Conceptual Framework

on the Assessment of the Impact of Organic Agriculture

on the Economies of Developing Countries

FINAL

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Summary

The impact of organic farming in developing countries may be evaluated under a wide range of perspectives. Here we focus on three main areas: economic, environmental and social effects and develop a feasible approach to organic adoption assessments that is – in our intentions- flexible enough to be used in countries with potentially diversified conditions in terms of data availability on this issue.

The **economic aspects** are taken into consideration from three point of views:

- general regulatory framework for agriculture and organic farming in particular
- economic effects of organic farming adoption at a macro level
- economic effects of organic farming adoption at a micro level

The regulatory framework is analysed in order to highlight the institutional conditions in which the organic farming sector is operating. Both general agro-environmental policy system and eventual specific aspects directly linked with organic farming are considered, together with indirect institutional aspects like marketing and advisory measures/services that might influence the organic sector. Description of the procedures for data and information collection are provided.

The macroeconomic potential impacts of conversion to organic agriculture is analysed basically from two perspectives: direct consequences on commodity output variation and indirect effects on the agro-food system and rural development. The issue of effects on agricultural output is talked considering the two main factors involved: land use and yields. According to data availability situations, different approaches are suggested and a methodological approach for assessments of output variation under different take up scenario is provided.

Impact on aggregate output is only the most visible effect of widespread organic conversion. Side effects on the entire agro-food system, on the industry of technical inputs, on labour market, rural development and international trade should also be taken into consideration. In this case however the difficulties of impact assessment are exacerbated by the lack of statistical data and, in many cases, of literature on such issues. Therefore a structured-qualitative approach - Multi Stage Qualitative Analysis – is developed, with the aim to individuate:

– the core competences in a country that might be more affected by organic farming development,

– main risks and opportunities that might derive from organic farming development

The micro-economic implication of organic farming adoption are analysed focussing on representative organic farms, with particular emphasis on the remuneration of family labour and profitability consequences of conversion. A budget scheme for economic micro evaluation is provided, together with guidelines for the selection of representative organic farms under different

countries conditions. Attention has been paid also to the aspects of comparison between organic and conventional farming in order to assess if and to what extent organic farming may actually represent an economically viable alternative to conventional farming.

Finally, an evaluation of subjective motivations and barriers to organic conversion for farmers is proposed, based on qualitative analysis hinging on focus groups and in-depth cognitive interviews, and specific guidelines for interview management are provided.

Environmental impacts of organic farming uptake are often considered among the main consequences of conversion. Assessment can be done very thoroughly by using Life Cycle Assessment (LCA). LCA emerged as a worldwide environmental management tool in the form of the ISO 14040 series. It allows to break down the environmental impact in many different categories, e.g.: Abiotic depletion; Global warming; Ozone layer depletion; Human toxicity; Fresh water aquatic eco-toxicity; etc. Using a case study approach to collect data on organic agriculture and common software packages will allow to easily quantify such impacts and relate them to previous conditions (i.e. conventional farming).

The **Social impact** of organic farming will be investigated using a stepwise approach.

Social impacts can be characterised and defined in many ways. The following definition is widely understood and used: "By social impacts we mean the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society."(Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003).

Social Impact Assessment (SIA) has been defined by the International Association for Impact Assessment (IAIA) as "that procedure that includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment". SIA is not a single method but a collection of tools and approaches. A wide range of social science methods can be used in carrying out SIA and a variety of data-gathering techniques is employed, depending on purpose and context. Most of the evidence is primary data from the affected area (e.g., survey research, informant interviews, oral histories, participatory group exercises). Other, secondary, sources that can be used include census data, geographical data (including maps), national and local government statistics, documentation from non-governmental organisations (NGOs) and community-based organisations, local histories, newspaper reports and, where available, previous social science research. A good SIA should provide qualitative and quantitative indicators of social impacts that can be understood by decision-makers and citizens alike.

In our approach, firstly it is necessary to provide a description of the social setting concerning the main social aspects and actors of the country. Secondly, key social indicators shall be defined on the ground of existing data and information, eventually integrated by qualitative desk analysis. Thirdly the social indicators may be used as a basis for prediction simulations, using expert assessments. More specifically the aim will be to estimate likely social impact of organic farming in the future, using both quantitative and qualitative methods. Finally, results of simulations and implications of changes expected on the social side from organic uptake will be discussed and summarised.

1. Introduction

In what follows we develop a conceptual framework for the evaluation of the impact of organic farming on the economies of developing countries (DCs). The effects of conversion to organic farming in developing countries (DCs) will be specifically analysed referring to three areas of interest:

- Economy
- Environment
- Society

Evaluations can be performed at different level, and impact assessment of organic farming in developing countries is by no means a simple task.

In order to achieve a transversal evaluation of impacts on different domains (i.e. economic, environmental and social) some basic definitions need to be given, in order to clarify the objectives of this paper.

Indicator: "an indicator can be defined as the measurement of an objectives to be met, a resource mobilised, an effect obtained, a gauge of quality or a context variable" (EC, 1999). Extensive international experience in the use of indicators has existed for a long time, especially in the macro-economic field (e.g. GNP, unemployment rate, etc.). Indicators have been for long time associated with statistics, but unfortunately for many emerging topic or fields of analysis (such as organic agriculture) often official or unofficial statistics are very inadequate when not lacking at all. Efforts to construct indicators for assessing the impact of organic farming is therefore a more difficult task than in the measurement of the impact of other field of economic activity.

Summary of indicator categories: The EU has recently proposed (CEC, 1999) a useful categorisation of indicators for socio-economic evaluation, known as the MEANS programme. Relevant indicators are categorised as follows:

1) Resource Indicators: Provide information on the financial, human, material, organizational or regulatory means used by operators for implementing a programme/policy.

2) Output Indicators: Represent the product of the operator's activity or everything that is directly obtained in exchange for public activity.

3) Result indicators: Represent the immediate advantage for the direct beneficiaries of the programme. Result indicators provide information on changes which occur for direct beneficiaries.

4) Impact Indicators: Represent the consequences of the programme beyond its direct and immediate interaction with the beneficiaries.

Including:
a) Consequences for direct recipients which appear in the medium term;
b) Consequences that affect people or organizations that are not direct beneficiaries in the short or medium term.

Impacts can be either market or non-market effects (positive or negative externalities).

Impacts are generally out of the control of scheme operators and in the terms of the MEANS analysis they generally require a reflexive, qualitative approach to evaluation with key actors employing a host of approaches, including concept mapping, cross tabulation, synergy assessment and multi-criteria analysis.

5) Context Indicators: Context indicators are the business/social/environmental identifiers that aid in the identification of subsets of the organic community or regions that are more or less important in assessment of outcomes/results and impacts of programming.

Methods of producing and using indicators: in general involving suppliers and users of information is a key option. In what follows we report different approaches to impact indicators measurement in the three domains analysed: economic, environmental and social.

Impact assessment: different steps are needed in order to asses the impact of organic farming on the economies of developing countries, namely:

a) defining the scope of the assessment and the domains to be assessed. In our concept paper the transversal evaluation will focus on three macro-domains: economic, environmental and social.
b) clarify the objectives of the evaluation. This will be done in each of the following section of this paper.
c) selecting indicators for the evaluation. Our paper will focus on impact indicators; in order to do this we will often refer to output and result indicators too.

d) gathering data in order to measure the indicators. In this paper we will provide a host of methods enabling the analyst to gather the relevant information on the field, given usually very little official statistics are available on the organic farming sector.

e) Estimating net impacts of organic farming on the economies under scrutiny. Net impact is defined as Gross impact – Deadweight – Unintended Displacement/Substitution. Deadweight is the term given to change that would have been experienced even in the absence of a specific development (in our case organic farming). Assessing displacement or substitution is relevant when the occurred change has geographical or beneficiaries implications, like in the case that organic farming development could have a positive impact in a certain area/group of people while "displacing" negative (economic, social or environmental) impacts to an other area/group of people.

In what follow we will concentrate specifically on issues b), c), and d), leaving issue e) to be tackled when the actual evaluation will take place.

For the analysis three main types of approaches will be followed:

descriptive analysis: consultation and review of existing literature, and of studies and existing documents; evaluation and description of information collected through questionnaires;

quantitative analysis: elaboration of statistical data and of data collected through questionnaires and quantification of the phenomena under investigation;

qualitative analysis: expert assessments for the integration or substitution of quantitative evaluations.

The three icons will be inserted in the text in order to facilitate the reader to visualize quickly the type of approach required for each step of the analysis.

2. Economic impact

This section considers in detail the following issues:

- Definition of the regulatory and legislative framework for organic farming;
- Analysis of the impact of different levels of organic conversion on total production of agricultural commodities;

- Analysis of indirect effects due to the adoption of organic conversion at a macro-economic level;
- Analysis of the impact of organic conversion at a micro-economic level on family farm incomes
- Analysis of the factors that influence conversion to organic

2.1. Regulatory framework for organic farming in DCs

The wide range of country-specific environment for organic farming requires an analysis of the regulatory framework and policy context that may be encountered in order to properly evaluate the possible effects of organic farming uptake. A preliminary step is the individuation of the exact definition and terminology for organic farming assumed as official in each country; in fact, often different synonymous for organic farming are used, like ecological farming, biological farming etc.

Following **Lampkin et al (1999)**, the basic scheme for the analysis of the regulatory framework for organic farming policies is as follows:

- General (i.e. conventional and organic) agro-environmental policy system, with a description of the role played by organic farming policies;
- Support schemes specific for organic farming (national and/or regional level);
- Other agro-environmental and rural development support schemes that may indirectly affect organic farming;
- Marketing and processing measures for organic products and foreign trade measures;
- Advisory services, certification, education and training, research and development;

Data collection can be carried out by local specialists, that should ideally be native speakers and recognised expert in organic farming. In order to reach a comprehensive description of the regulatory framework, two approaches may be used jointly:

- direct contact with key informants through phone, postal or personal interviews;
- literature review of the topic.

Concerning the first approach, a **standardised questionnaire** shall be defined including a "core" set of basic information that must be collected for each country, and a secondary set of information that shall be included if available with a reasonable level of effort.

For what concerns the literature review, this must focus on available official documents at a national and/or regional level concerning the organic sector, eventually including certification standards if available, and on scientific publications, covering scientific journals, specialised literature and eventually grey and unpublished literature.

FAO (2000) has developed and distributed a general questionnaire concerning basic information on the organic sector, where also some regulatory and legislative aspects are considered. It would be therefore extremely useful to integrate the information eventually already available in the regulatory framework analysis of the present study.

2.1.1. General agro-environmental regulatory framework

  A general overview of the policies for the agricultural sector in the countries where the analysis will be performed is essential to understand the relative weight given to organic farming and to assess if and to what extent agriculture policies are actually beneficial for the organic sector. A preliminary step is a short description of the agricultural sector in terms of main agricultural productions, number of farmers, average farm size, foreign trade balance for agro-food sector. The FAO legal database can be a useful basis for this task.

The quantitative description may be integrated by a qualitative SWOT analysis.

The description of agricultural sector should be accompanied by a short description of the evolution of the agricultural policy system in the investigated countries covering the key elements and relevant turning points over the last decades.

 This step of the analysis requires a description of the basic framework of agricultural policies, aiming to understand the overall public support for the agricultural sector. If relevant (i.e. actually present and implemented), for each country the issues to be investigated are in particular:

- Protectionist policies for agricultural incomes, like tariff and/or non tariff barriers to trade, export Subsidies, price integration, direct income support, etc;
- Aids for investments and purchase of inputs;
- Agro-environmental support schemes;
- Technical support and extension services;
- Any other relevant policy aspects.

A further issue to be considered is the eventual country membership to international trade partnerships that might be relevant for agricultural trades, taking into consideration:

- description of the general aim of the partnership;
- list of other member states;
- description of the most influenced agricultural production;
- possible direct or indirect effects on organic products trades.

A description of the national and local authorities for agricultural policies should be included, with a short description of the role played by each actor in the agricultural policy system. At this stage it is essential to individuate clearly all the actors involved directly or indirectly in the definition and implementation of the organic farming policies both at a national and local level.

2.1.2. Specific policy support schemes for organic farming

Relevant regulation

The description of the specific policies and support schemes for organic farming should consider in particular the general aim of the regulations, and the specific areas of interest. All the relevant regulations should be listed, identifying when they have been issued, and the specific areas of concern. We expect that issues covered by these regulation regard the following areas:

- Conversion to and maintenance of organic farming methods
- reduction of pesticides and fertilisers,
- weed and plant control,
- production of forage for livestock productions,
- livestock productions,
- agencies/regulation of the certification system
- reliability of the certification and accreditation system.

Implementation

 For each measure a short description of the implementation should be provided, giving a quantitative description in terms of numbers of hectares, livestock units, and farms that have been interested by the organic schemes.

Such information may be accompanied by a description of the total public expenditure per implemented measure.

Eligibility

The description of the measures for organic farming should be integrated by that of the eligibility conditions of applicants, providing a description of the following aspects:

- eligible farmers typology: consider if partial and staged conversion is allowed, maximum time period allowed for conversion;

- eventual certification requirements: consider if official certification from a certification body is required to be eligible for aids, if there are differences between crop and livestock certification, and if there is a minimum time period of maintenance of the organic scheme;
- farm size: considers if there are maximum and minimum size requirements;
- eligible crops: considers if there are crops excluded from support;
- livestock density and livestock number: considers eventual requirements in terms of stocking rate and LU.

Economic support for organic farming



This aspect is crucial to evaluate the actual attractiveness of organic farming support measures. Information is required concerning the kind of support available for organic farming, and the criteria used for the support definition. In particular it should be pointed out if support is justified in terms of income loss due to conversion or if it incorporates also additional incentives, like possible payments to the processing small and medium enterprises sector.

Particularly relevant is the description of the eventual payment diversification for crop, livestock typology and farm type and location. A quantitative description of payment level should be provided according to the scheme adopted for payments in the country analysed.

Concerning payments, it should be considered if they are diversified according to the following cases:

- converting or continuing organic farms: helps to recognise if conversion costs are specifically taken into account;
- period of conversion: considers if payments are stable through time or if they reduce progressively;
- farm size: considers if payments are reducing as farm area increases.

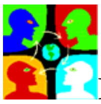
Public expenditure on organic farming policies



A quantification of the public expenditure on organic farming should refer to the main areas of funding, and possibly considers payment per farm and/or crop types. These figures would help the assessment of the actual effectiveness of organic policies, and constitute the basis for a comparison with benefits arising from organic farming diffusion, that will be possibly measured in the further steps of the analysis.

2.1.3. Other agro-environmental and rural development support schemes that may indirectly affect organic farming

Other agroenvironmental and rural development measures, even if not explicitly focussed on organic farming, may produce side effects that may influence organic farming both positively and negatively.

 Possible positive effects may be those concerning extensification programmes, specific payments for less favoured areas, specific policies for labour intensive farm structures, policies for high quality food products etc. A qualitative assessment of the conditions and motivation which may favourite organic farming may help in integrate the quantitative description of the organic payments.

On the other side, it is to consider if there are other environmental friendly farming systems (but not fully organic: e.g integrated farming) that may represent a possible alternative to organic farming, hence absorbing part of potentially organic farms. From this point of view a qualitative analysis would help in individuating the main reasons for not choosing the organic scheme, possibly with a critical assessment of the farm types that may find more attractive alternative environmental measures or market incentives.

2.1.4. Marketing and processing measures for organic products and foreign trade regulations

Market may play a fundamental role for the competitiveness of organic products, specially in conditions where public support is insufficient to cover the gap of economic performance with respect to conventional products: premium prices, product differentiation, higher quality and environmental friendly image are some of the usual "plus" of organic products. In situations where financial support for conversion and maintenance of organic farming is low, organic farmers may rely only on consumers willingness to pay higher prices in order to obtain a compensation for lower yields or higher costs that may arise due to the organic practice. Appropriate demand pull policies for organic products may contribute to reduce the overall public expenditure required for an increase of organic production as they allow for lower supply subsidies, and can represent therefore a feasible solution for developing countries where budget restriction represent an obstacle for supporting organic farming. From this point of view international partnerships for trade of organic products may play a major role, given the higher incomes and willingness to pay of western consumers for high quality products.

A description of the measures available for market development should investigate how they integrate with policy-driven supply increase, and if they lead to market distortion or unfair competition. Also, it is necessary to indicate the organisation playing the main role in organic market development, individuating if it is public or private, and if it operates on a national or international level (co-operative, no profit organisations?).

2.1.5. Certification standards, advisory services, education and training, research and development

Certification standards

Standards for organic farming are intended to promote consumers confidence and prevent the undermining of the market through fraudulent trading (Lampkin et al 1999). They are based on legislation and definitions that may be set on a international or national level (both private or public).

Concerning the international level it is necessary to consider if IFOAM or CODEX Alimentarius definition of organic farming and food are adopted in the country under investigation. These basic standards can be considered as minimum level standards that are internationally accepted and provide a basis for developing more detailed standards at a national level.

National legislation and regulation for organic standards and certification may be based on international requirements: a description of how and if it is integrated nationally is therefore necessary. The role and activity of inspection and certification bodies in particular should be described, identifying their position in the national and international context (i.e. accreditation) on the matter.

Advisory services, training and education, research and development

This step aims to identify the kind of advisory, extension and information services available, providing (if available) a description of the number of farmers using such services and indicating if the services offered are integrated with the main agricultural extension services or if there are specific services for organic farming. A description of the main types of advisory and extension services is necessary, together with that of the main actors offering such services.

Analogue description should be provided for training and education services: range of training types available, kind of institutions offering the services (e.g. agricultural and/or high schools, universities, private bodies)

Concerning the research and development activities for organic farming it should be described the institutions involved and possible cooperation among them both on a national and international level. Besides, a description of the main projects and research activities should be provided, with a short indication of the main themes considered.

Summing up, the main steps for the analysis of the regulatory framework for organic farming are:

- Preliminary description of agricultural sector in general and of the organic farming sector: quantitative analysis; qualitative analysis;
- Description of the overall regulatory framework for organic agriculture (if any): qualitative analysis
- Detailed description of specific measures for organic farming, including marketing and certification regulation: quantitative and qualitative analysis;

2.2. Potential impact of conversion to organic agriculture on agricultural commodity production

The main factors explaining output variations due to the adoption of organic farming are basically organic land area and organic land-use patterns and yields (**Zanoli, Gambelli, 1999**). Probably the most critical factor in the analysis is represented by yields, given that the debate about the exact (and eventual) loss in yields for organic farming is far away from a univocal solution. Any comparison between organic and conventional yields depends on a certain number of variables, like environmental conditions, farmers' skills, the period of conversion, the country considered, farm location and structure, and so on.

Another controversial issue is the difference between organic and conventional land-use patterns; both influence the quantity and composition of agricultural output due to the conversion to organic schemes. Again, a wide range of factors that can directly or indirectly affect land-use pattern changes should be taken into account. These are in some cases difficult to account for and often depend on country-specific characteristics. In particular, attention should be paid to specific rotation schemes adopted by organic farming, which cause material differences in areas harvested under different crops. Furthermore, organic farming manuring is often heavily based on livestock production, therefore causing a tendency to reallocate farm activity in order to balance livestock and crop production according to the proper organic management of the farm.

The basic variables influencing output variation may also have a direct influence on public expenditure. Different land-use patterns may modify direct payment expenditure through a reallocation of payments given on a per crop or type of animal production; impacts on public expenditure may arise also referring to the management of foreign trade of agricultural commodities.

Organic conversion might also cause several spill-over effects on public expenditure that do not only affect public expenditure for organic agriculture, but also organic farming supporting schemes in general. Health care costs may also be reduced, through an increase in food quality - from the consumers' side - and a reduction in professional diseases – from the farmers' side. Furthermore, a general reduction in environmental costs might be expected from a widespread adoption of organic farming.

2.2.1. Measurement of output variation: methodological aspects

Output variation can mainly be considered under two perspectives: total – or aggregated – output variation, and crop-specific output variation.

In the first case, the most sensible aggregation rule is to convert the physical output of each crop into monetary units, in order to obtain comparable variables. Of course, in this case a bias factor is introduced in the analysis, i.e. prices; for each crop, prices can differ among countries, making comparisons and aggregation not completely reliable. More importantly, we should expect price bias to be an even more crucial problem when comparing organic and conventional products.

When single crops are considered, then the price-bias problem is virtually avoided. Aggregation can be performed anyway in physical units within each general product category, to overcome the lack of detailed information. For example, pulses production (in T) can be considered as a whole when no detailed information is available about the single pulse typologies.

<u>Output variation for specific crops</u>

As a basic approach, single crop output is measured multiplying the respective areas and yields. As the main objective here is to assess what would be the variation in output if the conversion to organic farming takes place according to different rates of adoption, two main sources of output variation must be considered: the difference in yields and the different land-use allocation among crops for organic and conventional farming.

  The first factor should (theoretically) be quite easy to determine, by measuring the yield differences between the organic and conventional cases for each crop. Of course, heavy simplifications must be used, as a single-value yield for each crop-country is required here, hence excluding consideration of yield variations among different regions or different organic farms (including those just converted). Furthermore, another general caveat must be considered: a time-series-yield average would of course be recommended, in order to “clean” the data of statistical noise (due, for example, to weather variations), but this information is often not available. (see section 1.2.2)

  The second factor of the analysis, i.e. the different land-use structure of organic and conventional farms, can be determined extrapolating data from existing literature. If this is not available or is considered not sufficient, information on land use pattern for organic farming should be done by calculating the relative share (for example, % of wheat area) of each crop in the organic and conventional regimes over the total utilisable agricultural area. (see section 1.2.2)

Once data on land and yields are available for the organic and total (i.e. conventional + organic) cases, output variations can be computed both by crop and eventually by country.

For each crop, the expected output is determined by:

$OrgUAA \times share_i \times OrgY_i$

where: OrgUAA = total UAA (ha) x % of hypothesized organic conversion;

share = organic area share (%) of the i-th crop;

$OrgY_i$ = organic yield of the i-th crop.

The final output variation is computed with reference to the actual total production for the i-th crop.

Some problems arise within this general approach, mainly for the country-level analyses. The first one is which crops should be considered, or, in other words, which level of crop aggregation should be worked with. For example, should cereals be considered as a whole, or should they be split into soft and durum wheat, oats, barley, rye, etc.? Of course, much of the answer depends upon how much detailed information we can obtain.

A further problem that also affects the analysis at the commodity level is that we have to take into consideration if it happens that organic farms are more likely to be located in marginal areas, due e.g. to lower opportunity costs deriving from the lower yields of these areas. This would cause problems for generalising both yields and area computations and for this reason it should be taken into consideration if the observed organic yields should be increased by a percentage that reflects the influence deriving from an unfavourable location in order to be actually comparable with the conventional yields. At the same time, an assessment of whether the (organic) marginal land would have been continued to be farmed by conventional practices is also necessary. These evaluations could be done on the basis of expert assessments and technical and agronomical considerations, focussing on the country's specific agronomical conditions.

Aggregated output variation

When considering the evaluation of the overall output variation due to a general switch to organic farming, it is necessary to introduce a monetary measurement unit, i.e. prices.

A basic approach to aggregated output variation can be described as follows:

Approach I:

$\Delta out_i/Ha = \Delta Y_i \times [WB_i - WC_i]$

where: Δout_i = output variation for the i-th crop

ΔY_i = variation of organic vs conventional yield for i-th crop (%);

WB_i, WC_i = organic and conventional prices for i-th crop.

This scheme allows the accounting for both quantity (physical production) and value (price) influences in output. Of course, an additional problem here is the information about prices. These can differ widely, even within a single country for the same crop – particularly due to seasonal and regional differences - and can cause the results of the output variation to not be very reliable. Besides, not all organic production is sold at premium prices, and a varying percentage is sold on the conventional market; furthermore, a varying percentage is sold on the organic market in different market channels, which consequently leads to different price-premiums.

The total output variation will be determined by $\sum_{i=1}^{k} \Delta out_i / ha \times UAA_i$, where UAA_i is the i-th crop total area (ha) which is supposed to convert to organic farming.

A second, very simplified approach can also be considered, which simply hinges upon information about the gross outputs of organic farms, without producing detailed information about the basic factors determining output variation. This can be described as follows:

Approach II:

$\Delta out/ha = GOC/ha - GOB/ha$

where GOC/ha and GOB/ha are, respectively, the average Gross Output per hectare for conventional and organic farms, which can be derived by samplings of representative farms for each of the categories.
The total output variation will be determined by:
ΔoutTot= Δout/ha × N° of ha converted.

If information on prices are available, the most informative approach would be the first one; when information on prices is unavailable, the output variation per crop in physical terms may offer more detailed information, though not aggregated. The quantitative assessment of output variation constitutes the basis for the evaluation of the impact that the different levels of conversion to organic may have on food security. For this purpose it is necessary to assess the overall internal demand of commodities, in order to consider if and to what extent possible agricultural output reductions may be covered by imports, taking explicitly into account the specific demographic and international economic condition of the country.

Concerning livestock, we expect that scarcity in data availability will considerably affect analysis feasibility. Two main areas must be investigated: cattle milk production and meat production. The main factors to focus on for evaluating output variation due to conversion to organic are:

- Stocking rate variation, in terms of Livestock Unit (LU)per ha: likely, in many DCs no significative differences are expectable for this factor; it may therefore be sufficient to consider the effects on final meat and milk production due to different hypothesis on organic LU;
- Yield variation in milk production (ΔOrg MilkY), in terms of kg milk/cow/year with respect to conventional milk production;
- Meat yield variation (ΔOrg MeatY), in terms of slaughtered weight/LU/year with respect to conventional meat production.

Milk and meat production variation due to organic conversion may be respectively computed as follows:

- ΔOrg MilkY × Org LU

- ΔOrg MeatY × Org LU

concerning meat, the measurement should be done for all the relevant kind of meat production (e.g beef, pork, sheep…)

2.2.2. *Measurement of output variation: data requirements*

Crop productions

Concenring crops, when considering the direct effects that organic conversion might have on output, the attention is mainly focused on the assessment of yields reduction, as well as the different land-use patterns.

FAO has developed and distributed a general questionnaire concerning basic information on the organic sector, where also data on area and production are considered. It would be therefore extremely useful to integrate the information eventually already available in the output analysis of the present study.

<u>Yields</u>

   Regarding yields, there is generally no unanimous agreement on the exact loss in yield for the various crops or livestock products. Data differ quite a lot according to the specific environmental conditions, the farmers' skills, the period of conversion, the country, and so on. Furthermore, a significant lack of data is usually encountered in this field, and a quantitative indication of the yield differences between the organic and conventional cases is often missing for many crops in many countries, both due to the above-mentioned difficulties, and to the general lack of specific studies in this sector.

Here we suggest, for each country, to take the total average yield as a reference point for each crop, and collect estimates of organic yield through literature review of existing studies if available, or through expert assessments. The total average yield for each crop can be simply defined as: total production for i-th cro / total area of i-th crop. It can therefore be interpreted as a weighted average of the different farming types (high input conventional farming, traditional and other low input farming and organic farming – where present) for i-th crop in a given country, where of course the prevailing farming type has the highest weight. Data on country’s average yield should be available from national statistics or from FAO database. For what concerns the organic yield data, they should be taken from existing database or data of certification bodies where available, or extrapolated by existing literature. If no official or published information is available, expert assessment should be used to produce estimates of organic yields. The reference average yield canb be of help in guiding experts to assess variation of organic yields with respect to the official yield data rather than produce a direct estimate. For example if for a certain country the average national yield of cereals is 3 tons per ha, experts may estimate that organic yield are on average 20% lower, i.e. deriving and estimate of 2,4 tons per ha. An indication of the expected organic yield variation around the stated data may be of help for producing sensitivity analysis of total output impact using extreme yield values. These may be collected considering existing literature evidence when available, e.g. indicating the higher and lower figures found in literature for a specific crop yield, or using expert assessments (Table 1).

Table 1 example of data yield data collection

	Conventional yield Tons/ha	Organic yield Tons/ha	Expected range variation of organic yield +/-
Crop 1	3.0	2.6	+/- 0,26 tons/ha
Crop 2			
: :			
Crop n			

Given the wide range of environmental conditions that may be encountered in many countries, it would be advisable to stratify yield data according to macroareas that share common basic environmental characteristics, like for instance mountain, hill and plain areas, or dry, semi-humid, humid areas, etc. For each macro-area and crop the reference yield should ideally be the average of yields observed in a sufficiently wide time frame, in order to average out biasing effects due to climatic variation and other exogenous factors.

Land use patterns

The other main factor to consider for output variation, i.e. land use, is also difficult to evaluate. A wide range of elements need to be taken into account that can directly or indirectly affect land-use pattern changes. The most important factor is probably the specific rotation schemes adopted by organic farming, which cause extensive differences in area harvested under different crops. Furthermore, in organic farming manuring is often heavily based on livestock production, hence also causing a tendency to reallocate farm activities in order to balance livestock and crop production according to the proper organic management of the farm.

This results in a different land use for the “average” organic farm, where for instance fodder crops, legumes and pasture are more prevalent than in the conventional situation. For example, in the European agricultural systems, on a *ceteris-paribus* basis, this leads to a reduction in the area harvested for crops like wheat, maize, and root crops in general. Concerning cereals, generalisations are difficult, as some specific cereals, like oats, which can be inserted into the organic farming rotation schemes, might be cropped more widely, hence compensating for the reduction of cereal areas due to wheat and maize. Furthermore, specific products, like emmer for example, sometimes experience a renewed importance, not only with regard to rotation requirements, but also because they may help to differentiate the production, and hence to exploit the potentials of the market niches (**Santucci, 1997**), which may be an option for exports.

Actually, market driven forces might have some indirect effect on land use for organic farming, not only through the demand for specific products, but also via different price patterns for organic products, and modifications in consumer tastes (**Midmore and Lampkin, 1994**).

In fact, organic price premiums, where existing, may be not evenly distributed over all products, and, of course, this can stimulate the production (i.e. land use) of those products for which premiums are higher. Again, it is very difficult to assess to what extent and for which product in particular this factor can interact with organic land use, because this would require in-depth studies on price elasticities for the various crops, which is evidently a hard task by itself, and becomes nearly impossible given the general lack of data about organic product prices.

<u>If statistical data on organic areas are available</u>, the “representative” organic land use pattern may be estimated considering the share of the aggregated (i.e. total Agricultural Areas) surfaces dedicated to different productions, possibly taking into account a time frame wide enough to originate consistent averages.

A deep time length allows to average out the effects of rotation that may produce for a single year bias in the actual land use: e.g in a four course organic rotation for cereals based on two years of cereals, one year of legumes, and one year of green manure, if data are collected in the year dedicated to cereals, this would overestimate cereals weight.

It is to be taken into consideration that environmental and agronomic condition may vary considerably within a country’s territory, and in such cases a generalisation at a national level of land use pattern built up on national aggregated data may represent an oversimplification of the actual situation, leading to biased results in the simulation of output variation. A stratification of land use data would be advisable, following the same approach used for yields.

<u>If statistical data on organic areas are not available</u> a feasible approach to the problem of estimating the different land use pattern under organic farming is to individuate for each country’ macro-area the most likely rotation schemes that may be assumed as typical for the representative organic farm, and to compare it to mainstream rotation schemes of conventional farming. Information on this issues shall be obtained through existing literature or expert assessments. An average conventional land use pattern may be computed (eventually for each macro area) based on national or FAO databases, and it can be modified on the basis of the information raised on the different rotation schemes. For instance, if standard conventional rotation for cereals production is based on a four course rotation with three years of cereals and one year of break crop, while the organic rotation scheme for cereals is as in the previous example two years of cereals and one year legumes and one year green manure, we expect that organic land use for cereals is reduced by 50% with respect to the conventional case.

Livestock production

For what concerns livestock production, we expect some difficulties in data collection. Where available, data on stocking rate should be collected especially in countries where conversion to organic may produce significant impact on the number of LU. In most of DC we expect this would not be the case, so this data needs not to be collected. Required data are necessarily those concerning milk and meat yields for the relevant livestock productions. The same procedure proposed for crop yield data collection may be followed.

2.2.3. Measurement of output variation: results layout

Once data for yield and land use are available, potential impact of different levels of conversion to organic may be computed.

As a result, a summary scheme like Table 2 will be produced, based on **Midmore and Lampkin (1989)**:

Table 2 Scheme for expected output variation according to different levels of organic take up (values in ,000 Tonnes)

	Overall organic take up:			
	5%	10%	…	100%
Crop 1				
Crop 2				
: :				
Crop n				

The basic info necessary to fill in table 2 are the organic yields for the n crops considered, and the utilisable agricultural area breakdown by crop of the country.

Two ways for proceed can be defined:

- The simple one hinges upon a strong ceteris-paribus assumption about the land use pattern of the national average and organic cases: i.e. assumes that the observed national land use pattern will not change under the different % of conversion to organic farming. Therefore, the overall output variation is simply computed using the specific organic yields with the national land use data.
- A more complex, but maybe more realistic, approach is to take into account the specific land use pattern of organic farming. These information, if available, can be obtained using the approaches discussed in section 2.2.2. In this case the organic yield data shall be used together with the expected land use pattern under the different % of organic adoption.

As discussed in section 2.2.2 it may be the case that for a country disaggregated macro-area data are available. The overall input variation due to organic conversion may be obtained summing up the output variation computed for each macro-area. Two approaches may be followed: the first one assumes that organic conversion takes place in the same proportion in each of the country's macro-areas; the second one may assume that different conversion rates may occur in different macro-areas, according to more or less favourable environmental conditions for organic farming. This would allow also to model the effects of policies supporting organic conversion specifically in particular areas, like for instance less favoured areas.

In this case more detailed results may be obtained using a more detailed geographical detail, as indicated in Table 3. Note that macro area disaggregation may be produced for each scenario from 5 to 100% of organic take up.

Table 3 Scheme for expected output variation with macro-areas disaggregation under the 10% organic take up scenario (values in ,000 Tonnes)

	Scenario: Overall organic take up = 10%				
	Macro area 1	Macro area 2	…	Macro area k	Total
Crop 1					
Crop 2					
: :					
Crop n					
total					

The results on output implications due to organic conversion may be commented according to the country's policy for agricultural commodities. Issues to be considered are in particular:

- Development objectives
- self sufficiency for basic commodities (e.g. cereals, milk);
- foreign trade balance for agricultural commodities

Both qualitative and quantitative indicators may be developed for assessing the consequences on food self-sufficiency due to organic conversion, indicating the main areas of problems that may be expected to emerge in terms of possible import increase, ability to pay for possible income increases, food categories that may be expected to become scarce.

Summing up: output variation due to different hypothesis on organic take-up must be computed on the basis of two main factors:

- Yield variation due to organic conversion: data will be collected using available literature or expert assessment, on the basis of provided questionnaires;
- Land use variation due to specific organic land use patterns: data will be collected using available literature or expert assessment on rotational schemes.

Eventually, an aggregated output variation (i.e. in value, not in tonnes) if information on prices are available.

2.3. Indirect macro effects of organic conversion at a macro-level

Besides direct effects on commodities production, the conversion to organic farming may have a wide range of indirect effects on the agro-food system, on the industry of agricultural inputs and machinery, and on rural development in general. From this point of view in particular, multiple roles of organic farming should be considered.

"Beyond its primary function of producing food and fibre, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of biodiversity, and contribute to the socio-economic viability of many rural areas."
(OECD Declaration of Agricultural Ministers Committee - 1998)

There is scope for accounting for the positive "goods" that agriculture can produce beyond commodities that farmers sell in the marketplace. These goods can be defined quite broadly, but generally include rural community values such as a large number of independent, family farms, strong local economies that both rely on the economic output local farms and supply them with agricultural goods and services, rural employment, and the continued health of rural culture. Environmental goods usually mentioned include contributions to biological diversity, clean water and air, bioenergy, and improved soils. Other products include regional or national food security, landscape values, food quality/food safety, and improvements in farm animal welfare.

The issues of social and environmental impact will be specifically considered in **SECTION 2 AND 3**, here we will focus mainly on indirect economic effects.

Even narrowed, the analysis of indirect effects of conversion to organic takes into account a wide variety of aspects, due to linkages with the entire agro-food sector and with non agricultural sectors. A structured qualitative approach seems therefore the most effective way to take into consideration the consequences on a heterogeneous range of sectors. Multi-Sectoral Qualitative Analysis developed by **Roberts and Stimson (1998)** may be a basis flexible enough for such purposes, and it is already been used to assess the effects of organic farming in the agro-food market by **Beckie et al (2002).**

2.3.1. Adaptation of standard MSQA

Multi Sectoral Qualitative Analysis may be considered as an evolution of standard SWOT analysis widely used in marketing for strategic analysis, of which maintains the qualitative approach based on expert assessments and the general aim of investigate present and potential effects, both positive and negative, of some strategic action.

The method follows an approach based on the analysis of interactions between a set of economic, social and environmental sectors and a set of territorial competences/characteristics. This kind of analysis may be of help for in depth analysis of a complex system key factors, through an investigation of relationships and linkages that play a major role. The relevance of such interactions is measured by a qualitative judgment made by a panel of experts, and then converted into a numerical scale. As a result a set of indexes is produced, that summarise the overall role played by sectors and competences in the analysed regional context. The analysis of interactions among sectors and territorial competences can be integrated by an evaluation of the potential risks and opportunities for the regional context under analysis, based again on qualitative expert assessments converted into numerical values and subsequently summarised in a set of index.
For our purposes the original approach of Roberts and Stimson (1998) must be adapted to suit specifically the analysis of organic conversion in a specific country, and may be re-defined as **Multi Stage Qualitative Analysis (MSQA)**. A two level approach may be adopted:

- Evaluation of competences and of the organic system specific components (supply chains of crop and livestock productions);
- Evaluation of opportunities and risks of growth of each supply chain and of the organic system as a whole.

Evaluation of competences and supply chains of the organic sector

 The “sectors” used in Roberts and Stimson (1998) may be referred to the more specific MSQA context of the supply chain system linked to organic production: the crop and livestock sectors must be treated separately, and for each the main elements of the supply chain can be considered:

- Main production types (e.g for crops: arable crops, fruit, horticulture, industrial crops, etc., for livestock cattle, milk pork, sheeps, etc.)
- seed, mechanical and other input industry;
- processing industry,
- certification and labelling system,
- trade and marketing sector

of course these are general categories, that may be further detailed according to each country specific conditions.
Competences are horizontal characteristics of the regional/national socio-economic system that transversally affect all the sectors of the organic system. They refer therefore to the potential

resources available to organise efficiently the different resources necessary for the organic sector as a whole. A possible list of competences for the organic sector may be as follows:

- economic performance;
- marketing capacity;
- technological level;
- human resources;
- management skills;
- financial issues;
- administrative issues;
- infrastructure availability

Again, competences must be defined according to the actual relevant aspects that may be encountered in the analysed country by the expert panel. Each of the competencies characterise to different extent each supply chain of the organic sector, and a joint evaluation of such interactions is the basis of MSQA analysis. Interaction are marked in a qualitative way on the basis of a scale of attributes ranging from “weak”, “medium”, “strong”. A higher number of qualitative values may be defined by the user, but in general no more than 5 are used. The use of qualitative judgements for assessing how a sector is “compatible” with a competence is preferred as it is usually more user friendly with respect to numerical values.

Qualitative values are then converted into numeric values, e.g. “weak” =1, “medium” = 2, “strong” = 3. The numerical conversion allows for the computation of two indexes: competency index and sector index. The Sector Index (SI) and Competency Index (CI) are defined as:

$$SI_i = \frac{\sum_{j}^{k} S_{ji}}{k \times \max S}$$

$$CI_j = \frac{\sum_{i}^{n} S_{ji}}{n \times \max S}$$

where Sji is the numerical score of the assessment of competency j with respect to sector i, k is the number of competencies, n is the number of supply chains, and maxS is the maximum value that the numerical score may assume (3 in our example).

The indexes range between 0 and 1: the closer CI_j is to 1, the highest is the overall importance of j-th competency in the country; the closer SI_i is to 1, the highest is the performance of the i-th sector measured considering all the competencies. The joint evaluation of both indexes series gives information about the filiere with the higher performances, and the competences that may be considered as crucial in the investigated system. A graphical representation may help in summarise the results for the two indexes sets.

Evaluation of potential risks and opportunities for competences and supply chain

This phase of the analysis considers how potential opportunities and risks may affect exogenously the organic system, and is therefore crucial in order to evaluate in advance possible actions that may be taken in order to avoid potential crisis or exploit at best eventual positive scenarios that may occur.

  Risk and opportunity analysis is structured on a similar way as for the supply chain-competence matrix. The main difference is that supply chain are now analysed with respect to a set of potential risks and opportunities instead than a set of territorial competences.

A set of g risks must be defined by the panel of experts, according to the specific situation of the country investigated.

As an example, a list of potential exogenous factors that may represent risks or opportunities for the organic system may be as follows:

- Globalisation
- economic conjuncture;
- price stability at international level
- GMOs contamination
- Technological development and innovation in the sector;
- Public opinion;
- Capital and financial resources availability;
- Skilled labour force availability;
- Natural resources availability;
- Technical assistance,
- Political climate,
- Administration stability;

Two matrixes can be generated: one refers to the evaluation of risks/opportunities for the set of n organic supply chains, the other one to the evaluation of risks/opportunities for the set of k competences.

Again, qualitative assessments for the l-th risk/opportunity and the i-th supply chain/j-th competence may be used and converted into numerical values: negative values for risk assessments, positive values for opportunities assessments. The risk/opportunity index for the i-th supply chain is defined as follows:

$$ROFI_i = \frac{\sum_{l}^{g} S_{li}}{g \times \max S}$$

ranging between –1 and 1and allows to individuate the supply chain that are expected to have more opportunities of development (ROFI close to 1) and those that are expected to face more risks (ROFI close to –1).

Similarly, a Risk/opportunity index may be computed for the l-th exogenous factor as follows:

$$ROI_l = \frac{\sum_{i}^{n} S_{li}}{n \times \max S}$$

ranging between –1 an 1, allows to classify the exogenous factors as risks (negative ROI values) or opportunity (positive ROI values).

The very crucial aspect of MSQA is in the expert assessment data source, and therefore the selection and training of expert that will participate to the analysis must be clearly defined. Experts potentially involved must cover all the basic themes linked with the economic impact of organic farming, and should be people directly involved in the organic sector. They are therefore stakeholders of the organic sector, and **Appendix I** describes the basic steps that must be taken into account for their selection.

Summing up: The economic function of organic farming within the agro-food system, adapting a Multi Stage Qualitative Analysis, provides the following results:

- A description of the main characteristics of the organic system under investigation (main supply chains and relevant competences, risks and opportunities;

- Individuation of the "stronger" and "weaker" supply chains;
- Individuation of the competences playing key roles in the organic system analysed;
- Individuation of the supply chain that may be expected to be most influenced by emerging opportunities and risks;
- Individuation of the most relevant risks and opportunities for the organic system analysed;

Such approach allows to take into consideration the wide range of indirect effects of organic farming development, using flexible qualitative data within a structured methodology that offers easily interpretable results.

The analysis is heavily based on stakeholder (i.e. expert) assessment, and guidelines for stakeholder selection are provided.

2.4. Potential impact of conversion to organic agriculture at a micro-level

The aspects that may determine a variation in the profitability of a farm after conversion to organic both in positive and negative terms can be schematised in the following aspects:

- Potential yield loss;
- Change in land use due to rotational requirements;
- Price variation for organic products;
- Managerial difficulties;
- Cost variation for purchased input.

The information to be collected refers mainly to:

- structural data (i.e. UAA dedicated to each crop or livestock production, geographical location, altitude, presence of irrigation, etc.)
- technical data (yield loss, different input requirements, substitution of technical input with labour, etc.)
- economic data (i.e. gross output, variable costs, fixed costs, profits, etc.).

2.4.1. Individuation of representative organic farm

Note that here the term "representative" is not used in strict statistical terms, as we expect that representative databases of organic farms are very unlikely to be available. Therefore we adopt a "subjective" approach where on the basis of expert knowledge the farm types considered more diffuse and representative of the organic sector in the country are taken into account. The selection of experts can follow the guidelines indicated in Appendix I.

For practical reason here we suggest to take into account basically the following criteria; according to specific country situation such criteria may be changed or integrated.

Basic checklist for farm selection

- Dominant farm type (e.g. arable, livestock, permanent crops, mixed crop/livestock, etc…)
- Farm size mode (e.g. between 10 and 20 ha, or between 30 and 40 livestock units)
- Prevalent farm locations (e.g. plain humid areas, mountain areas, etc.)

As an example, if in a country the main organic production are arable crops and livestock, these two farm types should be taken into consideration. For each farm type (one for the livestock, one for the arable farm)the typical farm location and farm sizes should be individuated. In this simple example we may individuate two representative organic farms, one for each of the dominant farm types selected:

- Farm A: livestock farm, located in mountain areas with 15-20 Livestock units
- Farm B: arable farm, located in plain areas, with 15-20 ha of Utilisable Agricultural Area

Once the representative farm(s) has been individuated, it is necessary to collect the budget data required for economic analysis. Appendix III provide schemes of the data structure required.

Such data may be collected using different (not necessarily alternative) approaches. More details are indicated in Appendix II

A first possibility is to select a representative "average" farm trying to represent different production types and locations. Representative farms may be derived from statistical data if they are available, stratifying the total sample according to geographical area, livestock or crop production, etc. Such approach hinges upon the availability of a well structured database for organic farms, containing structural and economic information.

A second choice is to build up a set of organic farms through direct data collection, in order to make an in depth case study analysis based on real data from a limited farms sample. The selection of farm may be done taking into account different farm types and farms locations that may be considered relevant for the country investigated.

Finally, a third option is to define "virtual" representative organic farms using desk analysis and expert assessments via a guided procedure aiming to describe a consistent budget for an imaginary typical organic farm.

2.4.2. Results: budget data evaluation

Once the data for the representative organic farm are available, they may be used to generate standard farm budget results, aiming to investigate gross farm income, net farm income and final profit, as indicated in **Table 4**. Both revenues and costs categories need to be described in detail (see table 5-7) in order to allow for in depth investigation of main factors influencing the final economic result. The proposed scheme is based on economic budget definition, and in therefore a partial description of the farm performance given that the financial budget is missing. For our purposes and given the expected general difficulties in data collection, the economic budget approach may be considered a sufficient information base.

Table 4: Scheme for the computation of the main economic budget results

Revenues	**Costs**
1. Gross output	
	2. Variable costs
3. Gross Income = 1 - 2	
	4. Fixed costs
5. Family Farm Income = 3 - 4	
	6. Family wages
7. Profit = 5 - 6	

In **Appendix III** the detailed scheme of required information for the budget definition is presented. The general approach is quite simple: the basic elements of output and variable and fixed costs are disaggregated in terms of quantities and unit prices, and total values accordingly computed. Such scheme is the basis for different in depths analysis:

- distinction between technical and price based factors for the achievement of the main budget results;
- sensitivity analysis in terms of price variation of both inputs and output in order to individuate the critical values that assure the achievement of positive profits.
- partial budgeting analysis aiming to analyse the performance and contribution to the overall economic results of single farm productions (e.g livestock and crop productions).
- role played by subsidies using simulations concerning different combinations of price premiums and subsidies level computed subject to the achievement of positive final economic results.

2.4.3. Results: comparison with the conventional case

The issue of comparability between organic and conventional farms

Besides the evaluation of economic performances of the different farm types considered, a further in depth analysis would be the comparison of economic results between representative organic and conventional farms. This requires the individuation of a feasible approach for the individuation and selection of comparable farm sets for the organic and conventional categories. The issue of comparability between farm system is highly problematic, as discussed among other by Lampkin (1994)**.** Different methods have been used in the literature and for our purposes we can summarise two general approaches. The first one, originally proposed by **Schulze Pals (1994)** and recently discussed by **Offerman and Nieberg (1999)** uses a "temporal" comparison between organic and conventional farms that were comparable at the time of conversion of the organic ones. The second approach uses a "spatial" approach, and considers the individuation of comparable organic and conventional farms in the same time period.

The choice of a conventional reference farm depends on the availability of data and resources.

As the objective is to isolate the effect of the farming system on profits, the choice of characteristics for the selection of comparable conventional farms has to be restricted to 'non-system determined' factors. Examples of factors that are clearly 'non-system determined' are locational factors such as region, soil texture, topography, climate and market distance (**Fowler, Lampkin and Midmore 1998**).

  A very simple first approach for assessing the potential income of the conventionally managed farm is therefore to use average data of a sample of conventional farms in the same region

Besides theoretical issues, the problem of comparability is often conditioned by data availability. Usually a much wider sample is available for conventional than for organic farms, the latter being often described through ad-hoc direct sampling. **Zanoli and Gambelli (2001)** have developed an approach for such situation, based on k-means clustering. Each organic farm is used as a centroid, and comparable conventional farms are clustered around each organic farm according to the "closeness" of their characteristics with respect to the organic "centroid". As a result, k groups of conventional farms are individuated, and for each group an "average" conventional farm is computed and can be considered as directly comparable with the respective organic centroid farm. Note that this approach can be compatible with the selection procedure of the representative organic farms: once these have been defined, if a database of conventional farms with the necessary budget and structural information is available, then conventional comparable farms may be selected. If an adequate database for conventional farms is not available then the direct sampling or desk analysis procedures for the selection of representative organic farms may be followed, maintaining the basic characteristics of the organic representative farms in terms of farm type, size, and location.

Partial budgeting comparison between organic and conventional farms

Once a set of comparable organic and conventional farm is available, direct comparison between the two categories may be performed on the basis of the economic budget schemes above indicated.

When comparing organic and conventional farms particular attention shall be paid to the individuation of areas of relative profitability of the organic scheme. Standard quantitative results must be taken into consideration, like Gross output, Gross income, Family net Income and Profit. But besides the standard microeconomic analysis, an effort must be made in order to individuate if the organic practice may produce side positive effects for the farmer. In particular, further aspects to take into consideration are:

- number of crop and livestock products available in organic and conventional farms: this helps in assess potential risk reduction due to production diversification in organic farming; also to be taken into consideration is the eventual export potential of organic vs conventional products;
- farm gate prices for organic and conventional products: help to individuate the main area of market competitiveness of organic farming. May be considered in relation to the above mentioned point.
- evaluation of farmers family self consumption: the wider range of products may constitute a strong advantage for families heavily hinging on self produced commodities in Countries where food security is an issue. An analysis of the nature of commodities produced may help in considering nutritional benefits.
- measurement of the ratio between working capital and fixed assets: helps in assessing if organic farms may be considered less risky due to a higher share of labour and other short term input with respect to conventional farming.

Quantitative results arising from the organic and conventional comparison may feed into the following section 2.4.4 concerning the analysis of factors leading, or constraining, farmers conversion to organic.

 A summary of the basic results arising from micro-economic analysis of organic farms and from the comparison with conventional farms may be produced according to the following scheme (Table 5). Where available, quantitative economic results in terms of $ per ha must be reported. This eliminates scale problems for direct comparison of economic data.

Table 5 Summary of main results from comparison of organic and conventional farms

Strengths of organic vs conventional farms	$/ha	Other quantitative indicator	**Weaknesses of organic vs conventional farms**	$/ha	Other quantitative indicator
Added Returns			**Added Costs**		
e.g. none			e. g. certification costs		
Reduced Costs			**Reduced Returns**		
E.g. costs for pesticides and fertilisers			E.G. yields reduction (for specific crop)		
Reduced investments			**Increase of investments**		
e.g. cost reduction for reduced machinery requirements			e.g. costs for specific machineries and other inputs needed for organic practices**:**		
Other (specify)					
Production diversification					
e.g. range of products available (provide short description /comments)					
Capital requirements					
e.g. total fixed asset stock (provide short description /comments)					
Price premiums					
(provide short description /comments)					
Other (specify)					

Shaded areas not to be considered.

Summing up: the analysis of farm incomes is based on the individuation of representative organic farms for the main farm types that characterise the Country investigated. Depending on data availability, sampling stratification or elaborations based on expert assessment are the information basis for this step. The main results to be obtain are:

- A detailed description of the economic budget of the representative organic farms, with the individuation of the main budget indicators and the exploitation of sensitivity analysis on prices of input and output.
- A comparison with equivalent conventional farms, aiming to individuate through partial budgeting analysis the areas where organic farming may be considered favoured or unfavoured from an economic point of view. The issue of comparability is to be taken into consideration and practical suggestions for selection of comparable conventional farms are provided

2.4.4. Motivations and barriers to conversion

In order to investigate factors or patterns that lead or constrain conversion decisions and to determine truthfulness and importance of those factors, qualitative methods of rapid, low cost data collection could be employed.

Experience with data collection and analysis in developing countries suggests that many widely used rigorous data collection methods, particularly censuses, sample surveys, and similar quantitative methods, are not always the most appropriate for generating information impact assessment. Such methods require considerable investment of time and resources and tend to generate data that are too elaborate for their intended purposes (Kumar, 1987)

As a result, there has been a growing interest in the use of less rigorous methods that can provide timely information cost-effectively.

Among these methods of "rapid appraisal" three are particularly suited for analysing motivations and barriers. These are:

- focus group interviews
- in-depth cognitive interviews (laddering)
- interviews with key informants

In **focus groups**, participants discuss ideas, issues, insights, and experiences among themselves. Each member is free to comment, criticize, or elaborate on the views expressed by previous speakers. The role of the moderator is simply to stimulate discussion and keep it focused.

The group should be limited to 8 to 12 carefully selected participants. As far as possible, the group should be homogeneous in composition, with members sharing similar background and experience. A session generally lasts 1 to 2 hours, although in some cases it can exceed this limit. The moderator introduces the subject, keeps the discussion going using subtle probing techniques, and tries to prevent a few participants from dominating the discussions.

Specific subject areas in which focus groups have been used include: market research (where it was first used) to assess the impact or potential impact of a new product or service (Stewart & Shamdasani, 1990); public relations (Sink, 1991); advertising (Linda, 1982); healthcare and family-planning projects (Bertrand et al., 1992); political campaigns (Lydecker, 1986); club member services (Lydecker, 1986); training evaluation (O'Donnell, 1988); graduate program assessment (Sink, 1991); and research efforts (questionnaire development and hypothesis formulation) (Morgan, 1988).

Focus groups are well suited to discuss motivations and barriers to conversion as well as to explore potential recommendations and suggestion to overcome the latter. Other issues to consider in the discussions are: availability of information on marketing, prices, etc, such as possible increase in export opportunities and economic risk reduction due to lower investments in fixed farm costs (information systems), technology availability, cost of production, health awareness, export opportunities, certification procedures, and availability of organic pest control products and organic fertilizers.

In-depth interviews with farmers are suitable to explore farmers' behaviour and elicit their attitudes and beliefs with regards to farming activity. Using a sequential interviewing method known as "laddering" (Reynolds & Gutman, 1988) motivations that lie behind framers' choices as well as barriers to convert to organic farming can be analysed in depth. In-depth laddering interviews can be used to explore farmers' goal structures, which are strictly related to motivations since a goal is the aim or end of an action, and serves to direct behaviour (Zanoli & Naspetti, 2001). Goals serve two motivational functions (Pieters et al., 1995). First, they influence the *direction* of behaviour by expressing *what* to achieve and *how* and *why* the goal in question is meant to be attained. Secondly, they influence the *intensity* of behaviour, by determining the *hierarchy* of the actions to be undertaken and by expressing the *weight* of the criteria which represent the goals in decision-making.

The cognitive structure of farmers' decisions can be seen as a hierarchy or "means-end chain": perceived attributes of organic agriculture lead to consequences for farmers which contribute to those values which are important to them. Achieving positive consequences, which are embedded in the personal value system, can be seen as the motivating driver of a concrete behaviour; for example, the decision to convert or not.

Laddeering interviews are conducted using a special interview guide and can be also conducted using the paper-and-pencil format (hard laddering questionnaire).

Using a specific software (Mecanalyst), it is possible to aggregate of the Means-End Chains (MEC) into a Hierarchical Value Map, linking different levels of goals or attributes to consequences and values. These maps are the graphical representations of farmers' motivational structures.

Key informant interviews are the most widely used rapid, low-cost data collection method. If informants are carefully selected and appropriate interview procedures are followed, such interviews can be a source of rich, insightful data that might not be available from other sources.

Simply stated, key informant interviews involve interviewing a select group of individuals who are likely to provide the needed information, ideas, and insights on a particular subject.

Key informants should be carefully selected to reflect diverse viewpoints and concerns. They should be recruited from various occupational groups, socioeconomic strata, and organizations.

In order to explore positive and negative factors influencing conversion to organic farming, key informants could be selected among the following groups:

- farmers, both conventional and organic;
- farmers organisations representatives;
- extension agents and advisors;
- policy-makers;
- scholars and researchers.

Key informant interviews are conducted using an interview guide that lists the topics and issues to be covered during a session. The interviewer frames the actual questions in the course of discussions. The atmosphere of these interviews is informal, resembling conversation among acquaintances. The interviewer subtly probes the informant to elicit more information

and ideas. The interviewer takes detailed notes. If all the relevant items are not covered in an interview, the researcher goes back to the informant again. Key informant interview are particularly appropriate when an understanding is required of the motivations and attitudes that direct farmers' behaviour. For instance, on the basis of interviews conducted with key informants, an investigator should be able to find answers to questions such as the following: Why are farmers not confident in the stability of organic prices & incomes? Why are local entrepreneurs not showing any interest in the technical assistance provided to convert to organic farming? Etc.

In all these cases, interviews can provide relevant information and insights on which to evaluate the potential impact of organic farming on the economies under investigation.

3. Environmental impact

- To give an updated description of environmental impacts of organic farming adoption in Developing Countries;

- To evaluate the role of organic farming in the consumption of environmental resources;
- To measure where possible actual positive and negative effects of organic farming in Developing Countries.

Environmental impact is a fundmental issue to be taken into consideration for a comprehensive evaluation of the role played by organic farming. Environmental, health and social aspects are strictly related with the particular organic approach to farming, but their evaluation may require great efforts for data collection and analysis.

Currently, the most relevant environmental indicator system has been originally presented by OECD in 1997, and recently modified and updated (OECD 1997, 1999, 2001, http://www.oecd.org/dataoecd/28/1/1890235.htm). It is developed with regard to environmental and resource use effects in order to enable the analysis of country-specific situations, to evaluate environmental policies and to measure environmental quality. OECD provides also a set of indicators specifically targeted to the agricultural sector; it is based on the Driving Force – State – Response (DSR) approach and it is based on solid methodology concerning the environment and natural resources measurement.

There is a general agreement in literature that the DSR framework improves substantially existing approaches to environmental indicator concepts, and can be considered as a reference point for environmental analysis. OECD approach has been recently taken into consideration by **EU Commission (2001)** for statistical data collection purposes and by **FAO (2001)** for a critical discussion and review of relevant agri-environmental indicators systems.

Environmental indicators aim:

- to help monitor and assess agri-environmental policies and programmes, and to
- provide contextual information for rural development in general;
- to identify environmental issues related to the investigate Country's agriculture;
- to help target programmes that address agri-environmental issues;
- to understand the linkages between agricultural practices and the environment.

As indicated in **COM (2001)144**, the main criteria for choosing agri-environmental indicators are:

- *relevance* –address the key environmental issues
- *responsiveness* –change sufficiently quickly in response to action
- *analytical soundness* – based on sound science
- *measurability* – feasible in terms of current or planned data availability
- *ease of interpretation* –communicate essential information in a way that is unambiguous and easy to understand;

- *cost effectiveness*–costs in proportion to the value of information derived

The OECD set of environmental indicators for agricultural sector contains several sub-categories assigned to each of the three DSR components:

Driving forces:

- Environment
- Economy and society
- Farm inputs and outputs

State:

- Ecosystem
- Natural resources
- Health and welfare

Response:

- Consumer reaction
- Agro-food chain responses
- Farmers behaviour
- Government policies

Stolze et al (2000) have used a qualitative approach for the study of the environmental effects of organic farming in Europe within the EU project "Organic Farming and the CAP". The analysis evaluates organic farming environmental performances in comparison with conventional farming, that represents therefore an appropriate reference system. A general theoretical problem is the individuation of the appropriate farming system to use for comparison:

- typical farming system;
- best practice management;
- management plus specific measures for environmental protection.

This means for example that different environmental performance of conventional farming may be considered, like integrated farming, high-input conventional farming, low-input farming. Analogously different variation of organic farming may be taken into consideration, like "standard" organic, best practice organic farming, and highly environmental friendly organic farming (e.g. providing exclusive areas of "pure nature").

The choice of concentrating the analysis on the comparison of organic and conventional environmental performance allows to simplify and adapt the original OECD indicators set.

Concerning the Driving forces, only farm input and output can be considered, as environmental, economic and social frameworks are not a defined characteristic of the farming system, nor does a farming system affect these factors.

The approach of **Stolze et al (2000)** is a step by step qualitative assessment for data aggregation:

- firstly each parameter for a given environmental indicator is analysed on the basis of available data and literature;
- secondly the results of the studies are reviewed and commented;
- finally the parameter results are aggregated by indicator.

The aggregation procedure is based on a final qualitative assessment of the organic farming performance with respect to conventional farming, according to the scheme of Table

Table 6. Assessment scale used for indicator evaluation

Scale		**Organic farming performs…**
++	=	much better
+	=	better
0	=	the same
-	=	worse
--	=	much worse
		…than conventional farming

Source: Stolze et al (2000)

3.1. Life Cycle Assessment (LCA)

One of the most prominent empirical approach for the measurement of environmental impact of an industry, sector or product is Life Cycle Assessment (LCA).

LCA is a methodology used for analysing and assessing the environmental loads and potential environmental impacts of a material, product, or service throughout its entire life cycle, from raw materials extraction and processing, through manufacturing, transport, use and final disposal.

Early forms of LCA were used in the United States in the late 1960s for defining corporate environmental strategy, and later in the 1970s by government agencies as an aid for developing public policy. In the late 1990s, LCA emerged as a worldwide environmental management tool in the form of the ISO 14040 series.

The methodology for LCA in the food sector has been developed during the last decade and progress in terms of methodological robustness and data availability has been demonstrated - among others – at a series of LCA-food conferences organised in Brussels (1996, 1998) and Gothenburg (2001).

The interpretation of the results from previous phases of the study is made in relation to the original objectives established initially.

3.1.1. LCA tools

The LCA tool consists of a number of discrete stages that are summarised in Figure 1, and are the follow:

Goal and scope definition

The first phase of the LCA study involves defining the purpose of the study, its scope, data quality goals, and functional unit. The project sponsor generally shapes the purpose and scope, and it is important that they are clearly defined to avoid any subsequent misunderstandings about the wider application of the results. LCA objectives can be classified broadly into system improvement studies, in which the goal is to identify opportunities for reducing the environmental effects of an existing system or process, and comparative studies, in which the intent is to select an optimal product of process from a number of predetermined alternatives. Scope definition involves specifying system boundaries, functional unit, allocation assumptions, inventory parameters, and impact categories that will be used.

Inventory Analysis

The inventory analysis is a detailed life cycle inventory (LCI) analysis, with compilation of data both about energy and resource use and on emissions to the environment, throughout the life cycle. This phase involves the quantification of environmentally relevant material and energy flows of a system using various sources of data. Essentially, an accounting of system inputs and outputs is performed. The data used may come from a variety of sources, including direct measurements, theoretical material and energy balances, and statistics from databases and publications. Data quality can often be a problem in LCA's, with complete absence of data perhaps being more of a difficulty than data quality. Definition of an appropriate functional unit is fundamental to the credibility of an LCA. The functional unit is the unit of analysis for the study, and it provides a basis for comparison if more than one alternative is being studied. It should be defined in terms of the services provided by any product, process, or activity under analysis.

Impact Assessment

The Impact Assessment consists in an assessment of the potential impacts associated with the identified forms of resource use and environmental emissions. It analyzes and compares the environmental burdens associated with the material and energy flows determined in the previous phase. The conventional approach is to classify the inventory flows into specific impact categories (e.g., global warming, resource depletion, ecotoxicity). Normalization and weighting (or valuation) of the impacts is also included in this stage. If necessary, the individual impacts can then be aggregated into a single composite environmental index.

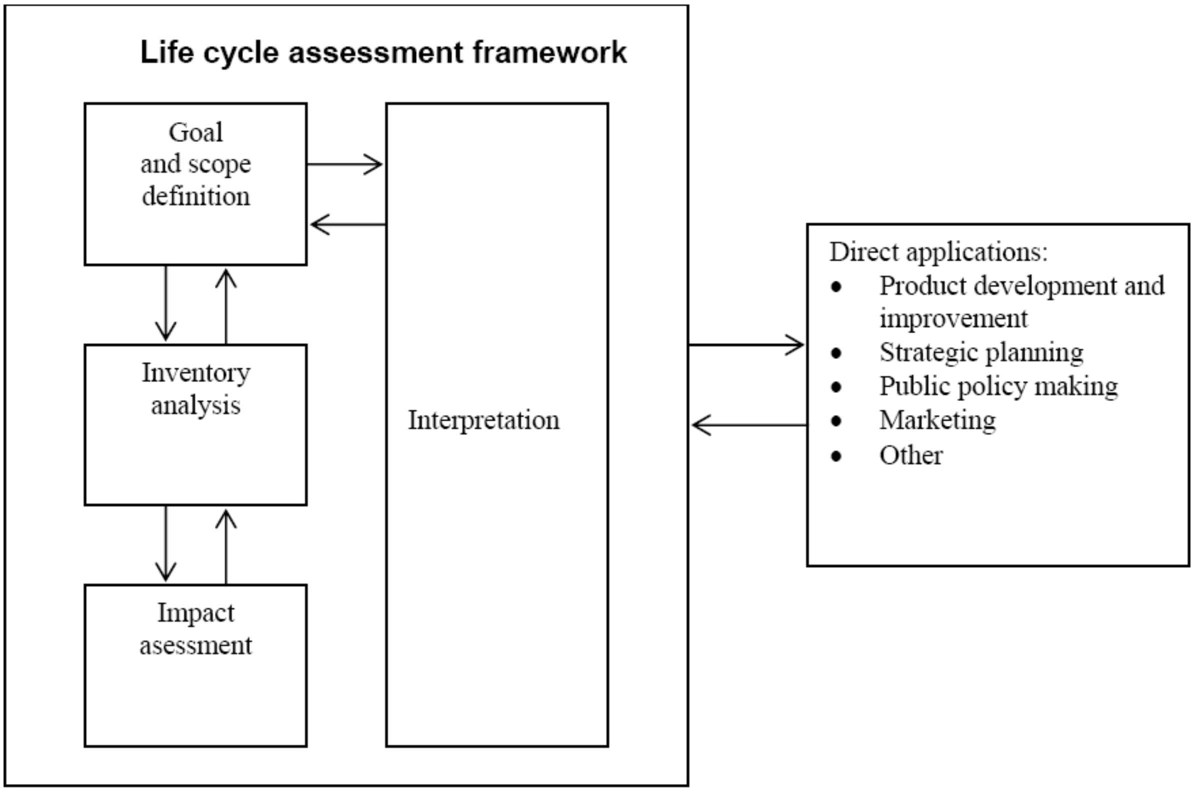


Figure 1: Different stages of the Life Cycle Assessment

Interpretation

The interpretation (ISO, 2000b) or Improvement Assessment (SETAC, 1991) utilizes the results of the preceding stages to meet the specified objectives. Typically this phase will generate a decision or plan of action. For diagnostic LCAs, data is used to identify critical segments or "hot spots" in the life cycle, which contributes disproportionately to the total system environmental impact. These problem areas can then be eliminated or reduced through system modifications. In the case of comparative LCAs, the competing system life cycles are ranked based on environmental performance and the optimal alternative is selected.

3.1.2. LCA Applications

LCA is applied in different perspectives and different areas and is mostly used in the following contexts:

Policy making

There is an increasing interest in using LCA to underpin public sector decisions on policy and practice. For example, as the basis for European environmental legislation including Integrated Pollution Prevention and Control (IPPC) and Integrated Product Policy.

Product design and product improvement

Design for the environment is an approach that uses a simplified life cycle approach to enable a product developer to obtain a quick assessment of the implications of, for example, material and component selection.

Process selection and design

Within the processing, currently processes are selected and plants designed by considering only the immediate process. However, local optimisation of a process can lead to overall reduction of environmental performance, typically by transferring environmental burdens to other points in the life cycle. Design of the whole life cycle rather that just one process has yet to be properly developed and accepted.

Supply chain management

A purchaser at one point in the life cycle of a product may have greatest scope to improve the product life cycle by selecting suppliers with better environmental performance.

For the implementation of Life Cycle Analysis different software are available. They include different methods of calculation and different databases for different uses and applications, depending on the original objectives requirements.

To illustrate our theory on the LCA analysis and application, an example of LCA application on the production of organic milk is given.

3.1.3. LCA steps

An LCA study consists of four steps:

Definition of the Goal and Scope of the Study

In the goal and scope the most important choices are described, such as:

- The reason for executing the LCA, and the questions, which need to be answered.
- A precise definition of the product, its life cycle, and the function it fulfils. In case products are to be compared, a comparison basis is defined (functional unit).
- A description of the system boundaries.
- A description of the way allocation problems will be dealt with.
- Data and data quality requirements.
- Assumptions and limitations.
- The requirements regarding the LCIA procedure, and the subsequent interpretation to be used.
- The intended audiences and the way the results will be communicated. If applicable, the way a peer review will be made.
- The type and format of the report required for the study.

Goal

It is obvious any LCA study should have goal. However, in ISO there are some particular requirements to the goal definition:

The application and intended audiences shall be described unambiguously. This is important, as a study that aims to provide data that is applied internally can be quite differently structured than a study that aims at making public comparisons between two products. For example, in the latter case, ISO states weighting may not be used in impact assessment and a peer review procedure is necessary. It is also important to communicate with interested parties during the execution of the study.

The reasons for carrying out the study should be clearly described. Is the commissioner or practitioner trying to prove something, is the commissioner intending to provide information only, etc.

Scope

A particularly important issue in product comparisons is the functional unit or comparison basis. In many cases, one cannot simply compare product A and B, as they may have different performance characteristics. For example, a milk carton can be used only once, while a returnable milk bottle can be used ten or more times. If the purpose of the LCA is to compare milk-packaging systems, one cannot compare one milk carton with one bottle. A much better approach is to compare two ways of packaging and delivering 1000 litres of milk. In that case one would compare 1000 milk cartons with about 100 bottles and 900 washings (assuming 9 return trips for each bottle).

System Boundaries

It is helpful to draw a diagram of the system and to identify the boundaries in this diagram. Important choices in this area are:

- Will the production and disposal of capital goods (trucks, injection moulding machines etc) be included?

As in energy analysis, one can distinguish three orders:

First order: only the production of materials and transport are included (this is rarely used in LCA).

Second order: All processes during the life cycle are included, but the capital goods are left out.

Third order: Now the capital goods are included. Usually the capital goods are only modelled in a first order mode, so only the production of the materials
needed to produce the capital goods are included.

- What is the boundary with nature?

For example, in an LCA on paper it is important to decide if the growing of a tree is included. If it is, one can include the $CO2$ uptake and the land use effect. In agricultural systems, it is important to decide if agricultural areas are seen as a part of nature or as a production system (technosphere). If this is seen as nature, all pesticides that are applied is to be seen as an emission. If agricultural areas are seen as an economic system, one can exclude the pesticides that remain in the area, and only include the pesticides that leach out, evaporate or that are accidentally sprayed outside the field.

Allocation

Many processes usually perform more than one function or output. The environmental load of that process needs to be allocated over the different functions and outputs. There are different ways to make such an allocation. ISO recommends the following procedure in order to deal with allocation issues:

- Avoid allocation, by splitting the process in such a way that it can be described as two separate processes that each has a single output. Often this is not possible, for example, wooden planks and sawdust are both an economic outputs of a sawmill, but one cannot split the sawing process into a part that is responsible for the sawdust and one that is responsible for the planks.
- Another way to avoid allocation is to extend the system boundaries and by including processes that would be needed to make a similar output. For example, if a usable quantity of steam, produced as a by-product, is used in such a way that it avoids the production of steam by more conventional means, one may subtract the environmental load of the avoided steam production. A practical problem is often that it is not always easy to say how the steam would be produced alternatively.
- If it is not possible to avoid allocation in either way, the ISO standard suggests allocating the environmental load based on a physical causality, such as mass or energy content of the outputs. For example if the sawdust represents 40% of the mass, one can allocate 40% of the environmental load to sawdust. In the case of allocating steam, we believe the mass of the steam is not a very relevant basis.
- If this procedure cannot be applied, ISO suggests using an socio-economic allocation basis, such as the economic value. For example if the saw dust represents 20% of the value generated by the saw mill one can allocate 20% of the environmental load to this output.

Model of the Product Life Cycle

Making a model of the product life cycle with all the environmental inflows and outflows requires a data collection. This latter step is usually referred to as the life cycle inventory (LCI) stage.

Inventory

The most demanding task in performing LCAs is data collection. However much data is available in our database you will usually find that at least a few processes or materials are not available, or the available data is not representative. Depending on the time and budget you have available, there are a number of strategies to collect such data. It is useful to distinguish two types of data:

- Foreground data
- Background data

Foreground data refers to very specific data you need to model your system. It is typically data that describes a particular product system and particular specialised production system.

Background data is data for generic materials, energy, transport and waste management systems. This is typically dada you can find in databases and literature.

3.1.4. Life Cycle Impact Assessment (LCIA)

The study stage of Life Cycle Assessment intends to understanding the environmental relevance of all inflows and outflows.

Most LCA experts do not develop impact assessment methodologies, they prefer the selection of what has been publish. Like in the inventory stage, also in impact assessment the Goal and Scope definition is the most important source of guidance for the selection of the method and the impact categories.

The most important choice you make is the desired aggregation level of the results. This usually depends on the way you would like to address your audience, and the ability of your audience to understand detailed results.

The ISO 14040 standard defines an LCA as a compilation and evaluation of the inputs and outputs and the potential environmental impacts of a product system through its life cycle. In this definition, it is clear that impact assessment is an integral part of LCA. The ISO 14040 standard defines the impact assessment phase as the "phase of a LCA assigned to the study and evaluation of the possible environmental impact caused by the system-product under study and has the aim to identify and underline the entities of the modifications generated by resources' consumptions and by the discharges in the environment, included in the inventory". In brief, Life Cycle Impact Assessment is defined as the phase in the LCA aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system. It is considered as the transition phase between the data collection and analysis to the study of the environmental impacts.

The impact assessment methods themselves are described in ISO 14042. In this standard, a distinction is made between:

- *Mandatory elements*, such as classification and characterisation
- *Optional elements*, such as normalisation, ranking, grouping and weighting.

This means that according to ISO, every LCA must at least include classification and characterisation. If such procedures are not applied, one may only refer to the study as a life cycle inventory (LCI).

An important distinction is made between internal and external applications. If results are intended to compare (competing) products and they are to be presented to the public, weighting may not be used.

An important step is the selection of the appropriate impact categories. The choice is guided by the goal of the study. An important help in the process of selecting impact categories is the definition of so called endpoints. Endpoints are to be understood as issues of environmental concern, like human health, extinction of species, availability of resources for future generation etc. ISO does not recommend using certain endpoints4, but requires a careful selection and definition of endpoints first. Subsequently, impact categories can be selected, as long as the environmental model that links the impact category to the endpoint is clearly described. It is not necessary to describe this link quantitatively.

Classification

The inventory result of an LCA usually contains hundreds of different emissions and resource extraction parameters. Once the relevant impact categories are determined, these LCI results must be assigned to these impact categories. For example CO_2 and CH_4 are both assigned to the impact category "Global warming", while SO_2 and NH_3 are both assigned to an impact category acidification. It is possible to assign emissions to more than one impact category at the same time; for example SO_2, may also be assigned to an impact category like Human health, or Respiratory diseases.

Characterisation

Once the impact categories are defined and the LCI results are assigned to these impact categories, it is necessary to define characterisation factors. These factors should reflect the relative contribution of an LCI result to the impact category indicator result. For example, on a time scale of 100 years the contribution of 1 kg CH_4 to global warming is 42 times as high as the emission of 1 kg CO_2. This means that if the characterisation factor of CO_2 is 1, the characterisation factor of CH_4 is 42. Thus, the impact category indicator result for global warming can be calculated by multiplying the LCI result with the characterisation factor.

Normalisation

Normalisation is a procedure needed to show to what extent an impact category has a significant contribution to the overall environmental problem. This is done by dividing the impact category indicators by a "Normal" value. There are different ways to determine the "Normal" value. The most common procedure is to determine the impact category indicators for a region during a year and, if desired, divide this result by the number of inhabitants in that area.

Normalisation serves two purposes:

1. Impact categories that contribute only a very small amount compared to other impact categories can be left out of consideration, thus reducing the number of issues that need to be evaluated.

2. The normalised results show the order of magnitude of the environmental problems generated by the products life cycle, compared to the total environmental loads in Europe.

Damage assessment / Ranking

The methods presented here will all still be difficult to interpret, as there is a wide range of impact category indicators. To simplify interpretation further, a grouping procedure can be used in the Eco-indicator 99 and the EPS2000 methodology. In these methods, the category indicators are defined close to one of the three endpoints to achieve an optimum environmental relevance. The impact category indicators that refer to the same endpoint are all defined in such a way that the unit of the indicator result is the same. This allows addition of the indicator results per group. This means that the indicator results can be presented as three indicators at endpoint level without any subjective weighting. Interpreting three instead of a multiple set of indicators is much easier.

Weighting

Weighting is the most controversial and most difficult step in life cycle impact assessment, especially for midpoint methods. Several solutions have been proposed to solve or simplify the weighting problem:

1. Use a panel that assesses the impact category and proposes default weights. There are several problems in this approach:

• It is very difficult to explain to a panel the meaning of the impact category indicators. They are too abstract ("CO2 equivalency" or "proton release").

• In a Midpoint approach, the number of indicators to be assessed is usually rather large (10 to 15).

• Panels tend to give a very small range of weights (usually between 1 to 3). This is called framing in social sciences. This is a problem in both endpoint and midpoint methods.

2. Distance to target. If it is possible to set a target for each impact category and its target can be used to derive at a weighting factor. If the difference is high, the weight is high. The Ecopoint method uses targets set by the Swiss government, the Eco-indicator 95 method uses targets that reflect to necessary reduction to lower the damage to a certain level that is the same for all impact categories (this can also be interpreted as a damage approach). Also this approach has some difficulties:

• In the case policy targets are used, it is not clear if all targets are equally important.

• policy targets are usually formed as a compromise between interest groups, and need not to reflect the "real" need to reduce environmental impacts.

• In case scientific targets are used, different types of damages need to be weighted.

3. Monetarisation: In EPS2000 all damages are expressed in the same monetary unit: Environmental Load Units comparable to Euros. In the methodology, the assumption is made that these different types of costs (present cost and willingness to pay and future extracting costs) can be added. This can be interpreted as a weighting step in which the weighting factors for these different types of costs equals one.

In the Eco-indicator 99 methodology, the weighting problem was the starting point of the development. Some of the problems associated with the weighting have been reduced or solved, but the weighting step will always remain difficult. An interesting approach has been developed by [Hofstetter et all 1999] using a weighting triangle (only possible after using the grouping methodology: Resources, Ecosystem quality and Human health). This triangle can be used to present the weighting problem on a case-by-case basis to stakeholders. It can be used to take a decision without actually knowing the weights.

3.1.5. Interpretation

Life Cycle Interpretation and Improvement is defined by ISO 14040 norm as "Phase of a LCA in which the inventory results and/or of the impact analysis, are elaborated correspondingly to the study objective and in such to reach conclusions and recommendations".

The interpretation phase is the conclusive phase of the LCA that seeks to propose or suggest basic changes to reduce the environmental impact.

3.1.6. Software for LCA

Different software for the LCA analysis are available on the market. One of the most versatile is SimaPro, which we suggest to use for our purposes.

SimaPro 5 offers a wide number of alternative methods to carry out this phase of the study:

CML 1992

CML 2 baseline 2000

Ecoindicator 95

Ecoindicator 99

Ecopoints 97

EDIP/UMIP 96

EPS 2000

Ecoindicator 99

The Eco-indicator 99 is a state of the art impact assessment method for LCA, with many conceptual breakthroughs. The method is also the basis for the calculation of eco-indicator scores for materials and processes.

These scores can be used as a user friendly design for environment tool for designers and product managers to improve products.

Weighting is a controversial step in impact assessment. Taking weighting as the starting point of the Eco-indicator 99, we worked top down to complete the method.

This is in contrast with the "bottom up" approach found in the traditional theme oriented methods, where a panel can be confronted with ten or more abstract environmental themes to weight. New damage models and 3 perspectives were developed to complete the method.

Damage categories

The need to simplify the weighting procedure meant we needed to define the "Eco" we wanted to "indicate" first. The following damage categories (endpoints in ISO terminology) were defined:

Damage to Human Health

Damage to Ecosystem Quality

Damage to Resources

New damage models were developed that link inventory results into three damage categories.

Weighting results

The result of the panel procedure is that Human Health and Ecosystem Quality are considered to be of almost equal importance, while Resources are considered to be half as important.

The following Figure 2 gives an overview of the structure of the eco-indicator 99 methodology.

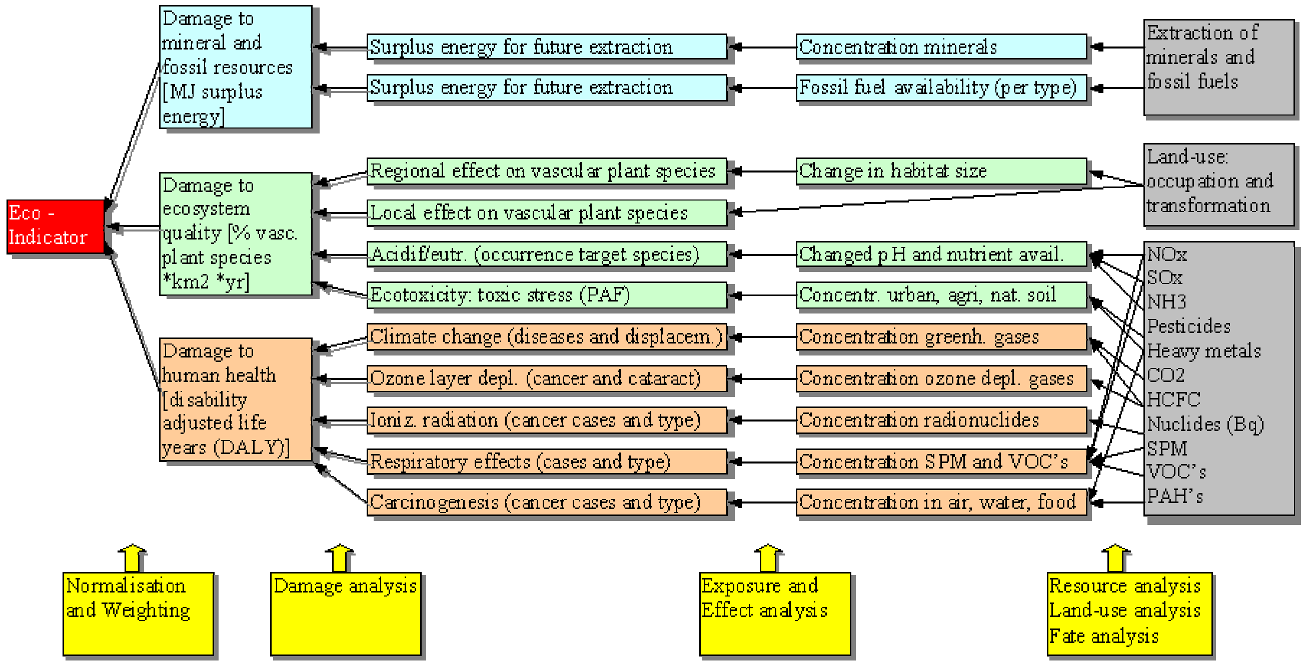


Figure 2: Structure of the eco-indicator 99 methodology.

<u>Human Health</u>

Damages to human health are expressed in Disability Adjusted Life Years or DALY's. This method, developed by Murray, is used by WHO and WorldBank. An important element is a scale that rates the different disability levels.

Damage models were developed for respiratory and carcinogenic effects, the effects of climate change, ozone layer depletion and ionizing radiation.

In these models four steps are used:

1. Fate analysis, linking an emission (expressed as mass) to a temporary change in concentration.
2. Exposure analysis, linking this temporary concentration change to a dose.
3. Effect analysis, linking the dose to a number of health effects, such as occurrence and type of cancers.
4. Damage analysis, links health effects to DALYs, using estimates of the number of Years Lived Disabled (YLD) and Years of Life Lost (YLL), (following [Hofstetter 1998]).

<u>Ecosystem Quality</u>

Damage to ecosystem quality are expressed as percentage of species disappeared in a certain area, due to the environmental load (Potentially Disappeared fraction or PDF). The PDF is then multiplied by the area size and the time period to obtain the damage.

The damage category Ecosystem Quality is unfortunately not as homogeneous as the definition of Human Health. It consists of Ecotoxicity, Acidification and Eutrophication, Land use and land transformation.

Resources
Damages to Resources, minerals and fossil fuels, are expressed as surplus energy for the future mining of resources [Müller Wenk 1998].

3.2. Case Study: LCA Application on Organic Milk

Hereafter we present an example of LCA analysis applied to the organic sector, in particular to the production of organic milk. In the following example we showed results only from the organic process of milk production, however it is usually relevant to compare the organic/conventional production of a certain product applying the same process for both type of production and comparing the results.

3.2.1. Organic Farm Inventory

The organic milk farm considered for this life cycle analysis produced 978.500 kg of milk in the studied year (01/01/04 to 31/12/04).
The seeded land for forage production is of 85 ha from which 4 ha of organic alfalfa, 46 ha of oat and Italian ryegrass mixture, and 35 ha of triticale for silage. However, land labour does not concern all the land area, such areas covered with alfalfa which are not seeded each year.

Manuring

2.000.000 kg of farm dung and 1.000.000 kg of sewage are distributed once a year respectively with a manure spreader and a sewage slap and correspondingly 2.244 kg and 729 kg of gas oil is used.

Soil preparation

81 ha are ploughed twice using 2138,4 kg of gas oil, than harrowed once using 1069,2 kg.

Seeding/Sowing

Seeding is done using 1.620 Kg of gas oil than land levelling is made using 1.093,5 kg of gas oil.

Grass Cutting

Grass cutting, conditioning and transportation to the farm require 506 Kg of gas oil. This operation concerns the oat and the Italian ray grass.

Harvesting

Harvesting is made with a roll packer that consumes 414 Kg of gas oil.

Transport

Transporting the hay ball from the cultivated area to the farm requires 552 kg of gas oil.

Hay Baling and Drying

Baled hay is transported to the farm and is dried with a quick dehydration for immediate use. Therefore an electric dehydrator for drying is used and is alimented by an electric generator of 220 v that is also used to produce electricity to the whole farm as it is not connected to the local electric alimentation.

Silage (Ensilage)

Silage is made with the triticale produced on farm and this operation requires 693 kg of gas oil.

3.2.2. Milking Cows

The studied farm contains 120 Frisian and Brown breeds milking cows, in a free range.

Unifeed of Milking Cows

Milking cows fed within the studied year with a mixture composed of:

Mays Flour	146.400 kg
Toasted Soy	36.600 Kg
Ground Barley	58.560 Kg
Triticale Silage	622.000 Kg
Oat and Italian Rye grass Hay	220.000 Kg
Organic Alfalfa Hay	40.260 Kg
Conventional Alfalfa Hay	36.600 Kg
Ground Broad Beans	47.580 Kg
Chard Pulp	21.960 Kg
Supplements	18.300 Kg

Raw materials, except on farm produced forages, are bought from Padova. Each year 24 deliveries are made and each one requires 7.823,04 kg of gas oil.

The unifeed administration occurs through the feed-mixers in which the forages and the raw materials are carried and this operation consumes 324,096 kg of gas oil. Raw materials are preventively mixed through an electric mill that consumes 300.632 kW, than these latter are placed in the feed-mixers through five cochlea (snail-shaped ear tube) consuming 8.212,5 kW. The feed-mixers have a consumption of 5840 kg of gas oil per year.

The value indicated for unifeed administered to the milking cow include also the preparation and administered of others mix done during the day for the rest of the heard: dry cow, heifer, calves up to six months of age and weaned calves.

Stable Management

The stable is divided in different zones that needs a lot of time to manage. Specially the rest/sleeping zone and the feeding aisle that need a daily cleaning corresponding to a consumption of 27.37,5 Kg of gas oil. The cleaning of the milk pipes is done through the milking machine, in fact, the time of cleaning is included within the 5 hours of milking.

Milking

Cows are entered in a milking room of 10 cows capacity to which are annexed the waiting rooms for cows prior to milking and the milk bay. The milking machine and the milk pomp consume together 219 kg of gas oil, a low consumption due to the "inverter" installation that reduces energy consumption. The collected milk is transferred to a fanned refrigerator that consumes 8760 kW of electric energy and a milk tank that consumes 25,55 kW of electric energy.

3.2.3. Dry Cows

In average the farm contains 20 dry cows in per year.

Daily Feedings of Dry Cows

These animals are fed with a mixture composed of:

Forage	73.000 kg
Winter Wheat Bran	7.300 Kg
Spontaneous pasture	36.500 Kg

In this case raw materials are imported from Padova and preparation and administration has been already calculated above.

Management and Cleaning

Dry cows can freely move between closed and open spaces and have free access to pasture, therefore cleaning is occasional and 180 kg of gas oil are annually needed for these operations.

3.2.4. Heifer

There are 48 heifer in the farm.

Heifer Feeding

Forage	105.120 kg
Coarse Wheat Grain	17.520 Kg
Mays Flour	8.760 Kg
Spontaneous pasture	350.400 Kg

Heifer Management

Heifer are raised in a semi-open area with free access to pasture and no particular management (180Kg of gas oil).

3.2.5. Calves (up to 6 months of age)

Calves that were born and kept in the farm within the studied year are 120.

Calves Feeding

Calves are fed with cow milk till the sixteenth day after birth and consumed 39.000 kg.

Than, calves are fed with 10 % ratio of the same meals composition as their mothers, for 4 months:

Triticale Silage	6.220 kg
Oat and Italian Rye grass Hay	22.000 Kg
Organic Alfalfa Hay	4.026 Kg
Conventional Alfalfa Hay	3.660 Kg
Mays Flour	14.640 Kg
Ground Barley	5.856 Kg
Toasted Soy	3.660 Kg
Ground Broad Beans	4.758 Kg
Chard Pulp	2.196 Kg
Supplements	1.830 Kg

Management and Cleaning

Cleaning the calves space is done once a week and it needs 180 Kg of gas oil.

3.2.6. Weaned Calves (male calves of more than 6 months of age)

Weaned calves present in this farm are 50.

Weaned Calves Feeding

Weaned Calves are fed with a mixture prepared as explained above and composed of:

Oat and Italian Rye grass Hay	63.875 Kg
Triticale Silage	118.625 Kg
Mays Flour	27.375 Kg
Barley Flour	18.250 Kg
Coarse Grain	9.125 Kg

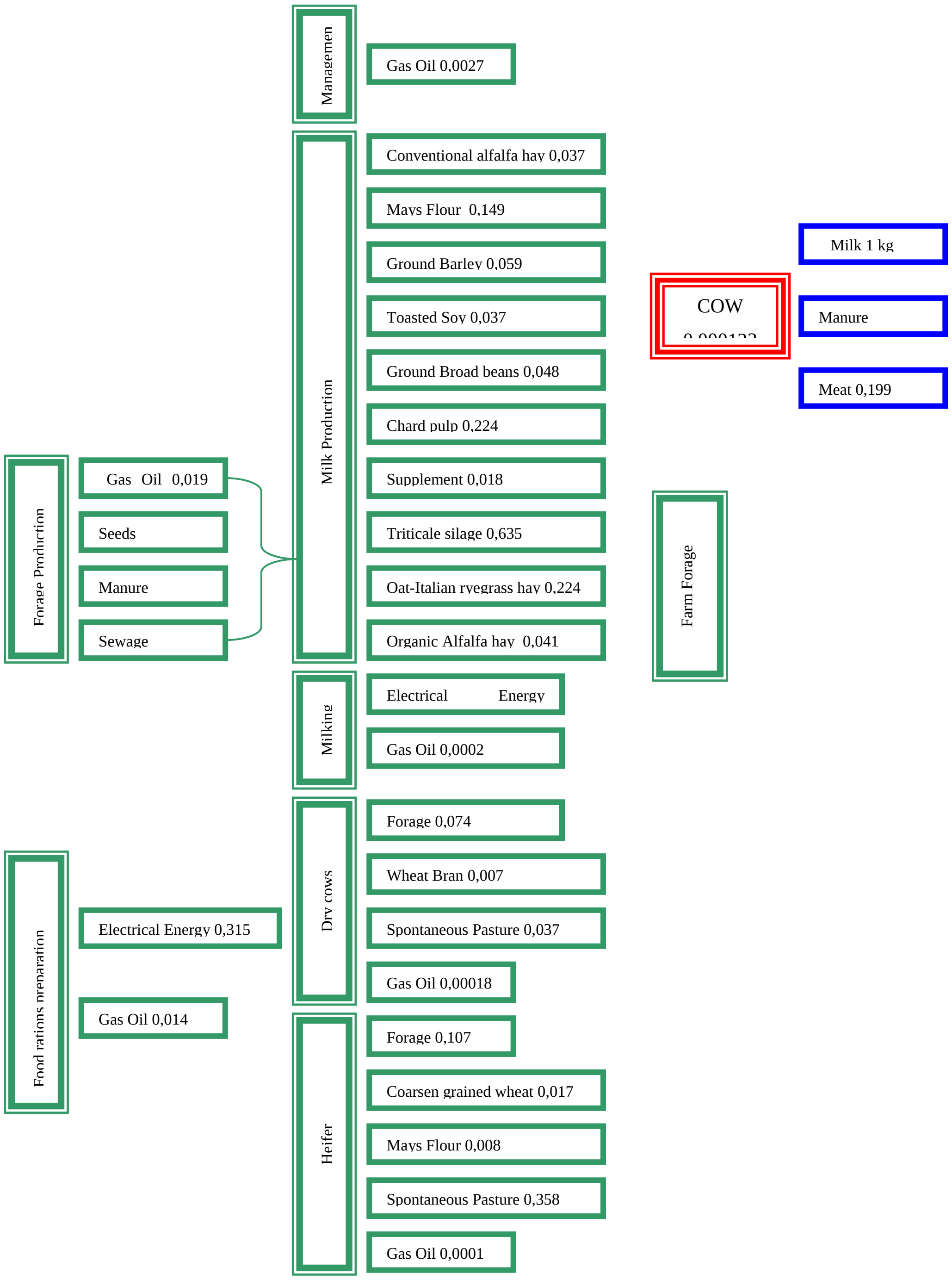
Weaned Calves Management

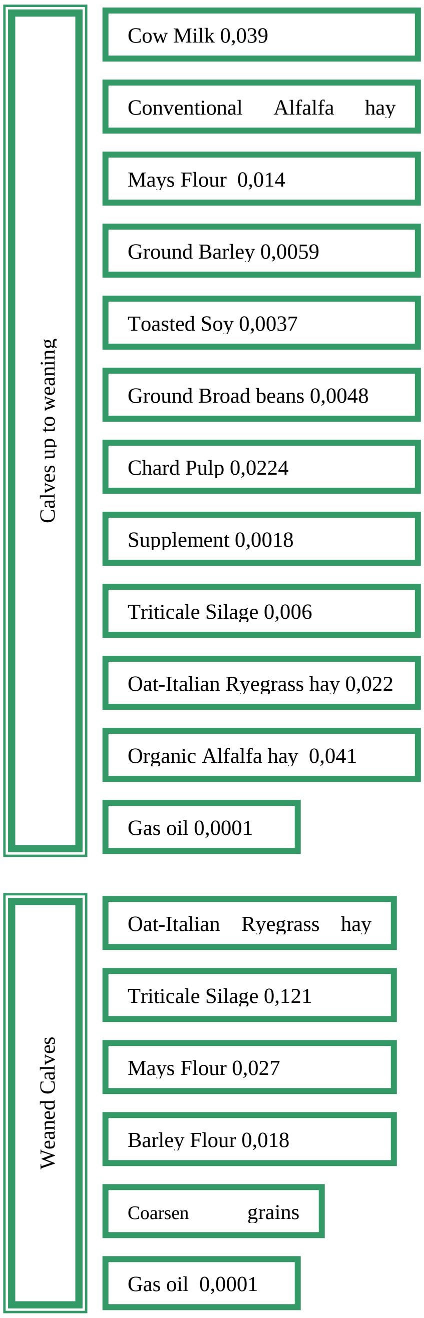
Weaned calves are free to move between closed and open spaces towards pasture, therefore cleaning is occasional and 180 kg of gas oil are annually needed for these operations.

3.2.7. Output

Output are: 978.500 kg of milk, 63.000 kg of calves meat, 733,84 kg of heifer meat, 50.000 kg of weaned calves meat and 2.000.000 kg of manure entirely recycled within the farm.

All data refer to one functional unit =1Kg of milk. Therefore the inventory is represented as follow:





3.2.8. Process analysis

The collected data has been inserted in the Simapro5 program and calculated and analysed with the Ecoindicator99 method, results are summarised in the following graph X. The impact categories considered are the following:

- Human health
- Ecosystem quality
- Abiotic Depletion
- The total damage

The total damage weights principally on human health and is equivalent to 5,09E-5 points. The two other impact categories have a minor gravity: the *Ecosystem quality* has a value of 1,18E-5 points while the *Abiotic depletion* 2,67E-6 points. However all these values are infinitely low.

Within each category the damages causes are shown:

- Organic Forage (in yellow);
- European Diesel refining (in red);
- Livestock Food from Wheat (in green);
- Protein from Wheat (in blue);
- Italian Electrical Energy (in fuchsia).

Therefore, results (Figure 3) shows that the electricity and the wheat protein extraction processes, together with the raw material production for the livestock feeding are the most significant factors responsible of the environmental impact of the organic milk production.

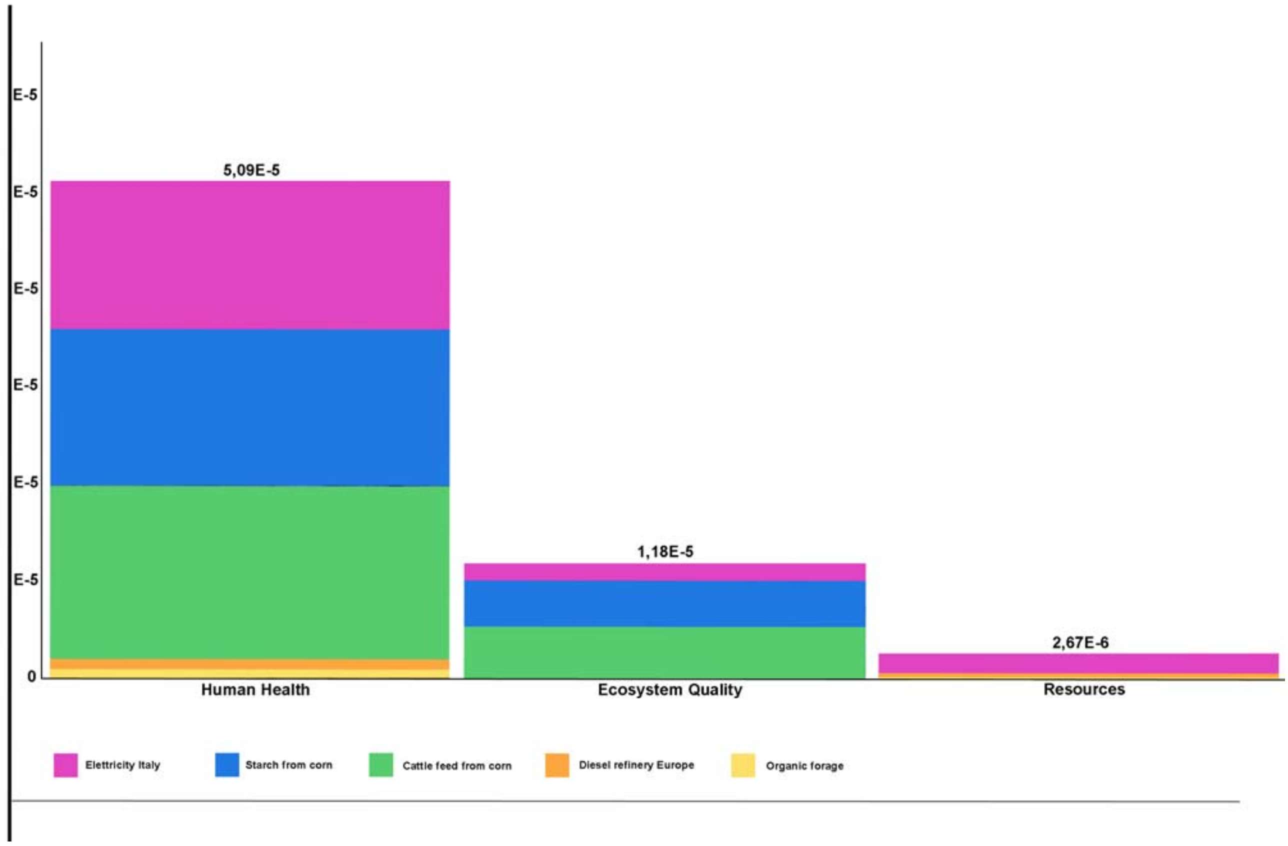


Figure 3: Environmental impacts of organic milk production

The number showing the environmental impact of organic milk production process is an empirical number composed of several impact categories as shown in the following figure.

In this case, the causes of damages are the same considered for the previous analysis but the impact categories are more numerous:

- Abiotic depletion;
- Global warming;
- Ozone layer depletion;
- Human toxicity;
- Fresh water aquatic eco-toxicity;
- Marine aquatic eco-toxicity;

-
- Terrestrial eco-toxicity;
- Photochemical oxidation;
- Acidification;
- Eutrophication.

The environmental impact has the greatest weight on the Marine aquatic eco-toxicity; (2,76E-13 points) even if the value is infinitely low due to the major measure accorded to the Italian electric energy (in fuchsia). According to the Italian legislation (law n° 963/1965), “the substances considered as pollutants are those that cause chemical and physical alterations to the environment as such to influence unfavourably the aquatic organisms life”. This juridical definition reflects the biological conception of the pollution as it is based on a scientific interpretation of the feed-back mechanism with which acts the pollution in the marine ecosystem. Such pollution is directly correlated to the climate changes that cause water rise and the reduction of marine ice-cap. Therefore the natural flows of water circulation are altered, which affect the animal and vegetal reproduction of marine species and causing serious damages to the marine ecosystem.

Summing up:

- The environmental impact of organic farming will be investigated by means of Life Cycle Assessment.
- The information basis will be specific data on farms and processing units
- The assessment of impacts will be obtained by case study of selected relevant farms and firms

4. Social impact

Social impact has to do with changes in:

- Human population;
- Labour requirements & employment;
- Gender issues such as change in gender division of labour;
- Rural devleopment, land abandonment and urbanisation processes;
- Local community change;
- Human nutrition, health & public safety issues.

By social impacts we mean "the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society."(Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003).

The International Association for Impact Assessment (IAIA) defines Social Impact Assessment (SIA) as that procedure that "includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment"(Vaclay, 2003).

According to this definition:

1. SIA contributes to the process of adaptive management of policies, programs, plans and projects, and therefore needs to inform the design and operation of the planned intervention.
2. SIA builds on local knowledge and utilises participatory processes to analyse the concerns of interested and affected parties. It involves stakeholders in the assessment of social impacts, the analysis of alternatives, and monitoring of the planned intervention.

6. The good practice of SIA accepts that social, economic and environemntal impacts are inherently and inextricably interconnected. Change in any of these domains will lead to changes in the other domains. SIA must, therefore, develop an understanding of the impact pathways that are created when change in one domain triggers impacts across other domains, as well as the iterative or flow-on consequences within each domain. In other words, there must be consideration of the second and higher order impacts and of cumulative impacts.

Figure 4 summarizes the principles of SIA and related guidelines.

Figure 4. Principles and guidelines for social impact assessment

Achieve extensive understanding of local and regional settings to be affected by the action or policy
- Identify and describe interested and affected stakeholders and other parties
- Develop baseline information (profiles) of local and regional communities

Focus on key elements of the human environment
- Identify the key social and cultural issues related to the action or policy from the community and stakeholder profiles
- Select social and cultural variables which measure and explain the issues identified

Identify research methods, assumptions and significance
- Research methods should be holistic in scope, i.e. they should describe all aspects of social impacts related to the action or policy
- Research methods must describe cumulative social effects related to the action or policy
- Ensure that methods and assumptions are transparent and replicable
- Select forms and levels of data collection analysis which are appropriate to the significance of the action or policy

Provide quality information for use in decision-making
- Collect qualitative and quantitative social, economic and cultural data sufficient to usefully describe and analyze all reasonable alternatives to the action
- Ensure that the data collection methods and forms of analysis are scientifically robust
- Ensure the integrity of collected data

Ensure that any environmental justice issues are fully described and analyzed
- Ensure that research methods, data, and analysis consider underrepresented and vulnerable stakeholders and populations
- Consider the distribution all impacts (whether social, economic, air quality, noise, or potential health effects) to different social groups (including ethnic/racial and income groups)

Undertake evaluation/monitoring and mitigation
- Establish mechanisms for evaluation and monitoring of the action, policy or program
- Where mitigation of impacts may be required, provide a mechanism and plan for assuring effective mitigation takes place
- Identify data gaps and plan for filling these data needs

A convenient way of conceptualising social impacts is as changes to one or more of the following (Vaclay, 2003):

- people's way of life – that is, how they live, work, play and interact with one another on a day-to-day basis;
- their culture – that is, their shared beliefs, customs, values and language or dialect;
- their community – its cohesion, stability, character, services and facilities – and their political systems – the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose;
- their environment – the quality of the air and water people use; the availability and quality of the food they eat; the level of hazard or risk, dust and noise they are exposed to; the adequacy of sanitation, their physical safety, and their access to and control over resources – and their health and wellbeing – health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity;
- their personal and property rights – particularly whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties;
- their fears and aspirations – their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

For the purpose of assessing the social impact of organic farming in developing countries, we suggest the following main indicators for each domain:

Domain	Indicator

People's way of life	• Number of new jobs (full-time equivalents: FTE) created by organic farming:
	  - temporary (incl. seasonal)
	  - permanents
	• Number of new farms and enterprises started directly as organic
	• Organic farmer's household size
	• Number of female farm workers over total number of workers in organic farms (incl. farmer)
	• Number of female organic farmers over total number of organic farmers
	• Number and share of household purchasing organic food
	• Share of organic consumption over total domestic food consumption
	• Number of shops selling organic products
	• Number of traders (import/export) of organic products
	• Organic exports (in dollars or local currency)
	• Total organic turnover (in dollars or local currency)

Culture	• Ratio of organic farmer's household spending on culture to spending on leisure • Number of book purchased • Number of periodicals purchased • Number of children attending higher education establishments over total number of children • Number of alphabetized family members over total number of members
Community & Political system	• Number of active voluntary associations • Number of farmers cooperatives • Political participation (number of actual voters over total eligible voters) • Number of divorces over total number of marriages in the community • Number of abandoned children over total number of children born • Number of schools over total population • Numbers of doctors over total population • Number of people who require involuntary resettlement • Number of indigenous people targeted/involved • Area of indigenous settlement/total land area affected
Environment, Health & Wellbeing	• Average daily intake of kcal per household member • Average daily intake of proteins per household member • Average daily intake of vitamins per household member • Rate of suicides in the population • Rate of reported rapes and sexual attacks in the female population • Rate of reported family abuse over children in the children population • Number of working children < 14 years old over total number of children < 14 years old • Number of labour accidents among organic farmers • Prevailing diseases among organic farmers • Average life expectation at birth

Personal & property rights	• Size of organic farms in hectares • Number of organic livestock per organic farm • Share of owned land over total cultivated land by organic farmers • Degree of farmer self-sufficiency in household food production • Debt (in US $)/hectares in organic farms • Number of bankrupt organic farmers over total number of organic farmers
Fears & aspirations	• Main reported safety hazards among organic farmers • Main reported fears among organic farmers • Main reported aspirations of organic farmers

Some of these indicators could be used for comparisons between organic rural "districts" (where there is a significant proportion of organic farms and enterprises) and conventional districts.

 In general, social impact is the most difficult to assess.

The basic steps to be followed for the prediction of changes in the social environment and the assessment of impact of these changes can be described as follows:

Step 1: Identification of Critical Social Indicators

The first step is to select the appropriate social indicators on the basis of availability of quantitative measurements. These could be chosen among those presented in the previous table or supplemented by others agreed by the Assessment Team.

The first step involves identifying those social impact domains that represent critical items relative to the human environment. Development of organic farming is often expected to have neutral impact on many domains since it stems from previous conventional agricultural practices, but in some marginal areas it may have a positive impact on population and therefore a negative impact on the public services. To identify these critical impact areas generally requires:

a. the selection of appropriate indicators on the basis of availability of data. A participatory approach, involving farmers and other stakeholders, is particularly recommended.

b. a comparison of expected future service levels with existing service levels, as well as the use of local planning factors and community design standards to assess the needs of the new development and its occupants.

Step 2: Data collection

The second step is to collect pertinent data and information that will enable description of the context in terms of various selected social impact domains such as those described above. Accomplishing this step will generally require the use of various sources of information such as census data, statistical abstracts of various governmental agencies, planning agencies, chambers of commerce, university research departments & libraries, and others. Detailed data collection and analysis are needed to clarify the expected impact and effects of projects or strategies for the development of organic farming on different groups, including the poor and excluded. Appendix IV sets out various methods for data collection that can be used to identify the people affected either positively or negatively and to provide measurements of the social indicators identified in the previous step.

Step 3: Prediction of Changes in Social Indicators

This requires that one have various tools, techniques, and methodologies for making these predictions. Once a number of relevant impact indicators are selected for each social domain, the third step involves the quantitative prediction, or at least qualitative description, of the changes in the social environment as the result of the new organic development. The measurement and description of the current situation, of the deadweight and of the potential impact foreseen with different level of conversion to organic farming on the society should be achieved mainly by means of desk research, supplemented – if the budget allows it – by other qualitative and quantitative methods of data collection (see Appendix IV).

In order to estimate the probable social impact of organic farming in the future, future-focus methods could be used such as:

- **Straight-line trend impact analysis:** projecting current trends, such as population change or employment, into the future (with or without modifying the rate of change). Its simplest form is a quantitative statistical forecasting model (e.g. simple time-series regression with simulation) enriched by qualitative assessments, that allows the definition of possible events that might modify the estimated trends. This approach turns out to be particularly effective for at least two reasons: it combines traditional and qualitative forecasting techniques, and stimulates analysts and experts to take into account possible effects of "unusual" events. Nevertheless, it does not take into account effects of interrelationships among variables. A further limitation of this method is the fact that it emphasizes the predetermined trends and allows only limited account for uncertain events. But it is very simple to use and can be easily combined with any of the following.
- **Comparative case study**: examining how an affected community has responded to change in the past, or the impact on other communities that have undergone a similar action. Traditional approaches to rural development focus primarily on economic issues, such as the improvement of output, income and employment. When connected to the concept of sustainability, however, a rather more multifaceted perspective has emerged, not only in relation to the conservation of environmental resources, but also social and cultural dimensions (Midmore et al, 2005). The case study approach allows mapping of complex interrelationships in rural development to describe functional transformations in the use of resources such as land, labour, knowledge and underlying nature. Using the framework of Actor Network Theory (ANT), case study can expose the asymmetry of power relations in a rural network. Actors are entities able to connect material, social or cultural artefacts to create a life-world filled with other entities, having their own history, identity and relations.

Between them are intermediaries, the means by which actors are defined in the interaction, and the Actor Network consists of actors and intermediaries which transmit relationships. Using this framework, comparative case study allows to develop a mapping framework to describe the dynamics of power relations, showing actors as nodes and mapping them across both horizontal and vertical network relations. This mapping concerns relationships between people, and allows to explore the social effects of any new rural development, such as that related to organic farming.

- **Delphi**: The Delphi approach involves successive questionnaires to an expert panel, using feedback to refine an informed perspective on complex or uncertain issues. (Padel and Midmore, 2005). More generally, the technique is seen as a procedure to ‘‘obtain the most reliable consensus of opinion of a group of experts...by a series of intensive questionnaires interspersed with controlled opinion feedback’’ (Rowe Wright, 1999). Delphi is not a procedure intended to challenge statistical or model-based procedures, against which human judgment is generally shown to be inferior: it is intended for use in judgment and forecasting situations in which pure model-based statistical methods are not practical or possible because of the lack of appropriate quantitative data, and thus where some form of human judgmental input is necessary. Four key features may be regarded as necessary for defining a procedure as a 'Delphi'. These are: anonymity, iteration, controlled feedback, and the statistical aggregation of group response. Anonymity is achieved by means of questionnaires, which are iterated over the same panel without allowing undue interactions and pressures to emerge, contrary to what is obtained by the means of focus groups. Between each iterations, respondents are informed of the opinions of their anonymous colleagues, thus providing controlled feedback. After 2 or more round of questionnaire iteration, the group judgement is taken as the statistical average (mean or median) of the experts’ estimates on the final round.
- **Scenario analysis:** scenarios are logical-imaginations based on construction of hypothetical futures through a process of mentally modelling the assumptions about the variables in question; experts can be asked to analyse different scenarios and assess their implications on social indicator. Scenarios are helpful to develop the likely, alternative or preferred future of a community or society. Scenarios can be used to compare different outcomes (best versus worst case). Scenario analysis usually is based on following steps:

1. Develop a common framework of analysis. Define the issues that should be understood better in terms of time frame, scope and decision variables. Review the past to describe what has happened and get a feel for the degree of uncertainty and interrelations.

2. Exploratory analysis. Using STEEP (Social, Technological, Economic, Ecological, Political environment) analysis, make a list of current trends and predetermined elements that will affect the variables of interest. Construction of a flow-chart of interlinkages and causal relationships. Identify uncertainties and examine interrelations among the uncertain events. Identify the critical decision-makers.
3. Plot the scenarios. Identify the key uncertainties (driving forces) likely to have relevant impact on specific social context. Assess the degree of uncertainty and the impacts of different driving forces, in order to build a set of different scenarios. Identify events that could trigger the sequence of the events, suing cause-effect analysis. Select the most probable sequences of the events and decisions.
4. Write the scenarios. The scenarios are first drafted in skeleton form, to highlight their main ingredients. Once accepted by the Assessment Team, they should be expressed and painted in detail, by a verbal narrative describing the events and showing how the future might evolve in that direction.
5. Stakeholder analysis. Identify stakeholders and key players in each scenario. Analyse the likely impact of each scenarios on them and on their decisions.

- Assess the internal consistency and plausibility of the scenarios. Identify where and why the scenarios may be incoherent or internally inconsistent (in terms of trends and outcome combinations). Eliminate combinations that are not credible or impossible, and create new scenarios until internal consistency is achieved.

Step 4: Discussion of Implications of Changes

The final step in the prediction and assessment of the impacts on the social environment involves a discussion of the implications of these changes for each domain area impacted. These implications could be examined by comparing the values of the impact measures used, such as students generated prior to development versus students generated after development, or number of hospital treatments required prior to development versus number of hospital treatments required after development. Differences in these values would mean either an increase or decrease in some type of service, demographic characteristic, or other social indicator. Such changes must then be examined in terms of their impact, whether adverse (if so, then why and what are the consequences) or beneficial, on the social. In the case of adverse changes, mitigation suggestions should be given as much as possible.

Summing up:

- The social impact of organic farming will be investigated according to a simplification of standard assessment techniques for development projects.
- The information basis will be the analysis of existing quantitative data, which will be collected by desk research and supplemented with qualitative and/or quantitative data gathered by different data collection tools
- The assessment of impacts for each indicator category will be obtained by analysing the implication of changes using quantitative measurements and/or a qualitative aggregation approach.

5. Conclusions

The proposed approach to impact evaluation of organic farming uptake in developing countries focuses on three main areas: economic, environmental and social impacts. For each area specific methodologies are proposed, trying to maintain feasibility as a main constraint. Therefore for each aspect alternative methodologies are proposed, according to different grades of data availability on the organic sector in the countries under analysis. An integrated use of both quantitative and qualitative information is proposed as “best option” in most of the proposed approaches, but a purely qualitative alternative based on expert assessment is anyway proposed as basic approach. For this reason specific guidelines are provided for expert selection as their knowledge can be used in all the proposed impact assessment methods. Table 6 shows a synthesis of the expected results, type of methodological approaches and data requirements for the three main areas investigated.

Table 6: Synthesis of the organic farming impact analysis

	Economic impacts				Environmental impacts	Social impacts
	Policy framework	Direct Macro impacts: output variation	Indirect Macro impacts	Micro impacts		
Type of results	Description of agricultural sector and of the organic farming sector; Description of the overall regulatory framework for organic agriculture (if any): Detailed description of specific measures for organic farming	Output variation by commodity (in Tonnes) due to conversion; Yield and land use variation Aggregated output var (in $)	Individuation of: – main supply chains and relevant competences, risks and opportunities; – "stronger" and "weaker" supply chains; – key competences organic system; – supply chains most exposed to opportunities and risks; – most relevant risks and opportunities for the organic system ;	Selection of representative organic farms Budget analysis; Comparison with conventional cases; Partial budgeting; Budget simulations;	LCA and environmental indicators	Description of social setting; Identification of critical social indicators; Prediction of changes in social indicators; Evaluation of implication of changes;
Specific methodology	Study of existing database, legal sources and literature Questionnaire; SWOT analysis	Specific models provided; Questionnaires;	Multi-stage Qualitative Analysis;	Sample stratification Direct farm survey Qualitative farm definition; Comparison techniques provided What-if simulaitons	LCA	Trend impact analysis, Case study, Delphi, Scenario analysis.
Common methodology	Stakeholder analysis for expert selection	Stakeholder analysis for expert selection	Stakeholder analysis for expert selection	Stakeholder analysis for expert selection	Stakeholder analysis for expert selection	Stakeholder analysis for expert selection
Data and information requirements	Agricultural databases; Legal databases/ docs;	Agricultural databases; Literature review; expert assessments;	Expert assessments;	Agricultural databases; Literature review; expert assessments;	Data on production and processing; Case study	Desk research of secondary sources, Surveys, Focus Groups, Expert assessments

Once the consequences of organic farming uptake have been evaluated according to the proposed procedure, a possible synthesis of the main outcomes may be obtained through a multicriterial approach. The general structure of Analytic Hierarchy Process (AHP) models in particular can be used to summarise the overall picture of economic, environmental and social impacts. AHP, originally proposed by Saaty (1980), can handle both quantitative and qualitative data, and reaches a consistent ranking of factors that are part of a complex system. For our purposes, the complex concept of “impact of organic farming on the economies of developing countries” can be disarticulated into:

- Factor 1: Impact on economic aspects;
- Factor 3: Impact on environmental aspects;
- Factor 3: Impact on social aspects.

AHP allows for nested disaggregation of concepts when necessary: in our case the “impact on economic aspects” factor can be further disaggregated into:

- Sub factor 1.1: Direct macro economic impacts
- Sub factor 1.2: Indirect macro-economic impacts
- Sub factor 1.3: Micro economic impacts

On the basis of the results of the analysis performed in each country, it will be possible to summarise in qualitative terms the overall impacts using the pairwise comparison method of AHP. With reference to the country where the analysis is effected, and on the ground of the results obtained, each factor shall be pairwise evaluated in these terms with any other:

Table 7: example of comparative evaluation ranking for organic farming impacts

Comparative evaluation	Definition	Explanation
1	Equally important	Two decision elements (e.g., factors) equally influence the overall judgement.
3	Moderately more important	One decision element is moderately more influential than the other.
5	Strongly more important	One decision element has stronger influence than the other.
7	Very strongly more important	One decision element has significantly more influence over the other.
9	Extremely more important	The difference between influences of the two decision elements is extremely significant.

2, 4, 6, 8	Intermediate judgment values	Judgment values between equally, moderately, strongly, very strongly, and extremely.
Reciprocals		If v is the judgment value when i is compared to j, then 1/v is the judgment value when j is compared to i.

As a result AHP produces normalised weights measuring the relative importance of the three basic factors taken into consideration in the analysis (and the relative importance of the sub factors as well), hence yielding a syntetic ranking of the most relevant consequences of organic farming adoption in each of the countries where the procedure is applied. This represent a basis for comparison among countries, and can also be used as a first step towards further investigation concerning effectiveness of policy action also from a monetary point of view.

APPENDIX I: Stakeholders selection

<u>Some definitions</u>

Following the International Institute for Environment and Development (**IIED 2001**), stakeholders can be defined as all people who matter to a system. Stakeholders are those who have rights or interests in a system. If you are concerned with the future of a system – the stakeholders are those you should worry about. For an organisation, for example, stakeholders are any group or individual who can affect, or is affected by the achievement of the organisation's purpose. This definition is too broad for some as it includes interested parties as well as affected parties. Some prefer to restrict the term to those who have a 'stake', claim or vested interest – those who provide something of importance to the organisation / system, and expect something in return.

The first step for stakeholders selection is therefore the individuation of the system to be analysed.

<u>Stakeholder selection: a stepwise approach</u>

Given the above definitions, the range of stakeholders that might be considered relevant for the analysis of the case studies in the selected areas of interest is quite wide. The Advisory Committee AC, can be considered as the reference point for the individuation of relevant stakeholders for the case studies. In order to ensure the inclusion of all relevant stakeholder groups and to select interview partners from all relevant levels we propose a stepwise approach.

In the firs step, a general list of potential stakeholders for each case study , as comprehensive as possible, shall be produced by the AC , hinging on their knowledge of the case study area rural system. For the purposes of the project, stakeholders referring to the primary sector, with particular attention to organic farming must be taken into account. Not only farmers but also representatives of the various stages of food chains should be considered. Besides, also non agricultural representatives shall be taken into consideration, given the necessity to analyse a complex system of rural development locally based. Therefore, policy makers, local inhabitants and people from other business sectors (e.g SMEs, services, tourism etc) must be included.

To define relevant stakeholders some **key questions** might be helpful:

- who are the potential beneficiaries of a rural development based on OF?
- who might be adversely affected by a rural development based on OF?
- who has influence in the local area investigated?
- who is likely to be voiceless?
- who is likely to resent change?

- who has money, skills or key information needed?
- whose behaviour (or intentions) has to change to achieve success?

The key stakeholders identified need to be representative for their group. Criteria for this are:

- identity: does the representative share the views of the group he/she represents?
- accountability: does he/she have a mandate to speak for the group or for certain important parts of a stakeholder group?
- Selection to ensure representativity can be further guided by other characteristics like age, gender, etc, as far as possible

In the second step, stakeholders may be clustered by the AC into homogeneous groups, in terms of roles and importance. For this purpose, we can adapt the standard procedure of stakeholder analysis (Dick, 1997) aiming to classify stakeholders in terms of influence and involvement in the rural system analysed.

Table 8 Stakeholder analysis

Stakeholders	Involvement		Influence	
	Estimates	Confidence	Estimates	Confidence
Name				
Name				
…				

Table 8 can be compiled according to the following indications.

Column 2: best estimate of the stakeholder's attitude, from supportive to opposed. A five-category code can be used:

++ strongly involved

+ weakly involved

0 indifferent or undecided

Column 3: How confident we are about your estimate in column 2. Here symbols can be used:

V(a tick) for fully confident

? for reasonably confident (some missing information, perhaps, or some doubts about interpretation)

?? for an informed guess

Unless the group achieves immediate agreement, then at least one question mark is warranted.

Column 4: best estimate of the influence of the stakeholder. A two-category code is usually enough:

H - high; this person or group has power of veto, formally or informally

L – low; this person can do little to influence the outcomes of your intended actions

Column 5: How confident we are about your estimate in column 4. same codes as in column 2 can be used.

In the third step key stakeholders need to be defined: for this purpose, results arising from Table 1, can be organised as indicated in Table 9:

Table 9 Classification of stakeholders according to relative influence and involvement

High involvement	Intermediate stakeholders	Key stakeholders
Low involvement	Marginal stakeholders	Intermediate stakeholders
	Low Influence	**High Influence**

At this stage, a qualitative assessment of the consistency of the classification can be obtained by counting the number of question marks (?) that have been assigned to the stakeholders in the stakeholder analysis (table 1).

Key stakeholders should be considered those who have both high involvement AND high influence in the investigated rural systems of the case studies, and should be necessarily included in the analysis. They constitute the core group of experts to base assessments on.

Despite this can be considered as a loss of potential information, marginal stakeholders, i.e. those who have both low involvement AND low influence, may be eliminated if the overall number of stakeholders exceeds a manageable size (indicatively 20 people).

Intermediate stakeholders are those who have high involvement OR high importance concerning the analysed system. Should it be necessary to narrow down the number of stakeholders also after the elimination of marginal stakeholders, the degree of uncertainty linked with the assessment given in table 1 may be taken as a criteria for the exclusion of intermediate stakeholder (high uncertainty = elimination).

In order to be sure that no relevant stakeholder has been left out from the analysis, the stakeholders individuated with the present procedure can make a final brainstorming based on the selected stakeholder list with the aim of considering possible amendment or integration to the list itself.

APPENDIX II: Guidelines for selection of representative organic farms and comparable conventional farms.

Note that here the term “representative” is not used in strict statistical terms, as we expect that representative databases of organic farms are very unlikely to be available. Therefore we adopt a “subjective” approach where on the basis of expert knowledge the farm types considered more diffuse and representative of the organic sector in the country are taken into account. For practical reason here we suggest to take into account at least the following criteria; according to specific country situation such criteria may be changed or integrated.

Basic checklist for farm selection

- Dominant farm type (e.g. arable, livestock, permanent crops, mixed crop/livestock, etc…)
- Farm size mode (e.g. between 10 and 20 ha, or between 30 and 40 livestock units)
- Prevalent farm locations (e.g. plain humid areas, mountain areas, etc.)

Number of representative organic farms.

This number should ideally range between 1 and no more than 4-5 farm types. A single farm type could suffice where organic farms tend to be quite homogeneous in terms of dimension, location and type of productions. Where a higher differentiation is present, then additional representative farms can be added.

In some cases it may happen that for the same farm type two or more typical locations or farm sizes are to be considered as relevant for properly describe the organic situation. If this should happen, the number of representative organic farms would increase accordingly, adding complexity to the analysis. Again a subjective evaluation concerning both the diversification of the organic sector on one side, and the actual resources allocated for the analysis should be done in order to maintain manageable the number of representative farms.

Data structure of the representative organic farms

The information ideally should be structured in accountancy terms, in order to be able to extrapolate the information required in Table 10, Table 11, Table 12 (see appendix III)

Data source

Ideally, once the representative farm(s) has been individuated, data should be extrapolated from existing databases, averaging the farms that satisfy the requirements..

In practice we expect that in few countries such databases are available with the required level of information detail. Therefore two alternatives may be identified:

The first one is to perform a direct survey of farms belonging to the representative farm identikit, collecting the budget information required. Of course, the higher is sample size the higher will be the quality of the information collected, but again feasibility consideration are to be taken into account.

According to our example:

- Farm A: livestock farm, located in mountain areas with 15-20 Livestock units
- Farm B: arable farm, located in plain areas, with 15-20 ha of Utilisable Agricultural Area

Farm A and Farm B like farms could be directly surveyed, hence selecting eg for Farm A type about 5-15 livestock farms located in mountain areas with a number of livestock units ranging from 15 to 20.

The second alternative is to "rebuild" with desk analysis the ideal representative farms. A virtual representative farm may be "rebuilt" considering for each of the main productive types (e.g. crop or livestock) the following aspects:

- "typical" farm size,
- average yields per product type(data already collected for yields under section 2.2.2 may be used)
- average labour and capital input requirements (information on these issues may be collected from technical manuals – literature reviews, agronomic technical manuals
- average farm gate prices (and eventual subsidies);
- average share of labour, capital, purchased input costs over gross output (information on these issues may be collected from technical manuals – literature reviews, agronomic technical manuals)

A panel of experts (agronomic technicians, farmers, local policy makers, …) will define on the basis of their knowledge, experiences and available literature the likely features of a typical organic farm sticking to the location, size and farm type requirements defined when individuating the representative organic farm(s).

The expert selection can be done using the stakeholder analysis procedure indicated in Appendix I.

APPENDIX III Data collection for economic budget analysis of organic and (comparable) conventional farms

The general approach is quite simple: the basic elements of output and variable and fixed costs are disaggregated in terms of quantities and unit prices, and total values accordingly computed. Such scheme is the basis for different in depths analysis:

- distinction between technical and price based factors for the achievement of the main budget results;
- sensitivity analysis in terms of price variation of both inputs and output in order to individuate the critical values that assure the achievement of positive profits.
- partial budgeting analysis aiming to analyse the performance and contribution to the overall economic results of single farm productions (e.g livestock and crop productions).
- role played by subsidies using simulations concerning different combinations of price premiums and subsidies level computed subject to the achievement of positive final economic results.

NB: Shaded areas indicate that the specific information they refer to is not required/applicable

Table 10 Gross output components:

	Quantities	**Unit price**	**Total**
1. GROSS OUTPUT			
Crops:			
annual crops:			
Crop 1			
Crop 2			
: :			
Crop n			
Subsidies			
Pluriannual crops:			
Crop 1			
Crop 2			
: :			
Crop n			

Subsidies			
Livestock:	(livestock units)		
Beef			
Sheep, goats			
Pigs			
Other			
Subsidies			
Other farm incomes			
Marketing of farm processed food Artisan activities Other (please specify)			

Table 11 Variable cost components

	Quantities	Unit price	Total
2. VARIABLE COSTS			
Variable costs for crops (please disaggregate per crop where possible):			
Fertilisers			
Pesticides			
Seeds			
other			
Variable costs for livestock (please disaggregate per livestock type where possible):			
Water			
feed			
Health and other			
Variable costs for machineries(please disaggregate per livestock type where possible):			
Fuel and lubricants	kg		
Maintenance	n. of applications	Price per application	
Rents			

Marketing and processing costs (please disaggregate per livestock type where possible):			
Non family workers	A.W.U.		
Other			

Table 12 Fixed costs and overheads components

	Quantities	Unit price	Total
4. FIXED COSTS AND OVERHEADS			
Depretiation:			
Building			
machineries			
Other			
Overheads			
Interest on borrowed capital and fixed assets		%	

This information will feed into the scheme presented in **Table 4**, section 2.4.2:

gross output (1)– variable costs (2) = gross income (3)
gross income (3) – fixed costs (4) = net income (5)
net income (5) – family labour "shadow wages"(6) = farm profit (7)

Note that (6) can be defined as the remuneration of the labour activity of the farmer and his relatives and can be computed multiplying the total family labour hours per year by the average wage rates of agricultural workers.

The basic structure of the farm budget can be used to compute partial budgets, i.e. budget referring to specific crop or livestock activity, in order to measure their contribution to the overall farm profit. This would allow to individuate

- The crop/livestock activities that are more profitable
- The price conditions under which each crop/livestock activity would increase their profitability
- Eventual crop/livestock activities where cost incidence is higher (and therefore scope for increase efficiency or think to reorient production)

This basic budget scheme can constitute the basis for simple optimisation models like what-if simulation and goal-oriented models.

APPENDIX IV Data collection for Social Impact Analysis

In data collection is of paramount importance to distinguish between quantitative and qualitative approaches.

Quantitative data should be looked for at first. It is likely that little quantitative data exist to measure the selected indicators in most of the developing countries, especially when organic agriculture is concerned. Nevertheless, it should be explored:

a) if existing data are readily available; and
b) if quantitative data could be collected in the near future.

In any case, quantitative data need to be supplemented by qualitative information, since in most cases the dimension of orgabnic farming is too small to allow significant statistical analyses.

Qualitative data and approaches allow the community itself to analyze its own development and determine the most important effects of farming practices and solutions to existing problems. At the project level, such information may be critical for the design for projects and policies aimed at developing organic farming.

Qualitative data and approaches also enable causality to be introduced between variables.

The reason for combining quantitative and qualitative approaches is to tap the breadth of the quantitative approach and the depth of the qualitative approach. In general, the following statements are true:

(i) Integrating methodologies can result in better measurement.

(ii) Confirming, refuting, enriching, and explaining can result in better analysis.

(iii) Merging the quantitative and qualitative findings into one impact assessment can lead to better action.

Some ways in which the integration of methodologies can be achieved are to use quantitative survey data to determine the individuals/communities to be studied through the qualitative approach; use qualitative work to determine the design of the quantitative survey questionnaire; to identify variables of importance to respondents; to identify types of questions that should be asked in the formally structured interviews; to determine the design of the quantitative survey questionnaire; to pre-test the quantitative survey questionnaire.

Qualitative approaches can enrich and explain findings of quantitative studies/surveys. Qualitative work can be used to identify issues or obtain information on variables not obtained by quantitative surveys. Qualitative work can also be used to understand unanticipated results derived from quantitative data. In principle, each of these mechanisms may operate in either direction–from qualitative to quantitative approaches or viceversa.

Data Collection Systems

1. Population Census

The population census contains basic information on all citizens of a country. The census is carried out for all households in order to obtain basic information on the population, its demographic structure, and its location. In most countries, it is carried out by the national statistics institute, which can then provide data to lower levels of government, tailored to local information needs. The information gathered is limited. Information on household income & consumption are generally not included. Census data, however, normally provide the following:

(i) information at different levels of disaggregation within the country or region;

(ii) descriptive statistics of households and farms;

(iii) production and land use data; and

(iv) employment patterns.

2. Household Surveys

Household surveys can be an important resource for social impact assessments and diagnostics and are essential for analysis of welfare distribution. Household surveys can be an indispensable tool for measuring the extent and distribution of income, and analyse employment patterns and wages.

At the same time, an important shortcoming of aggregate household-level analysis is that it can provide only limited understanding of the intra-household distribution of resources, especially of income and consumption.

While the census covers the whole population, surveys interview only a subset, generally a small fraction. This sample of households is carefully chosen so that the results of the survey accurately describe living conditions in the country, and different parts of the country. Sampling should be based on mapping of actual settlements. Sampling is most often informed by a recent population census. The sample size—the number of households interviewed—will vary with several factors:

(i) The indicator to be measured. A survey that aims to measure countrywide averages of income will require a larger sample than a survey designed to measure the percentage of the population with water connections.

(ii) The level at which data are needed. Determining the national electricity connection rate will require fewer households to be interviewed than determining a regional or district rate.

(iii) The population. Household surveys are much smaller than a population census and therefore also less costly.

Disaggregation of the collected data will increase their analytical usefulness. Gender is one of the many ways in which data can be disaggregated, and the rationale for doing so is that – in earning income, in finding and keeping an employment, as well as in achieving many other personal rights – women face different constraints than men.

3. Focus Groups

Focus groups are one of the most frequently used techniques in qualitative research. A focus group can be defined as a loosely structured interactive discussion conducted by a trained moderator among a small group of respondents. The value of the technique lies in discovering the unexpected, which results from a free-flowing group discussion.

Focus groups are normally composed of 8 to 12 individuals. A session typically lasts between one and two hours. Participants' comments are usually recorded on audio or videotapes which eventually become the basis for a report summarizing the contents of the discussion. The number of sessions conducted on a topic varies. Although Calder (1977) suggests that a sufficient number should be conducted until the moderator can anticipate what the participants are going to say, he indicates that this usually happens after three or four sessions on the same topic. The value of the technique lies in discovering the unexpected, which emerges naturally from a free-flowing group discussion.

Focus groups are particularly useful when analysing the social effects of new projects, policies, products, and trying to obtain a basic understanding of the causality underlying events.

4. Key-informant in-depth interviews

In some instances, when exist some key-people that can help assessing social impacts or provide relevant data for social impact assessment

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