way in which ecosystems work is not known. Whilst uncertainty will decline through time the natural

world remain incompletely known. So deciding to conserve today a wilderness area for example, is a risk minimising behaviour if we are unsure about the consequences of its degradation. This is the rationale to the safe minimum standard principles introduced primarily by Ciriacy-Wantrup (1952). The rule is to prevent reductions in the natural capital stock below the safe minimum standard identified for each of its critical component. Assuming an increase in scientific knowledge, these standards are expected to be regularly revised. A safe minimum standard approach shifts the burden of proof from those who wish to conserve to those who wish to carry on the project of interest.

While some substitution is possible between certain elements of natural and man-made capital (for example technical progress allows for a decrease in car fuel consumption), many natural assets provide non-substitutable services. For these reasons the weak sustainability rule is limited in scope, and a strong sustainability rule would require that some natural assets be held constant or increasing. The important question here is how much of these assets should be held constant? A rule for sustainable development is to prevent reductions in the level of specific natural assets below some constraint values. This is a stringent prescription since it would involve all projects having a detrimental effect on critical component to be banned.

A series of operational principles for sustainable development have been established (Daly, 1990). The emphasis is on the carrying capacity, biodiversity, ecosystem integrity and similar concepts that identify limits or thresholds of acceptable change to the environment. Otherwise, the distinction between risk and uncertainty is very important. Risk means a deleterious effect associated with some probability while the context is to be one of uncertainty when probabilities are not known. Absence of knowledge about probabilities has given rise to the precautionary principle which is an essential component of a sustainable development strategy. It is very difficult to get a clear definition and interpretation of the precautionary principle (Pearce, 1998) but practical prescriptions can be made:

1. Select the no-project option, when the degradation may be irreversible, or when there is little prior experience or scientific confidence about the outcome.
2. Maintain a large safety margin and require use of best available technology when the cost of degradation may be potentially serious but reversible.
3. Use conventional evaluation and decision-making when the threat to the environment is neither irreversible nor to be serious.

## **2.4. Sustainability vs. efficiency**

The principle of sustainable development has emerged as a unified approach to environmental and development policy. A common sense of all interpretations of this principle is that current decisions should ensure that future generations have access to the resources required to enjoy life opportunities no less satisfactory than our own. refers to an inter-temporal equity principle rather than an efficient principle. Sustainability refers to an inter-temporal equity principle rather than an efficiency principle. As such, sustainability would be potentially inconsistent with a conventional project analysis since it denies the possibility that greater net benefit now can be secured at the expense of the future. In this view, standard evaluation should be supplemented by sustainability constraints. Indeed, assume that current generation decides to reduce the stock of natural capital and to invest in man-made assets, in order to ensure that next generation well-being does not decline. If the elasticity of substitution between these two

types of assets is low, the current generation bears a huge financial burden to compensate the next one. On line with this standpoint the World Bank (1991) provides guidance on the operational meaning of sustainability: 'The Bank endeavours to ensure that each project affecting renewable natural resources (e.g., as a sink for residues or as a source of raw materials) does not exceed the regenerative capacities of the environment'. A project that exceeds the regenerative capacities of its environment is reducing its future capacity to produce and to that extent is counting capital depreciation as income. When a project is accepted, impact compensation can be used as a form of mitigation. If for example, a negative impact on a landscape cannot be avoided by a project of interest, then a balancing landscape benefit is provided. This can be formulated as:

1. Avoid the adverse effect if possible.
2. If not, minimise the effect.
3. Then provide a balancing beneficial effect in the same area or if that is not possible eventually in a different area.

This requires an evaluation an evaluation of the value and type of landscape element being adversely affected, and a balancing benefit of equal or greater value as close to the site as possible.

## **2.5. A tentative typology of projects**

Table 2 gives a tentative *a priori* typology of the 25-projects of interest. First of all there are classified into four categories:

1. Infrastructures,
2. Natural resources,
3. Agro-tourism,
4. Quality products,
5. Historical and cultural heritage.

Then the likely impact on the four categories of capital (man-made, natural, human and social) is given. Expected impacts on the import and export of the local economy are also indicated. The size of the project is defined according to total investment cost (Table 2).

Infrastructures related to public utilities such as waste water treatment (F2) or the provision of water for irrigation and human consumption (F4, S3) are considered as well as forest roads (F5, I3, S2) and footpaths (I4, S1). The former projects are based on large investments in reproducible capital in terms of machines and civil engineering, involving imports of capital goods and services. As they favour economic development they positively affect exports through an increase in agricultural production and tourists frequentation. They have also a positive impact on human and social capitals. Otherwise, their impacts on natural capital are likely contrasted, negative for a reservoir and positive for a wastewater treatment device. The investments for the three forest roads and two footpaths are modest, so their impacts on the various types of assets are expected to be limited. In terms of import, the effects are negligible because their building does not require a very high expertise. They may positively affect tourist trade and therefore exports indirectly.

Forest and grassland restoration projects (E1, G4, G3, S5), as well as the fire prevention programme (E2) are expected to have a very positive effect on natural capital. The scope of the effect is directly linked to the size of the investment. Such projects lead to a better concern of the resident population regarding the environment. In addition, they support the development of outdoor recreation by local people and tourist. To a certain extent they favour tourism and therefore positively impact exports.

There are two types of RDPs projects under the heading 'agro-tourism'. Two projects involve an increase in tourist accommodation (E3, G2) while three projects target the development of recreational activities (E4, E5, S4). All favour exports through an increase in tourist trade, as such they can adversely impact the environment.

The development of quality product processing has a direct positive impact on man-made capital, but the impact on natural capital may be contrasted among projects. The associated four RDPs (F1, G1, I1, I5) require a skilled labour which is not always available locally. So a certain amount of money can be spent outside the region of interest and benefits foreign people, this generates an import of services at least during the pre-installation and installation periods. In the long run they are likely to lead to an increase in the exports.

Three projects (F3, I2, G5) are concerned with the protection of historical and natural. They are likely to favour the training and education of the local population and lead to an increase in human and social capital. Otherwise, as they attract more visitors they have a positive effect on exports but can adversely affect the environment.

Table 3. A tentative classification of projects of interest

Type of project	Acronym	Size	Expected impact on capital				Expected impact on	
			K <sub>R</sub>	K <sub>N</sub>	K <sub>H</sub>	K <sub>S</sub>	Import	Export
Infrastructures								
Wastewater	F2	Medium	++	++	+	?	++	+
Dam	F4	Large	++	--	++	+	++	+
Irrigation	S3	Large	++	--	++	+	+	+
Forest road	F5	Small	+	?	0	+	0	+
Forest road	I3	Small	+	?	0	+	0	+
Forest road	S2	Small	+	?	0	+	0	+
Footpath	I4	V. Small	0	?	+	+	0	+
Footpath	S1	Small	0	?	+	+	0	+
Natural resources								
Forest restoration	E1	Medium	0	++	+	+	0	+
Forest restoration	G4	Medium	0	++	+	+	0	+
Forest restoration	G3	Large	+	+	+	+	+	+
Fire prevention	E2	Large	0	++	+	+	0	+
Grassland	S5	V. Small	0	+	?	?	0	+
Agro-tourism								
Accommodation	E3	Medium	++	--	+	+	0	+
Accommodation	G2	Medium	++	--	+	+	0	+
Recreation	E4	Small	0	?	+	+	0	+
Recreation	E5	Medium	0	?	+	+	0	+
Recreation	S4	V. Small	0	?	+	+	0	+
Quality products								
Olive oil	F1	Medium	+	-	+	+	+	+
Traditional sausage	G1	Small	+	0	+	+	+	+
Dairy farm	I1	Medium	+	0	+	+	+	+
Slaughter house	I5	Small	+	0	+	+	+	+
Historical and cultural heritage								
Theatre	F3	Medium	++	0	++	++	0	++
Museum	I2	Medium	++	0	++	+	0	++
Old bridge	G5	Small	+	0	+	+	0	+

V. Small: very small

## **3. Evaluation tools and cost-benefit analysis**

### **3.1. Background**

Several types of analyses have been developed over the years to provide environmental, economic and social information to the policy process. Most analyses rely on an Environmental Impact Analysis (EIA). It is essentially an identification and study of all significant environmental repercussions stemming from a proposed decision. EIAs are largely the work of natural scientists, who focus on tracing out and describing the physical impacts of projects with a special emphasis on linkages with the ecosystem. More broadly, impact assessment is defined as: 'The process of systematic analysis of the likely impacts of intervention by public authorities. It is as such an integral part of the process of designing policy proposals and making decision-makers and the public aware of the likely impacts' (European Commission, 2002a).

From the standpoint of welfare economics, cost-benefit analysis (CBA) is the primary analytical tool. In its broadest sense it refers to the measurement of the economic costs and benefits from any change in resource allocation in the economy (Boadway and Bruce, 1984). According to this perspective, an efficient policy is defined as one which maximises net benefits. The implementation of CBA poses a number of problems which are difficult to overcome, alternative procedures are therefore considered.

A comparison of the economic analysis approach underpinning CBA with that of EIA reveals some important contrasts which assist understanding of evaluation methods. In essence, CBA involves the monetization of all the costs and benefits of a proposed project and its alternatives, and the assessment of the resultant benefit over a given time horizon. EIA adopts a highly objective physical science approach to directly assess environmental impacts while CBA focuses upon their socio-economic interpretations as values. As such, CBA is anthropocentric and produces assessments which reflect a human rather than physical view of a project. CBA often appears more quantitative, employs a single unit as opposed to multiple units of measurement used by EIA.

### **3.2. Overview of CBA**

Economic theory has been founded on the notion of a rational individual who makes decisions on the basis of a comparison of costs and benefits. The essence of the cost-benefit approach is to extend this to the area of public decision making with respect to policy, programme and project. As projects are concerned, CBA compares costs and benefits of different project options over time and attempt to maximise the value of society's resources. As many of the costs and benefits as possible are expressed in monetary terms and further impacts are identified and quantified as well as they can be. A CBA is therefore a decision tool which judges projects according to a comparison between their costs and benefits. It essentially includes four steps:

1. Specify clearly the project, indicating what happens if not implemented.

2. Describe quantitatively the inputs and outputs of the program.
3. Estimate the social costs and benefits of these inputs and outputs.
4. Compare these benefits and costs.

As they are required for every EIA, the two first step are not specific to CBA. The first step includes a complete specification of the main elements of the programme (location, timing, group involved, connections with other programmes). The next step is to determine the relevant flows of inputs and outputs. For some projects which are limited in scope, this is reasonably easy while for a number it is much harder. These projects are spread out over long periods of time, so specifying inputs and outputs involves predictions of future events, often quite remote in time.

The third step is to put values on input and output flows in order to measure costs and benefits. This leads to two interrelated questions:

1. Which costs and which benefits are to be included?
2. How are the costs and benefits to be evaluated?

All benefits and costs are to be included, consisting of private and social, direct and indirect, tangible and intangible. Benefits and costs are given by the standard principles of welfare economics. Benefits are based on the consumer's willingness to pay for the project. Costs are what the losers are willing as compensation for giving up the resources. With respect to the second point, there are several reasons why market prices cannot be used in straightforward way:

1. If income is not optimally distributed, in principle this can be accounted for by applying a system of distributive weights to costs and benefits.
2. When commodities are traded in distorted markets, it is appropriate to use shadow prices. A social price would therefore mean that the market price was being adjusted to include effects that the market does not record, or records imperfectly.
3. If the project causes indirect impact in markets elsewhere in the economy, there are may be additional welfare changes to be considered.

The comparison of benefits and costs over time raises the following question:

At what interest rate are future benefits and costs to be discounted to obtain the present value (the equivalent value that one is receiving or giving up today when the decision is being made)?

### 3.3. Appropriate decision rule

The aim is to maximise the difference between benefits  $B$  and costs  $C$ . The difference can be regarded as the additional resources that are now available. The greater the difference, the greater the contribution of the project. When no constraints other than production possibilities exist, all projects with a positive difference should be approved. With other constraints such as budget constraints (Brent, 1990), or environmental constraints the decision-making process is not so straightforward.

Suppose CBA concludes that building a forest road is a valuable project because the benefits exceeds the costs. This means that the gains to some from having the road exceed the losses to others from having the road. For there to be a Pareto improvement, the winners should compensate the losers so that everyone is better off with the road. This test is also called the overcompensation test, because the gainers can compensate the losers and have something positive left off. However, this compensation rarely occurs. It is the controversial Kaldor-Hicks compensation principle which relies on a potential Pareto improvement. Indeed, CBA 'has been founded on the principle of a virtual Pareto improvement' (Mishan, 1976).

Society is concerned not only with total income, but how it is distributed. A project can significantly modify income distribution when prices change (Brent, 1996). Suppose, one can distinguish group 1 that incurs the costs and group 2 that gets the benefits. Let  $a_1$  and  $a_2$  be the social value of a unit of benefits to group 1 and group 2 respectively. One can assume that people in group 1 are wealthier than people in group 2, and so  $a_1$  is smaller than  $a_2$ , the decision rule allowing for both efficiency and distribution is:

$$\text{Max } a_2B - a_1C$$

The coefficients  $a_1$  and  $a_2$  are distributional weights which reflect the trade-off between efficiency and distribution. There is no policy contradiction to approve inefficient projects when weighted benefits exceed weighted costs because society is better off with the project. One cannot always expect that projects will be both efficient and distributional fair. Specifying the weights makes clear the value judgements regarding social preferences.

Now suppose that the project is financed with public money so we need to consider that taxes may have to be raised to pay for it. This causes a surplus loss called an 'excess burden' (Brent, 1996). The excess burden is added to the costs to form the total loss of welfare from the project development. Then the decision rule becomes:

$$\text{Max } a_B B - a_C C$$

Where  $a_B$  is the social value of a unit of benefit and  $a_C$  is the social value of a unit of tax revenues. Consider the marginal cost of public funds by:  $MCF = a_C/a_B$  which is assumed to be greater or equal unity (Brent, 1996). The role of the marginal cost of public funds is to scale up the costs by the amount of the excess burden and require that benefits be larger by this amount.

### **3.4. Social discount rate**

A sum of money available in the future is generally regarded as being worth less than the same sum of money available now because if the future sum were available now it could be invested at the going rate of interest to ensure its return plus accumulated income from interest on it at the later date. The main role of discounting is therefore to help in aggregating a series of costs and benefits which are spread over the life of the project. This procedure using the social discount rate yields the net present value of the project whose sign indicates whether or not society would be better off with the programme in place. Clearly the net present value is lower the higher is the discount rate and the more distant in time is the availability of the future sum.

Projects can be compared and ranked in terms of their contribution to social welfare. Because the ranking depends upon the discount rate it is sometime advocated to classify programmes according to their internal rate of return. This procedure is unreliable because it can lead to selecting a less profitable project for the society. This results from two different problems (Boadway and Bruce, 1984). First of all the internal rate of return criterion makes no direct use of the social discount rate. Thus this criterion can select a project B over a project A, whereas in present value terms A would be preferable at certain values of the discount rate. Otherwise if the sign of the net benefit stream changes more than once there are several internal rates which are the roots of a polynomial equation. If so the internal rate of return criterion can be ambiguous. The appropriate decision rule should be based on the net present value criterion so it is not possible to avoid the choice of the social discount rate.

As costs and benefits of projects can be risky, it is commonly argued that the discount rate should be adjusted upward by a risk premium to value future uncertain returns. Note that if discount rates are adjusted to incorporate risk is not always upward, indeed uncertain costs should require a downward adjustment of the discount rate to increase the present value. The correct procedure to value uncertain returns is to use the certainty monetary equivalent. This is the amount risk adverse individuals would be willing to pay with certainty for the risky prospect. The certainty equivalent should then be discounted using the rate of interest individuals use to discount other perfectly certain flows (EPA, 2000). Sensitivity analysis provides a systematic method to assess the effects of crucial parameters such as discount rate and time horizon on the present value of the project of interest. Otherwise, when risk-pooling or risk-spreading occur the risk of the project can be ignored (Boadway and Bruce, 1984). Risk-pooling refers to the case where there are a number of impacts which are diversified and to some extent independently distributed. A related phenomenon is that of risk-spreading, whereby the risk of a project is made negligible if it is shared by a large number of persons.

The social discount rate reflects the current generation's views about the relative weight to be given to benefits and costs occurring in the future. Otherwise, the logic of a discount rate, even a very small one, leads to giving a negligible weight to events far ahead. Any positive discount rate leads the analysis to strongly devalue and almost ignore distant impacts. With a low discount rates, it is often possible to justify a very disruptive infrastructure project. Many take the view that for long-run environmental projects the appropriate discount rate is zero. Olson and Bailey (1981) argue that using a zero value is irrational if capital is productive and there is a demand for investment funds. However, there is a point of divergence here for discounting in environmental management since not all natural capital is reproducible (Hanley and Spash, 1993).

Some argues that discounting ignores the fact that society is composed of mortal individuals of different generations. When a project extends over several generations, it does not seem justified to apply the time discounting of those who started it as the society were made up of immortal individuals. There are intergenerational externalities due to the fact that present actions determine the economic and ecological capacity that the future will inherit (Padilla, 2002). The discounting issue has in recent years become linked with the ongoing debate concerning sustainable development and specifically questions regarding the extent to which can be modified to meet the requirements of sustainability and many proposals have been made. Nevertheless, the problems associated with using a positive discount rate for intergenerational context remains controversial.

International practice shows a wide range of approaches in interpreting and choosing the value of the social discount rate to be adopted. In the United-States, for intra-generational social discounting the Office of Management and Budget (2000) recommends 7% which is an estimate of the average real pre-tax rate of return generated by private sector investments, while the Environmental Protection Agency suggests 2 to 3% (EPA, 2000). For inter-generational social discounting, economic analyses should present a sensitivity analysis of alternative discount rate from 2% up to 7% as in the intra-generational case, as well as scenarios with very low rates from 0.5% (EPA, 2000). EU members used in the past a range of discount rate: 6% in the UK, 5% in Italy, 6% for transport and 4% for water projects in Spain, and 8% in France since 1984. In its guidelines for CBA, the European Commission (2002b) recommends a 3%-5% range.

### **3.5. The monetisation of intangibles**

A number of direct and indirect services provided by environmental resources to society are involved. These services range from biological diversity to the protection against fire, including landscape beauty. Many of these services never enter into private markets and remain unpriced by the public sector. For example, the market price of land does not generally account for the nutrient filtration and wildlife habitats provided by a wetland. The market undervalues wetland or hedgerows services because it does not integrate a series of costs and benefits. Moreover some benefits accrue to more than just the owner of land. Water filtration benefits all those located downstream and on the other hand damages stemming from pollution or erosion are also borne downstream. Off-site benefits and costs can concern large populations. For example there is an international concern with respect to specific habitats for migratory birds. Recognition that environmental resources are systematically mispriced by the market has forced policy makers to consider other means to assess the value of these resources. Within a neo-classical framework, non-market valuation uses trade-offs between conservation and development to access the value of unpriced environmental resources. Direct and indirect methods have been developed in order to put a monetary value on environmental resources. All of them try to estimate changes or variations in consumer surplus involved by the variation in services delivered by environmental resources. A number of drawbacks and criticisms regarding these methods remain. The monetisation of environmental benefits with methodologies such as the contingent valuation method is not a component of this research.

Impacts on the environment from a particular project, for example a change in water quality, loss of species, ecosystem damage have been in the past often identified but not valued in monetary terms because there were no methods with which to value them. There has been a great deal of research in recent years into methods of valuing non-market goods and services in order to include them in CBA.

A number of benefits and costs consist of non-marketed items which are referred to as intangibles. Their monetary value must be inferred by either indirect or direct methods (Freeman, 1993). Indirect methods (hedonic pricing, travel cost, averting expenditure) are based on the observed behaviour of individual when faced with choices which might reveal the value that they implicitly place on intangibles. Direct methods (contingent valuation and stated preference) use survey techniques to elicit evaluations by the means of a questionnaire. They rely on the maintained hypothesis that attitudes are a good predictor of actual behaviour of individuals.

To date techniques for the monetary valuation of intangibles have been more extensively developed and applied in the United States than in Europe. In part, this reflects the difference in public concern for the consequences of changes in the quality and quantity of available natural resources and the effects of pollution on human health. However, a number of other factors further limit the use of monetary (particularly contingent valuation) in Europe. For Barde and Pearce (1991), three categories of obstacle exist: ethical/philosophical; political; and methodological/technical. Our opinion is that the main obstacle is the first one, because methodological problems are overestimated and political obstacles are linked to the fact that valuation techniques are largely unknown by policy makers, or are rejected for philosophical and ethical reasons.

In many European societies there is a considerable resistance to the idea of estimating the monetary value of human health and safety, and valuing landscape or national heritage. The willingness to pay criterion is rejected both by conservationists, and also by the school of institutionalist economics (Kapp, 1970). The former group question the philosophy and practice of economic valuation, while the latter claim that the principle of maximising expected utility is too reductionist and inadequate for quantifying such goods. Such critics also point to the lack of consensus amongst neo-classical economists regarding the accuracy and comprehensiveness of these techniques, as further supporting their reservations. Otherwise, some critics believe most sincerely that monetizing the environment is merely a further step in global degradation of the human spirit, let alone the natural world.

The most disclaimer to make concerning the monetary evaluation methods is that they are not capable of valuing the environment. The environment is indeed a multi-attribute entity which yields a complexity of values, and economic methods only target to value humans' preferences for some aspects of certain environmental goods and services. There is a growing body of literature in Europe, trying to show people's willingness to pay for environmental goods. This literature reflects both the changes which have occurred in recent years in the environment debate and the fact that the protection of the environment has moved to the forefront of the political agenda.

What evidence then is there of this research effort influencing either policy, regulation or projects in Europe? Considering the policy level first, it appears possible that estimates of the likely environmental benefits from implementing legislation are needed to stimulate public awareness and support for policy development. A recent study (Kuick *et al.*, 1992) analysed preparation for regulatory measures in the EU. Examples imply a cost-benefit comparison of the various control and non-control strategies. The decision analysis made a comparison of the costs and benefits, but no actual monetary assessments of the benefits were made. Moreover the study also reports that, when interviewed, at least one official expressed scepticism regarding the use of monetary assessment approaches for the preparation of regulations. Despite a greater experience in the monetisation process, the United States Environmental Protection Agency does not routinely do benefit-cost analyses of all its regulatory programmes. This is partly because the laws do not call for it, and probably because it is so difficult to achieve. In the EU, CBA of investment projects is explicitly required for the new EU regulations for structural funds (European Commission, 2002b). Clearly then there is a potential role for valuation techniques within project evaluation. The monetization of environmental impacts related to flora and fauna, soil, water, air, as well as impacts on material assets and cultural heritage is likely to receive an increasing attention. In the Medmont programme it has been decided to integrate non-market benefits of a specific project under the work package 8.

### **3.6. CBA and sustainability**

CBA seeks to quantify in money terms as many as the costs and benefits of a project as possible, including items for which the market does not provide a satisfactory measure of economic value. Extended CBA, which takes account of the environmental and social impacts of projects, can be expected to lead to better decisions and to greater environmental sustainability than those decisions which would be made in the absence of such considerations. Nevertheless, reliance on this technique alone is inadequate because it does

not capture the essence of sustainability which involves constraints on certain specific natural assets. As such sustainability is potentially inconsistent with CBA since it restricts the way in which compensation may apply. It has been suggested that extended CBA might have sustainability integrated into it (Pearce et al., 1989). They propose that decisions be subject to a constraint that for the group of projects undertaken by a decision-maker 'environmental damage should be zero or negative'. This statement reflects their basic view concerning sustainability. Sustainability requires the welfare of future generations to be no smaller than of present generation. They believe that this is most likely to be achieved when future generations inherit a stock of natural assets no less than the current stock. Consider a project  $i$  with net natural damage  $E_i$ , one rule is for holding the natural capital constant is to prohibit any project  $i$  for which  $E_i > 0$ . However, this would be very restrictive, so they suggest that this requirement be applied across the set of projects undertaken under a programme. At the programme level it is required that:

$$\sum_i E_i \leq 0$$

This modifies the extended CBA which take accounts of externalities and aims at maximising the present value of net benefits. It requires that:

$$\sum_t d^t (B_{it} - C_{it} - E_{it}) > 0$$

where  $d^t$  is the discount factor,  $B$  are the benefits and  $C$  the costs. It is however possible that for the set of projects satisfying the above, positive environmental damage occurs overall. Thus in addition, the sustainability criterion requires that:

$$\sum_{it} d^t E_{it} \leq 0$$

The present value of net environmental damages should be non-positive. Based on this rationale, extended CBA should be applied under a sustainability constraint.

This supplemented form of extended CBA allow for tradeoffs which the very concept of natural capital maintenance is trying to refute. Nevertheless, the basic argument against the CBA remains valid. Indeed, costs and benefits are aggregated anonymously, that is without regard to the identity of the gainers and losers. Assuming that preserving the environment is a moral duty, it can be deduced that the current generation should make some, but not unlimited, sacrifices for the environment. This statement endorses the basic idea of a safe minimum standard rule according with which a sufficient area of habitat should be preserved to ensure the survival of each unique species, subspecies, or ecosystem, unless the costs of doing so are intolerable high (Ciriacy-Wantrup, 1968; Bishop, 1978). There is a wide base of support for a policy framework based on the safe minimum standard rule, however the literature is very limited about should be such a policy.

## 4. An integrated framework

### 4.1. Background

Compared with EIA which is primarily based in the physical sciences, CBA is based on a firm methodology and is more quantitative. However this potential advantage is also a significant disadvantage in that a primary problem arises in translating all of the potential environmental impacts in monetary values. In practice, this deficiency of valuation directly contributes to the relatively restricted scope of CBA compared with EIA and, most importantly, to extreme scepticism as to its value among non-economists who often question the validity of the anthropocentric paradigm on which it relies. Cost-effectiveness analysis is sometimes considered to an alternative answer to this scepticism. It is often thought as one-half of a CBA where costs, but not benefits, are estimated in monetary terms. It essentially takes the objective as given, then the costs of various alternative ways of achieving this objective are evaluated.

The status and role of CBA in public decision making have been the subject of continuing discussions as well as political and administrative conflicts. Some observers have taken the position that CBA is really an attempt to short-circuit the process of political discussion and decision that should take place about public projects. From a slightly different standpoint, given the increasing importance attached to deliberative processes and stakeholder involvement in public-decision making, it is apparent that no one tool can provide relevant insights and prescriptions for all environmental contexts. This raise at least two questions:

1. Are all these tools necessary for sustainable development management?
2. Should we continue to develop each one or is there need, and scope, for greater integration?

First of all, these tools target very different objectives and therefore are positioned at different stages of the decision process when it is currently applied. In addition, integration could be inefficient as it is simply not possible to join separate tools designed to achieve separate objectives. Nevertheless all these tools belong to a common framework which is strategic environmental assessment (Partidário, 1999).

A combination of approaches is expected to produce the most useful and meaningful information when compiling indicators. It is advocated in order to generate a blend of different types of project relevant information. Indicators are commonly understood as quantitative or qualitative variables which provide information about changes in for example environmental, economic and social conditions. Significant research effort has been devoted to the elaboration of environmental indicators during the fifties and the sixties. Indicators were seen to provide the information needed by decisions makers and useful to inform the general public. Some synthetic indicators, in form of indexes were expected to integrate all the relevant information with respect to the issue of interest. The issue indicators did not receive much attention during the following decades. But since the late eighties there is an increasing attention to develop environmental indicators to analyse the effects of sectoral policies on the environment. This revival for environmental indicator work mostly derives from the request at the 15<sup>th</sup> annual Economic Summit of the Group of Seven (G7) held in Paris in July 1989. It was stated that: 'The OECD within the context of its work on integrating

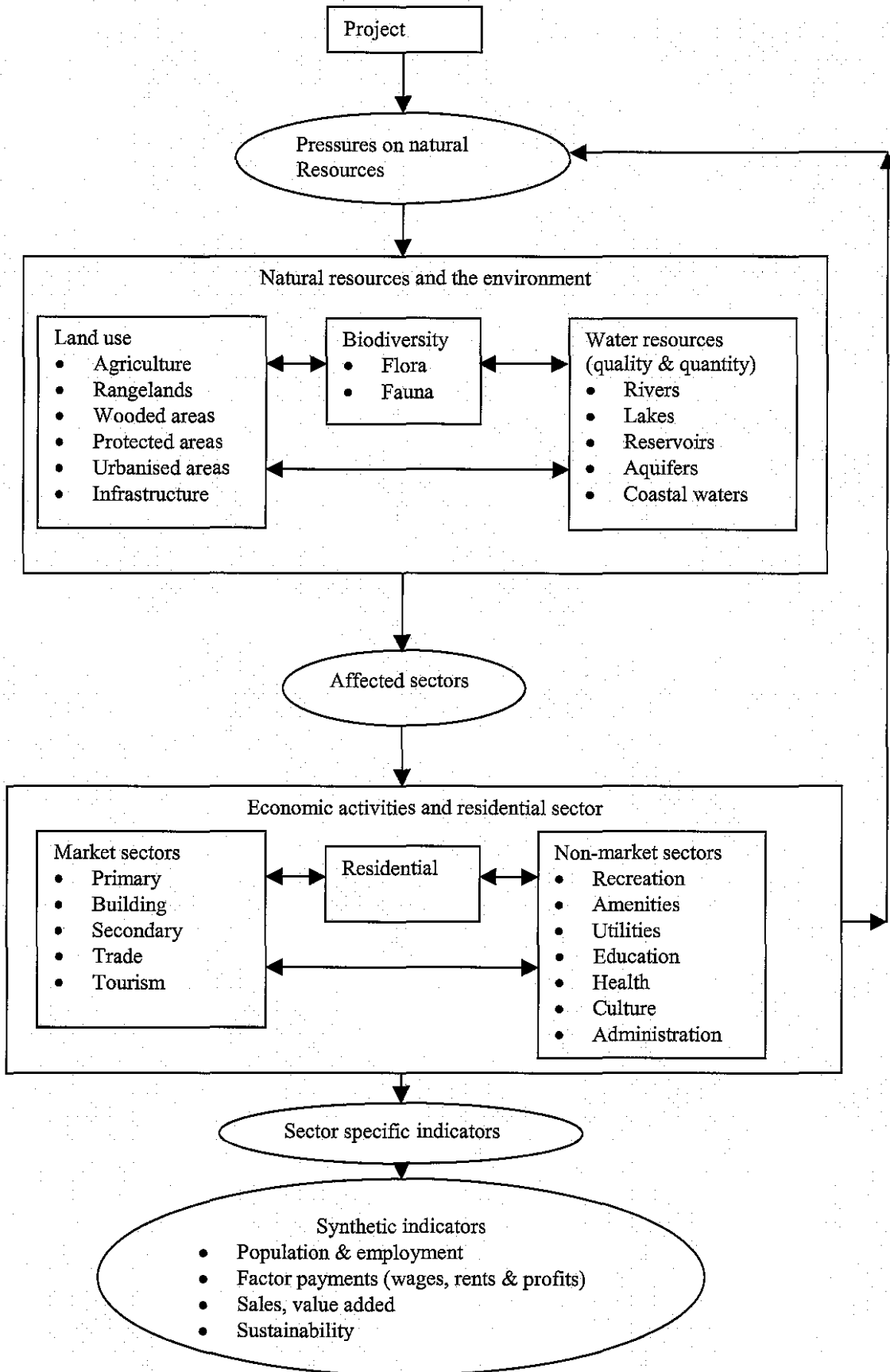
environment and economic decision-making, should examine how selected environmental indicators could be developed' in July 1990, the Houston Summit reinforced this. The work carried on by the OECD focuses on sets of indicators to be used for the integration of environmental and economic decision-making, at national and international level. These indicators can also be valuable in communicating with the public.

## ***4.2. Environmental, economic and social indicators***

Relationships between the environment, and the economic and social sectors as well as the linkages between the components of each sector which result from the implementation of the project under examination are relatively complex (Diagram 1). One box in the diagram is devoted to the natural resources and the environment while a second box focuses on the economic activities and the residential sector. Environmental indicators refer to the pressures on land use, biodiversity and water resources. Among economic activities, there is a division between market and non-market sectors.

In addition the diagram shows the dynamic pattern which results from the various relationships inside each box, and from the feedback which links the economic and social outcome to the environmental sphere. This implies that a comprehensive description of the project impacts will be based on a combination of state indicators related to capital stocks, and flow indicators which refer to the variation in capital stocks.

**Diagram 1. The continuous feedback process resulting from the project under examination.**

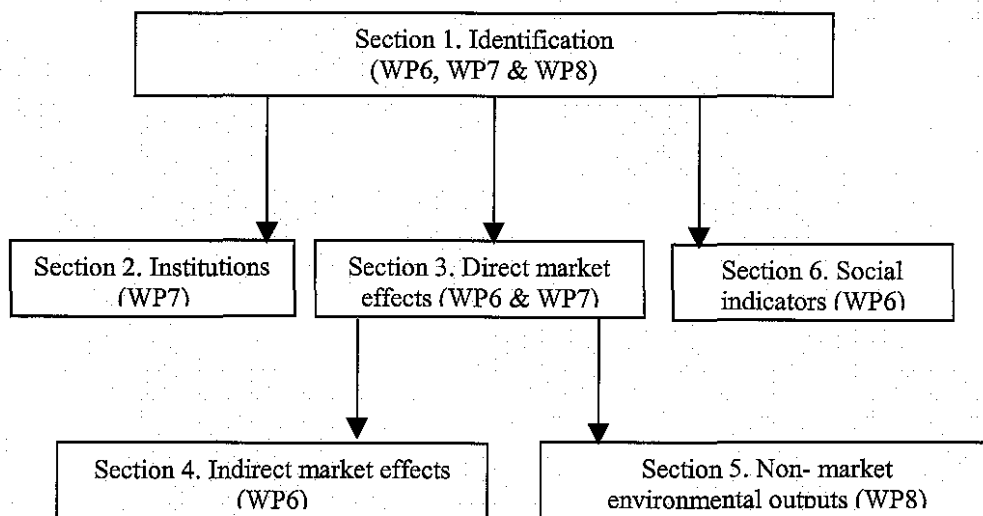


The key objectives in developing indicators for evaluating the projects of interest for Medmont are:

1. The measurement of their environmental performance.
2. The assessment of the role institutional factors on their design, implementation and control.
3. The measurement of their direct and indirect impacts on the relevant activities of the local economy, as well as on its export and import.
4. The measurement of their impacts on employment and the welfare of the local communities.
5. Environmental accounting, which involves the development of natural resource accounts, the adjustment of national economic and the creation of satellite accounts for environmental purposes.

There is an obvious correspondence between these five objectives and the different work packages of Medmont. Work packages 6, 7 and 8 are under the headings 2, 3, 4 and 5, while work packages 3, 4 and 5 are under the first heading. The structure of the consolidated questionnaire which deals with the work packages 6, 7 and 8 is given in Diagram 2. Section 1 is a general one, whereas Sections 2, 3 and 6 are independent from each others. Data collected in Section 3 are input to Section 4 and Section 5 which are associated to work packages 6 and 8.

**Diagram 2. Structure of the consolidated questionnaire**



### **4.3. Selecting economic and social indicators**

Criteria for selecting indicators are extensively discussed in the literature (Bonnieux and Dupraz, 1999). Four important issues have to be considered:

1. Project relevance.
2. Theoretical soundness.
3. Measurability.
4. Aggregation relevance.

In the context of Medmont, it is crucial to emphasise that it is their value for project analysis which is of greatest importance. A proposed indicator must serve the needs of decision-makers and its use should lead to better decision than would have been possible without it. From this perspective the project relevance criteria refers to the ability to show a clear linkage between the project of interest, and its economic and social impacts.

Theoretical soundness requires that indicators are theoretically well founded. To be valued, they must be based on a consistent theory and derived from an accepted methodology. This implies they result from a comprehensive debate unambiguously related to a strong theoretical background, forecasting and information systems. Meeting the theoretical soundness criteria should improve communicating to local authorities, landholders, stakeholders and the general public. Communicating to the general public requires a long run effort in terms of extension and education. This cannot only rely on the publication of brochures and newspaper articles.

As regards the measurability criteria indicators must satisfy valid sampling, statistical and consistency methodologies. Attributes from which they are derived, are mainly selected from existing statistical data sets. In this context it is crucial to rely on accessible data with low measurement errors and to select data sets with historical data suitable for trend identification.

Indicators must be applicable at the case-study level and capable of regional differentiation as well as international comparisons. Most data are collected at the level of administrative areas which differ from landscape system, landscape type and ecotope levels. Therefore the appropriate level of aggregation for each indicator has to be carefully considered.

Meeting these criteria lead to a system of economic indicators that are consistent with the European System of Integrated Economic Accounts, which is derived from the United Nations Revised System of National Accounts (SNA, 1993). In addition, they comply with the specific requirements for farming and forestry (European Commission, 2000 and 2002c). The implementation of the underlying concepts and rules is not straightforward and needs an original research effort, especially if the greening of national accounts is targeted in the long run.

Maintenance of sufficient capital stocks (environmental and man-made) is a crucial issue for sustainability. While some substitution is possible between certain elements of natural and man-made capital, many natural assets provide non-substitutable services. The important question is how much of these assets should be held constant? State indicators would refer to the baseline and would be completed with flow indicators for evaluating the project impacts on the relevant stocks. The work package 6 being restricted to the economic and social dimensions, Table 4 illustrates the contrast between state and flow indicators with man-made and human capital examples.

Table 4. Examples of state and flow indicators

Man-made capital	
State indicators	Flow indicators
Fixed assets per sector including <ul style="list-style-type: none"> <li>• Infrastructures</li> <li>• Reception capacities               <ul style="list-style-type: none"> <li>• Recreational facilities (footpath)</li> </ul> </li> </ul>	Change in fixed assets
Human capital	
State indicators	Flow indicators
Number of people employed per activity (sex, age) Education & training of the labour force	Number of new jobs Development of skills & training Extension services

A number of characteristics of projects are relevant to their evaluation. Referring particularly to agricultural projects, Conway (1987) suggests that four characteristics may be of particular interest:

1. Level of returns.
2. Stability of returns.
3. Sustainability of returns.
4. Impact on the distribution of income.

He suggests that projects are to be preferred, other things equal, the higher their level of returns, the less variable their returns, the greater the sustainability of their returns and the greater the equality which they induce in the distribution of income. But the precise way in which these characteristics are to be measured is not stated. The distinction between efficiency and equity indicators is instrumental to propose a solution. Efficiency indicators focus the link between inputs and outputs. Only if the local economy is competitive and production factors are sufficiently remunerated, the production potential can be sustained in the long run. Equity indicators address issues related to whether or not development between sectors, regions and social groups is balanced. An appropriate system of indicators according to efficiency and equity is proposed in Table 5 to cover both the economic and social dimensions (European Commission, 2001b). With respect to efficiency, economic indicators are related to output, productivity and competitiveness while social indicators deal with the labour force and institutions (institutional indicators are not considered in work package 6). With respect to equity, economic indicators refer to a series of items such as the structure of the population or the distribution of businesses according to their size, while social indicators target issues such as the distribution of income, labour conditions and access to public utilities and amenities.

Table 5. Efficiency and equity indicators

	Economic dimension	Social dimension
Efficiency	<u>Output indicators (quantity)</u> sales, value added, physical indicators where it is not possible to quantify <u>Output indicators (quality)</u> conversion to organic farming, PDO, PGI, TSG Education of the labour force <u>Productivity indicators</u> land, capital, labour <u>Competitiveness indicators</u> value added per worker, composition of income (share of transfer payments), savings & debt	<u>Indicators on the labour force:</u> indicators related to human capital Indicators on institutions
Equity	<u>Population</u> Indicators on age structure & trend in population Indicators on migratory & natural balances Unemployment rate (sex, age) <u>Production</u> Income/capita Share of the different sectors Size of businesses & farm holdings <u>Employment</u> Size of the working population Labour pressure (% of young people) Public sector/private sector employment <u>Balanced development over space</u> Distance and travel time to urban centres Indicators on infrastructure, services (including retail shops, health infrastructure, leisure facilities, cultural heritage, amenities & outdoor recreation)	<u>Distribution of income</u> Share of population under the poverty line <u>Indicators on labour conditions</u> Share of households in which no member is in employment Share of population with only lower education <u>Access to public utilities &amp; resources</u> Share of population which benefits services

The economy is broken down into industries which comprise groups of kind-of-activity units. A division into eight sectors is considered (Table 6) putting emphasis on land attached activities (agriculture and forestry), as well as services linked with tourist trade (hotels and restaurants). For these sectors, indicators are related to the basic concepts which in order to derive a series of production accounts. In addition, there are indicators related to production processes and quality products. Indicators on the labour force (job creation, education and training) are defined according to this division into eight sectors (Table 6). Other social indicators aim at evaluating impacts on the welfare of the resident population (Table 7). They are organised under six headings.

Table 6. Economic and social indicators according to economic activities

Sectors	Indicators
Agriculture & Aquaculture	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)  Land use has changed (ha per crop, increase in irrigated land)  New varieties have been introduced (Yes/No)  New breeds have been introduced (Yes/No)  Local breeds have been protected (Yes/No)  The intrinsic quality of products is improved (Yes/No)  Uptake of quality labels has increased, PDO, PGI, TSG, (Yes/No)  Uptake of organic farming has increased (Yes/No)</p>
Forestry	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)  Land use has changed  New varieties have been introduced (Yes/No)  The intrinsic quality of products is improved (Yes/No)</p>
Mining & other Primary activities	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)</p>
Building and civil engineering	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)</p>
Food and drink	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)  Demand for processed products has increased (Yes/No)  Price has increased (Yes/No)</p>
Other industries	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)</p>
Hotels & Restaurants	<p>Sales have increased  Value added has increased  Exports have increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)  Increase in stock of accommodation by types (# &amp; %)  Occupancy rates have increased (# &amp; %)  Price has increased (Yes/No)</p>
Other services	<p>Sales have increased  Value added has increased  New jobs have been created, skilled vs. non-skilled (# &amp; %)</p>

Table 7. Social indicators related to the welfare of the resident population

Sectors	Indicators
Housing & settlement	Dwelling completions (# & %) Population change (# & %) Migration rates
Outdoor recreation	People involved have increased (# & %) Footpath creation (km) New hunting licenses have been sold (# & %) New angling licenses have been sold (# & %) New members have joined environmental trusts (# & %)
Natural & historical Heritage	Average number of visitors Average number of tourists People involved (#)
Infrastructures	Change in traffic flows Distance and travel time to the nearest urban centre
Wastes & injuries	Fire hazard Solid waste Amenities

Finally, all indicators are organised into the consolidated questionnaire as follows regarding the work package 6.

### Section 3. Direct market effects

Basic information on economic flows with and without the project is provided in Tables 50, then it is broken down according to the division of the economy into eight sectors in Tables 52 to 56. The objective is to identify the various economic flows in order to separate those which benefit local firms from those which benefits firms located outside the case-study area. Indeed, the same amount of expenditures may create very different impacts depending upon the type of projects. Several tables are based on a shortcut to produce relevant information on imports and exports involved by the projects of interest. For example, the building of a dam implies expenditures in terms of engineering which may mainly benefit big companies located outside. This flow is associated with an import of the case-study area and do not lead to an increase of local income. On the other hand, tourism is likely to be beneficial as far as tourists are coming from abroad or from other regions, sales are considered exports of the case-study area.

### Section 4. Indirect market effects

Since there is no available input-output table, this section does not provide a comprehensive picture of all indirect market effects. It mainly targets impacts on agriculture, forestry, food and drink, and tourism. Here there is a combination of quantitative and qualitative indicators which allow to make a comparison between the project and the no-project options. This approach is not firmly founded but gives a means to face the lack of economic data for small economies. With respect to data requirement it is relatively parsimonious.

## Section 6. Social indicators

This part of the questionnaire is concerned with the resident population of the case-study area. First of all, it gathers the indicators related to employment and human capital according to economic sectors as shown in Table 6. Other indicators cover the various issues referred in Table 7.

## 5. A cross-project analysis

This section is divided into three main parts:

- Direct market effects (section 3 of the consolidated questionnaire),
- Indirect market effects (section 4 of the consolidated questionnaire),
- Social indicators (section 6 of the consolidated questionnaire).

### 5.1. Direct market effects

The relevant information related to economic flows and stocks is provided by Tables 50 and a series of derived Tables. All used concepts are consistent with the system of economic accounts (SNA, 1993) and its specific requirements for farming and forestry (Caparrós *et al.*, 2003; European Commission, 2000 and 2002c).

In order to compare the different projects, normalised indicators are defined from these tables. Three steps are considered:

1. Calculation of the present values of the variables of interest,
2. Definition of economic aggregates,
3. Definition of normalised indicators.

The first step is shown in Table 8. A series of new variables is defined, each one equals the present value of basic variable whose values are given in Tables 50.

Table 8. Present values of aggregates of interest

Variables <sup>1</sup>	Definition	Correspondence <sup>2</sup>
X13	Ordinary outputs	A1
X14	Internal investment	A2
X16	Operating subsidies	
X17	Initial value of capital	A3
X18	Residual value of capital	A4
X19	Labour cost related to ordinary outputs	B1
X20	Raw materials related to ordinary outputs	B2
X21	Services without rent related to ordinary outputs	B2
X23	Labour cost related to internal investment	C1
X24	Raw materials related to internal investment	C2
X25	Services without rent related to internal investment	C2
X27	Subsidies on internal investment	
X28	Internal investment net of economic margins	D1
X29	External investment	D2
X290	Depreciation	Table 50 a2
X31	Subsidies on external investment	

1. Variables refer to present values over the life of the project with a 4% discount rate.
2. See Table 50 a.

### 5.1.1. Definition of the present values of the aggregates of interest

#### *Total output*

Outputs are the items defined as final outputs plus intermediate outputs (outputs used in the same period that they are produced for obtaining other final outputs in the same enterprise). Outputs are valued at market prices, therefore without taking into account taxes and subsidies on products. Total output includes ordinary outputs:

$$TO = X13 + X14$$

Where X13 is ordinary outputs and X14 is internal investment.

#### *Intermediate consumption*

Intermediate consumption is divided into raw materials and services:

$$IC = X20 + X21 + X24 + X25$$

Where X20 + X21 is for producing ordinary outputs and X24 + X25 is for internal investment. All these costs are calculated without taxes and subsidies.

#### *Fixed capital consumption*

Fixed capital consumption (FCC) equals depreciation. This variable is normally given in Table 50a2 using a linear depreciation rule. When this information is not available the following approximation formula is used:

$$FCC \approx X17 - X18 + X14 + X29$$

Where X17 and X18 are the initial and residual values of capital, while X14 and X29 are total internal and external investments. Finally in Table 8:

$$FCC = X290$$

#### *Total costs*

Since labour is desegregated between ordinary outputs and internal investment. Total costs are defined as follows:

$$TC = IC + FCC + LC$$

#### *Gross value added*

The balance of the production accounts is the gross value added which equals the payment to the primary factors of production. Two concepts of value added are considered.

Then gross value added at market prices is defined as follows:

$$GVA_{mp} = TO - IC$$

By subtracting the operating subsidies net of taxes on products (OST), gross value added at factor costs is obtained:

$$\begin{aligned} GVA_{fc} &= GVA_{mp} - OST \\ OST &= X16 \end{aligned}$$

#### *Net value added*

Net value added is obtained by subtracting the remuneration of fixed capital. At market prices it is defined as follows:

$$NVA_{mp} = GVA_{mp} - FCC$$

And net value added at factor costs is:

$$NVA_{fc} = GVA_{fc} - FCC$$

#### *Net operating margin*

Net operating margin is:

$$\text{NOM} = \text{TO} - \text{IC} - \text{FCC} = \text{NVA}_{\text{mp}} - \text{LC}$$

Where LC is labour costs:

$$\text{LC} = \text{X19} + \text{X23}$$

### *Immobilised capital*

Immobilised capital is calculated using an approximated formula:

$$\text{IMC} \approx \text{X17} + \text{PP}_{\text{IU}} + 0.5(\text{X14} + \text{IC} - \text{PP}_{\text{U}} + \text{LC})$$

$\text{PP}_{\text{IU}}$  is initial production in progress used while  $\text{PP}_{\text{U}}$  is production in progress used.

### *Sustainable income*

Two concepts of sustainable income can be defined, sustainable at market prices and sustainable income at factor costs.

Sustainable income at market prices is:

$$\text{SI}_{\text{mp}} = \text{NVA}_{\text{mp}} + \text{CG}$$

Where CG is capital gain.

Sustainable income at factor costs is:

$$\text{SI}_{\text{fc}} = \text{NVA}_{\text{fc}} + \text{CST}$$

Where  $\text{CST} = \text{X27} + \text{X31}$

is capital subsidies net of taxes on capital goods. Therefore:

$$\text{SI}_{\text{mp}} - \text{SI}_{\text{fc}} = \text{CG} + \text{CST} - \text{OST}$$

## **5.1.2. Definition and analysis of normalised indicators**

In order to compare the different projects a series of normalised indicators is considered. Their values are given in Table 9.

### *Composition of total output*

Two indicators are considered:

Share of ordinary outputs in total output:  $\text{X13}/\text{TO}$

Share of internal investment in total output:  $\text{X14}/\text{TO}$

The composition of total output varies very much among projects. The share of internal investment in total output ranges from 0.9% for I1 (dairy farm) up to 99.4% for S2 (forest road) and 100% G2 (accommodation) and I4 (footpath).

Very different values are observed for similar projects. For example, let us consider the two footpaths S1 and I4, the share of internal investment is respectively 12.1% and 100%. The same remark applies to forest roads with 2.4% for I3 and 99.4% for S2, or projects dealing with historical and cultural heritage with 3.6% for F3 (theatre), 19.6% for I2 (museum) and 87.6% for G5 (old bridge).

A detailed inspection of Table 9 shows that there is no simple relationship between the output composition and a simple criterion such as the category, the size or the country.

### *Composition of total costs*

Three indicators are considered:

- Share of intermediate consumption in total costs: IC/TC
- Share of fixed capital consumption in total costs: FCC/TC
- Share of labour costs in total costs: LC/TC

Let us consider the two first indicators in some details.

The share of intermediate consumption in total costs ranges from 0.2% for S4 (recreation) to 87.9% for F1 (olive oil co-operative). There is a link between this ratio and the type of projects. The RDPs that concern the production of quality food are characterised by high values: 87.9% for F1 (olive oil), 67.1% for G1 (traditional sausage), 72.2% for I1 (dairy farm) and 77.8% for I5 (slaughter house). They contrast with those that target forest restoration and conservation: E1 (13.5%), E2 (13.1%), G3 (14.9%), G4 (24.9%). The values are close for similar projects: 36.7% for I3 (forest road) and 48.6% for S2 (forest road) on one hand, 51.0% for F4 (dam) and 48.9% for S3 (irrigation) on the other hand.

Data related to capital stocks and depreciation are more fragile, so the share of fixed capital consumption in total costs should be considered very carefully. It ranges from 0% for F4 (dam), and 0.8% for I3 (forest road) to 99.7% for S4 (recreation). So extreme values are suspected.

Anyway, some comments can be made by type of projects. Four projects dealing with natural resources, among five, show consistent values: E1 (19.0%), E2 (24.2%), G4 (16.2%) and S5 (13.5%). The same remark applies to the two projects that concern tourist accommodation: E3 (33.9%) and G2 (32.9%). The share of fixed capital consumption in total costs is also very stable for three projects among the four related to the production of quality food: F1 (4.3%), I1 (1.1%), and I5 (2.9%). Otherwise, there are significant differences between similar projects: I4 (50.0%) and S1 (3.7%) that are two footpaths, I3 (0.8%) and S2 (11.8%) that are two forest roads.

Despite some discrepancies, the composition of total costs is broadly linked to the type of projects. This conclusion was expected, because there is a close relationship between a type of

project and a precise technology. Approximation made, data quality but also differences in the context can explain these apparent inconsistencies.

***Production account***

At market prices, two indicators are considered:

Share of intermediate consumption in total output:  $IC / TO$

Share of gross value added at market prices in total output:  $GVA_{mp} / TO$

One additional indicator is considered at factor costs:

Share of gross value added at factor costs in total output:  $GVA_{fc} / TO$

The two first indicators, at market prices, give the distribution of total output between intermediate consumption and value added. Value added allows to pay the contribution of primary inputs (land, capital and labour) to the production process. Comprehensive data on value-added are available for twenty-two RDPs out of twenty-five.

The share of gross value added at market prices provides an appraisal of total factor productivity. The different projects are easily ranked according to this criterion.

First of all, projects concerning infrastructures are characterised with a high level of total factor productivity: 74% for F2 (wastewater network), 75% for F4 (dam) and 82.5% for S3 (irrigation). Forest roads and footpath are also characterised by a high level of productivity: 99.6% for S2, 73.3% for S1 and 73% for I3. Forest restoration and conservation projects are also profitable related to productivity level: 93% for E1, 73.7% for G3, and 88% for G4. But the score of the fire prevention programme E2 is relatively modest with 38.9%.

Projects targeting the production of quality products illustrate two different cases. The level of productivity ranges from 16.3% for F1 (olive oil), to 44.1% for I1 (dairy farm) and 46.4% for G1 (traditional sausage). The range of values among the other projects is very wide. However there are differences among projects targeting similar activities: 60.3% for F3 (theatre) and 41.5% for I2 (museum), 40.1% for E4 (recreative area) and 66.2 % for E5 (visitor centre).

The share of gross value added at factor costs in total output is an interesting indicator because it takes into account the operating subsidies net of taxes on products. To some extent it is not a private indicator but a social one because it does not include monetary transfer from the other sectors of the economy and which benefit the RDPs. A comparison of the two indicators related to value added focuses five projects for which the operating subsidies amount a significant part of total output: F2 (wastewater network), F3 (theatre), F4 (dam), I3 (forest road) and S5 (grassland reactivation). Their relatively high levels of total productivity mainly result from operating subsidies. Two projects (F4 and S5) have a negative gross value added at factor costs.

***Private margin rate***

A private margin rate is defined as follows:

$$NOM/TO$$

Compared to gross value added at market prices, private margin takes into account labour costs. This indicator provides some insight into the private profitability of the project. A negative margin therefore implies that a private entrepreneur, despite the mentioned operating subsidies, would not have invest in such a project.

### *Profitability rates*

A series of profitability rates are defined by comparing various flows to the immobilised capital.

Private profitability rate:

$$PPR = \text{NOM} / \text{IMC}$$

Capital gain profitability rate:

$$\text{CGR} = \text{CG} / \text{IMC}$$

Sustainable income at market price rate:

$$\text{SI}_{\text{mp}} / \text{IMC}$$

Sustainable income at factor cost rate:

$$\text{SI}_{\text{fc}} / \text{IMC}$$

According to the sign of these indicators, projects can be classified in terms of private and public profitability. Private profitability is based on the net operating margin while social profitability results from a positive sustainable income. Indeed, a sustainable RDP is associated with a positive capital gain and gives in addition a positive sustainable income. However, it must be emphasised that non-market goods are not considered in this calculation. Therefore their integration could shift a specific project from one category to another. A comprehensive assessment should integrate the offside effects of RDPs. Either a drastic reduction of negative externalities or an increase in the provision of amenities are likely to modify the conclusion with respect to social profitability. Thus the following comments must be considered as a first attempt and not as a definitive conclusion.

Since the estimation of immobilised capital and capital gain is fragile, we mainly rely on private profitability rate and sustainable income at factor cost rate. So a RDP is categorised as privately profitable if NOM is positive and socially profitable only if  $\text{SI}_{\text{fc}}$  is positive.

A combination of private profitability and social profitability criteria leads to simple classification of the RDPs (Table 10). A comparison with Table 2, shows that the category of projects matters while the size does not.

RDPs related to forest roads (I3, S2), footpath (S1), forest restoration (E1, G4) and the production of quality products (F1, G1, I1) are privately and socially profitable. The irrigation project (S3) lies in this category while the wastewater network (F2) is not privately but is socially profitable. For the latter the valuation of abatement of pollution would likely make it socially profitable. The same type argument is likely to apply for the other RDPs dealing with the improvement of the natural resource base: E2 (fire prevention), G3 (forest restoration), S5

(grassland reactivation). Including the positive non-market environmental benefits they generate should make them socially profitable.

The five RDPs directed towards the improvement of agro-tourism facilities are distributed into three cells in Table 10. Only one recreative area (E4) is profitable in both private and social terms. Two no-privately profitable RDPs two are socially profitable: E3 (country house with accommodation and footpath) and E5 (visitors' centre). Finally, G2 (accommodation) and S4 (outdoor activity) are unprofitable from the two standpoints.

The two cultural projects are socially profitable, but classified differently related to private profitability: F3 (theatre) is privately profitable while I2 (museum) is not. Finally, G5 (old bridge) which is the only project concerning historical heritage has a negative score on the two criteria. However, non-market benefits are likely to shift it to the socially profitable cell. Though private profitability is questionable, historical and cultural oriented RDPs are expected to be socially profitable.

Table 9. Present value of the normalised indicators with the RDP (%)

RDP	Composition of total output		Composition of total costs			Production account			Private margin rate	Profitability rates	
	X13/TO	X14/TO	IC/TC	FCC/TC	LC/TC	IC/TO	GVamp/TO	GVAfc/TO		NOM/TO	NOM/IMC
E1	65,4	34,6	13,5	19,0	67,5	7,0	93,0	72,7	48,3	48,3	130,7
E2	23,3	76,7	13,1	24,2	62,6	61,1	38,9	38,9	-365,2	-365,2	-31,9
E3	36,0	64,0	16,8	33,9	49,3	22,4	77,6	77,6	-33,4	-33,4	42,3
E4	90,7	9,3	64,9	9,2	25,9	59,9	40,1	40,1	7,6	7,6	84,8
E5	82,9	17,1	33,1	14,2	52,6	33,8	66,2	66,2	-1,9	-1,9	97,9
F1	97,4	2,6	87,9	4,3	7,8	83,7	16,3	14,1	4,7	4,7	31,2
F2	95,8	4,2	22,7	30,3	47,0	26,0	74,0	19,1	-14,5	-14,5	33,6
F3	96,4	3,6	45,7	6,0	48,3	39,2	60,8	46,7	14,3	14,3	114,0
F4	64,5	35,5	51,0	0,0	49,0	25,0	75,0	-66,9	51,0	na	na
F5	na	na	na	na	na	na	na	na	na	na	na
G1	66,5	33,5	67,1	19,8	13,1	53,6	46,4	46,3	20,1	20,1	54,8
G2	0,0	100,0	49,1	32,9	18,0	77,2	22,8	22,8	-57,2	-57,2	-25,7
G3	13,0	87,0	14,9	49,3	35,8	26,3	73,7	73,7	-76,6	-76,6	-14,8
G4	87,5	12,5	24,9	16,2	59,0	11,8	88,2	88,2	52,6	52,6	307,2
G5	12,4	87,6	68,0	28,8	3,3	83,6	16,4	16,4	-22,9	-22,9	-19,8
I1	99,1	0,9	72,2	1,1	26,7	55,9	44,1	41,2	22,6	22,6	101,8
I2	80,4	19,6	32,2	2,4	65,4	58,5	41,5	41,5	-81,6	-81,6	118,6
I3	97,6	2,4	36,7	0,8	62,5	27,0	73,0	58,3	26,6	26,6	161,6
I4	0,0	100,0	19,1	50,0	30,9	295,2	na	na	na	na	na
I5	95,5	4,5	77,8	2,9	19,3	216,0	na	na	na	na	na
S1	87,9	12,1	50,9	3,7	45,4	26,7	73,3	73,3	47,5	47,5	225,3
S2	0,6	99,4	48,6	11,8	39,6	0,4	99,6	99,6	99,1	99,1	195,2
S3	89,8	10,2	48,9	19,4	31,7	17,5	82,5	76,2	64,2	64,2	354,4
S4	42,0	58,0	0,2	99,7	0,1	62,3	37,7	37,7	-26230,4	-26230,4	-10547,6
S5	76,8	23,2	63,3	13,5	23,2	43,6	56,4	-27,1	31,2	31,2	-29,2

na: not available.

Table 10. Private and social profitability of RDPs

Private profitability	Social profitability	
	NO	YES
NO	E2 Fire prevention G2 Agro tourism G3 Forest restoration G5 Old bridge S4 Outdoor activity	E3 Country house E5 Visitors' centre F2 Wastewater network I2 Museum
YES	S5 Grassland reactivation	E1 Natural regeneration E4 Recreative area F1 Olive oil co-operative F3 Theatre G1 Traditional sausage G4 Forest restoration I1 Dairy farm I3 Forest road S1 Forest learning trail S2 Forest road S3 Irrigation project

### 5.1.3. Land use changes

Table 11 summarises the average change in land use with and without the RDP. First of all it must be noted that the required information is available for nineteen projects. A simple comparison shows a significant change in land use for twelve projects.

Despite data limitations, some comments can be made. First of all several projects have a significant impact on the distribution of agricultural land between used and non-used land. This may result either in an increase in used agricultural land, (I1, I5) or a decrease (S3), but for some project this distribution remains stable G3 (forest restoration). The two Italian projects (I1 and I5) target the development of quality products and are likely to favour an increase in farming. The Slovenian one (S3) is the irrigation project, so it will lead to a decrease in agricultural land which should be linked with a greater intensification of farming practices. The project S5 (the reactivation of the abandoned karst grassland) will induce a conversion of wood land into agricultural used land.

Logically forest road projects (F5, I3, S2) lead to a decrease in wood area, a modest diminution is also reported for one footpath (S1). For a number of projects: F5 (forest road), G1 (traditional sausage), G3 (forest restoration), I2 (museum), S1 (footpath), S2 (forest road), there is an increase in built area, while the decrease for G2 (accommodation) seems to be specific.

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Table 11. Average change in land use with and without the project (ha)

	Used agricultural land		Non used agricultural land		Wood area		Non agricultural land		Building & infrastructures		Inland water	
	with project	no project	with project	no project	with project	no project	with project	no project	with project	no project	with project	no project
E1	na	na	na	na	na	na	na	na	na	na	na	na
E2	0	0	0	0	0	0	-0.5	-2.5	2.5	2.5	0	0
E3	0	0	0	0	0	0	0	0	0	0	0	0
E4	na	na	na	na	na	na	na	na	na	na	na	na
E5	na	na	na	na	na	na	na	na	na	na	na	na
F1	0	0	0	0	0	0	0	0	0	0	0	0
F2	na	na	na	na	na	na	na	na	na	na	na	na
F3	0	0	0	0	0	0	0	0	0	0	0	0
F4	na	na	na	na	na	na	na	na	na	na	na	na
F5	0	0	0	0	-1	0	0	0	3.1	0	0	0
G1	0	0	0	0	0	0	0	0	0.01	0	0	0
G2	0	0	0	0	0	0	0	0	-0.1	0.1	0	0
G3	52.4	52.4	5.6	5.6	313	313	7.8	7.8	0.37	0.4	0	0
G4	na	na	na	na	na	na	na	na	na	na	na	na
G5	0	0	0	0	0	0	0	0	0	0	0	0
I1	50	-50	-50	50	0	0	0	0	0	0	0	0
I2	0	0	0	0	0	0	0	0	0.17	0	0	0
I3	0	0	-150	150	-0.5	0	0.5	0	0	0	0	0
I4	0	0	0	0	0	0	0	0	0	0	0	0
I5	10	-50	-10	50	0	0	0	0	0	0	0	0
S1	0	0	0	0	-0.5	0	0	0	0.5	0	0	0
S2	0	0	0	0	-0.5	0	0	0	0.5	0	0	0
S3	-111	0	111	0	0	0	0	0	0	0	0	0
S4	0	0	0	0	0	0	0	0	0	0	0	0
S5	30	0	0	0	0	30	0	0	0	0	0	0

na: not available

#### 5.1.4. Effect on imports

The implementation of RDPs involve an increase in both external investment and intermediate consumption. A comparison with the no-project case highlights different situations. The impact can be more limited where projects reinforce already existing programmes. Nevertheless some lead to a dramatic increase in external investment while for others there is a significant impact through intermediate consumption. But overall, the total flow is directly linked to the size of the project of interest.

The flow of purchases associated with the increase in external investment and intermediate consumption may benefit the local economy but is likely to boost imports as far as equipment, machinery and specific services are needed. The impact on imports is assessed from Tables 52 and 53 of the consolidated questionnaire which provide the distribution of these purchases according to the location of the selling firms.

Table 12 is derived from Tables 52 of the consolidated questionnaire. It gives the percentage distribution of the present value of external investment according to sectors, with a division between local and non-local firms. Available information on external investment is limited since it concerns ten projects only. External investment is concentrated on three sectors: building and civil engineering, industries and services. It can be directed toward local or non-local firms. The share of local firms in the total depends upon sectors and projects. As far as building and civil engineering is concerned, local firms attract the whole investment.

Since local firms cannot provide specific equipments and services, a significant share of purchases benefits non-local firms. E2 (forest fire prevention), I1 (dairy farm), I4 (footpath) and I5 (slaughter house) induced purchases of machinery or equipment which benefit non-local firms, while F1 (olive oil co-operative) and G2 (accommodation) required services provided by non-local firms. There is only one project, G1 (traditional sausage) for which machinery and equipment were bought locally, and also another one, G5 (old bridge) for which services were provided by local firms.

Table 13 is derived from Tables 53 of the consolidated questionnaire. Information on the distribution of intermediate consumption is available for eighteen projects among twenty five. Purchases benefit most sectors of the economy and are more balanced between local and non-local firms than purchases associated with external investment. They are mainly directed towards local firms for goods produced by agriculture, forestry, and building and civil engineering. Nevertheless two projects F1 (olive oil co-operative) and I5 (slaughter house) induce the purchase of agricultural commodities to non-local firms.

With respect to the building and civil engineering sector, non-local firms benefit from three projects: E2 (fire prevention), F3 (wastewater network) and G2 (accommodation). In addition it must be noticed that I1 (dairy farm) lead to the purchase of intermediate goods provided by non-local firms of the food sector. For the other industries, purchases are directed towards non-local firms, except for E2 (fire prevention). With respect to services, there is a balance between local and non-local firms.

The distribution of intermediate consumption and the distribution of external investment according to the location of the providing firm are more or less similar. Local firms can provide basic goods and services, but equipment or machinery as well as specialised services

are imported. This results from the small scale of the local economy. However purchases to non-local firms made to the farm sector by F1 (olive oil co-operative) and I5 (slaughter house), and to the food industry by I1 (dairy farm) show that these RDPs impact a bigger area than the case-study area. They need to import commodities because they operate at a relatively large scale.

Table 12. Distribution of the present value of external investment with the RDP (%)

		Building & civil engineering		Industries		Services	
		local firms	non-local firms	local firms	non-local firms	local firms	non-local firms
Spain	E1						
	E2				100%		
	E3	100%					
	E4						
	E5						
France	F1					100%	
	F2						
	F3						
	F4						
	F5						
Greece	G1			100%			
	G2					100%	
	G3						
	G4						
	G5					100%	
Italy	I1				100%		
	I2	100%					
	I3						
	I4				100%		
	I5				100%		
Slovenia	S1						
	S2						
	S3						
	S4						
	S5						

Table 13. Distribution of the present value of intermediate consumption with the RDP between local and non-local firms (%)

		Agriculture & aquaculture		Forestry		Building & civil engineering		Food & drink		Other industries		Services		Total
		local firms	non local firms	local firms	non local firms	local firms	non local firms	local firms	non local firms	local firms	non local firms	local firms	non local firms	
Spain	E1													na
	E2						14.2						81.3	100.0
	E3					100.0								100.0
	E4													na
	E5													na
France	F1	72.0	18.1			1.8							8.1	100.0
	F2													na
	F3						5.3					54.9	39.8	100.0
	F4													na
	F5			100.0										100.0
Greece	G1	60.4				39.6								100.0
	G2						54.1	5.6				40.3		100.0
	G3			0.2		99.0						0.8		100.0
	G4													na
	G5					100.0								100.0
Italy	I1								45.0		27.0	10.0	18.0	100.0
	I2					16.2						83.8		100.0
	I3					4.7						45.0		100.0
	I4			50.3		18.2					81.8			100.0
	I5		47.7			4.7				38.1			9.5	100.0
Slovenia	S1													na
	S2			37.8		62.2								100.0
	S3	54.1				45.9								100.0
	S4	25.0				75.0								100.0
	S5	100.0												100.0

na: not available

### 5.1.5. Effect on exports

Direct effects on the local economy are also analysed through the distribution of sales according to economic sectors, and to their spatial distribution (with a division between the local market, exports to the rest of the region and exports to the rest of the world). Table 14 provide present values of the corresponding flows of sales and sums up the relevant information for thirteen RDPs.

The spatial distribution of sales varies significantly among projects. There is a first group of RDPs for which local sales amount 100% of the total: F2 (wastewater network), I5 (slaughter house), S2 (forest road), S4 (recreation) and S5 (grassland reactivation). This may result from the type or the scale of the project. For example the services of an utility such as F2 are sold locally. Otherwise, the market open to a modest scale project such as S4 is limited in scope.

In contrast, there is a second group for which most outputs are exported: F1 (olive oil cooperative), F3 (theatre) and G4 (forest restoration). A comparison between F1 and I5 on one hand and I1 (dairy farm) on the other hand illustrates two different situations. F1 and I5 are exporter while the output of I1 is locally sold. Otherwise, F3 attracts people from abroad and positively impact tourist trade.

For the others, there is a balance between sales in the local market and exports. In addition, note that the division of exports between the rest of the region and the rest of the world is instrumental for Slovenia and France only.

The distribution of sales per sector reflects the type of investment. There is a first series of projects whose sales consist in farm commodities, S3 (irrigation), S4 (recreation), or forest products, G3 (forest restoration), G4 (forest restoration), I3 (forest road), S2 (forest road), S5 (grassland reactivation), or a combination of both such as S1 (footpath). Three RDPs favour the development of the food industry, F1 (olive oil co-operative), I1 (dairy farm), I5 (slaughter house), while the sales of F2 (wastewater network) consists in public utility services whereas F3 (museum) and I1 (dairy farm) contribute to the output of the service sector.

Table 14. Spatial distribution of the present value of sales with the RDP (%)

	Agriculture & aquaculture			Forestry			Food & drink			Hotels & restaurants			Other services			Total
	Local	ROR	ROW	Local	ROR	ROW	Local	ROR	ROW	Local	ROR	ROW	Local	ROR	ROW	
E1																
E2																
E3																
E4																
E5																
F1							20	60	20							100
F2													100			100
F3										7	16.3	42.6	15.1	14.4	4.6	100
F4																
F5																
G1																
G2																
G3				65.6	34.4											100
G4				10.5	89.5											100
G5																
I1							56.6	3.8		39.6						100
I2																
I3				90.9	9.1											100
I4																
I5							100									100
S1	38.5	38.5				23										100
S2				100												100
S3	47.8	26.1	26.1													100
S4	100															100
S5				100												100

ROR: rest of the region. ROW: rest of the world.

## 5.2. Indirect market effects

### 5.2.1 Outline

A number of indirect effects are assessed through a series of qualitative indicators which are given in Table 15. The tentative classification of projects (Table 2) is instrumental to make comments related to indirect effects.

First of all, a series of RDPs favour biodiversity through the protection of local varieties or breeds, and the implementation of new varieties. A positive effect on local varieties is reported for E1 (forest restoration), E2 (fire prevention), F1 (olive oil co-operative) and I2 (museum). In addition, E1 and F1 lead to the development of new varieties. Local breeds are protected by G1 (traditional sausage), I5 (slaughter house) and S5 (grassland reactivation).

A positive impact on technology or innovation is reported for five RDPs: F1 (olive oil co-operative), G1 (traditional sausage), I1 (dairy farm), I2 (museum) and I5 (slaughter house). This impact may be related to the protection of a traditional technology (G1, I2), or the development of a new technology (F1, I1, I5). Moreover, these impacts are associated with the introduction of a new product or brand (except for I1).

An increase in the quality of commodities or products is reported for fifteen RDPs. As expected this group includes the four RDPs favouring quality products (F1, G1, I1, I5), and projects which are directed towards the improvement of the resource base such as forest restoration ones (E1, G3, G4), the fire prevention project (E2), and the grassland reactivation project (S5). In addition forest roads (F5, I3, S2) and three infrastructures (F2, F4, S3) are also included in this set.

Finally nothing is indicated for the projects directed towards agro-tourism supply: accommodation (E3, G2), visitors' centre (E5), outdoor activity (E4, S4) as well as the theatre (F3) would not have similar indirect effects. The same comment applies to footpaths (I4, S1).

### 5.2.2. Detailed analysis

Similar mechanisms apply to homogeneous groups of RDPs which target comparable objectives.

#### Infrastructures

- **F2 (wastewater network).** This RDP allows housing development and the growth of tourism in the case-study area which are shown by a series of indicators related to the number of dwellings and tourist capacities.
- **F4 (dam).** The reservoir makes possible an increase in water supply which benefits the residents and the tourist, and the farm sector. On one hand this RDP is a complement of

F2 while on the other hand it leads to an increase in irrigated land (orchards, vineyards, forage crops and cereals).

- **S3** (irrigation project). This RDP has similar impact on the farm sector than F4, with an increase in irrigated land (orchards, potatoes and vegetables, forage crops and cereals).

### Forest roads

A forest road improves the access to sites and therefore benefits forestry and recreational activities with possible impact on tourist capacities. The magnitude of these effects vary among the three RDPs which were considered.

- **F5**. The improvement benefits outdoor recreation, mainly mushrooms picking and hunting. The positive impact on timber production is limited.
- **I3**. The better quality of timber is also due to the longer size of logs thanks to the easier transport conditions. Otherwise there is more hotel rooms and campgrounds, hiking became safer.
- **S2**. A better quality of logs and higher possibility of exploitation must be noted, while effects on tourism are small.

### Footpaths

- **I4**. Only a small increase in visit-days is reported.
- **S1**. This is a forest learning trail in a forest which has a strong social role and attracts many visitors from Slovenia and Italy. Visitors, especially schoolchildren, acquire knowledge about the forest, its role and tree species. All tree species and other instructive items are described on wooden boards. More than 100 indigenous and foreign tree species are present there. This RDP led to a significant increase in the number of visitors and positively impacted the number of hotel rooms, secondary houses and B&B.

### Natural resources

Four projects among five target forest restoration or protection. They positively affect ordinary outputs both in quantitative and qualitative terms. They also indirectly impact livestock or honey production. The same mechanism with direct and indirect effects applies to the fifth RDP which consists in grassland reactivation.

- **E1 (forest restoration)**. This RDP is based on natural regeneration and allows the protection of local oak tree species which are emblematic in the Mediterranean forest. It favours an increase in the production of firewood and different types of cork (curruca, bornizo and segundero).
- **G3 (forest restoration)**. This RDP takes place in oak degraded forests. A better quality of timber and firewood as a result of the silvicultural treatments and an increase in the quantity of firewood are reported. It indirectly leads to a growth of livestock (sheep and goats).
- **G4 (forest restoration)**. This RDP takes place in a burnt forest. It generates the same type of impacts related to direct output (firewood and timber) as well as to livestock than G4. In addition, there is an increase in the production of honey associated with a better quality.
- **E2 (forest fire prevention)**. This RDP concerns a cork oak natural park. Services related to prevention, surveillance and fire-fighting benefit forest and agriculture in general.
- **S5 (grassland reactivation)**. The conversion of abandoned karst grassland in agricultural use led to an increase in permanent grassland and wooded area, and the protection of local breed of sheep (Istrska Pramenka), which is relatively rare. This RDP should promote sheep breeding though mutton is not popular. A small increase in the number of visitors (expert excursions in groups) is also reported.

## Agro-tourism

All projects target an improvement in tourist supply either through an increase in lodging capacities or a growth in outdoor activities. Some are more oriented towards environmental education as they rely on specific programmes for young people. They participate to a variable extent to the protection of natural and historical heritage.

- **E3 (accommodation)**. This RDP is based on the rehabilitation of a typical rural house with accommodation and a path. Its direct output is related to various tourist services including guided visits which target environmental education. Therefore this project participates in the protection of natural and historical heritage.
- **G2 (accommodation)**. This estate offers new B&Bs.
- **E4 (recreation)**. This RDP provides recreational opportunities mainly for school students.
- **E5 (recreation)**. This RDP involves a visitors' centre which provides information, miscellaneous services, guided visits and environmental education. Advice and information are related to the ecological value of the natural park. In addition a better management of the campsite is expected.
- **S4 (recreation)**. This RDP is primarily oriented to an adrenaline sport (paragliding). But it indirectly impacts other tourist services such as food and lodging.

## Quality products

These RDPs lead to the adoption of a new technology and often favour the protection of a traditional one with a positive impact on the quality and the development of new products. They generate up stream effects which benefit the farm sector and down stream effects which benefit tourism.

- **F1 (olive oil co-operative)**. The processing chain complies with EU standards, the olive oil is more tasty with a more stable grade. The traditional orchard (sabine olive) has been renovated while the irrigated one (picholine olive) has increased. In addition a new technology for harvesting irrigated orchards (vibrator machines) has been introduced. It requires a special renovation cut in order to keep the main branches of olive trees.
- **G1 (making and selling a traditional sausage meat)**. The traditional sausage, which had disappeared from the market, as no people, who knew how to produce it remained in the case-study area. Better quality food, as sausage meat is produced in a traditional way based on raw materials coming from the area. The RDP contributes to the diversification and improvement of ecotourism. In addition it encourages the protection of a local breeds.
- **I1 (set up of a dairy farm and agro-tourism by a co-operative)**. The new production of fresh organic milk involves the development of an more advanced technology. Moreover the RDP made possible the creation of a specific brand for fresh organic milk.
- **I5 (building of a private slaughter house for a local breed of sheep)**. Sheep meat was a traditional food in the case-study area. The operator is planning to develop products of sheep meat salami. This should lead into the promotion of sheep breeding among local farmers.

## Historical and cultural heritage

All these RDPs favour at least one type of heritage and positively impact tourist trade.

- **F3 (theatre)**. This RDP combines the rehabilitation of a mansion with an increase in lodging capacities with theatre training for the general public. It has a positive impact on tourism and favour the protection of cultural and historical heritage.
- **G5 (old bridge)**. The rehabilitation of an old traditional monument has a positive effect on tourism.
- **I2 (ethnographic museum)**. The museum owns some collections of traditional agricultural tools and instruments (dairy equipment for cheese making). An apple and pear orchard and a wild-rose garden have been created outside the museum using seeds of selected local species with the purpose of preserving local genetic heritage.

Table 15. Indirect effects of the RDP on the local economy

	Agriculture and forestry						Food and drink		
	Local varieties	New varieties	Local breeds protected	Traditional technology protected	New technology introduced	Increase quality of commodities	New products or brands	New technology introduced	Increase quality of products
E1	1	1	2	2	2	1	2	2	2
E2	1	2	2	2	2	1	2	2	2
E3	2	2	2	2	2	2	2	2	2
E4	2	2	2	2	2	2	2	2	2
E5	2	2	2	2	2	2	2	2	2
F1	1	1	2	2	1	1	1	1	1
F2	.	.	.	.	.	.	2	2	1
F3	.	.	.	.	.	.	2	2	2
F4	2	2	2	2	2	1	2	2	1
F5	2	2	2	2	2	1	2	2	2
G1	2	2	1	1	2	2	1	2	1
G2	2	2	2	2	2	2	2	2	2
G3	2	2	2	2	2	1	.	.	.
G4	2	2	2	2	2	1	1	2	1
G5	2	2	.	.	.	.	.	.	.
I1	2	2	2	2	1	2	2	1	1
I2	1	2	2	1	2	2	2	2	2
I3	2	2	2	2	2	1	2	2	2
I4	2	2	2	2	2	2	2	2	2
I5	2	2	1	2	1	.	1	1	1
S1	2	2	2	2	2	2	2	2	2
S2	2	2	2	2	2	1	2	2	2
S3	2	2	2	2	2	1	2	2	2
S4	2	2	2	2	2	.	2	2	2
S5	2	2	1	2	2	1	2	2	2

1: Yes 2: No

### **5.3. Social indicators**

This sections provides an overview of the impact of the RDPs on the welfare of the resident population. It is based on a series of quantitative and qualitative indicators which are grouped under the following headings:

- Labour force,
- Housing and settlement,
- Recreational activities,
- Natural and historical heritage,
- Transportation network,
- External effects.

#### **5.3.1. Labour force**

Most RDPs (20 among 25) resulted into an increase in the labour force (Table 16). It is really significant for seven projects:

- E2 (fire prevention) with 50 new jobs,
- E5 (recreation) with 43 new jobs,
- G4 (forest restoration) with 39.6 new jobs,
- S3 (irrigation) with 35 new jobs,
- S1 (footpath) with 33 new jobs,
- S4 (outdoor activity) with 23 new jobs,
- F1 (olive oil co-operative) with 22.5 new jobs.

Large projects (E2, S3) and medium size ones (E5, F1, G4) are more likely to lead to a positive impact on the number of jobs than the smallest ones. Nevertheless, a small one (S1: footpath) and a very small one (S4: recreation) were more efficient from this standpoint. Indeed, they indirectly impact the labour market because they allowed the development of new activities in the tourist sector. The same mechanism worked for E5 (recreation) with a direct creation of jobs in the building sector and an indirect creation in services. A two step mechanism also apply to F1 (olive oil co-operative) and S3 (irrigation) for which more jobs were created indirectly in farming than directly in the building sector and the food industry.

The ratio of skilled jobs to total jobs ranges from zero for five RDPs up to one for G4 and S4. For a series of projects this ratio is about on-fourth to one-half: E2 (fire prevention), F1 (olive oil co-operative), S1 (footpath), S3 (irrigation).

Education effort due to the projects is relatively modest. Training improvement is reported for only seven RDPs among twenty five (table 17). But there is a significant number of people who benefited a new training in four cases only:

- E2 (fire prevention) with 100 people,
- E3 (accommodation) with 100 people,
- S3 (irrigation) with 90 people,
- S5 (grassland reactivation) with 20 people.

A more limited educational effort is reported for three projects: G1 (traditional sausage), I2 (museum), S1 (footpath). Training effort mainly favours general and technical education. Adult education is emphasised by two projects and children education by one.

In order to conclude, RDPs have a significant impact on job creation. Small projects can result into an important number of new jobs when they favour the development of new activities in the tourist sector or encourage new crops. Otherwise, the balance between skilled and unskilled jobs is very contingent to the type of project. The impact on the training of the local population is relatively limited and concerned some RDPs only.

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Table 16. Change in the number of jobs due to the RDP

	Agriculture & aquaculture		Forestry		Building & civil engineering		Food & drink		Hotels & restaurants		Other services		Total all activities	
	All Jobs	Skilled jobs	All Jobs	Skilled jobs	All Jobs	Skilled jobs	All Jobs	Skilled jobs	All Jobs	Skilled jobs	All Jobs	Skilled jobs	All Jobs	Skilled jobs
E1														
E2			47	35							3	3	50	38
E3											1	1	1	1
E4														
E5					32	0					11	1	43	1
F1	20	5					2.5	2.5					22.5	7.5
F2														
F3									1	0	2	0.5	3	0.5
F4														
F5			0.5	0									0.5	0
G1							2	1					2	1
G2							1	1	5	3	1	1	7	5
G3			7.5	7.5									7.5	7.5
G4			2.6	2.6	37	37							39.6	39.6
G5					1.8	0							1.8	0
H1							2	0	2	0			4	0
H2							1	0			3	1	4	1
H3			0.5	0	0.2	0			0.5	0			1.2	0
H4													0	0
H5	1	1					1	1					2	2
S1			1	1					30	10	2	0	33	11
S2			0.5	0	0.2	0							0.7	0
S3	25	5			10	3							35	8
S4									10	10	13	13	23	23
S5	1	1							0.05	0			1.05	1

Table 17. Number of people benefiting a training improvement with the project

	General education	Technical education	Children education	Adult education	Total
E1	0	0	0	0	0
E2	0	100	0	0	100
E3	50	50	0	0	100
E4	0	0	0	0	0
E5	0	0	0	0	0
F1	0	0	0	0	0
F2	0	0	0	0	0
F3	0	0	0	0	0
F4	0	0	0	0	0
F5	0	0	0	0	0
G1	0	2	0	1	3
G2	0	0	0	0	0
G3	0	0	0	0	0
G4	0	0	0	0	0
G5	0	0	0	0	0
I1	0	0	0	0	0
I2	4	0	3	0	7
I3	0	0	0	0	0
I4	0	0	0	0	0
I5	0	0	0	0	0
S1	2	2	0	0	4
S2	0	0	0	0	0
S3	30	30	0	30	90
S4	0	0	0	0	0
S5	10	10	0	0	20

### 5.3.2. Housing and settlement

An increase in the resident population is reported for five projects only (Table 18):

- F1 (Olive oil co-operative),
- F2 (wastewater network),
- F3 (theatre),
- F4 (dam),
- G1 (traditional sausage).

There is an important increase associated to F2 and F4, with respectively 40 and 44 new residents. In addition, ten new houses were built related to F2. Urbanisation was limited by a lack of infrastructures (shortage of water in Summer, inefficiency of wastewater treatment) so the building of a wastewater network had such a significant effect on the resident population and the dwelling market. The impact of the three other RDPs is relatively limited with a marginal effect on the dwelling market.

Impact on living conditions of the resident population is assessed with one overall indicators and four specific ones which address respectively the effects on income, education, utilities and infrastructures. Most RDPs lead to a general improvement in living conditions except the followings:

- E5 (visitors' centre),
- F5 (forest road)
- I1 (dairy farm),
- I2 (museum)
- I4 (footpath),
- I5 (slaughter house).

A positive impact on income is reported for thirteen RDPs, while a positive one either on utilities or infrastructures is indicated for eleven. Education has been positively affected by four projects.

Table 18. Impact of the RDP on housing and settlement

	Resident population		New houses		Living conditions				
	Δ	#	Δ	#	General	Income	Education	Utilities	Infrastructures
E1	2	0	2	0	1	1	2	2	2
E2	2	0	2	0	1	2	2	1	2
E3	2	0	2	0	1	1	1	2	2
E4	2	na	2	na	1	1	2	2	2
E5	2	na	2	na	2	na	na	na	na
F1	1	8	2	0	1	1	1	2	2
F2	1	40	1	10	1	2	2	2	1
F3	1	0	2	0	1	1	2	2	1
F4	1	44	1	0	1	2	2	1	2
F5	2	0	2	0	2	2	2	2	2
G1	1	2	1	1	1	1	2	2	2
G2	2	0	2	0	1	1	2	1	2
G3	2	0	2	0	1	1	2	2	2
G4	2	0	2	0	1	2	2	1	1
G5	2	0	2	0	1	2	2	1	1
I1	2	0	2	0	2	2	2	2	2
I2	2	0	2	0	2	2	2	2	2
I3	2	0	2	0	1	2	2	1	1
I4	2	0	2	0	2	2	2	2	2
I5	2	0	2	0	2	2	2	2	2
S1	2	0	2	0	1	1	1	1	1
S2	2	0	2	0	1	1	2	1	1
S3	2	0	2	0	1	1	2	2	1
S4	2	0	2	0	1	1	2	2	2
S5	2	0	2	0	1	1	1	2	2

1 : yes ; 2 : no

### 5.3.3. Recreational activities

The impact of RDPs on recreational activities is assessed through eight indicators. A specific project can lead to a positive or a negative impact as well as a zero impact (Table 19).

There is a limited number of negative effects. They resulted from three projects:

- E2 (fire prevention),
- S3 (irrigation),
- S5 (grassland reactivation).

E2 restricts the access to site and therefore negatively affects a series of recreational activities such as walking, hunting, angling, horse riding and biking. The negative impact on recreation of S3 is more limited since it only concerns walking and hunting. S5 has a negative impact on picking berries or mushrooms.

Eight projects facilitate the collection of berries or mushrooms, while thirteen have a positive impact on the access to site or a specific recreational activity. Therefore it can be argued that the RDPs improve the recreational opportunities which may benefit the resident population as well as the visitors.

Table 19. Impact of the RDP on recreational activities

	Picking berries, mushrooms	Access to sites	Walking and hiking (footpath)	Hunting	Angling	Horse riding	Biking	Skiing
E1	2	2	2	2	2	2	2	2
E2	2	3	3	3	3	3	3	2
E3	2	2	1	2	2	2	2	2
E4	2	2	1	2	2	2	2	2
E5	1	2	1	2	1	1	1	2
F1	2	2	2	2	2	2	2	2
F2	2	2	2	2	1	2	2	2
F3	1	2	1	2	2	1	1	2
F4	2	2	2	2	2	2	2	2
F5	1	2	2	2	2	2	2	2
G1	2	1	1	2	2	2	2	2
G2	2	2	2	2	2	2	2	2
G3	2	2	2	2	2	2	2	2
G4	na	na	na	na	na	na	na	na
G5	2	2	1	2	2	2	2	2
I1	2	2	2	2	2	2	2	2
I2	1	1	1	1	2	2	1	2
I3	1	1	1	1	2	2	1	2
I4	1	2	1	2	2	2	2	2
I5	2	2	2	2	2	2	2	2
S1	1	1	1	2	2	2	2	2
S2	1	1	1	1	2	2	1	2
S3	2	2	3	3	2	2	2	2
S4	2	1	1	2	1	2	2	2
S5	3	2	1	2	2	2	2	2

1: positive effect

2: no effect

3: negative effect

### 5.3.4. Natural and historical heritage

The impact of RDPs on natural and historical heritage is assessed through eight indicators. A specific project can lead to a positive or a negative impact as well as a zero impact (Table 20), however negative effects are limited.

Two indicators (wildlife and fauna, and traditional orchards) address the natural dimension. A positive effect is reported for seven projects:

- E1 (natural regeneration),
- E4 (recreation),
- E5 (recreation),
- F1 olive oil co-operative),
- I2 (museum),
- S1 (footpath).

And a negative one on wildlife and fauna for five:

- I3 (forest road),
- S2 (forest road),
- S3 (irrigation),
- S4 (recreation),
- S5 (grassland reactivation).

Two indicators (historical building and rural houses) refer to the historical heritage. Positive impacts are indicated for nine projects:

- E2 (fire prevention),
- E3 (accommodation),
- E5 (recreation),
- F3 (theatre),
- G5 (old bridge),
- I1 (dairy farm),
- I2 (museum),
- I5 (slaughter house),
- S5 (grassland reactivation).

An improvement in the know how which is related to human capital is indicated for G1 (traditional sausage) and I2 (museum).

Finally, there are three indicators which refer to cultural heritage (historical events, traditional music and museum). Logically F3 (theatre) and I2 (museum) have a positive effect for at least one of these indicators. In addition two recreational RDPs (E5 and S4) have a similar impact.

RDPs can positively impact historical and cultural heritage but their impact on natural heritage is more questionable. Indeed a series of adverse effects on wildlife and fauna, and traditional orchards is indicated.

Table 20. Impact of the RDP on natural and historical heritage

	Wildlife and fauna	Traditional orchards	Historical building	Rural houses	Know how	Historical events	Traditional music (theatre)	Museum
E1	1	2	2	2	2	2	2	2
E2	na	2	1	1	2	2	2	2
E3	2	2	1	1	2	2	2	2
E4	1	2	2	2	2	2	2	2
E5	na	1	1	1	2	1	2	2
F1	2	1	2	2	2	2	2	2
F2	na	2	2	2	2	2	2	2
F3	2	2	1	1	na	1	1	2
F4	2	2	2	2	2	2	2	2
F5	2	2	2	2	2	2	2	2
G1	2	2	2	2	1	2	2	2
G2	2	2	2	2	2	2	2	2
G3	2	2	2	2	2	2	2	2
G4	2	2	2	2	2	2	2	2
G5	2	2	1	2	2	2	2	2
I1	na	2	2	1	2	2	2	2
I2	2	1	1	1	1	1	2	1
I3	3	2	2	2	2	2	2	2
I4	na	na	na	na	na	na	na	na
I5	na	na	na	1	na	na	na	na
S1	1	2	2	2	2	2	2	2
S2	3	2	2	2	2	2	2	2
S3	3	2	2	2	2	2	2	2
S4	3	2	2	2	2	1	1	1
S5	3	2	1	2	2	2	2	2

1: positive effect

2: no effect

3: negative effect

### 5.3.5. Transportation network

The integration of RDPs in the transportation network is assessed through five indicators (Table 21). A change in traffic flows is reported for ten projects:

- F3 (theatre),
- F5 (forest road),
- G1 (traditional sausage),
- G2 (accommodation),
- G5 (old bridge),
- I3 (forest road),
- I4 (footpath),
- I5 (slaughter house),
- S4 (outdoor activity),
- S5 (grassland reactivation).

And a limited increase in the number of vehicles is indicated for G1, G2, G5 and I3.

Most projects are well integrated in the road and rail network except the followings:

- E1 (forest restoration),
- E3 (accommodation),
- F3 (theatre),
- G3 (timber).

Anyway driving time to the nearest urban centre remains limited. The maximum driving time equals one hour for G5 (old bridge). For projects integrated in the tourist market such as E3 (accommodation) and F3 (theatre) it is respectively a quarter of an hour and three quarters of an hour.

The last indicator refers to the remoteness of the site where RDPs take place. From this viewpoint, an improvement is reported for four projects.

- G1 (traditional sausage),
- G2 (accommodation),
- G5 (old bridge),
- I3 (forest road).

Table 21. Integration of the RDP in the transportation network

	Change in traffic flows	Increase in the # of vehicles/day (number)	Road & rail network	Nearest urban centre from the RDP site (hours)	Remoteness alleviated due to the projet
E1	2		2	0.5	2
E2	2		1	0.25	2
E3	2		2	0.5	2
E4	2		1	na	2
E5	2		1	0.25	2
F1	2		1	0.1	2
F2	2		1	0.25	2
F3	1	na	2	0.75	
F4	2		1	0.25	2
F5	1	na	1	0.5	2
G1	1	3	1	0.33	1
G2	1	50	1	0.1	1
G3	2		2	na	2
G4					
G5	1	62	1	1	1
I1	2		1	0.5	
I2	2		1	0.08	
I3	1	75	1	0.3	1
I4	1	na	1	0.16	
I5	1	na	1	na	
S1	2		1	0.16	2
S2	2		1	0.5	2
S3	2		1	0.5	2
S4	1	na	1	0.7	2
S5	1	na	1	0.16	2

1: yes 2: no

### 5.3.6. External effects

RDPs are likely to generate a number of offside effects. These externalities can concern the natural base or directly impact the welfare of the population, they can be positive or negative. Eight specific indicators are considered (Table 22).

A reduction in fire hazards is reported for seven RDPs:

- E1 (forest restoration)
- E2 (fire prevention)
- I2 (museum)
- I3 (forest road)
- S2 (forest road)
- S3 (irrigation)
- S5 (grassland reactivation)

While an increase is indicated for three:

E4 (recreation)

- F1 (olive oil co-operative)
- S4 (recreation)

Two indicators refer to the impact of RDPs on waste (solid wastes and effluents including nitrates). A positive effect related for at least one indicator is reported for four projects:

- E1 (forest restoration)
- F1 (olive oil co-operative)
- F2 (wastewater network)
- S5 (grassland reactivation)

While a negative impact on solid wastes is indicated for three:

- E4 (recreation)
- F3 (museum)
- S1 (footpath)

There is an increase in water withdrawal associated with:

- F3 (museum)
- S3 (irrigation)

A reduction in erosion is expected from four RDPs:

- E1 (natural regeneration)
- E2 (fire prevention)
- G4 (forest restoration)
- G5 (old bridge)

While an increase is reported for eight projects:

- E4 (outdoor activity)
- I2 (museum)
- I3 (forest road)
- S1 (footpath)
- S2 (forest road)
- S3 (irrigation)
- S4 (outdoor activity)
- S5 (grassland reactivation)

Finally, three indicators refer to the amenities (noise, viewing and crowding). Most projects have a positive or a no-effect with respect to these indicators. Let us consider only the negative ones. Five RDPs are likely to increase noise:

- E4 (outdoor activity)
- F3 (museum)
- S1 (footpath)
- S2 (forest road)
- S4 (recreation)

One with a negative effect on viewing:

- S4 (recreation)

And three a negative one on crowding:

- E4 (recreation)
- S1 (footpath)
- S5 (grassland reactivation)

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Table 22. External effects of the RDP

	Fire hazard	Solid wastes	Effluents/ nitrates	Water withdrawal	Erosion	Noise	Viewing	Crowding
E1	1	2	2	2	1	2	1	2
E2	1	2	1	2	1	2	1	2
E3	2	2	2	2	2	2	2	2
E4	3	3	2	2	3	3	1	3
E5	2	2	2	2	2	2	2	2
F1	3	2	1	2	2	2	1	2
F2	2	1	1	2	2	2	1	2
F3	2	3	2	3	2	3	1	2
F4	2	2	2	2	2	2	2	2
F5	2	2	2	2	2	2	2	2
G1	2	2	2	2	2	2	2	2
G2	na	na	na	na	na	na	na	na
G3	2	2	2	2	2	2	2	2
G4	2	2	2	2	1	2	2	2
G5	2	2	2	2	1	2	1	2
I1	2	2	2	2	2	2	2	2
I2	1	2	2	2	3	2	2	2
I3	1	2	2	2	3	2	2	2
I4	na	na	na	na	na	na	na	na
I5	na	na	na	na	3	na	1	na
S1	2	3	2	2	3	3	1	3
S2	1	2	2	2	3	3	1	2
S3	1	2	2	3	3	2	2	2
S4	3	3	2	2	2	3	3	1
S5	1	2	1	2	3	2	1	3

1 : positive effect

2 : no effect

3 : negative effect

## 6. Multi-criteria analysis

### 6.1. Methodology

The easiest way to introduce the methodology is to adopt a geometric viewpoint. Let us consider a huge data set organised within a two-way table. This means that the data consist of a two-way array or matrix of values where the rows are associated with a set of individuals, and the columns are associated with a set of variables. Here in the Medmont context, the projects are the projects and the variables the indicators. Among the numerous possible methods to handle this matrix, principal components analysis and correspondence analysis are particularly relevant :

1. To reveal relationships among the indicators, among the projects, and between the indicators and the projects by dimension reduction.
2. To suggest what the basic underlying indicators might be.

Dimension reduction is the most important of these issues. The idea is to portray the data set by a series of projections which minimise the loss of information. So we have to find a trade-off similar to the compromise a geographer makes by projecting the earth on a map.

Dimension reduction on the projects means representing the projects by a smaller number of co-ordinates.

Historically, factor analysis has given much greater attention to dimension reduction on the indicators, and principal components analysis has tended to emphasise the projects. In any given application there may be good reason to emphasise one aspect or the other, but there is no intrinsic reason to continue this imbalance of emphasis. Rather one should realise the symmetry and utility of both aspects in order to study the relationships among the projects, the indicators or both. For these reasons the following section provides an unified treatment of the dimension reduction issue.

Let us consider a matrix of data:

$$X = (x_{ij})_{i=1, \dots, n; j=1, \dots, p}$$

where  $i$  denotes the projects and  $j$  the indicators. This matrix can be viewed as being a set of  $n$  row-vectors  $x_i$  of dimension  $p$ , thus the data set is set of  $n$  points in the space  $\mathcal{R}^p$ . The general objective of all factor analyses is dimension reduction. It means projecting this data set in a space of lower dimension. If we were able to visualise a  $n$ -dimension space such methods would not be useful. Since the projection distorts the data set, a measure of distortion is needed in order to assess the quality of the portray in  $\mathcal{R}$  or  $\mathcal{R}^2$ . The projection procedure depends on the distance which have been selected but its general characteristics can be shown with the Euclidean distance. The distance between two points  $i$  and  $i'$  is given by the usual formula:

$$d^2(i, i') = \sum_{j=1}^p (x_{ij} - x_{i'j})^2$$

Let us assume that all data have been centred so the centre of gravity of the data set equals the origin  $O$  in  $\mathbb{R}^p$ . The total inertia of the data set is then given by:

$$I_0 = \sum_{i=1}^n d^2(i, O)$$

This formula can be modified in order to take into account weights attributed to the projects. Now suppose that  $x_i$  is projected on the axis  $\Delta u_1$  whose unitary-vector is  $u_1$ . The length  $c_{i1}$  of the projection equals the scalar product of the two vectors  $x_i$  and  $u_1$ . Therefore the inertia of the projection of the data set on the axis  $\Delta u_1$  is:

$$I_1 = {}^t C_1 C_1$$

where  $C_1$  denotes the column-vector whose generic element equals  $c_{i1}$  and  ${}^t C_1$  is the transposed vector of  $C_1$ . So the mathematical problem is to find the axis  $\Delta u_1$  such as the inertia  $I_1$  is maximum. The corresponding program follows:

$$\underset{u_1}{\text{Max}} {}^t C_1 C_1 \text{ subject to } {}^t u_1 u_1 = 1$$

Using the Lagrangian the first order condition for a constrained maximum is easily derived:

$${}^t X X u_1 = \lambda_1 u_1$$

where  ${}^t X$  denotes the transposed matrix of  $X$ , and  ${}^t X X$  is a positive definite matrix of order  $p$ . Thus  $u_1$  is an eigenvector associated with the eigenvalue  $\lambda_1$  of  ${}^t X X$  which is called the matrix of inertia. It is easily shown that:

$$\lambda_1 = I_1$$

so  $\lambda_1$  is the biggest eigenvalue of  ${}^t X X$  and then  $u_1$  is the corresponding unitary eigenvector.  $u_1$  is the first factor. The same procedure can be applied to determine the second factor which associated with the second eigenvalue of  ${}^t X X$ . There is a second constraint in the program, indeed  $u_1$  and  $u_2$  are orthogonal.

The total inertia of the data set is:

$$I_0 = \text{trace}({}^t X X)$$

Inertia being additive, it can be shown that:

$$I_0 = \sum_{j=1}^p \lambda_j = \sum_{j=1}^p I_j$$

where  $\lambda_j$  is the  $j$ th eigenvalue of  $'XX$ , and:

$$\lambda_j = I_j \quad \forall j$$

and eigenvalues are ordered:

$$\lambda_1 > \lambda_2 > \dots > \lambda_p$$

Since  $I_j$  equals the inertia of the projection of the data set on the  $j$ th axis (or factor),  $\lambda_j$  is the inertia explained by this axis. The  $p$  axes are orthogonal. Each project is plotted represented in this new  $p$ -dimension basis. Using linear algebra techniques, a dual relationship between  $\mathfrak{R}^p$  and  $\mathfrak{R}^n$  can be proved. This implies that the indicators can also be plotted in the same vector-basis and therefore that the distances between projects and indicators can be interpreted in the same way that distances between projects or between indicators.

From the above mathematical derivation, practical guidelines are easily stated. The rate of inertia is often used to measure the share of total inertia explained by each factor. It is given by:

$$\tau_j = \frac{I_j}{I_0} = \lambda_j / \sum_{j=1}^p \lambda_j$$

Each factor is a linear combination of row-vectors (projects) so in order to interpret the axes it is crucial to consider their relative weights. The contribution is a crucial concept which offers a powerful tool. First of all recall that:

$$I_j = \sum_{i=1}^n c_{ij}^2$$

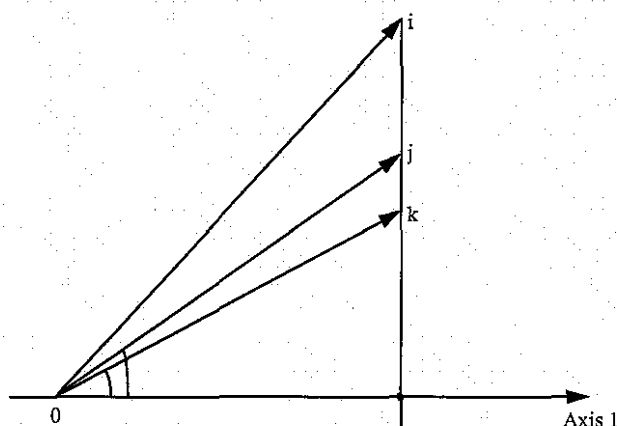
then contribution to factor  $j$  of  $i$  is defined by:

$$CTR_j(i) = c_{ij}^2 / I_j$$

Due to duality between indicators and projects, the contribution of each indicator is defined on the same line. In order to give a consistent interpretation of the different axes, attention must be paid to projects and indicators having the biggest contributions.

In order to highlight the analysis, supplementary indicators or projects named illustrative indicators or illustrative individuals are often considered. They do not enter into the computation of eigenvalues and eigenvectors. However they are plotted in the new orthogonal basis. The quality of the projection is an important issue. Consider for example three illustrative points  $i$ ,  $j$  and  $k$ . The angles between the corresponding vectors and axis 1 for example provide a good indicator of reliable the projections are. On Figure 1 all the three vectors project on the horizontal axis  $l$ , but it is obvious that  $l$  is a better plot for  $k$  than for  $j$  and for  $j$  than for  $i$ . The squared-cosinus of the angle is used instead of the angle itself but this change does not matter as far as the quality of the projection is concerned. The squared-cosinus is also computed for the active indicators and projects which are taken into account to diagonalise the matrix of inertia. But here there is a direct relationship with contributions and looking at angles do not really improve the interpretation of the factors.

Figure 1. Quality of the projection.



Principal components analysis is relevant to deal with continuous indicators. But it does not work for qualitative indicators. Indeed the topology of the data set is not correctly described with an Euclidean distance. Therefore other concepts of distance have to be considered to deal with qualitative indicators. The chi-squared distance is well adapted to dummy indicators and the correspondence analysis method is based on the underlying topology (Hill, 1974). But our data set is more complex since there is a combination of quantitative and qualitative indicators. Qualitative indicators do not pose any problem *per se* because they can always be converted into a set of dummy indicators without loss of information. This procedure can also be applied to continuous indicators but it leads to a loss of information. However it is probably the only practical way to deal with a huge set of indicators of different categories. This methodology named multiple correspondence analysis has been applied and the chi-squared distance used.

## 6.2. Results

### 6.2.1. Factor Selection

The objective is to achieve the selection of the most relevant indicators and a stable typology of the RDPs with respect to the coding step. This point is clearly links with the issue of robustness which has been considered. The outcome of this procedure is given in Tables 23a and 23b which provide the set of indicators which are taken into account in the final multi-criteria analysis whose results are considered below. This first selection of indicators is the outcome of a series of essays. It includes economic and social indicators which are associated to each RDP of interest.

Finally, 62 indicators with a total of 180 modalities are considered. But, in order to run the algorithm all modalities are converted in binary variables, so 118 dummies are defined and the data set for the active variables is a matrix where the number  $n$  of rows equals the number of RDPs and the number  $p$  of columns equals the number of dummy variables. Here  $n$  is 25 and  $p$  is 118.

Table 23a. Active variables: economic indicators

Indicator	Acronym	Modalities <sup>1</sup>	Dummies
Present stage of the RDP	PSTA	3	2
Scale of the RDP	SCAL	4	3
Identification	2	7	5
Value added at factor costs	VAFV	2	1
Private margin	PRIV	2	1
Capital gain	CAPG	2	1
Sustainable income at market prices	SIMP	2	1
Sustainable income at factor costs	SIFC	2	1
Share of ordinary output in total output	SHOD	5	4
Share of internal investment in total output	SHIN	5	4
Share of intermediate consumption in total costs	SHIC	5	4
Share of fixed capital consumption in total costs	SHCP	5	4
Share of labour in total costs	SHLA	5	4
Share of intermediate consumption in total output	SHIO	5	4
Share of gross value added at market prices in total output	SHGV	5	4
Share of local firms in external investment	SHLO	3	2
Share of local firms in intermediate consumption	SHLC	3	2
Share of exports in total sales	SHEX	4	3
Direct market effects	15	55	40
Local varieties have been protected	LOCV	2	1
New varieties have been introduced	NEWV	2	1
Local breeds have been protected	LOCB	2	1
Traditional technology has been protected	TRAD	2	1
New technology has been introduced	NETE	2	1
Increase in the quality of commodities (farming and forestry)	QUAL	2	1
New products or brands have been introduced	NEPR	2	1
New technologies in the food and drink sector	NECF	2	1
Increase in the quality of products (food and drink sector)	INCQ	2	1
Indirect market effects	9	18	9
Economic indicators	26	80	54

1: empty cells are not considered.

Table 23b. Active variables: social indicators

Indicator	Acronym	Modalities <sup>1</sup>	Dummies
Change in the number of jobs	DELJ	5	4
Change in the number of skilled jobs	DELT	5	4
General education	GENE	4	3
Technical education	TECH	4	3
Children education	CHIL	3	2
Adult education	ADUL	3	2
<b>Employment and human capital</b>	<b>6</b>	<b>24</b>	<b>18</b>
Increase of the resident population	DELRI	2	1
New houses	NEHO	2	1
Change in living condition (general)	LIVG	2	1
Change in living condition (income)	INCO	2	1
Change in living condition (education)	LIVI	2	1
Change in living condition (utilities)	LIVU	2	1
Change in living condition (infrastructures)	LIVF	2	1
<b>Housing and settlement</b>	<b>7</b>	<b>14</b>	<b>7</b>
Picking berries and mushrooms	MUSH	3	2
Access to site	ACCE	3	2
Walking and hiking	WALK	3	2
Hunting	HUNT	3	2
Angling	ANGL	3	2
Horse riding	HORS	3	2
Biking	BIKI	3	2
<b>Outdoor and recreation</b>	<b>7</b>	<b>21</b>	<b>14</b>
Wildlife and fauna	WILD	3	2
Traditional orchards (local varieties)	TORC	2	1
Historical building	HIST	2	1
Know how	KNOW	2	1
Museum	MUSE	2	1
<b>Natural and historical heritage</b>	<b>5</b>	<b>11</b>	<b>6</b>
Change in traffic flows	CHAN	2	1
Integration in road and rail network	ROAD	2	1
Remoteness alleviation	REMO	2	1
<b>Infrastructures</b>	<b>3</b>	<b>6</b>	<b>3</b>
Fire hazard	FIRE	3	2
Solid waste	WAST	3	2
Effluents	EFFL	3	2
Water withdrawal	WATE	3	2
Erosion	EROS	3	2
Noise	NOIS	3	2
Viewing	VIEW	3	2
Crowding	CROW	3	2
<b>Waste and injuries</b>	<b>8</b>	<b>24</b>	<b>16</b>
<b>Social indicators</b>	<b>36</b>	<b>100</b>	<b>64</b>
<b>All indicators</b>	<b>62</b>	<b>180</b>	<b>118</b>

1: empty cells are not considered.

Figure 2 gives the value of the 23 eigenvalues and the associated rates of inertia. Factor selection results from both theoretical and empirical considerations. First of all there are two possible statistical tests. The first one is based on a comparison between observed eigenvalues and the maximum they can reach, provided that vector-rows and vector-columns are independent in probability. The second one, the Catell scree-test, looks at the first change in direction of the curve ( $\lambda_j$ ), it is therefore based on the first difference between succeeding eigenvalues. This leads to select five factors since:

$$\lambda_4 - \lambda_5 < \lambda_5 - \lambda_6$$

One empirical test consists in comparing the contribution of variables and modalities to the average rate. But a definitive test consists in the researcher's ability to interpret factors and to extract meaningful information. As a conclusion five factors are selected. Globally they explain 41% of total inertia, a share which is quite high for this type of data set.

Figure 2: Eigenvalues and inertia

Trace before diagonalisation .. 1.9032  
 Sum of eigenvalues .... 1.9032

	Eigen value	%	Cumulative %	
1	0.1917	10.07	10.07	*****
2	0.1683	8.84	18.92	*****
3	0.1511	7.94	26.86	*****
4	0.1407	7.39	34.25	*****
5	0.1351	7.10	41.35	*****
6	0.1235	6.49	47.83	*****
7	0.1110	5.83	53.67	*****
8	0.0932	4.90	58.57	*****
9	0.0892	4.68	63.25	*****
10	0.0850	4.47	67.72	*****
11	0.0760	3.99	71.71	*****
12	0.0680	3.57	75.28	*****
13	0.0635	3.33	78.62	*****
14	0.0622	3.27	81.89	*****
15	0.0556	2.92	84.81	*****
16	0.0501	2.63	87.44	*****
17	0.0437	2.30	89.74	*****
18	0.0419	2.20	91.93	*****
19	0.0332	1.75	93.68	*****
20	0.0307	1.61	95.29	*****
21	0.0261	1.37	96.66	*****
22	0.0229	1.20	97.87	*****
23	0.0222	1.17	99.03	*****
24	0.0184	0.97	100.00	*****

## 6.2.2. Indicator selection

Table 24 sums up the required information to select the set of relevant indicators. Active variables are ranked according to their contribution to the definition of each of the five selected factors. In addition the number of modalities has to be taken into account. Indeed the average contribution of a single modality depends on the total number of modalities. This average is  $100/180 = 0.56$ , so the average contribution of active variables varies as follows: 1.11 for two modalities, 1.67 for three, 2.22 for four and 2.78 for five which is the maximum in the data set.

Table 24. Active variables ranked in decreasing order according to their contribution

1 <sup>st</sup> factor		2 <sup>nd</sup> factor		3 <sup>rd</sup> factor		4 <sup>th</sup> factor		5 <sup>th</sup> factor	
TECH	5.3	ACCE	7.2	NETE	7.0	SHIC	6.9	SHIO	6.7
GENE	5.2	ANGL	6.8	NECF	7.0	SHOD	6.7	SHOD	6.5
CHIL	5.2	BIKI	6.6	SHEX	6.7	SHIN	6.7	SHIN	6.5
ADUL	5.2	HORS	6.5	WALK	5.3	SHIO	6.6	DELJ	6.3
SHIO	5.0	WALK	5.4	INCQ	4.5	SHCP	5.8	SHCP	5.7
SHLA	4.4	HUNT	5.3	DELJ	4.3	SHLA	5.4	SHGV	5.4
DELT	4.2	SCALE	3.7	SHOD	3.9	SCALE	3.8	SHIC	4.8
SIFC	3.6	LIVF	3.2	SHIN	3.9	QUAL	3.8	SHLA	4.1
INCO	3.3	LOCV	3.1	NBHO	3.8	HORS	3.6	DELT	3.2
SHOD	3.1	SHIC	3.1	SHIC	3.5	WATE	3.2	NOIS	3.1
SHIN	3.1	EFFL	2.7	SHLO	3.3	DELJ	3.2	WILD	2.8
SHGV	3.1	EROS	2.6	TECH	2.8	MUSE	3.1	WAST	2.5
DELJ	3.1	DELT	2.6	DELT	2.6	SHGV	3.1	WATE	2.5
SCALE	2.9	SHCP	2.5	ACCE	2.4	SHEX	3.0	CHAN	2.4
SHIC	2.9	LIVU	2.3	MUSE	2.4	WAST	2.7	HORS	2.3
SIMP	2.7	SHOD	2.3	BIKI	2.2	DELT	2.7	EROS	2.3
SHEX	2.7	SHIN	2.3	ADUL	2.1	NOIS	2.6	MUSH	2.2
CHAN	2.2	SHLA	2.3	DELRI	1.7	PSTA	2.1	SHEX	2.2
CROW	1.9	FIRE	1.9	NOIS	1.7	ANGL	1.9	CAPG	2.1
LIVI	1.8	SHLO	1.8	NEWV	1.5	CAPG	1.6	GENE	2.0
BIKI	1.8	DELJ	1.8	WILD	1.5	PRIV	1.4	TECH	2.0
SHCP	1.8	SIMP	1.6	HIST	1.5	WILD	1.3	PSTA	1.4
SHLO	1.8	LIVG	1.5	MUSH	1.4	GENE	1.3	ACCE	1.4
SHLC	1.8	SHIO	1.5	CROW	1.4	BIKI	1.2	FIRE	1.4
HORS	1.6	SHGV	1.4	SHCP	1.4	TORC	1.2	INCO	1.3
NEPR	1.4	SHLC	1.4	PSTA	1.3	EROS	1.2	SHLC	1.3
LIVG	1.4	SIFC	1.3	SCALE	1.3	NETE	1.1	SHLO	1.1
MUSH	1.4	INCO	1.0	NEPR	1.3	NECF	1.1	SIMP	1.0
VIEW	1.4	MUSH	1.0	VIEW	1.3	HIST	1.1	NEWV	1.0
PRIV	1.1	QUAL	0.9	SHLA	1.3	FIRE	1.1	LIVU	1.0
WATE	1.1	HIST	0.9	HUNT	1.2	WALK	0.8	SIFC	0.8
LOCB	1.0	WAST	0.9	GENE	1.0	SHLO	0.8	BIKI	0.8
WILD	1.0	GENE	0.9	FIRE	0.9	INCQ	0.7	ADUL	0.8
FIRE	0.9	CHAN	0.8	CHIL	0.9	HUNT	0.7	PRIV	0.7
VAFA	0.8	NOIS	0.8	CAPG	0.8	TECH	0.7	LIVI	0.7
TORC	0.8	PSTA	0.7	HORS	0.8	CHIL	0.7	TRAD	0.6
REMO	0.7	PRIV	0.7	PRIV	0.7	LIVU	0.6	NEPR	0.6
WAST	0.7	CAPG	0.7	ANGL	0.7	BFLL	0.6	INCQ	0.6
EROS	0.7	CHIL	0.7	BFLL	0.7	VIEW	0.6	KNOW	0.6
NOIS	0.6	VIBW	0.6	SHIO	0.7	CROW	0.6	CROW	0.6
INCQ	0.5	CROW	0.5	SHGV	0.7	ADUL	0.5	DELRI	0.5
DELRI	0.5	TECH	0.5	WAST	0.6	NEHO	0.4	HIST	0.5
HUNT	0.5	NEWV	0.4	SHLC	0.6	LIVG	0.4	MUSE	0.5
HIST	0.5	WATE	0.4	EROS	0.5	NEPR	0.3	VAFA	0.4
MUSE	0.5	SHEX	0.4	TRAD	0.4	ROAD	0.2	ANGL	0.4
PSTA	0.4	ADUL	0.4	KNOW	0.4	SIMP	0.1	CHIL	0.4
CAPG	0.3	TRAD	0.3	CHAN	0.4	TRAD	0.1	SCALE	0.3
NETE	0.3	INCQ	0.3	SIFC	0.3	INCO	0.1	LOCV	0.3
NECF	0.3	KNOW	0.3	REMO	0.3	LIVF	0.1	LIVF	0.3
LOCV	0.2	DELRI	0.2	WATE	0.3	MUSH	0.1	NEHO	0.2
WALK	0.2	MUSE	0.2	VAFA	0.2	ACCE	0.1	HUNT	0.2
ROAD	0.2	ROAD	0.2	LOCV	0.2	KNOW	0.1	VIEW	0.2
QUAL	0.1	REMO	0.2	SIMP	0.1	SHLC	0.1	LOCB	0.1
EFFL	0.1	LOCB	0.1	LOCB	0.1			LIVG	0.1
		NEPR	0.1	QUAL	0.1			WALK	0.1
		WILD	0.1	LIVI	0.1			REMO	0.1
				LIVU	0.1			EFFL	0.1
				TORC	0.1				
				ROAD	0.1				

Table 25. List of selected indicators

Direct market effects	
Composition of total output	SHOD, SHIN
Production account	SHIO, SHGV
Composition of total costs	SHIC, SHCP, SHLA
Share of local firms in external investment	SHLO
Share of exports in total sales	SHEX
Sustainable income	SIMP, SIFC
Indirect market effects	
Protection of local varieties	LOCV
Introduction of a new technology	NETE, NECF
Increase in the quality of products	QUAL, INCQ
Employment and human capital	
Change in the number of jobs	DELJ
Improvement in the training of the residents	GENE, TECH, CHIL ADUL
Housing and settlement	
New houses	NEHO
Change in living condition	INCO, LIVI, LIVU, LIVF
Outdoor and recreation	
Access to site	ACCE
Outdoor activities	WALK, HUNT, ANGL, HORS, BIKI
Natural and historical heritage	
Museum	MUSE
Infrastructures	
Change in traffic flows	CHAN

Table 25 gives the list of selected indicators which summarizes the collected information related to the twenty-five RDPs of interest. This proposal deserves a series of comments.

### Direct market effects

All indicators are derived from Table 50 of the questionnaire and require a good economic expertise. First of all, the composition of total output, as well as total costs, and a production account are required. In addition, two indicators related to the integration of the local economy into the region and the country are needed. They concern the share of local firms in external investment and the share of exports in total sales. Finally, it would be useful to come up with an indicator of sustainable income. But this required a lot of effort.

### Indirect market effects

Indicators are related to an increase in the quality of products and the introduction of a new technology either they concern the primary sector or the food and drink industry. In addition, there is a specific indicator for the protection of local varieties.

### Social indicators

Here the most relevant are related to employment and human capital as well as housing and settlement. Information on job creation and training improvement is specially relevant. Otherwise, based on factor contribution the number of new houses is a better indicator than the variation of the resident population. However this result may be contingent, and the other indicator is also relevant. Change in living conditions can be captured through several

indicators. With respect to the other categories, a parsimonious approach is wise. The choice among the different possibilities is depending upon data availability.

### 6.2.3. Factor description

A description of the five first factors is provided in the following tables. Each indicates:

- Active modalities with the highest contributions,
- Illustrative modalities with the highest square cosinus,
- RDPs with the highest contributions.

Modalities and RDPs with a negative co-ordinate are shown on the left side of each table whereas others are on the right side. Absolute values of co-ordinates are given in parentheses.

#### First factor

Active modalities	
LIVI1 (1.26) INCO1 (0.77) TECH1 (0.57), ADUL1 (0.52) CHIL1 (0.49), GENE1 (0.47)	SIMP1 (1.13) SIFC1 (0.95) CHAN1 (0.62)
Illustrative modalities	
SIFC2 (0.45), CHAN2 (0.41)	INCO2 (0.51)
RDPs	
E5 (0.70) F3 (0.59), I2 (0.51) S3 (0.46) S1 (0.63)	S4 (0.87) I5 (0.72), I4 (0.69), G5 (0.67) G1 (0.59)

This factor mainly combines social profitability indicators (SIMP, SIFC) with indicators referring to an improvement either in the training of the residents (GENE, TECH, CHIL, ADUL) or in living condition in general (INCO). Factor one integrates two facets of sustainability, the economic and the social one. In addition, change in traffic flows (CHAN) is correlated with the previous indicators. An increase can result into a detrimental effect on living conditions.

**Second factor**

<b>Active modalities</b>	
	ANGL3 (4.05), HORS3 (4.05) ACCE3 (4.05), BIKI3 (4.05) WALK3 (2.51), HUNT3 (2.51) LOCV1 (1.30) LIVF1 (0.93), LIVU1 (0.78)
<b>Illustrative modalities</b>	
LIVF2 (0.36)	
<b>RDPs</b>	
F5 (0.59) G1 (0.42)	E2 (1.66) E1 (0.47)

This factor integrates three categories of indicators: recreational opportunities (ANGL, HORS, ACCE, BIKI, WALK, HUNT), the protection of local varieties (LOCV) and change in living conditions (LIVF, LIVU). The highest weight is associated with the first group of indicators which discriminates F5 (forest road) from E2 (fire prevention). The second group isolates E1 (forest restoration) from the other RDPs.

**Third factor**

<b>Active modalities</b>	
NEHO1 (2.91), SHEX2 (2.62) NETE1 (2.20), NECF1 (2.20) INCQ1 (1.04), SHLO1 (0.97) WALK2 (0.85)	MUSE1 (1.08)
<b>Illustrative modalities</b>	
	INCQ2 (0.41) NETE2 (0.30), NECF2 (0.30)
<b>RDPs</b>	
I1 (1.13), F1 (0.91) I5 (0.52)	S4 (0.66) S2 (0.49)

The third factor combines direct market effects ( SHLO, SHEX) and indirect market effects (INCQ, NETE, NECF). The increase in the number of houses (NEHO) also contributes to the definition of this factor. The proximity of the share of exports, the increase in the quality of products as well as the introduction of new technologies has to be underlined. This factor is associated with the growth of the local economy.

Three among four RDPs favouring quality products (F1, I1, I5) are discriminated from S2 (forest road) and S4 (recreation).

**Fourth factor**

Active modalities	
HORS1 (1.90) MUSE1 (1.20) SHOD4 (0.91), SHIN1 (0.91) SHIC2 (0.76) SHIO2 (0.62), SHCP2 (0.50)	QUAL1 (0.55)
Illustrative modalities	
QUAL2 (0.51)	SHIO1 (0.51)
RDPs	
F3 (0.87) E5 (0.55), F2 (0.43)	F5 (1.15) S3 (0.45)

The definition of the fourth factor is a bit confused. First of all it is based on direct market effects: composition of total output (SHOD, SHIN), production account (SHIO) and composition of total costs (SHIC). The relationship with the quality of products (QUAL) is straightforward but in addition modalities related to recreation are also active.

This fuzziness leads to first discriminate F2 (wastewater network) from F5 (forest road) and S3 (irrigation). In addition two RDPs are very close on this factor: E5 (recreation) and F2 (theatre).

**Fifth factor**

Active modalities	
DELT1 (0.94) CHAN1 (0.55)	SHIO1 (0.81), SHCP3 (0.72) SHOD2 (0.59), SHIN2 (0.59)
Illustrative modalities	
DELJ2 (0.81)	SHOD3 (0.59), SHIN3 (0.59) CHAN2 (0.37)
RDPs	
F5 (1.02) F3 (0.78) I4 (0.45)	G1 (0.41), G4 (0.41) E1 (0.61)

The fifth is based on economic aggregates, including the composition of total output (SHOD, SHIN), the production account (SHIO) and the composition of total costs (SHCP). Otherwise, two indicators directly linked with the growth of the economy have a significant contribution. They are associated to the change in the number of jobs (DELT) and in traffic (CHAN).

This factor discriminates F5 (forest road), F3 (theatre) and I4 (footpath) from G1 (quality product), E1 and G4 (forest roads).

### 6.2.4. A revised typology of the RDPs

On Figure 3, two groups of RDPs are easily identified. The first one includes: E5, F3, I2 and S1. These RDPs among other services provide either environmental or cultural education. This group is based on natural and cultural heritage. The second group includes G1, G5, I4 and I5 which more or less directly favour eco-tourism. A fifth RDP (S4) is close to this group. Two RDPs (F1, I1) are located on Figure 3 between these groups. They are indicated in italic instead of bolder letters because they do not contribute significantly to the definition of factors 1 and 2. Otherwise F1, I1 and I5 are close in the plan defined by factors 2 and 3. So three groups can be defined:

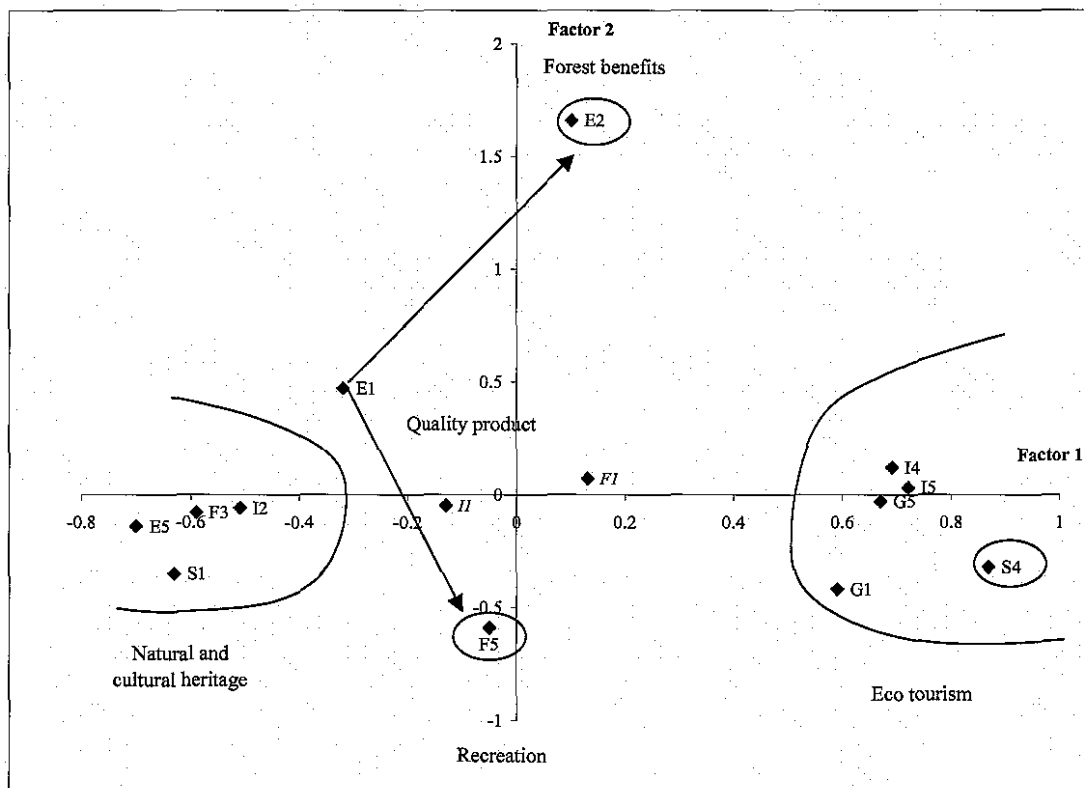
Group 1. Natural and cultural heritage: E5, F3, I2, S1

Group 2. Eco-tourism: G1, G5, I4, S4

Group 3. Quality products: F1, I1, I5

The profile of G1 (making and selling a traditional sausage meat) is closer to Group 2 than to Group 3, because this RDP contributes to the diversification and improvement of ecotourism.

Figure 3. Factors 1 and 2



Three RDPs (E1, E2, F5) are also identified on Figure 3 and define a triangle which reveals the so called Gutman effect and an underlying linear relationship. These RDPs can be ranked as following according to the balance between the category of benefits:  $F5 < E1 < E2$ . F5 favours recreational benefits while E2 is mostly oriented towards pure forest benefits. This point is made clear on Figure 4. In addition a group of eight RDPs (E1, E2, F5, G3, G4, I3, S2, S5) is defined. These RDPs rely on the restoration of the natural basis and promote the various forest outputs. The balance between market and non-market output varies among RDPs.

Figure 4. Factors 2 and 5

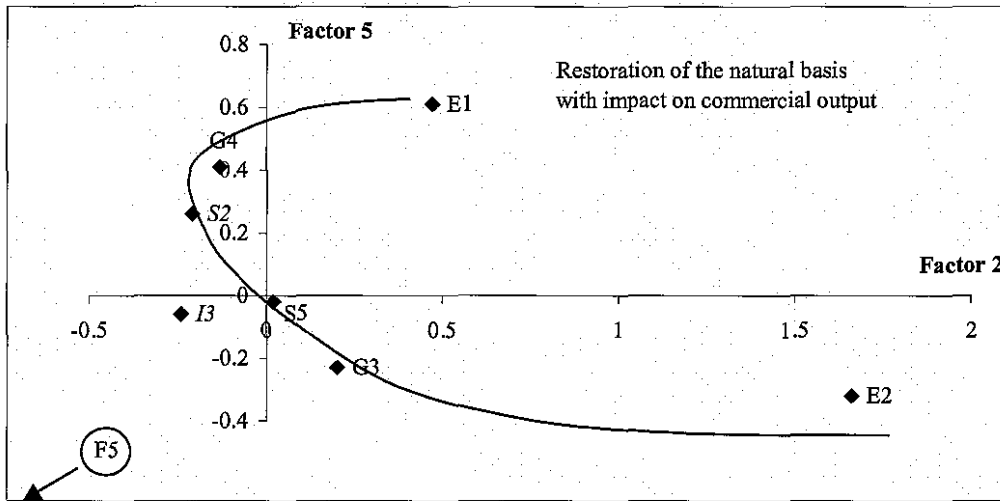


Figure 5 allows to identify two RDPs (E3, G2) which are mainly based on the development of new accommodation facilities. They can offer additional services, such as recreation for the public. So E4 is connected to this group which can be aggregated with Group 2 in order to define an agro-tourism group.

Finally, there is a fifth group which includes the RDPs related to infrastructures and public utilities: F2, F4, S3.

Figure 5. Factors 1 and 3

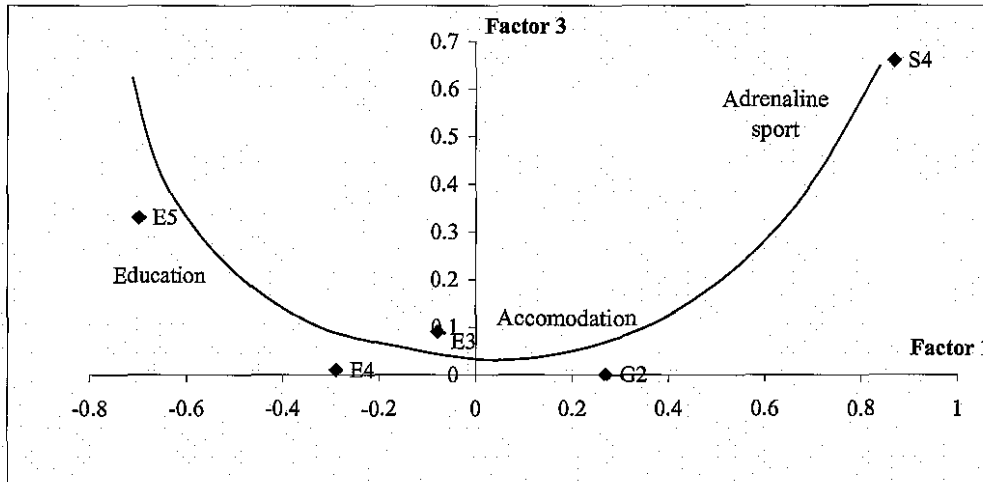


Table 26. Revised typology of the RDPs

	Group 1	Group 2	Group 3	Group 4	Group 5
E1				X	
E2				X	
E3		X			
E4		X			
E5	X				
F1			X		
F2	X				X
F3	X				X
F4					X
F5				X	
G1		X			
G2		X			
G3				X	
G4				X	
G5		X			
I1			X		
I2	X				
I3				X	
I4		X			
I5			X		
S1	X				
S2				X	
S3					X
S4		X			
S5				X	

- Group 1. Natural and cultural heritage
- Group 2. Agro-tourism
- Group 3. Quality products
- Group 4. Natural basis restoration
- Group 5. Infrastructures and public utilities

### **6.2.5. What is the area impacted by a project?**

Economic aggregates refer to the case-study area that extends over different spatial entities, including the ecotope level, the landscape type level and the landscape system level. Several indicators, such as external investment, intermediate consumption and ordinary output, have been broken down in order to separate the share of local firms in the whole economic flows. Where the location of firms is more precisely known, it is therefore possible to indicate what area level is impacted by the RDP (Table 27). Related to the other indicators, especially social indicators, it makes sense to proceed similarly as shown in Table 27.

Table 27. Area impacted by the RDPs according to the relevant indicators.

	E1	E2	E3	E4	E5	F1	F2	F3	F4	F5	G1	G2	G3	G4	G5	I1	I2	I3	I4	I5	S1	S2	S3	S4	S5
Size	3	4	3	2	3	3	3	3	4	2	2	3	4	3	2	3	3	2	1	2	2	2	4	1	1
External investment*																									
Intermediate consumption*						T	S	S	S																
Ordinary output*						S	S	S	S	T															
Local varieties / breeds						E																			
New technology						E																			
Quality of products						S			T	T															
Number of jobs						S		S	S	E															
Training of the residents						S		S	S																
Building of new houses						S	S		S																
Increase of local population						S	S	T																	
Outdoor activities							T	S		E															
Natural heritage						E		S																	
Cultural / historical heritage								S																	
Road traffic								T																	

Size. 1 = very small, 2 = small, 3 = medium, 4 = large. \* benefiting local firms. E is ecotope, T is landscape type and S is landscape system.

## 7. Discussion and conclusion

### 7.1. *Limitation of traditional analyses*

Physical information about environmental impacts is an essential prerequisite to cost-effectiveness analysis (CEA) and cost-benefit analysis (CBA), thus in practice an Environmental Impact Analysis (EIA) is primarily performed. It is essentially an identification and study of all significant environmental repercussions stemming from a proposed decision. EIAs are largely the work of natural scientists, who focus on tracing out and describing the physical impacts of projects with a special emphasis on linkages with the ecosystem.

In essence, CBA involves the monetization of all the costs and benefits of a proposed project and its alternatives, and the assessment of the resultant benefit over a given time horizon. As such, CBA is anthropocentric and produces assessments which reflect a human rather than physical view of a project. CBA often appears more quantitative, employs a single unit as opposed to multiple units of measurement used by EIA. Compared with EIA which is primarily based in the physical sciences, CBA is based on a firm methodology and is more quantitative. However this potential advantage is also a significant disadvantage in that a primary problem arises in translating all of the potential environmental impacts in monetary values. Despite methodological progress, ethical, philosophical and political obstacles still remain. There is a considerable resistance to the idea of estimating the monetary value of human health and safety, and valuing landscape or national heritage. The willingness to pay criterion is rejected both by conservationists, and also by the school of institutionalist economics.

The most disclaimer to make concerning the monetary evaluation methods is that they are not capable of valuing the environment. The environment is indeed a multi-attribute entity which yields a complexity of values, and economic methods only target to value humans' preferences for some aspects of certain environmental goods and services. In practice, this deficiency of valuation directly contributes to the relatively restricted scope of CBA and most importantly, to extreme scepticism as to its value among non-economists who often question the validity of the anthropocentric paradigm on which it relies.

From a different perspective, the status and role of CBA in public decision making have been the subject of continuing discussions as well as political and administrative conflicts. Some observers have taken the position that CBA is really an attempt to short-circuit the process of political discussion and decision that should take place about public projects. From a slightly different standpoint, given the increasing importance attached to deliberative processes and stakeholder involvement in public-decision making, it is apparent that no one tool can provide relevant insights and prescriptions for all environmental contexts.

## 7.2. Theoretical framework and socio-economic indicators

Public and scientific debate on sustainability pointed out the need to integrate fully environmental protection and the sound management of natural resources into all economic and social activity. However, despite the current sustainable development rhetoric there is no doubt that the frequently antagonistic relationship between economic development remains. So traditional environmental decision-making is being questioned because it does not integrate environmental objectives with economic and social issues. Strategic environmental assessment has been emerging in this context. It aims to provide the competent authority with a tool which enables it to be fully aware of the environmental and sustainability issues associated with a particular policy, programme or project. The objective is therefore to expand the competent authority's focus by providing a mechanism by which its goals will include cross-cutting environmental and sustainability perspectives. Thus strategic environmental assessment does not refer to a precise technique but to a general methodology which relies on a range of methods. Under the Medmont research programme, we developed a similar procedure to evaluate investment projects only, but with a more ambitious theoretical objective as it concerns both *ex ante* and *ex post* evaluation. With respect to on going projects both perspectives, *ex ante* and *ex post*, were considered. The technical methodologies used for *ex ante*, *ex post* and on going evaluation are similar. Each should identified, and quantified where possible, both the direct and indirect costs and benefits of the project. However, *ex post* evaluation tends to be based on actual data while *ex ante* evaluation relies on forecasts and projections.

Relationships between the environment, and the economic and social sectors as well as the linkages between the components of each sector which result from the implementation of the RDPs are described with a set of environmental and socio-economic indicators. The dynamic pattern which results from the various relationships between the many parameters of interest, and from the feedback which links the economic and social outcome to the environmental sphere is modelled with a combination of state indicators related to capital stocks, and flow indicators which refer to the variation in capital stocks. All indicators are organised in three specific sections of the consolidated questionnaire.

Economic indicators are consistent with the European System of Integrated Economic Accounts, which is derived from the United Nations Revised System of National Accounts. The implementation of the underlying concepts and rules is not straightforward and needs an original research effort. Economic indicators allow to estimate the direct and indirect market effects of RDPs. Direct market effects refer to a series of indicators such as output, investment, value-added, export and import of the case-study area. Indirect market effects mainly target impacts on agriculture, forestry, food and drink sector, and tourism. They combine quantitative and qualitative indicators. Economic indicators allow to make a comparison between the project and the no-project options.

Social indicators aim at evaluating impacts of RDPs on the welfare of the resident population. They are organised under several headings related to employment and human capital, housing and settlement, outdoor and recreation, natural and historical heritage, and negative externalities of the project.

### **7.3. Main findings**

The composition of total output varies very much among projects and there is no simple relationship between the output composition and a simple criterion such as the category, the size or the country. Despite some discrepancies, the composition of total costs is broadly linked to the type of projects. This conclusion was expected, because there is a close relationship between a type of project and a precise technology.

Projects concerning infrastructures are characterised with a high level of total factor productivity. Forest restoration and conservation projects are also profitable related to productivity level. Projects targeting the production of quality products illustrate different cases while the range of values among the other projects is very wide. There are differences among projects targeting similar activities. However, it must be mentioned that relatively high levels of total productivity may result from operating subsidies. So the profitability of these RDPs is questionable since it is due to monetary transfer from the rest of the economy.

The implementation of RDPs involve an increase in both external investment and intermediate consumption. A comparison with the no-project case highlights different situations. The impact can be more limited where projects reinforce already existing programmes. Nevertheless some lead to a dramatic increase in external investment while for others there is a significant impact through intermediate consumption. But overall, the total flow is directly linked to the size of the project of interest.

The flow of purchases associated with the increase in external investment and intermediate consumption may benefit the local economy but is likely to boost imports as far as equipment, machinery and specific services are needed. External investment is concentrated on three sectors: building and civil engineering, industries and services. It can be directed toward local or non-local firms. The share of local firms in the total depends upon sectors and projects. As far as building and civil engineering is concerned, local firms attract the whole investment. Since local firms cannot provide specific equipments and services, a significant share of purchases benefits non-local firms.

The distribution of intermediate consumption and the distribution of external investment according to the location of the providing firm are more or less similar. Local firms can provide basic goods and services, but equipment or machinery as well as specialised services are imported. This results from the small scale of the local economy.

The spatial distribution of sales varies significantly according to the type and the scale of the project. For example the services of utilities are sold locally as well as the output of the most modest scale projects. In contrast, there are RDPs aimed at the production of quality products or cultural projects whose outputs are mainly exported. As it was expected green-tourism attracts people from abroad and positively impact tourism.

RDPs have a significant impact on job creation. Small projects can result into an important number of new jobs when they favour the development of new activities in the tourist sector or encourage new crops. Otherwise, the balance between skilled and unskilled jobs is very contingent to the type of project. The impact on the training of the local population is relatively limited and concerned some RDPs only.

Though most projects positively affect recreational activities, some may lead to a negative effect through a restriction of the access to site. There is a similar balance between positive and negative effects on natural and historical heritage, with few negative ones. Some projects significantly benefit to the protection of historical building and rural houses, while some others favour the protection of wildlife and traditional orchards.

RDPs are likely to generate a number of offside effects. These externalities can concern the natural base or directly impact the welfare of the population, they can be positive or negative. For example a reduction in fire hazards is reported for seven RDPs while an increase is indicated for three others. Some RDPs lead to a reduction in nitrate pollution, while some others involve an increase in solid waste and water withdrawal. Adverse effects are associated either with an increase in the number of tourists or a growth in irrigation. In addition, a possible congestion is reported for some RDPs favouring the development of outdoor activities.

#### **7.4. Synthetic analysis**

The above analysis gives a very detailed description of the RDPs and show how diverse they are. However, it is more instrumental to come up with an overview of all this vast information. Correspondence analysis is a relevant methodology to handle such a data set. Indeed, it allows to reveal underlying relationships among the indicators, among the projects, and between the indicators and the projects by dimension reduction.

This procedure results into a limited list of thirty-four indicators that summarize the collected information related to the twenty-five RDPs of interest. With a limited loss of information, the data set can be depicted in a five-dimension space.

##### **First factor**

This factor mainly combines social profitability indicators with indicators referring to an improvement either in the training of the residents or in living condition in general. It integrates two facets of sustainability, the economic and the social one. In addition, change in traffic flows is correlated with the previous indicators. An increase can result into a detrimental effect on living conditions.

##### **Second factor**

This factor integrates three categories of indicators: recreational opportunities, the protection of local varieties and change in living conditions. The highest weight is associated with the first group of indicators which discriminates F5 (forest road) from E2 (fire prevention). The second group isolates E1 (forest restoration) from the other RDPs.

##### **Third factor**

The third factor combines direct market and indirect market effects. The increase in the number of houses also contributes to the definition of this factor. The proximity of the share of exports, the increase in the quality of products as well as the introduction of new technologies has to be underlined. This factor is associated with the growth of the local economy. Three among four RDPs favouring quality products (F1, I1, I5) are discriminated from S2 (forest road) and S4 (recreation).

**Fourth factor**

The definition of the fourth factor is a bit confused. First of all it is based on direct market effects: composition of total output, production account and composition of total costs. The relationship with the quality of products is straightforward but in addition modalities related to recreation are also active. This fuzziness leads to first discriminate F2 (wastewater network) from F5 (forest road) and S3 (irrigation). In addition two RDPs are very close on this factor: E5 (recreation) and F2 (theatre).

**Fifth factor**

The fifth factor is based on economic aggregates, including the composition of total output, the production account and the composition of total costs. Otherwise, two indicators directly linked with the growth of the economy have a significant contribution. They are associated to the change in the number of jobs and in traffic. This factor discriminates F5 (forest road), F3 (theatre) and I4 (footpath) from G1 (quality product), E1 and G4 (forest roads).

Based on this analysis, the following typology of RDPs is finally proposed:

- **Group 1. Natural and cultural heritage**
- **Group 2. Agro-tourism**
- **Group 3. Quality products**
- **Group 4. Natural basis restoration**
- **Group 5. Infrastructures and public utilities**

## 8. Recommendation

A comprehensive and firmly theoretical based methodology has been applied to the twenty-five RDPs of interest. Using a multi-criteria analysis it has been shown that all available information can be summarised with a relatively limited set of indicators (Table 25).

However, estimating these indicators requires an economic expertise and a lot of effort. Thus, in some circumstances, it may be justified to apply a simplified procedure that makes use of a panel of experts, such as with the Delphi method. The notion is that well-informed individuals, calling on their insights and experience, are equipped to make an evaluation of a RDP. Indeed, it is believed that their responses to a series of questionnaires will provide the best possible evaluation. The group may converge towards a single opinion, however the process does not require complete agreement by all panellists since the final outcome may be based on a majority opinion.

Before an evaluation is performed, a pre-assessment screening is recommended. It is a rapid review of available information to decide whether a detailed evaluation should be performed or not. It includes notification of the size of the project and the description of its environmental, economic and social impacts. If the RDP is likely to have major consequences either for the economy or the population then a detailed evaluation is carried out. This needs the development of quantitative indicators that are consistent with the system of accounts for the local area where the project takes place. Otherwise, for RDPs with likely limited impacts, a simplified evaluation is performed. It is consistent with the detailed procedure since it relies on the same theoretical concepts but do not seek to precisely value indicators. Indeed, A rough assessment, based on a rating, is only targeted.

Thus the panellists should be asked to review the relevant issues for RDP evaluation and to give their own rating for the indicators that are involved in Table 25. An illustration is given *infra*.

### 8.1. Direct market effects

Please rate the following indicators and indicate the area impacted by the RDP:

- Share of ordinary output in total output,
- Share of value added in total output,
- Share of intermediate consumption in total costs,
- Share of labour costs in total costs,
- Share of local firms in external investment,
- Share of exports in total sales,
- Probability that the RDP generates a sustainable income.

Rates should take the following values:

1 = 0-20%, 2 = 20-40%, 3 = 40-60%, 4 = 60-80% and 5 = 80-100%

## **8.2. Indirect market effects**

In your opinion what is the impact of the RDP on the:

- Protection of local varieties and local breeds,
- Introduction of a new technology,
- Increase in the quality of products.

Rates should take the following values:

1 = very low, 2 = low, 3 = moderate, 4 = high and 5 = very high

In your opinion what is the area impacted by the project?

## **8.3. Social effects**

In your opinion what is the impact of the RDP on the:

- Increase in the number of jobs,
- Improvement in the training of the residents,
- Building of new houses,
- Increase of local population,
- Improvement of outdoor and recreational activities (access to site, walking, hunting, angling, horse riding, biking),
- Improvement of natural heritage (wildlife, fauna, local varieties),
- Improvement of cultural and historical heritage (historical building, rural houses, know how, traditional music, theatre, museum),
- Increase in road traffic.

Rates should take the following values:

1 = very low, 2 = low, 3 = moderate, 4 = high and 5 = very high

In your opinion what is the area impacted by the project?

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