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Research Report
on the Analytic Multifunctionality Framework

Deliverable 2.1

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Research Report on the Analytic Multifunctionality Framework

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1 Introduction to the deliverable 'D 2.1.'

Let us remember the context and the objectives of MEA-Scope (Micro-economic instruments for impact assessment of multifunctional agriculture to implement the *Model of European Agriculture*).

Common Agricultural Policy (CAP) reform aims at higher international trade compatibility and better targeting of social, environmental and consumer concerns, while seeking to ensure the sustainable development of EU agriculture. To optimise the effectiveness and efficiency of CAP reform options towards multifunctionality implementations, tools are required to assess the impacts of agricultural production on the multiple functions of European landscapes.

The EU's *Model of European Agriculture* (MEA) has a multifunctional perspective but the EU and regional policy makers lack multifunctionality impact assessment tools. MEA-Scope is providing such a tool. To ensure compatibility with the MEA, a MEA-specific interpretation of multifunctionality will be devised and used in the design of MEA-Scope. Furthermore, MEA-Scope will analyse and evaluate the multifunctionality of agricultural production under a multitude of environmental, social and economic conditions. In particular, applied to one exemplary farming system (beef production) for different European landscapes, MEA-Scope allows to assess joint production of commodities and non-commodities in different regions.

Among the various tasks to be performed by WP2, the following scientific objectives concern directly the first deliverable (DoW, p11):

“MEA-Scope will develop an analytical framework that allows to pin-point amendments to the current multifunctionality approach of the MEA. These further developments make the MEA interpretation compatible with the international trade negotiation requirements without sacrificing its normative basis in sustainable development and the promotion of rural areas.”

The multifunctional perspective is thus an essential component of the Model of European Agriculture (MEA). It involves the recognition of a range of economic, social, cultural and environmental functions of agriculture in Europe.

In this context, the report aims to give an overview on the multifunctionality of agriculture

from a theoretical viewpoint, before making the concept operational as a policy tool (main task of the MEA-Scope project). In the DoW, page 26: “The analytic multifunctionality framework (AMF) must be an abstract conceptual framework, not an immediately applicable multifunctionality interpretation.” This concept has different meanings in the literature, which are discussed here. This point is of importance with respect to the impact of these approaches on the development of the indicator list and the modelling task. In this way, the deliverable D 2.1. should give a theoretical foundation to the MEA.

2 The European Model of Agriculture and the multifunctional perspective

2.1 The European Model of Agriculture: the driving force of the CAP

The ‘European model of agriculture’ was introduced into the terminology of the Common Agricultural Policy (CAP) with the Agenda 2000 reform (CEC, 1998). It is based on the suggestion that European farming provides multifunctional (non-market) side effects. These effects are generally associated with positive attributes and may include food security, food safety, animal welfare, cultural landscape, biodiversity and rural development (Glebe, 2003). It includes ambitions in relation to environmental- ethical- and cultural aspects of farming and production technology. This model could also be described as a multifunctional agricultural production system.

However, the importance given to the role of multifunctional benefits in European farming is not always recognised in other parts of the world. While the European Union (EU) stresses the importance of safeguarding the provision of positive agri-environmental goods, countries such as the United States (US) and the Cairns Group¹ play down the relevance of multifunctional effects, and instead, emphasise the importance of negative agri-environmental externalities.

Today there exist a large number of environmental schemes within the EU and often politicians justify the CAP with the multifunctionality of modern western agriculture. The modern view of the public role in agriculture is favouring a policy that is oriented towards an increased political responsibility for public goods. In this context, the political focus is now on jointness in the pro-

¹ MEMBERS OF THE CAIRNS GROUP ARE: ARGENTINA, AUSTRALIA, BOLIVIA, BRAZIL, CANADA, CHILE, COLOMBIA, COSTA RICA, GUATEMALA, INDONESIA, MALAYSIA, NEW ZEALAND, PARAGUAY, THE PHILIPPINES, SOUTH AFRICA, THAILAND, AND URUGUAY.

duction of private and public goods and environmental and cultural amenities.

The CAP is a widely debated policy in reference to its budget and its instruments. It has evolved from its initial objectives, which were set out in Article 32 of the Treaty of Rome: to increase agricultural productivity, ensure an equitable income for farmers, stabilise agricultural markets, ensure the availability of food and agricultural products and guarantee reasonable prices for consumers. However, the evolution of the CAP has been characterised by minor readjustments that have aimed to deal with apparent social demands. Thus, 45 years after 1957, the CAP pursues competitiveness rather than productivity, the supply of food must be not only abundant and affordable but also generally healthy and safe, and markets must be kept stable mainly because security of food supply is a public good (Gomez and al., 2004).

The rise in public awareness of the importance of maintaining rural communities has probably been the main driving force in the recent evolution of the CAP. As a result, agriculture must not only provide an adequate income for farmers but also respond to its social and territorial dimensions. Furthermore, in the course of the past few decades, knowledge of and concern for the environment have also increased substantially in Western Europe, demanding of the CAP adequate management of the relationship between agriculture and the environment.

2.2 The multifunctionality of agriculture

Multifunctionality has been widely used in the debate over agricultural policy lately and often in combination with arguments for why certain public support programs ought to be kept in place or introduced.

The concept of agricultural multifunctionality is the fruit of intense debate of which the initial phases date back to the early 90s. Its main phases, at both the international and European levels, include the principle of sustainable development ratified at the Rio Summit (1992), that of decoupling agriculture subsidies adopted in the Marrakech Agreements (1994) along with the concept of an integrated rural policy put forward at the Cork Conference (1996) and partially reiterated in the Berlin Agreements (1999) (Hervieu, 2002).

Following Hediger (2004), the concept accounts for the fact that agriculture is an economic activity that, beyond its primary function of supplying food and fibre, provides various non-markets outputs to society. These comprise a wide range of benefits, such as:

- environmental benefits: recreational amenities and aesthetic values of the rural landscape, non-use values of biodiversity and habitat protection, intrinsic values of ecosystem and watershed functions
- socio-economic benefits: food security, food safety, animal welfare, rural employment and the viability of rural areas, cultural heritage

The multifunctionality of agriculture is thus characterised by this set of non-market benefits that may constitute potential sources of market failure¹ and provide some theoretical argument for public intervention.

Consequently, the concept of agricultural multifunctionality summarises the multiple objectives currently facing the CAP. This concept, which emerged during the Agenda 2000 process of reform, reflects both the capacity of agriculture to produce a wide range of goods and services and the existence of a social demand for them, particularly due to the public good character of some of them (OECD, 2001).

Principles of Agenda 2000 are the following:

“The multifunctionality of agriculture and its varied role over and above the production of food expresses one of some main principles of Agenda 2000. This implies the recognition and encouragement of the range of services provided by farmers. Emphasis is to be put on a multi-sectoral and integrated approach to the rural economy in order to diversify activities, create new sources of income and employment and protect the rural heritage...”
(http://europa.eu.int/comm/agriculture/rur/back/index_en.htm)

An agricultural policy review in the light of the multifunctional aspects of agriculture was then given in Agenda 2000. This concept was introduced as the basis of the Model of European Agriculture (MEA) as a justification for changing the Common Agricultural Policy (CAP) from price support into income and acres support. In implementing the CAP, multifunctionality has become the leading concept of European agricultural policy. The Model of European Agriculture tries to find a new balance in an agricultural system that integrates social, spatial and ecological conditions. It is multifunctional by integrating the interrelated objectives of farmers and society on the production, territorial, and social level.

¹ MARKET FAILURE OCCURS WHEN THE MARKET PRICE OF A GOOD DOES NOT INCLUDE THE COSTS OR BENEFITS OF THE EXTERNALITY CONSIDERED. FOR INSTANCE, THE COST TO THE WHOLE SOCIETY OF WATER POLLUTION CORRESPONDS TO A MARKET FAILURE.

In this context, if it is to serve the citizens of Europe well, Gomez and al. (2004) consider that the CAP requires two kinds of corrective actions of policymakers: first, the optimal identification of the public objectives that are to be achieved and, in the second place, a suitable choice of policy instruments to be implemented.

If European citizens have always recognised that agriculture is not only a sector of economic importance but that it also plays a much wider role in society as a whole (CAOEU,1999), there is now a growing awareness of both new pressures on agriculture and a changing emphasis in society's expectations:

- pressure at world level, and within the EU, towards greater free trade is challenging the policies which for decades have made it possible for European farmers to produce high quality safe food for the European market using sustainable production methods and to maintain the diversity of European farming - with its vast range of production spread throughout the EU and the family-run farm at its heart;
- at the same time there is growing concern in Europe about food safety and quality and about certain technological developments. Society is also placing much greater emphasis on environmental protection, animal welfare, enhancing the countryside, preventing rural depopulation and the need for greater cohesion between richer and poorer regions.

There is considerable common ground between the expectations and concerns of farmers, those of consumers and those of European citizens as a whole. These new challenges must therefore be met by developing the European model of agriculture, which is multifunctional, by integrating the interrelated objectives of farmers and society in three main ways:

- **production:** to provide consumers with secure and stable supplies of healthy quality food & non-food products and to develop the EU's competitive position on the internal and world market based on sustainable production methods;
- **territorial:** to safeguard and enhance the countryside and to provide environmental services valued by the public at large; to underpin the infrastructure, the economy and employment in a vast number of villages throughout the European Union and to prevent depopulation and desertification in more remote and difficult areas;
- **social:** to contribute to reinforcing the economic and social cohesion between groups and regions - reducing disparities between the richer and poorer regions of the EU.

In this context, the EU's approach to the multifunctionality of agriculture stands for a nor-

mative approach where managing the European countryside is not in the hands of the farmers alone (Multagri, 2004). The multifunctional role of European agriculture consists of supplying safe high quality food while providing services which meet the firm expectations expressed clearly today by European citizens as a whole - services which are available to all and which therefore do not always have a marketable value.

2.3 CAP Reform: a long-term perspective for sustainable agriculture

On 26 June 2003, EU farm ministers adopted a fundamental reform of the Common Agricultural Policy (http://europa.eu.int/comm/agriculture/capreform/index_en.htm). The reform will completely change the way the EU supports its farm sector. The new CAP will be geared towards consumers and taxpayers, while giving EU farmers the freedom to produce what the market wants. In future, the vast majority of subsidies will be paid independently from the volume of production. To avoid abandonment of production, Member States may choose to maintain a limited link between subsidy and production under well-defined conditions and within clear limits. These new 'single farm payments' will be linked to the respect of environmental, food safety and animal welfare standards. Severing the link between subsidies and production will make EU farmers more competitive and market orientated, while providing the necessary income stability.

This reform will also strengthen the EU's negotiating hand in the ongoing WTO trade talks. The different elements of the reform will enter into force in 2004 and 2005. The single farm payment will enter into force in 2005. If a Member State needs a transitional period due to its specific agricultural conditions, it may apply the single farm payment from 2007 at the latest.

Some key elements of the reformed CAP are:

- A single farm payment for EU farmers, independent from production (decoupling); limited coupled elements may be maintained to avoid abandonment of production. This payment will be linked to the respect of environmental, food safety, animal and plant health and animal welfare standards, as well as the requirement to keep all farmland in good agricultural and environmental condition ('cross-compliance'),
- A strengthened rural development policy with more EU money, new measures to promote the environment, quality and animal welfare and to help farmers to meet EU pro-

duction standards starting in 2005,

- A reduction in direct payments ('modulation') for bigger farms to finance the new rural development policy,

These new measures within the CAP reform have to meet the sustainability of agriculture. Sustainable agriculture means to ensure that future generations can enjoy the benefits of Europe's unique environmental heritage and natural resources, as we do today. Achieving sustainability, means meeting three challenges:

- an economic challenge (by strengthening the viability and competitiveness of the agricultural sector);
- a social challenge (by improving the living conditions and economic opportunities in rural areas);
- and an ecological challenge (by promoting good environmental practices as well as the provision of services linked to the maintenance of habitats, biodiversity and landscape).

Sustainable agricultural production must also reflect the concerns of consumers, particularly with respect to quality, safety and traditional/organic production methods. Addressing the environmental dimension of the CAP includes at one level measures to *improve the environmental soundness of agricultural production* (e.g. investing in improved technology, promoting extensification). On the other level, it means measures *securing the function of farmers as stewards of the countryside* and to encourage them to actively preserve the rich rural landscape and biodiversity(http://europa.eu.int/eur-lex/en/com/cnc/2000/com2000_0020en01.pdf)

The measures to be adopted must obviously comply with existing environmental legislation. They must be based on the provisions of the reformed CAP resulting from Agenda 2000. Under the common rules on direct support schemes in those markets, Member States must lay down environmental requirements they consider to be appropriate and may make payments dependant on compliance with those requirements (cross compliance).

In addition, the policy on rural development (referred to in Agenda 2000 as the 'second pillar' of the CAP alongside the markets policy) includes special environmental measures, known as agri-environment measures. These provide for payments for commitments going beyond good agricultural practice. They constitute an important environmental tool, being compulsory in all rural development programmes and based on a voluntary commitment by farmers to greener

agriculture. The environment is no longer seen as an 'add-on' but as an essential part of agricultural and rural development and of the socio-professional life of farmers. Farmers, as the first link in the production chain, have a tremendous responsibility for the sound management of environmental resources and that responsibility must be recognised.

It should not be thought that more environmentally friendly agriculture means old-fashioned methods. For example, organic farming (one form of sustainable farming) uses modern, yet natural, plant-protection methods, which avoid the use of pesticides. Increased consumer awareness of food safety issues and environmental concerns has contributed to the growth in organic farming over the last few years. Although it only represented around 3 % of the total EU utilised agricultural area (UAA) in 2000, organic farming has in fact developed into one of the most dynamic agricultural sectors in the European Union.

Organic farming has to be understood as part of a sustainable farming system and a viable alternative to the more traditional approaches to agriculture. Since the EU rules on organic farming came into force in 1992, tens of thousands of farms have been converted to this system, as a result of increased consumer awareness of, and demand for, organically grown products.

Finally, it must be stressed that the aim is not to call into question the objectives of the reformed CAP but rather to ensure that the measures carried out actually achieve those objectives. Fully applied, the rural development policy is an essential tool for creating the conditions for sustainable farming. Consolidating this 'second pillar' is one of the main priorities of the CAP. Compliance with the financial perspective for 2000-06 requires that the resources available must be used as effectively as possible, making the accurate targeting of measures and their evaluation all the more important.

The sustainability of both agriculture and the environment is a key policy objective of today's common agricultural policy: "Sustainable development must encompass food production alongside conservation of finite resources and protection of the natural environment so that the needs of people living today can be met without compromising the ability of future generations to meet their own needs."

This objective requires farmers to consider the effect that their activities will have on the future of agriculture and how the systems they employ shape the environment. As a consequence, farmers, consumers and policy makers have shown a renewed interest in more environmentally friendly agriculture.

3 The multifunctionality of agriculture: a conceptual framework

If multifunctionality is a rather new concept, it nevertheless relates to old issues. It focuses on the fact that agriculture delivers other goods than commodities. Thus, if the traditional function of agriculture is to provide food (and fibres), new functions arise: agriculture may produce rural amenities (hunting, landscape...), ecological services, habitat for wildlife and biodiversity. In this context, two approaches of the multifunctionality of agriculture can be considered: one is focusing on the demand side issue (normative approach) while the second is focusing on the supply side issue (positive approach). (OECD, 2001)

3.1 The demand side issue of multifunctionality

Generally, European views on the multifunctionality of agriculture encompass a wide range of potential attributes which relate primarily to land use such as protection of wildlife habitat, biodiversity, landscape amenities, and to social attributes such as the viability of rural communities and food security (Blandford and al. 2004). As OECD has subscribed to this approach, we consider first some comments on its presentation of this issue.

According to the OECD (2001), “the key elements of multifunctionality are: i) the existence of multiple commodity and non-commodity outputs that are jointly produced by agriculture; and ii) the fact that some of the non-commodity outputs exhibit the characteristics of externalities or public goods, with the result that markets for these goods do not exist or function poorly.” More precisely, “Multifunctionality refers to the fact that agriculture, beside satisfying the basic demand of food, fulfils at the same time other functions society requires, such as biodiversity, pollution control, amenity values (i.e. landscapes), cultural heritage, food safety, rural settlement and retention of economic activities in less favoured areas. Then, multifunctionality becomes a policy issue when it is related to i) the existence of *multiple* commodity and non-commodity outputs that are *jointly* produced by agriculture, and ii) (some of the) non-commodity outputs show the characteristics of *positive externalities* or *public goods* (OECD, 2000). “Commodity outputs” (CO) in this view refer to the satisfaction of material, while “non-commodity outputs” (NCO) to the satisfaction of other needs expressed by the society” (Belletti and al. 2002).

The general framework on the multifunctionality of agriculture expressed by OECD gives the following sense to the concept: multifunctionality refers to the fact that “an economic activity may have multiple outputs and, by virtue of this, may contribute to several societal objectives at once.

Multifunctionality is thus an activity-oriented concept that refers to specific properties of the production process and its multiple outputs.” (OECD, 2001, p.6)

Within OECD, a lot of work has been done to shed light over the various forms of the multifunctionality concepts. Cahill (2001) discusses the concept in a manner very close to that of the OECD: multifunctionality may be considered as jointness in production and take a positive externality (e.g. jointness in production) in combination with a public good and a market failure to motivate a political initiative in the name of multifunctional agriculture.

Consequently, multifunctionality can be interpreted in terms of multiple functions assigned to agriculture and can be developed through a demand-oriented approach.

3.1.1. Multifunctionality within a demand-oriented approach: a functional dimension

In ecological economics, there is a tradition of identification, classification and valuation of ecosystem functions, goods and services.

Agriculture as an economic activity is given the objective of fulfilling certain functions in society. Here, the multifunctionality is not merely a characteristic of the production process but becomes a policy objective in itself. Multifunctionality concept is then analysed within a demand-oriented approach that seems advantageous in accordance with the micro-economic approach of the project and its objective to furnish a decision-making tool for European policy.

By considering Multiland (2004), the scope we propose for our project is to define functions as:

the factual or potential provision of material or immaterial goods and services that satisfy social expectations, meeting societal demand/needs through agriculture sector structure, agricultural production processes and the spatial extent of agriculture.

This working definition links multifunctionality to social demand and societal needs as an objective of public policy. The content of this work will consist of a ‘function’ definition and the identification of landscape functions, along with several analytic *dimensions* of multifunctionality.

Social demand relates to various factors; on the one hand there is the product and its characteristics, on the other hand there are the farm, the landscape, and rural areas. Multifunctionality also involves various stakeholders. Stakeholders may be defined as “those who have an interest in a particular decision, either as individuals or representatives of a group. This includes people who influence a decision, or *can* influence it, as well as those affected by it” (Earth Summit 2002). At the bottom, there are the farmers, local residents, tourists, the whole society and

their representatives.

Each function is associated to one or more stakes. Social expectation defines indeed the policy objectives that define in their turn the functions assigned to agriculture. To organise these stakes is thus to specify them on the basis of three criteria: - **the origin of the demand** (local versus global); - **the spatial dimension** (at the farm level or at the landscape level); - **the entity dealing with the function** (landscape related functions or institutional related functions). Institutional related functions are socio-economic context dependant.

The above definition is for instance a non-normative definition in the sense that it does not presuppose any specific definition of the common good or of specific objectives. The definition is open to the full range of societal needs and demands without passing a value judgment on their desirability, urgency or despicability. However, the landscape functions approach adopted in this project allows to scan and analyse several disciplinary sources (environmental and resource economics, landscape planning, agronomy, landscape ecology, ...) systematically for the identification and - if necessary - invention of agricultural functions.

To define landscape, in regard to the question addressed in this project, we take a very pragmatic point of view. In a first step, landscape can be simply regarded as sections of the face of the Earth that are larger than a single homogeneous plot or habitat, but smaller than a continent. But a better definition should refer to explicit criteria that include bio-geophysical and/or cultural attributes. From the bio-geophysical side, landscapes can be regarded as ecosystems. Consequently, the following definition may be more suitable for our project:

“An area composed of interacting ecosystems that are repeated because of geology, land form, soils, climate, biota, and human influences throughout the area. A generally heterogeneous composition of multiple land units that may contain multiple interacting ecosystems. Landscapes are usually defined for large areas, typically from 1000 to 100,000 ha in size.”
[\[www.ci.boulder.co.us\]](http://www.ci.boulder.co.us)

3.1.2. Definition of landscape functions in ecological economics

The capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly.

They classify functions into four groups:

- **Regulation functions** relate to the capacity of ecosystems to regulate essential ecological processes and life support systems. Additionally, they provide direct or indirect benefit to humans (see list of goods and services in the Table)
- **Habitat functions:** conservation of biological and genetic diversity
- **Production functions:** ecosystems provide a large variety of goods for human consumption ranging from food, medicines and raw materials to energy resources and genetic materials
- **Information functions:** ecosystems contributes to human enrichment and cognitive development by providing opportunities for reflection, recreation and aesthetic experiments.

De Groot and al. (2002) provide a definition of ecosystem functions as :The rank-order of function categories follows a certain logic. Regulation function and habitat function are essential for the maintenance of natural processes and components. They condition the maintenance and the availability of two other function-groups. One can establish some hierarchy between them. However, de Groot and al. (2002) stress that since they all support human life, the proposed hierarchy should not be interpreted too strictly. The nature and magnitude of value of ecosystems to human society can be analysed and assessed through the goods and services generated by these functional aspects. Three categories of values enable the assessment of total value of ecosystems for society: ecological values, economic values and social values. Ecological value must be interpreted as the importance of an ecosystem that is determined by the integrity of regulation and habitat functions and by ecosystem parameters (see de Groot and al. 2002). Social values are related to education, cultural diversity, heritage, etc...mainly information functions. Economic values are attached to market goods and non-market goods. For the market goods, the market price corresponds the economic value. Non-market goods do not have an observable monetary value. However, they are valued by society because of the existence of demand attached to use values and non-use values. The use value is the value to society from the actual or future use of the non-market good. Non-use values reflect the value beyond any use. The most commonly cited non-use value is the value society is willing to pay to guarantee that it simply exists (existence value). Other non-use values are thought to originate in society's willingness to pay to preserve for future generation (bequest values).

The following table lists ecosystem processes and components and goods and services provided.

Table 1: Functions, goods and services of natural and semi-natural ecosystems

	Functions	Ecosystem processes and components	Goods and services (examples)
	Regulation Functions	Maintenance of essential ecological processes and life support systems	
1	Gas regulation	Role of ecosystems in biogeochemical cycles (e.g. CO ₂ /O ₂ balance, ozone layer, etc.)	1.1 UVb-protection by O ₃ (preventing disease) 1.2 Maintenance of (good) air quality 1.3 Influence on climate (see also function 2.)
2	Climate regulation	Influence of land cover and biol. mediated processes (e.g. DMS-production) on climate	Maintenance of a favourable climate (temp., precipitation, etc) , for example, human habitation, health, cultivation
3	Disturbance prevention	Influence of ecosystem structure on dampening env. disturbances	3.1 Storm protection (e.g. by coral reefs) 3.2 Flood prevention (e.g. by wetlands and forests)
4	Water regulation	Role of land cover in regulating runoff & river discharge	4.1 Drainage and natural irrigation 4.2 Medium for transport
5	Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers)	Provision of water for consumptive use (e.g. drinking, irrigation and industrial use)
6	Soil retention	Role of vegetation root matrix and soil biota in soil retention	6.1 Maintenance of arable land 6.2 Prevention of damage from erosion/siltation
7	Soil formation	Weathering of rock, accumulation of organic matter	7.1 Maintenance of productivity on arable land 7.2 Maintenance of natural productive soils
8	Nutrient regulation	Role of biota in storage and re-cycling of nutrients (e.g. N,P&S)	Maintenance of healthy soils and productive ecosystems
9	Waste treatment	Role of vegetation & biota in removal or	9.1 Pollution control/ detoxification.
		Breakdown of xenic nutrients and compounds	9.2 Filtering of dust particles 9.3 Abatement of noise pollution
10	Pollination	Role of biota in movement of floral gametes	10.1 Pollination of wild plant species 10.2 Pollination of crops

11	Biological control	Population control through trophic-dynamic relations	11.1 Control of pests and diseases 11.2 Reduction of herbivory (crop damage)
	Habitat Functions	Providing habitat (suitable living space) for wild plant and animal species	Maintenance of biological & genetic diversity (and thus the basis for most other functions)
12	Refugium function	Suitable living space for wild plants and animals	Maintenance of commercially harvested species
13	Nursery function	Suitable reproduction habitat	13.1 Hunting, gathering of fish, game, fruits, etc. 13.2 Small-scale subsistence farming & aquaculture
	Production Functions	Provision of natural resources	
14	Food	Conversion of solar energy into edible plants and animals	14.1 Building & Manufacturing (e.g. lumber, skins) 14.2 Fuel and energy (e.g. fuel wood, organic matter) 14.3 Fodder and fertilizer (e.g. krill, leaves, litter)
15	Raw materials	Conversion of solar energy into biomass for human construction and other uses	15.1 Improve crop resistance to pathogens & pests 15.2 Other applications (e.g. health care)
16	Genetic resources	Genetic material and evolution in wild plants and animals	16.1 Drugs and pharmaceuticals 16.2 Chemical models & tools 16.3 Test-and essay organisms
17	Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Resources for fashion, handicraft, jewelry, pets,
18	Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	worship, decoration & souvenirs (e.g. furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)
	Information Functions	Providing opportunities for cognitive development	
19	Aesthetic information	Attractive landscape features	Enjoyment of scenery (scenic roads, housing, etc.)
20	Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for ecotourism, outdoor sports, etc.

21	Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting, folklore, national symbols, architect., advertising, etc.
22	Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features)
23	Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, etc. Use of nature for scientific research

Source : de Groot and al. (2002).

However, the concept of ecological sustainability is introduced to base the selection of goods and services in order to maintain the ecosystem functions and associated ecosystem processes and structures. This defines ecosystems functions within the concept of strong sustainability where no substitutability of natural capital is possible. Consequently, human uses that can impair the integrity and proper functioning of natural processes and components are not legitimate. This restricts the analysis to ecosystems that can provide all functions simultaneously and indefinitely. This proposition makes some sense for natural and semi-natural systems, as only a limited selection of human land uses is compatible with the unchanged persistence of ecosystem structure and species composition. For general application, the applied ecological sustainability is overly restrictive.

Schanze (2003) builds upon the function definition of de Groot (1992) and defines functions as:

The current and potential ability of processes, structures and ways of life in the naturegenic environment to provide and accept energy and material, as well as to use biological activity to satisfy human needs. (p.24).

The notion of capacity is replaced by a reference to the actual and potential provisioning of environmental goods and services. The introduction of this distinction surely coincides with an approach that is more societal demand oriented.

3.1.3. Landscape functions in the field of landscape ecology

Bastian (1998) argues that the ideas of landscape functions/natural potentials, which had been used first by Neef (1966), Haase (1978), Mannsfeld (1979) are helpful approaches not only for the analysis and the assessment of the landscape, but also to draft landscape-ecological goals. It is not a matter of landscape functions in the sense of “transport and fluxes of energy, mineral nutrients”, “organisation of species”, or “patch matrix interactions” (Forman, 1981). The objective here is to transform scientific knowledge to social categories, and to bridge the gap between nature and human society.

Natural potentials/landscape functions characterize the capability and usability of a landscape in a broad sense. Natural potentials/landscape functions encompass regulation and regeneration of landscape compartments (fraction of land cover for instance or landscape elements) and whole ecosystems as an entity and, on the other hand, the ability of landscape to satisfy needs and demands of human society.

The definition of landscape potential stems from the geographic landscape perspective and focuses on the identification of unexploited potentials for societal – particularly for economic – purposes. Then, landscape processes are included in the analysis as well as statements on the regeneration of useful landscape features and risks caused by natural processes.

In accordance with Haase (1978), a “total potential” of the landscape is subdivided into partial potentials. The subdivision is based on the diverse societal demands placed upon landscapes:

- Biotic yield potential
- Water potential
- Sink potential
- Biotic regulation potential
- Geoenergetic potential
- Settlement potential
- Recreational potential

Bastian and Schreiber (1999: p.37) approve of the landscape potential approach as a time-tested concept, which is used increasingly in conservation and in official planning documents. They stress however that the function concept is more flexible than the potential concept because it is more suitable for the representation of immaterial functions. They present a list of 32 landscape functions that are classified hierarchically in three function groups:

- **productions function** (economic function)
- **regulation functions** (ecological function)
- **social/human habitat functions** (social function)

We can note here that the important issue with the invention of landscape functions is not the classification system of the landscape functions, nor the function terminology at all, but the identification of needs and demands and the landscape states, structures and processes on which they depend. Bastian and Roder (1998) consider the list of following functions to assess landscape change for the case of a hilly zone in the region of Saxony in Germany. This supposes that the demand of society was previously defined. These functions are:

- potential biotic productivity: ability of a landscape to produce biomass by photosynthesis sustainability
- resistance to soil erosion: ability to withstand soil losses caused by human activities, which exceed normal (natural) amounts (e.g. by mineralisation processes, bedrock weathering)
- water retention capacity: ability of a landscape to contribute to balanced water runoff situations and to retain the water (e.g. prevent extreme flooding) by the reduction of fast runoff components (surface runoff, interflow)
- ground water recharge: flow of percolating water to ground water
- ground water protection: the different ability of a landscape to protect ground water against contaminants, to weaken their effects or to delay their penetration
- habitat function: the landscape's ability to supply favourable living conditions for a rich flora and fauna (with its biocoenoses, and biotopes)

- potential for recreation in the landscape : the landscape's capability to realize material and immaterial performances for human recreation, i.e. the relaxation, recreation, health, and enjoyment of the landscape in order to elevate fitness, well-being and longevity, and thus to satisfy cultural and aesthetical requirements of the society.

Only regulation function and social functions are addressed in this study.

3.1.4. OECD's approach of functions: externality and public goods

The externality and public aspect of non-commodity goods and services of agriculture was first addressed within the analytical framework provided by the OECD. The reason for discussing externality and public good aspects together is that externalities alone are not necessarily a source of market failure. Only those externalities with public good characteristics may require policy intervention. We present successively the concept of externality and public goods.

The concept of externality

We refer to the global definition of externality: "An external economy (diseconomy) is an event which confers an appreciated benefit (inflicts unappreciated damage) on some person or persons who were not fully consenting parties in reaching the decision or decisions which led directly or indirectly to the event in question" (Meade, 1973).

Two situations can arise according to the type of externality. For positive externalities (which affect in a positive way social welfare), the absence of market involves a sub-optimal offer. As positive externalities are consumed by their beneficiaries without paying a price, farmers are not incited to taking account in their decision-making process the impact of their actions on the social welfare. There is here incongruence between private and public interests. Public intervention by setting up a regulation or a subsidy thus becomes essential to correct this failure of the market to coordinate the offer of positive externality. By contrast, for negative externalities, an overproduction is probable because the private producer is interested in maximising his private profit whereas a lower level of production would be necessary to respect the socially acceptable level of negative externality. Here, the public intervention takes the form of a regulation or a tax.

The concept of positive externality is used for the interpretation of several functions of agriculture. In this vein, the OCDE externality (positive externality) definition distinguishes two cate-

gories of externality: - externalities with and without opportunity cost. Opportunity cost in this context refers to the costs that producers incur to produce the externalities. They are either in the form of increased costs associated with the increased inputs needed to produce the externalities, or reduced net profits associated with a reduction in the activities that generate the externalities. The production of externalities with opportunity costs is essentially the same as the production of two (or more) products under jointly constrained inputs. Producers of externalities with opportunity costs make explicit decisions on the allocation of input resources between the production of commodities and of externalities. It generally occurs after the appearance of a new regulation.

Generally, economists focus on the second category, externalities without opportunity costs because they insist on a definition of externality as an *unintended* side effect of an activity (Dorfman, 1993). This category of externalities is generated automatically without producers deciding to allocate resources to them. Economic inefficiency associated with these externalities arises only when there are divergences between marginal social costs and marginal private costs at the market price of the product generating the externalities. If there is no divergence between social and private costs at the market price, then there is absolutely no need for policy intervention, at least from an efficiency point of view.

Table 2: Classification of positive externalities without Opportunity Costs

- | |
|--|
| <ul style="list-style-type: none">a) Constant marginal benefits externalityb) Increasing marginal benefits externalityc) Decreasing marginal benefits externalityd) Discontinuous marginal benefits externalitye) Zero marginal benefits |
|--|

Source: OECD

Private costs are the costs that producers incur to produce a good that generates an externality. Social costs are obtained by subtracting the social benefits of the positive externality from the private cost. This reflects the true cost to society of producing the good when there is an externality. (Net) social costs are, therefore, lower than private costs if the externality is positive. Both private and social costs are usually expressed in marginal terms. Private marginal cost is that required to increase production by one unit, while social marginal costs are the

difference between the private (marginal) costs and the (marginal) benefits of the externality resulting from the increase by one unit of the product generating the externality. The divergence between private marginal cost and social marginal cost provides the marginal social benefit of an externality. Corresponding to the shape of the marginal social benefit, we then get sub-groupings of externality. There are five sub-groups: constant, increasing, decreasing, discontinuous, and zero marginal benefits.

The case of constant marginal social benefits has the most ordinal shape in the theoretical analysis of externalities might be quite rare in the real world since there is usually asymmetry between commodity and non-commodity production. The case of increasing marginal social benefits reflects those cases where the physical quantity of an externality increases as agricultural production increases. For example, Less Favoured Areas produce more externalities than production-efficient areas. The case of decreasing marginal social benefits incorporates the general characteristic of demand for many types of goods. The willingness for an additional quantity is a decreasing function of the quantity already acquired. Finally, the case of discontinuous marginal social benefits occurs with site-specific externalities where marginal benefits occur only in the areas where the externalities are generated.

Market failures associated with externalities occur when a market cannot be established between producers and consumers of the externality. In this context, the price of the market of the product is the only key variable that determines both the quantity of agricultural product as well as positive externality. The underproduction of the agricultural good consequently results in the under provision of a positive externality. Public intervention is then necessary. In this context, it is then important to analyse public good aspects of externality in order to define the nature of public intervention.

The concept of public goods

The economic classification of a public good is done according to the degree of excludability and rivalry. A good is non-exclusive if it is physically or institutionally (e.g. through laws) impossible, or very costly, to exclude individuals from consuming the good. A good is non-rival when a unit of the good can be consumed by one individual without diminishing the consumption opportunities available to others from the same unit. Pure public goods are goods that meet both of the criteria and private goods are defined by the non-existence of excludability and rivalry. Impure public goods, which lie between the two, are classified according to the degree of exclud-

ability and rivalry. However, for some type of goods, non-excludability can conduct to congestion problem. The individual consumption of a unit of the good negatively affects other users' utility, without reducing the amount of the good to be consumed by the others by one unit. It could lead to overexploitation of the resource.

Table 3: Classification of pure public goods, impure public goods and private goods

	Non-Rival	Congestible	Rival
Non-excludable	Pure public goods	Open access re-sources	Open access resources
<i>(Benefits involve only a small jurisdiction such as municipality)</i>	Local pure public goods	Common property resources	Common property resources
Excludable	Collective good	Club goods	Private goods

Source : OECD, 2001

The nature of public intervention differs for the type of public good. But, the non-governmental intervention is encouraged. Non-excludability prevents providers from charging user fees, voluntary provision tends to lead to under-provision of goods. However, even if a government decides to provide pure public goods, it is often difficult to estimate people's true willingness to pay for the good (*i.e.* the marginal value of the good to them). There is therefore a substantial risk of policy failure associated with the over- or underestimation of the willingness to contribute to the provision of a pure public good.

For excludable goods but non-rival, their private provision can be sustained by user fees. But, here, there will be efficiency loss due to provisioning decisions that tend to under-provisioning. Providers would take into account only those who can pay the prices determined by the capacity for providing the public good and consequently eliminate all other users whose willingness to pay is positive but inferior to the price. But the impact of market failures may be smaller than that caused by policy failures associated with government provision. Market provision could at least force users to reveal their true willingness to pay, which is often difficult in the case of government provision.

Agricultural externalities are not exchanged in the market. Therefore, they do not have an observable monetary value. However, they are valued by society because of the existence of demand attached to use values and non-use values. Furthermore, if agricultural externalities

contain the two kinds of values, the public good character differs according the type of beneficiaries. The following table provides the classification of agricultural externalities into pure public goods, impure public goods and private goods.

Note however that for landscape functions we have to distinguish, as Mollard (2003) suggests, two types of externalities. The "direct" externalities rise from the existence of technical or economic jointure with the agricultural production. It is the case of biological diversity or pollution. On the other hand, there are the "indirect" externalities whose bond with the agricultural production is much relaxed. Then, it is not easy to ascribe their supply to a specific agent. This is the case for the cultural value of the landscapes, or the ecological functions of ecosystem for which the participation of other actors than contemporary farmers are not negligible.

The multifunctionality of agriculture can be described by the characteristics of public goods or bads. In the latter case, some functions may have negative consequences for welfare (Vatn, 2002). Following the OECD's multifunctionality framework, Vatn suggests the following list that gives an overview on main-categories of outputs from agriculture with distinct public character:

- Environmental effects: landscape (biological diversity, recreation, aesthetics), cultural heritage, pollution,
- Food security (availability in different situations)
- Food safety (quality/ phyto-sanitary status)
- Rural concerns (rural settlement, rural economic activity)

Vatn (2001) explains further on that the various goods and bads are components of an integrated production system. They are an interlinked set of functions. Each good consists of several elements. Qualitative aspects are as important as quantitative ones. This implies that one good depends on the quantity and quality of others. E.g. Landscape values: The aesthetic value may depend on the level of biodiversity. If goods are not excludable, they often will be termed positive or negative externalities.

Finally, if OECD does not provide an exhaustive list of functions assigned to agriculture, it was recognized that the identification of these functions even concerns empirical work on multifunctionality and policy implications. We will see further, methods than can help to identify demand/needs related functions.

Table 4: Classification of pure public goods, impure public goods and private goods (Sketch)

	Non-Rival	Congestible	Rival
Non-Excludable	Pure public goods	Open access re-sources	Open access re-sources
	Landscape (non-use value) Natural habitat (non-use value) Biodiversity (non-use value)	Food security Landscape (use value by visitors)	
<i>(Benefits involve only a small jurisdiction such as municipality)</i>	Local pure public goods		
	Flood control Soil conservation Land slide prevention Redisent use of Landscape Cultural heritage (non-use value: region-specific)		
<i>(Excludable only to outsiders of a community)</i>		Common property resources	Common property resources
		Groundwater re-charge Natural habitat (use value) Biodiversity (use value)	
Excludable		Club goods	Private goods
	Natural habitat (non-use value) Biodiversity (non-use value)	Food Security (if special arrangements were made) Natural Habitat (non-use value under special conditions) Biodiversity (Non-use value under special conditions)	Landscape (use value by visitors if exclusion can be made) Cultural heritage (use value of historical buildings) Food security (use value by farmers)

Source : OECD, 2001

3.1.5. The multifunctional feature of agriculture and land according the FAO

FAO (1999) examines the multifunctional character of agriculture and land use. It recognizes that the multifunctional character of agriculture and land use is intrinsic but the explicit recognition of multifunctionality at national, regional and international policy levels and the understanding that functions can be an object of policy intervention facilitate the achievement of sustainable development objective in rural areas and in society in general.

According to this institution, multifunctional agriculture aims to be a **basic-needs oriented approach**. The first function of agriculture remains to provide food security, which is defined by FAO as “the access for all people at all times to enough food for an active, healthy life.” In this context, the FAO’s concept of the “Multifunctional Character of Agriculture and Land” is defined as the entire range of associated environmental, economic and social functions of agriculture by attaining food security (MultiLand 2004). This implies, that in addition to producing food, agriculture provides a wide range of non-food goods and services, shapes the environment, affects social and cultural systems and contributes to economic growth. All these functions of agriculture can finally contribute to the achievement of sustainable development.

FAO (1999, 2000) proposes a descriptive framework with two analytical dimensions: the institutional strength (including market maturity) and natural resources (natural capital) availability. The ability to use multiple functions of agriculture and land use depends on the institutional strength. Regions that are less endowed of natural capital but dispose of higher institutional strength are given greater ability to exploit multifunctionality. By contrast, lower institutional strength is a great obstacle for regions with higher natural capital to exploit multifunctionality. Presented this way, this assumption appears a bit simplistic. It stresses, however, that any multifunctionality framework should include a dimension that deals with institutional matters (normative/governance dimension).

The multifunctional approach builds on a sustainable agriculture and rural development approach by rendering it more effective by widening the focus to include a range of services from the agricultural sector and land use to society as a whole (rural and urban population). Four groups of functions are put forward:

Food security (production function): still the primary and foremost function of agriculture as it means that “all people at all times have economic and physical access to sufficient, safe, and nutritious food to meet dietary needs and food preferences for an active and healthy life” (World Summit action plan).

The realization of this primary function depends on the realization of the other functions depending for the most on the institutional context (for example, property rights plays an important role to help to optimise environmental functions. When farmers are confident that they have adequate rights of ownership, they will be more motivated to get more sustainable resource use within long-term planning).

Environmental function: agriculture and related land use can have beneficial and harmful effects of the environment within two spatial dimension : at the local level and at the global level.

Then the positive impacts of agriculture and land use at the local level are:

- Pollution abatement through management of soils and vegetation
- Increasing nutrient fixation and stock of biomass, and water buffering capacity
- Increasing ecosystem resilience with erosion-control techniques

Lists of negative impacts at the local level are:

- Pollution
- Loss of ecosystem resilience and diversity in the cultivated ecosystems
- Reduction of organic matter in the soil and reduced water retention capacity

Regarding these local environmental functions, agriculture and land use are relevant for global environmental problems as:

- Climate change by facilitating carbon substitution by bio-energy
- Reduction of desertification
- Biodiversity
- Water quality and availability
- Pollution

Economic function: at the top is the production of foods and primary materials. Agriculture also contributes to the local and national growth of the economy and generates employment for itself and for other sectors.

Social function includes the maintenance of rural communities and social viability that encompass local organization and local knowledge and technology, maintenance of cultural heritage.

The focus on food security, social and economic functions as well as environmental functions at the global level are closer to a demand-based perspective. In essence, the MFCAL approach mirrors the concerns of sustainable development in a broader sense (basic needs orientation, ecological, economic social and institutional consideration).

3.1.6. How to deal with the relations between agriculture, landscape and societal demand

3.1.6.1. Landscape functions and societal demand: methodological issues

Many frameworks cited above do not make methodological remarks on the identification of landscape functions; it is possible, however, to abstract more or less systematic lists of landscape functions or at least social demands placed upon landscapes from the literature. As the actual assemblage of such lists is not the objective of this work package, the section focuses on the analysis of perspectives from which contributions to a comprehensive inventory of landscape functions could be gathered.

First, as demand-based landscape functions rely on the states, structures and processes of ecological systems, the purely scientific knowledge of landscape functions contributes to the debate on the definition of landscape multifunctionality concept. Purely scientific concepts of this sort are found in Forman (1990).

However, within a more anthropocentric approach, social sciences tend to deal with this question in a different way by asking questions directly to users. This was the methodology approved by de Groot (2002) in order to identify social and economic values associated with various goods and services provided by ecosystems. Economic valuation enables the transformation of all ecosystem functions into monetary values that can be integrated into benefit-cost analysis. This was used for example by Costanza and al. (1998).

Economic valuation methods fall into four basic types: direct market pricing, indirect market method pricing, contingent valuation and group valuation.

Direct market pricing consists of estimating the exchange value that ecosystem services have in trade. This method is mainly applicable to goods (i.e. ecosystem production functions) but also some ecosystems information functions (e.g. recreation).

Indirect market pricing is when there are no direct markets for services but we can assess the valuation of the availability or the loss of these services. In this context, we can distinguish methods that are based on a benefit approach (hedonic pricing and travel cost method from those that are cost approach (avoided cost and replacement cost method).

Avoided cost and replacement cost

The damage cost avoided, replacement cost, and substitute cost methods do not provide strict measures of economic values, which are based on peoples' willingness to pay for a prod-

uct or service. Instead, they assume that the costs of avoiding damages or replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services. This is based on the assumption that, if people incur costs to avoid damages caused by lost ecosystem services, or to replace the services of ecosystems, then those services must be worth at least what people paid to replace them. Thus, the methods are most appropriately applied in cases where damage avoidance or replacement expenditures have actually been, or will actually be, made.

For example, society will invest more money in averting measures to preserve the quality of drinking water quality and they would, therefore, also appreciate its improvement much more. The cost people incur to avert the negative effects of contaminated drinking water is then taken as their willingness to pay for the improvement of water quality.

Travel Cost Method

The Travel Cost approach is well established as a technique for valuing the non-market benefits of outdoor recreation resources. In most cases it is based on the fact that a trip to a recreational site requires an individual to incur costs in terms of travel, entry fees, on-site expenditures and time. These costs of consuming the services of the environmental asset are used as a proxy for the value of the recreation site and changes in its quality.

Hedonic Price Method

This assessment technique is based on the idea that prices of commodities can be expressed as functions of the characteristics of these commodities. Environmental goods and services are part of these characteristics. One can then derive the willingness to pay for environmental services from the preferences people reveal through their market transactions. The hedonic price method is mainly applied to the real estate market.

Contingent Behaviour Method (relative valuation technique, stated preferences) asks people about their hypothetical future utilization behaviour contingent on a change in the quality or quantity of an environmental good. After first explaining the intended improvements of environmental services to the interviewed persons, the respondents are asked how this will change their future utilization behaviour. The resulting change in utilization costs is then interpreted as the willingness to pay for the change in quality of the ecosystems.

Market Simulation

With the help of the simulation of market processes, it is possible to value a whole batch of environmental aspects, or even several public goods simultaneously. Relative and, if possible, absolute values are obtained. Within such market simulation experiments, the individual choice situation in a competitive market for private goods is transferred into a market for environmental goods.

In *Contingent Valuation studies*, people are asked, through face-to-face interviews, what they are willing to pay for a benefit or to avoid a cost, or what they are willing to accept to forego a benefit or tolerate a cost. There are various methods of obtaining willingness to pay estimates using CVM. Boyle and Bishop (1988) provided an overview of the primary methods including payment card, interactive bidding, and dichotomous choice. In the payment card method, the respondent was asked to select a given monetary interval from a set of payment ranges. In the case of interactive bidding, the interviewees are asked initially what they would pay for a particular good. Based on the response, the surveyor provides the respondent with higher or lower values until convergence to a specific value is reached. Dichotomous choice involves a yes or no response from each individual, on whether they would be willing to pay a specific amount for a good.

More recently, *Attribute Based Choice Modelling* (ABCM) gains importance in environmental valuation. It is based on the idea that, people derive utility not from commodities themselves but from the properties or characteristics, or even attributes of these commodities. Hence, this method tries to value the different characteristics of environmental goods as forests, landscapes in the basis of surveys that ask individuals to rank alternatives. ABCM is comprised of several different valuation techniques like Choice Experiments, Contingent Ranking, Contingent Rating, which are all closely related to Conjoint Analysis but only choice experiments provide monetary valuation.

Group valuation/participatory approaches

Derived from social and political approach theory, participatory approach is developed to obtain stakeholders' preferences on decision related to environmental goods and services on the basis of an open public debate.

Each method has its strength and weaknesses. This is shown by the extensive empirical literature on ecosystem services valuation (de Groot and al., 2002). Table 2 provides an over-

view of the valuation method that fits each ecosystem function. The table suggests the existence of some relationship between the main type of function and the most preferred valuation methods: regulation functions were mainly valued through indirect valuation method (avoided cost and replacement cost); habitat functions mainly through direct market pricing and contingent valuation; production functions by direct market pricing and information functions by contingent valuation and indirect market pricing.

The application of participatory approaches for environmental valuation tasks is recent. They have been proposed as an alternative to standard economic valuation methods that are not meaningful enough to support political decisions. First, the general public is not equipped enough with environmental information and knowledge of issues to form a serious judgement about their monetary value. Second, most of the time this social demand still has to be built. Participative approach enables to elucidate the societal demand through a phase of clarification of the values of the various stakeholders and likely land use conflicts. The valuation process based on an open debate will be an opportunity to lead to a consensus.

In any case, however, expressions of actual needs, demands, or preferences are restricted by the knowledge base of the public actors/respondents/market participants. Restriction of the knowledge base results from inconclusive or absent scientific evidence, but also from an unwillingness or inability of part of the respondents to apply available knowledge to the problem at hand. Reasons for the unwillingness or inability may be long time scales, low assumed probability of relevant events, cognitive strategies to avoid/neglect unsettling thoughts, or strategic behaviour because of vested interests in the issue at stake.

Methods presented here are applicable only to identify or to value well-understood landscape functions. De Groot (1992) stresses that it is likely that there are many environmental functions that have not been discovered but that may have significant socio-economic importance. The notion of serendipity value (option value) is then important to maintain their availability for future use. Serendipity value refers to as yet undiscovered benefits of ecosystem characteristics.

3.1.6.2. Landscape and the sustainable development of rural areas

The review of approaches to identify the needs and demands that co-define landscape functions shows that a huge amount of knowledge for the analysis of the human-landscape interaction are available. While the knowledge is not yet systematised with regard to the multifunctional-

ity of landscapes, it is sufficient to draw up comprehensive lists of landscape functions. If such lists are to be used for the specific problem on sustainable development of rural areas, three issues have to be solved.

First, a sensible selection from the list must be made that meets the information needs of all stakeholders (local population, non local population, farmers, etc..., this is the sectoral and normative/governance dimension). Second, it must be made sure that the “resolution” of the landscape functions fits the problem at hand. These are the spatio-temporal and descriptive-factual dimensions. Finally, it must be sure that no relevant function is missing that may be specific to the local region at stake.

The framework for the analysis of agricultural multifunctionality interpretation with respect to sustainable development of rural areas has been based on the following five dimensions (Multi-Land, 2004):

1. mode of application and purpose: there are different meanings of the multifunctionality concept according to the scale dimension, and the sustainability dimension of the agriculture at different levels (farm, region, global). What is a specific multifunctionality interpretation used for and what is its purpose? For instance, in the case of OECD's interpretation, the purpose is to assess agricultural trade policies, particularly regarding claims that the multifunctionality of some agricultural production systems justifies public intervention (subsidies).
2. descriptive-factual dimension: statements based on the NCOs and their joint-production characteristics are the core of this dimension. Their combination with standard economic theory leads to the factual-descriptive ‘model’ of the interpretation of multifunctionality.

Which knowledge on the scientific, economic and socio-cultural systems is used? How was it gathered? How reliable and valid is it? How is it modelled?

3. spatio-temporal dimension:

The spatio-temporal dimension of multifunctionality has to be analysed through an explicit definition of gain and extent in time and space. Furthermore, this question can apply to the entire interpretation of the concept as well as to the descriptive-factual models it uses. We have to consider that spatial questions have to be addressed in an application of the framework to the planning of efficient compatible subsidy schemes (in the context of the MEA and WTO).

4. sectoral dimension:

Here, a strictly sectoral view is focussing on agricultural production and international trade concerns.

Are specific sectors of human activity (e.g., agricultural production), specific stakeholders (e.g., farmers), or specific landscape compartments, processes or topics (e.g., soils, water cycle, biodiversity) emphasised?

5. normative/governance dimension: a descriptive multifunctionality model is used for an analysis of the interdependencies of agricultural joint production. The economic framework used for an assessment of this question, in connection with the mode of application, can use efficiency-based measures and a free trade frame of reference.

Which stakeholder interests are addressed? How are legal requirements taken into account? How are decision-making processes conceptualised and structured?

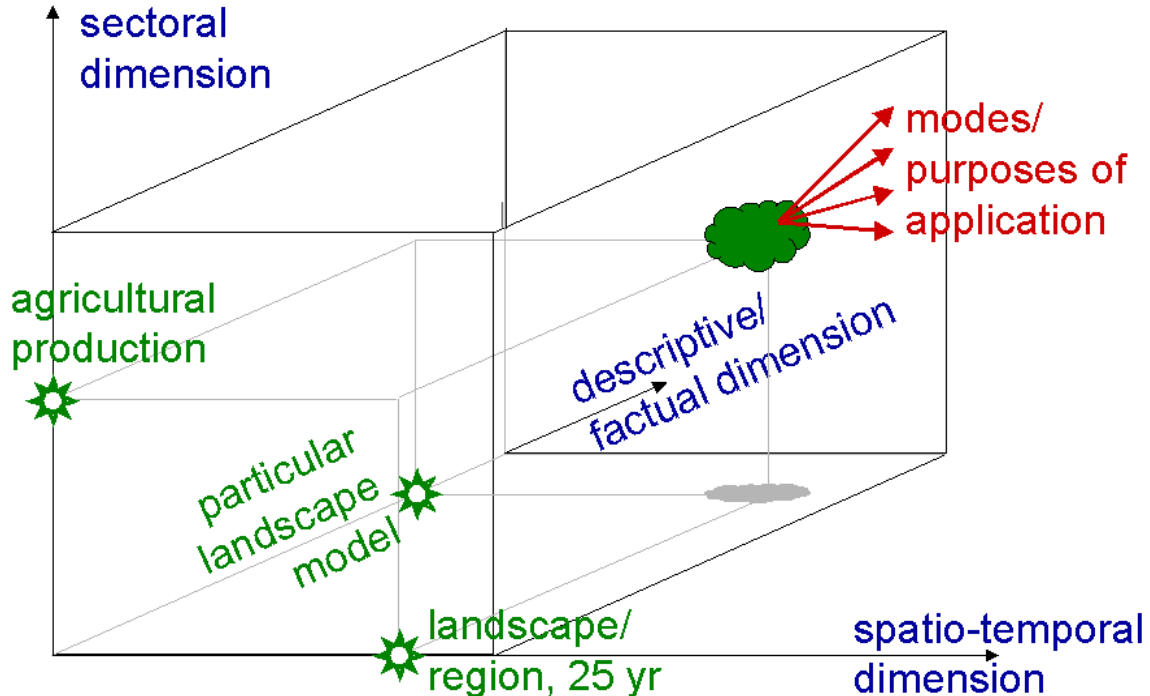


Figure 1: The dimensions of the analytical multifunctionality framework

Graphical depiction of the Analytical Multifunctionality Framework. For illustration purposes, a specific multifunctionality interpretation (green cloud) is located in respect to its sectoral focus, its spatio-temporal dimension, and its representation of causal/factual knowledge by a landscape model. The normative/governance dimension is not shown. (*Multiland, p14*)

Table 5: Relation between ecosystem functions and economic valuation techniques (Source de Groot et al., 2002)

Ecosystem functions (and associated goods and services)	Direct market Pricing*	Indirect market pricing					Contingent valuation	Group valuation
		Avoided cost	Replacement cost	Factor income	Travel cost	Hedonic pricing		
Regulation functions								
1. Gas regulation		+++	0	0			0	0
2. Climate regulation		+++	0	0			0	0
3. Disturbance regulation		+++	++	0		0	+	0
4. Water regulation	+	++	0	+++		0	0	0
5. Water supply	+++	0	++	0	0	0	0	0
6. Soil retention		+++	++	0		0	0	0
7. Soil formation		+++	0	0			0	0
8. Nutrient cycling		0	+++	0			0	0
9. Waste treatment		0	+++	0		0	++	0
10. Pollination	0	+	+++	++			0	0
11. Biological control	+	0	+++	++			0	0
Habitat functions								
12. Refugium function	+++		0	0		0	++	0
13. Nursery function	+++	0	0	0		0	0	0
Production functions								
14. Food	+++		0	++			+	0
15. Raw materials	+++		0	++			+	0
16. Genetic resources	+++		0	++			0	0
17. Medicinal resources	+++	0	0	++			0	0
18. Ornamental resources	+++		0	++		0	0	0
Information functions								
19 Aesthetic information			0		0	+++	0	0
20 Recreation and tourism	+++		0	++	++	+	+++	
21 Cultural and artistic	0			0	0	0	+++	0
22 Spiritual and historic					0	0	+++	0
23 Science and education	+++			0	0		0	0

Note : +++ most used ; ++: the second most; + third applied ; 0 can be applied

3.2. The supply side issue: production features

3.2.1. Multifunctionality as a characteristic of the production process

It seems that the discussion about multifunctionality may restore the classical economists' concern with joint products in agriculture (Freshwater and al., 2004). Initially, joint production referred to a technical link between two outputs in fixed proportions. But recently, it has become used in a more general sense with the possibility of variable proportions. Multifunctionality is thus understood as the production of more than one output. More exactly, it refers to the fact that agricultural production provides not only food and fibre but also different non-market commodities. Then, multifunctionality is merely a characteristic of the agricultural production process rather than a policy objective assigned to agriculture (in the last view, agriculture must fulfil certain functions in society).

Consequently, if the primary function of agriculture is the production of food and fibre, other functions exist and are related to the production of non-commodity outputs in the production processes. Table 6 can give some examples of non-food products provided by agriculture (from Bohman and al., 1999). Agricultural products may either be joint, complementary or competing. Jointness here may cover both goods and bads, which in principle can be both private and public.

Non-food products are both positive and negative externalities. The term externality describes a harmful or beneficial side effect that occurs in the production of an agricultural good. In the production process, waste or rural amenities may be produced jointly with the commodity output. These are externalities if they affect the well-being of others in a way that it is not transmitted by the market mechanisms. In other words, the producer does not bear the cost of waste cleanup or receive any compensation for the benefit of the rural amenities provided.

The agriculture activity produces multiple and interconnected (joint) outputs or effects, that may be positive or negative, intended or unintended, complementary or conflicting, valued in existing markets or not. It is important to note that complementary occurs within certain ranges (beyond these ranges, the two productions are competing for the common input). Furthermore, the production function may include goods and bads as a function of the relevant inputs (Vatn, 2001).

Table 6: Some examples of positive and negative externalities of agricultural production

Externalities:	positive	negative
Environmental:	<ul style="list-style-type: none"> + Open space + Soil conservation + Watershed protection + Flood control + Groundwater recharge + Biodiversity + Wildlife habitat 	<ul style="list-style-type: none"> – Odor – Soil erosion – Nutrient/pesticide run-off – Biodiversity loss – Decrease of Habitat quality – Habitat defragmentation – Emissions (green house gases)
Socio-economic:	<ul style="list-style-type: none"> + Rural income + Employment + Assure availability of food supply + High food quality + Scenic vistas of the landscape + Traditional country life + Cultural Heritage 	<ul style="list-style-type: none"> – Food contamination, e.g. by pesticides – Monocultures – Land use conflicts, e.g. with tourists, the industries etc.

Source: changed after BOHMAN et al.(1999: 9)

In general, the agriculture activity can be described as commodity (CO) and non-commodity outputs (NCO) of an activity. Within a given market and policy setting, the economic activity will result in a certain combination of the joint products. (Huylensbroek 2001)

The production aspects of multifunctionality are thus connected with the question of jointness in production. Joint production can be defined as “the simultaneous production of two or more goods from the same resource. For example the production of beef also results in the production of leather and the production of lumber also results in the production of sawdust. Joint production can be beneficial, that is, giving a producer multiple products to sell. But it can also be problematic when one of the joint products is undesirable, such as pollution or waste residuals”. (<http://amosweb.com/cgi-bin/gls.pl?fcd=dsp&key=joint+production>).

This definition emphasizes the relationship between an output and an NCO. In addition, it is very narrow, because it does not take into account jointly produced public goods; a farmer might not reap the benefits of the production of a beneficial jointly

produced product. For instance, one of the jointly produced goods might be increased biodiversity when a farmer changes his land use from intensive grazing into extensive grazing. Part of the benefits of the production of this biodiversity might be transferred to the farmer because it is included in the (higher) price of meat. However, tourists visiting the region might appreciate this increased biodiversity very much. Often though, they do not have to pay anything to enjoy an increased biodiversity in agricultural landscapes.

Generally, the case of joint production for an agricultural process with at least two outputs involves considering the special relationships between the production factors within the production process. The multifunctional feature of the production process thus arises from the physical link that supports the different outputs.

In this context, it is important to analyse the technical linkages between non-commodity and commodity outputs (complementarity and substitutions between them), and to define the relationships between the production factors within the agricultural production process which give rise to such linkages (Ferrari, 2004). A first study about this issue is proposed by Gatto et al. (1999). Through a classification of the countryside stewardship policies based on their effects on farming output, different levels of jointness between the commodity (food and fibres) and the non-commodity outputs (negative externalities like depletion or degradation of natural resources) are considered, while applying only to the case where positive and negative externalities are exclusive. However, negative and positive externalities are often overlapping. It is for instance the case of fertilisation, which can improve the landscape quality while diminishing the environmental quality and the biodiversity. When such a particular case applies, the degree of joint production, e.g. the change in jointness according to the complementarity/substitution characteristic attached to outputs, can be difficult to define.

Some recent studies focus on treating externalities in agricultural production as a multiproduct production process (Romstad, 1999; Paarlberg and al., 2002). In their model, Paarlberg and al. assume “the values or costs of externalities arise from the society’s preferences for attributes”, some of which may be linked to the production of CO. Externalities occur because agricultural production jointly generates non market attributes that societies value, so the externalities must be reflected in the social welfare function for a country as follows:

$$U = U(C_0, C_1, \dots, C_n, E_1(q_1, \dots, q_n), \dots, E_k(q_1, \dots, q_n))$$

where C_0 is the consumption of a non-agricultural good (composite) ; C_i ($i=1, \dots, n$) the consumption of several agricultural goods, and E_j ($j=1, \dots, k$) the externalities linked to agricultural outputs (q_i , $i=1, \dots, n$). The externalities that depend on the agricultural outputs in the economy are thus introduced in the welfare function. It follows that production of a specific commodity output might generate several externalities: that is, agricultural production is a multiproduct production process which provides both commodity outputs and externalities which may be linked to outputs.

The externalities are defined to be positively linked to social utility ($\frac{\partial U}{\partial E_j} \geq 0, \forall j$). However, the effects of changes in agricultural outputs on the externalities are unrestricted in sign ($\frac{\partial E_j}{\partial q_i} \geq 0$ or ≤ 0). Finally, a single production activity can yield positive and negative externalities: for example, a dairy cow produces milk, a marked output; positive externalities can be countryside services, and negative externalities like the emission of air pollutants which reduces environmental quality. The conceptual framework thus clarifies the effects of multifunctionality by modifying the social utility function to incorporate externalities. Furthermore, the authors show that multifunctionality never justifies trade interventions but only production subsidies and taxes.

3.2.2 Origins for jointness

According to the origin of jointness in production, three cases can be emphasized.

The first one is the case where jointness is due to the presence of technical interdependencies in the production process which implies the production of externalities along with private and public goods. That particular link is originally responsible of the production of negative externalities like pollutants, soil erosion, or positive ones like an improvement of soil fertility with specific agronomic practices. In this case, there is a link between the negative externality and the agricultural production level. Furthermore, the commodity production depends both on the allocated factors and on the production level of the other product. These interdependencies have an important implication: an increase in the production of the commodity good which follows an increase of the amount of the production factor used, can lead to a change in the marginal productivity of factors used to produce the non-commodity output. The marginal productivity of a

production factor with respect to the production of one output depends on the level of the production of another output. We may provide the following representation of such interdependencies:

Let Y_1 and Y_2 be the outputs of the production process; X_1, X_2 , the production factors.

The production function F^i of output Y_i is:

$$\begin{aligned} Y_1 &= F^1(Y_2, X_1) \\ Y_2 &= F^2(Y_1, X_2) \end{aligned}$$

The second case arises when jointness is due to the existence of a non-allocable production factor. That situation is observed when different products are obtained from a single input. It is the case of the production of wheat and straw, or of ovine meat and wool from sheep breeding for instance. The products interact with each other. Let X be the non-allocable production factor. We have the following representation:

$$\begin{aligned} Y_1 &= F^1(X) \\ Y_2 &= F^2(X) \end{aligned}$$

The OECD (2003) states that to analyse jointness, one needs to take into account the relationship between inputs and NCOs and not at the relationship between outputs and NCOs. This is because the increase in output does not necessarily increase the production of NCOs as well. OECD (2003) gives the following example: “a price incentive to produce milk in order to preserve pastoral landscape of which grazing cows are an element, could result in a deterioration of the landscape if farmers choose to move to an intensive feedlot system of producing milk”. Only if there is a fixed one-to-one relationship between input and output, the output/NCO relationship can be used.

In this way, according to the OECD (2003), three types of jointness may exist between NCOs and non-allocable inputs:

- 1 NCOs linked to fixed non-allocable inputs;
- 2 NCOs linked to variable non-allocable inputs with decreasing rates

of return;

- 3 NCOs linked to variable non-allocable inputs without decreasing rates of return.

NCOs also might have a joint production relationship with other NCOs: negative externalities, such as pesticides and fertiliser leakage, could have effect on landscape, biodiversity and habitat.

Finally, the last case is the one where outputs compete for an allocable and fixed input (whose role is played by land, or water for irrigation for example). The products compete for a production factor that is available in a fixed quantity at the farming level. Any increase of the production of one output reduces the quantity of the fixed input available for the production of the other product. Thus, there is interdependence within the products and within the inputs (for at least two production factors). In this case, the production process may be represented as:

$$\begin{aligned} Y_1 &= F^1(X_1) \\ Y_2 &= F^2(X_2) \\ \text{with } X_1 + X_2 &= X \end{aligned}$$

This case is very common in agriculture and is particularly relevant for analysing multifunctionality. The joint products are not related through the production level but to the use of land that may be considered as a limiting factor for the development of the farming concern. In this case, the jointness of the production has only to do with the land input.

3.2.3. About joint NCOs in agriculture

Recently, Huylenbroeck (2003) has given some examples of joint non-commodity outputs in agriculture: employment, food security, landscape, biodiversity, environmental quality (soil, air, water), cultural heritage... Furthermore, his study about the relationships between the non-commodity outputs and the commodity output through some concrete examples can bring some useful insight. His results are the following:

First of all, the link with the production level is only clear in case of negative externalities (cf. the example of water quality, but it would also be the case if other negative externalities such as soil quality or air quality were analysed). In most other cases the

coupling with the production level is weaker and has to be interpreted as follows: agriculture or any form of cultivation is in most cases a necessary condition to obtain the non-commodity output, but the yield in itself is not as important. In a few cases, however, above a certain level of production the non-commodity output decreases or is endangered (e.g. meadow birds are endangered if the farmer wants a first cutting of his grassland earlier than the end of the breeding season, genetic diversity is not compatible with having only high yielding varieties).

More important is that in all cases studied, the non-commodity output is dependent on the applied farm practices, systems or technologies. This confirms the production potential model of joint production stating that it will depend on economic conditions at what point of output combination farmers will produce. In most cases the non-commodity output is also linked to agricultural structures: specialisation and increased scale of farming have caused larger physical structures that in their turn allow the use of more modern technologies. All these factors together may contribute to the under provision of certain functions. A specific problem is that the level of jointness is in most cases depending on topography, soil quality, climate conditions and so on and thus spatially differentiated, causing problems of competitiveness in case measures are taken in a particular region.

A second aspect is in how far non-agricultural provision of the non-commodity output is possible or in other words in how far delivery of non-commodity outputs can be de-coupled from commodity production. Huylenbroeck states that if it is possible in theory to conserve the cultivation practices from which the COs depend on without selling the products (or at least not to be dependent on the selling), it is however a very expensive option in practice which may only be possible to conserve old practices with a cultural heritage or other value or in case of a high demand for the provision of the non-commodity output de-coupled from agriculture (e.g. water quality in water catchment areas). For non-commodity outputs with a high dependence on farming and for which the demand is to have a small quantity per area unit, agricultural provision is often the only way.

Furthermore, Huylenbroeck focuses on the mutual influence of other non-commodity outputs. In general, there is a conflict between social functions (employment and rural viability) and environmental functions of agriculture because (partial) de-coupling will in general be linked to a reduction of the employment (directly or indirectly because of weakening of the competitiveness) ... at least if no instruments are found to remunerate the higher costs for or lower production of commodity outputs. The only

case where there is a possible danger for food security is when cultural heritage protection by non-agricultural delivery (e.g. farming buildings) should mean that the land is occupied for industrial or domestic functions, which may not be reversed. In some cases there may be competition among some functions such as e.g. meadow bird conservation and bio-diversity in the meadows as both non-commodity outputs require different farming practices.

Finally, the author analyses to what degree decreases of commodity prices are creating market failure in the provision of non-commodity outputs. In some cases this has a clear positive effect on the non-commodity provision such as in case of reduction of negative externalities: e.g. more extensive beef production because of price reductions can be good for meadow birds or for field flora as long as farmers do not switch to other commodities (e.g. ploughing their land). In other cases the effect is negative because price reductions stimulate farmers to cut further on costs and to apply more efficient farming systems which are less compatible with the delivery of the non-commodity output.

Consequently, the analysis of the coupling between the non-commodity and the commodity outputs has to be done carefully to detect the nature of the jointness in production. In this way, Cahill (2001) suggests:

- even if separation of CO and NCO outputs is technically feasible, there may be potential for economies of scale: this means that joint production of several commodities is cheaper than separate production,

- if jointness exists, an examination of the extent to which it is related to the choice of farming system and technology (and to what extent these relationships can be changed) is required,

- the question of the spatial aspects of production: in the case of the mountain pasture for instance, it might be difficult to completely dissociate the landscape (or biodiversity values) from the production of milk or beef, but these values do not exist in the case of intensive feedlots in lowland areas with cattle that never roam or graze. In this case, there is jointness but only with respect to some part of production (and not the totality). Spatial considerations may become important when several NCOs are considered at the same time.

In a first synthesis concerning the analysis of jointness between CO and NCOs in OECD agriculture, Abler (2001) gives some interesting results. If both the negative and the positive externalities have to be considered in accounting for the multifunctional

characteristic of agriculture, a strong consensus lies only in the area of negative externalities (loss of biodiversity, water pollution from nutrients and erosion, threats to animal welfare, irrigation-related problems, greenhouse gas emissions) which are joint to the production of CO to at least some degree.

On the other hand, there is not as much consensus among countries regarding agriculture's positive externalities (NCOs). When taken as a whole, the following NCOs are only weakly related to CO: landscape, cultural heritage, rural economic viability, enhancement of biodiversity, groundwater resource recharge. But little attention is devoted to the question of how spatial factors might affect positive externalities. This issue should be considered within the MEA-Scope project.

Finally, we need more knowledge about the relationships between CO and NCO outputs, and between NCOs as well. In this context, an interesting question to be addressed should be the cross-relationships between negative and positive externalities.

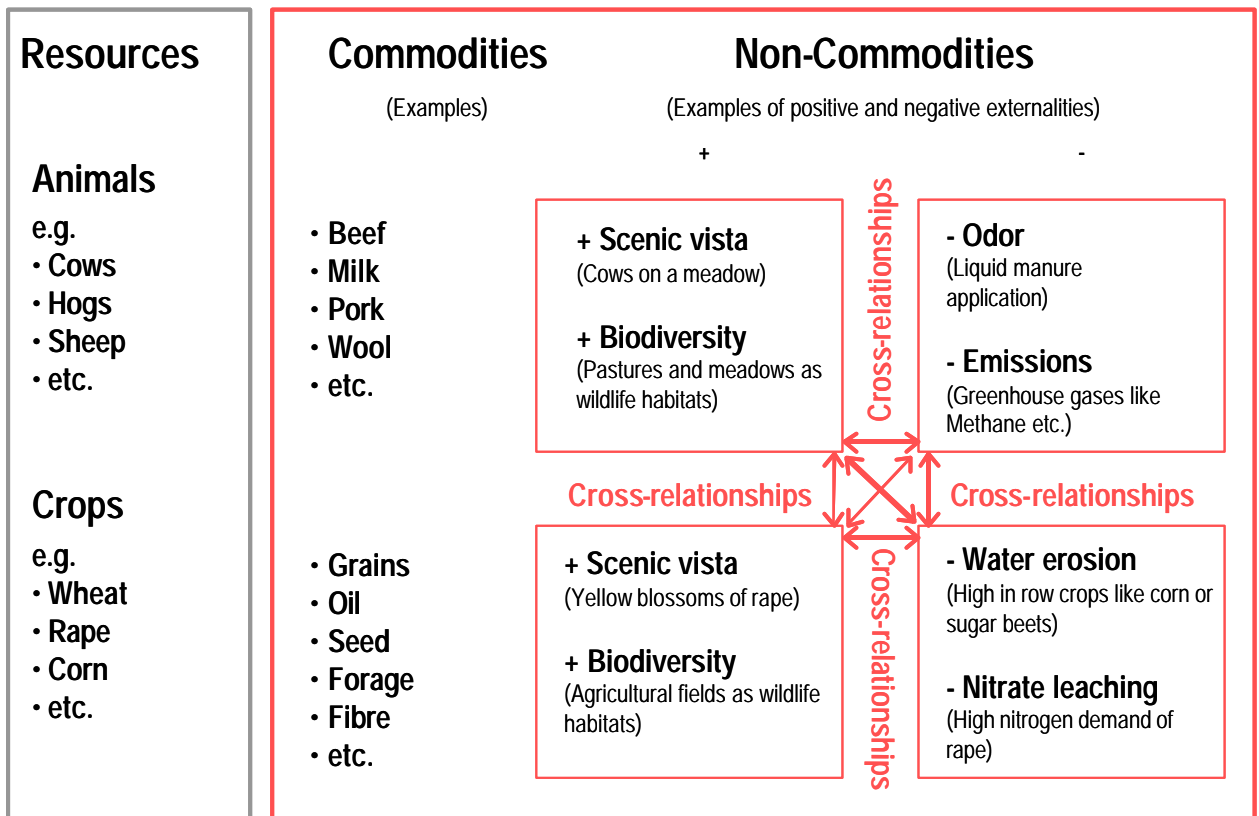
3.2.4. The question of jointness in production and cross-relationships between negative and positive externalities (trade-off functions)

The use of most agricultural resources¹ (e.g. certain crops like wheat or certain animals like cows) is leading to multiple products or outputs, like grains and straw for bedding in the case of wheat, or beef, milk, skins, etc. in the case of cows. Some of them are commodities and others non commodities. The joint production of non-commodities can be beneficial like producing scenic vistas of the landscape or contributing to soil conservation by reducing the risk of water erosion (positive externalities). But there can also be negative externalities, like the pollution of water bodies (with phosphorus, nitrogen, pesticides, etc.) or the loss of biodiversity due to agricultural production activities, which are unwanted from the point of view of the society. In this context commodities refer to the satisfaction of material needs, while non-commodities touch the non-material needs of the society (Belletti et al. 2002: 2).

In a previous work, a methodological approach to show how agricultural production activities are related to a number of positive and negative externalities was introduced with the modelling system MODAM, which contributes together with AgriPolis and FASSET to the MEA-Scope modelling approach. MODAM was designed to evaluate a

¹ HERE THE TERM "RESOURCE" IS MORE WIDELY USED AS A SOURCE OF MULTI FUNCTIONALITY . THE COMMON UNDERSTANDING

broad number of agricultural production practices regarding their effects on the environment, both negative effects, e.g. nitrate leaching, water erosion, as well as positive ones, e.g. providing habitat functions for certain animal species on agricultural fields (cp. Sattler & Zander 2004) as well as their economic performance. For example, the different ways in producing wheat by doing tillage by ploughing or with minimum tillage techniques, or applying different amounts of fertilizer or pesticides affects the jointly produced non-commodities. Compared to conventional tillage by ploughing, reduced tillage or zero tillage techniques will lower the risk of water erosion; or, the increase of nitrogen fertiliser input will augment the risk of nitrate leaching to the groundwater. These are both unwanted negative externalities. As a positive externality, respectively, the total omission of pesticide application will improve the habitat quality for sensitive species, like some beneficial insects.



Jointness of production

Figure 2: Jointness and cross-relationships of positive and negative externalities of agricultural production

Of course, there are many linkages between the different externalities, and they are more or less interrelated with each other. For instance, the change of the tillage system from ploughing to zero tillage will on the one hand certainly improve the protection of the soil from erosion, but on the other hand will reduce the recharge of groundwater due to the better soil coverage from vegetation residuals. These interdependencies are called cross-relationships of different externalities. The cross-relationships might either be positively or negatively correlated. gives a schematic overview about the jointness and cross-relationships of positive and negative externalities of agricultural production.

To show the jointness of production as well as the cross-relationship between different externalities the modelling system MODAM makes use of trade-off functions. *“Trade-off functions define how many units of one goal have to be sacrificed to gain one unit of another. They are of interest as they define the solution space, specify what is possible (transformation curve) and indicate the societal costs associated with different levels of goal attainment”* (Zander 2003: 128). “Goals” in this context refer to either the promotion of positive externalities or the mitigation of negative ones. In complex systems, like agri-environmental environments, where agricultural production takes place, the relations among different objectives are not easy to understand. So, when choices have to be made (collectively by the whole society or individually) to have less of one thing in order to get more of something else, trade-off functions can be an appropriate device to support decision by showing the interdependencies (Johnson 2000). For example, when farmers are given the choice between a number of production options, a trade-off function can show the relationship between the total output of the farm, in general the most relevant objective from the farmers’ point of view, and the extent of “jointly produced” water erosion, a negative externality which should be prevented from the viewpoint of society. An application of the model was done for a case study region in north eastern Germany where the total area of arable land is considered as a regional farm linear programming (LP) model (Sattler & Zander 2004).

In this context, the model system MODAM allows two kinds of scenarios (i) incentive orientated scenarios to assess the consequences of policy instruments like subsidies or taxes and (ii) regulation orientated scenarios to assess the effects of legislative policy options like environmental restrictions. Some of the modelling results show that the abatement of the potential soil losses through water erosion decreases the regional gross margin. This is due to the replacement of critical crop types like sugar beets or

potatoes (both crops with wide row distances but relatively high gross margins) by more suitable crops to prevent water erosion, like winter rye or winter barley, both crops with comparatively lower gross margins. But the loss in profit can be reduced to a minimum when the environmental restrictions are limited only to the most sensitive sites for water erosion. In this case the model has enough leeway to put production practices that go potentially with a higher level of erosion, but also higher economic revenues on those sites insensitive for water erosion which helps in minimising the financial loss.

Furthermore, an interesting question becomes how this procedure affects other externalities, as we know that they are cross-related to each other. For instance, the analysis of the cross-relationship between the externalities 'water erosion', 'nitrate leaching' and 'groundwater recharge' shows that the introduction of environmental restrictions to improve the ecological performance regarding the extent of water erosion also decreases the risk of nitrate leaching. Both externalities are positively correlated and can be reached in combination. But at the same time, the risk of insufficient groundwater recharge increases. Thus by enforcing the reduction of the risks related to water erosion, one has to consider that this might be cross-related to the lowering of the groundwater table in the long term, due to the diminished infiltration rate induced by the higher soil coverage. In this case, both externalities are negatively correlated.

Evaluating trade-offs, when done carefully and systematically, involves comparing the advantages and disadvantages of each of the available alternatives. Decisions based on information such as provided by trade-off functions are not all-or-nothing decisions, rather they enable decision makers to find out about compromises involving changes at the margins - a little more of this at the cost of a little less of that. These efforts may result in a mix of all those externalities that are of interest for the decision-makers - individually or on behalf of a certain community at the regional or national level.

Being shown the interdependencies between economic and ecological issues, CAP can get an idea about what amount of money has to be invested to compensate or motivate agricultural producers for the joint-production of those externalities, like pure drinking water, enjoyable landscape amenities, the prevention of soil degradation etc. that are appreciated by the society. Trade-off functions can also show where a multitude of aims can be obtained in combination (positively correlated externalities) and where conflicts have to be resolved (negatively correlated externalities).

3.3. Linkages between supply and demand side issues of multifunctionality: about functions and jointness

If all the non-commodity outputs were private goods, there would be functioning markets (supply and demand would balance) and there would be no public intervention (subsidies). When both jointness and market failure are supposed to exist, the need for a public intervention depends on the extent to which the non-commodity output called “positive externality” in question is a public good (Cahill, 2001).

Welfare maximising Pigouvian taxes and subsidies applied to NCOs would in theory internalise their external costs and benefits. But, as Blandford and Boisvert (2004) have reminded us, such an approach is difficult because it requires measures of the marginal benefits and costs associated with each NCO output. Additionally, by ignoring joint production such a procedure will overstate benefits or understate costs (Randall, 2002). In those circumstances, it seems difficult to formulate policies that can achieve a socially optimal supply of NCO outputs. A feasible solution could be to define production standards which may ensure the maintenance of wildlife habitat or biodiversity; in other words, to specify the conditions and actions that can increase the potential of desired NCOs and achieve the sustainability of agriculture.

In order to connect jointness (supply) and functions (societal demand), we have to increase knowledge by analysing:

- The coupling between CO and NCO outputs in agriculture: we know that jointness between these outputs is weak as long as externalities are positive (and conversely). This result is supported by an empirical study referring to OECD countries (Abler, 2001).
- The local, regional (landscape) level of NCO production: the question of spatial scale change (from farm to landscape level).

A way to go ahead with the discussion could be to study the correspondences between joint consumption and joint production. In a sense, it is a dual characterization of agriculture multifunctionality we consider here. Recently, Vermersch (2004) developed an analytical model where joint consumption results from the public character of the good which can provide several attributes. These are outputs of household production technologies. It follows that joint consumption is allowed through a collective utility function. The main hypothesis of his model is that the attributes of the public good

(health care and environmental protection) are joined to the food consumption. Consequently, it is possible to define two different structures of preferences for two consumers: a structure that expresses joint consumption and another which does not. But the main limit to this approach is that other NCOs that are not demanded by consumers of foodstuffs are excluded from the analysis.

At this stage, further improvement of this preliminary work is needed to give more indications for the linkages between supply and demand side issues within the framework of the MEA-Scope project.

4 Multifunctionality and beef production

Agricultural multifunctionality, jointness of production and the actual degree of jointness have a big influence in how we will use the models in the MEA-Scope project, because we will analyse the impacts of future CAP reform on multifunctional beef production.

In the previous part of this report, definitions of agricultural multifunctionality were given and the conceptual framework was presented. In this part, the degree of multifunctionality is first defined. Then, examples of COs and NCOs that are jointly produced in beef production are presented.

4.1 Degree of multifunctionality

In the literature, not very much information was found on the degree of multifunctionality. However, a first theoretical approach has been developed by Belletti and al. (2002) and will be presented here. The authors try to conceptualise multifunctional agriculture as a process by which NCOs are produced and reproduced.

To assess the degree of multifunctionality, the following formula is used:

$$(1) \quad \text{Value of agricultural production} = \text{NCO} + \text{CO}$$

As multifunctionality is a characteristic of agriculture, according to the authors, “this statement implies, that agriculture deserves support particularly when NCOs are public goods, and hence externalities are not internalised through individual or collective action; in this situation the production of public goods (and hence of NCOs) is sub-optimal” (Allaire and Belletti, 2002). The authors acknowledge that “European agriculture shows a large internal diversity in terms of the public-private goods pattern of production, and a support policy should be aware of the effects of the support on the level of public goods created jointly by agriculture.” However, they state that besides

this argument, “it should be considered that the meaning of ‘public good’ is context-dependent, and what is considered valuable by society at a certain time could change considerably in other contexts of space and time. The coherence between CO and NCO changes along time, and so the kind of support granted through public intervention”.

To assess multifunctionality aspects of a farm or a process, we should know when one farm is more multifunctional than another farm. Belletti and Marescotti tackle this issue by considering the case that

$$(2) \quad \text{NCO} = \alpha * \text{CO},$$

in which (2) shows a functional relationship between the production of a CO and NCOs, and in which α is the degree of multifunctionality (with values between 0 and 1). An increase in α shows an increase in the degree of multifunctionality while producing a particular CO.

An example of this function is the joint production of beef and the quantity or quality of an appreciated landscape: if beef production (CO) increases in a region, then the quantity or quality of the appreciated landscape (NCO) might be increased because land used for crop production is changed in land used for grazing. If the α would be low (e.g. 0.10), the production of appreciated landscape does not depend greatly on beef production in this case, and would therefore not be affected much when beef production would increase with a great amount. When the α would be high (0.90), the production of appreciated landscape would greatly depend on beef production, and therefore an increase in beef production would increase the quantity or quality of the landscape. See the next section for more examples on multifunctional beef production.

Often, joint goods show characteristics of public goods. Local agents (at individual or collective level, or public institutions (http://europa.eu.int/comm/agriculture/rica/sitemap_en.cfm)) can transform the public goods into a private one:

$$(3) \quad \text{NCO} = \beta * \text{Public goods} + (1-\beta) * \text{Private goods}.$$

Such a transformation from public to private goods decreases the value of β . Market failure in the provision of the NCO can thus be solved, under the assumption that commodisation does not change the quality of the NCO, and not considering distribu-

tive issues between consumers. “In this way public intervention can concentrate on the more ‘public’ goods, that is joint goods characterised by very high levels of non-excludability and non-rivalry.”

However, this first analysis of the degree of multifunctionality of agriculture can lead to some difficulties. The first one is the valuation of NCOs in general (is the monetary unit the best unit of measure?) and its relative value in connection with the CO produced at the farm level. The second is the question of aggregation of the different NCOs at the farm level as well as at the landscape level. These difficulties have to be considered and further work should be done for defining a relevant degree of multifunctionality, particularly in the context of beef production.

4.2 Multifunctional beef production with NCOs jointly produced in MEA-Scope

4.2.1. Introduction

Brouwer and Lowe (2000) wrote: “Cattle have impact on air soil and water quality, amenity value of countryside, landscape quality and diversity, maintenance of genetic diversity of domestic breeds and resource use.” It is interesting to know for the MEA-Scope project which NCOs are jointly produced in beef production. In this section, different NCOs that are jointly produced with beef production are analysed. Firstly, the necessity of an exact definition of a beef producer is made clear. Secondly, positive and negative NCOs that are provided by beef producers, both on farm scale and landscape scale, are described.

4.2.2. Definition of a beef producer

To analyse the joint products of beef production in the MEA-Scope project, the exact definition of a beef producer needs to be known. Milk producers are not necessarily beef producers and beef producers are not necessarily milk producers: milk producers are not automatically also beef producers because ‘beef’ often denotes the ‘quality’ meat of a bovine animal. However, milk can be a NCO, when it is jointly produced with beef while beef production is the main production activity. Furthermore, beef can be produced without the joint production of milk when calves drink up their mothers’ milk

(suckling cows).

The definition of a beef producer needs to be set up by the modellers and the persons developing the Analytical Multifunctionality Framework and the list of indicators to be used in the MEA-Scope project. One of the sources for definitions of different agricultural professions is the Farm Accountancy Data Network (FADN). FADN categorises farms into different farm types. Farm types that are important for MEA-scope are (farm type numbers between brackets):

- 1 Field crops (13, 14)
- 2 Milk (41)
- 3 Grazing livestock (42, 43, 44)
- 4 Granivores (50)
- 5 Mixed (60, 71, 72, 81, 82)

These categories are subdivided into many subcategories; see below. You can find more information about these categories on http://europa.eu.int/comm/agriculture/rica/sitemap_en.cfm

- 1 Milk
- 2 Milk and cattle rearing
- 3 Cattle rearing
- 4 Cattle fattening
- 5 Dairying with rearing and fattening
- 6 Rearing and fattening with dairying
- 7 Sheep and cattle combined
- 8 Various grazing livestock
- 9 Cattle-dairying, rearing and fattening combined
- 10 Mixed livestock-mainly dairying
- 11 Mixed livestock-mainly non-dairy grazing
- 12 Mixed livestock-granivores and dairying
- 13 Mixed livestock-granivores and non-dairy grazing

- 14 Mixed livestock-granivores with various livestock
- 15 Field crops and dairying
- 16 Dairying and field crops
- 17 Field crops and non-dairy grazing
- 18 Non-dairy grazing and field crops
- 19 Permanent crops and grazing livestock
- 20 Various mixed crops and livestock.

In these categories, some aspects of beef producing farmers that might be present as well are missing:

- 1 Beef producers who also engage in tourism activities;
- 2 Beef producers who also engage in educational activities;
- 3 Beef producers who also engage in nature conservation;
- 4 Beef producers who also engage in 'care' activities on the farm;
- 5 Any other beef producer type?

All these different characteristics need to be taken into account when modelling the impacts of CAP reform on multifunctional beef production, as a farmer might choose to decrease his production of meat and increase his production of vegetables or other livestock than beef, after CAP reform.

4.2.3. Production of NCOs jointly with beef production

Beef production affects the economic, social and environmental characteristics of both the farm and the region. Some of these effects can be called Non-Commodity Outputs (NCOs) or externalities, as they are produced jointly with beef production but do not have a market price. These NCOs might be positive or negative, for instance landscape amenities and pollution, respectively.

The effects of CAP reform on multifunctional aspects of beef production, and on the relationship between the joint production of COs and NCOs, depend on the characteristics of the farmers and of the region in which beef production takes place.

istics of the farmers and of the region in which beef production takes place. For example: if all beef producers in a region keep their cattle inside in feedlots, then CAP reform probably has a different effect on the landscape than if all beef producers keep their cattle outside most of the time.

An overview is presented below of positive and negative externalities (NCOs) produced jointly with beef production, on farm-scale and landscape-scale. This list is not a final list; more NCOs can be added as the MEA-Scope project proceeds. Besides NCOs, COs are also jointly produced with beef: examples are milk, hides, manure and production of renewable energy (biogas). The list is output oriented: beef is produced, and NCOs are produced as well while producing this beef. As the MEA-Scope project proceeds, it needs to be decided if the relationship between an input and the NCOs, or if the relationship between an output and the NCOs, is taken into account.

Examples of beef production that produce NCOs jointly (both positive and negative)

- 1 Beef production often occurs through grazing; this affects biodiversity and landscape (amenity). Landscape that is created by grazing might be interesting for tourists, so beef production produces the NCO: landscape amenity for tourists. In addition, a higher biodiversity might be attractive for tourists.
- 2 Beef production might influence agro-biodiversity through the conservation of different breeds by farmers. Different breeds have different characteristics; e.g. amount and type of vegetation preferred. This might affect landscape and biodiversity because different breeds have different grazing behaviour.
- 3 Beef production affects the landscape through animal housing. This might be a positive influence through the conservation of cultural heritage or a negative one when old buildings are torn down to build bigger modern ones (e.g. when farmers need to intensify and therefore cannot conserve cultural heritage because stables need to 'improve' their stables to European standards).
- 4 Beef production might affect employment; this can be a positive or a negative effect: if the quantity of cattle is increased, more people might be employed both on the farm and in the region.

- 5 Beef production might have an influence on the health of farmers, rural communities and tourists by providing a landscape, which people can enjoy. However, this effect might be negative, by emission of air pollutants and particulate matter.
- 6 Any agricultural activity, and therefore beef production, influences the rural community. Therefore, a change in the number of farmers and farmed land (e.g. abandonment) influences rural viability, rural income, traditional practices etc. The effect might be positive or negative.
- 7 Beef production affects the nutrient balance (through emissions of N, P, K, and C) in soil, water and air: this might affect biodiversity, landscape and habitats in a negative way.
- 8 Too intensive grazing might have a negative effect on landscape amenity, tourism, might create soil erosion, etc.
- 9 Beef production could lead to erosion; erosion affects water quality, landscape, biodiversity and habitat. Decreasing water quality affects biodiversity and habitat.
- 10 Beef production influences water availability, because cattle drink much water and sometimes fields for hay are sprayed with water.
- 11 Beef production emits GHG emissions through manure, use of machines and through means of transportation.

Linkages might exist between the different jointly produced NCOs. For instance when cattle trample banks and therefore create erosion, this eroded soil gets into the water and might affect BOD. This might have an effect on biodiversity and water quality. Furthermore, nutrients that were stored in this eroded soil might be dissolved in the water (environmental pollution). Another example is the effect that pesticide- and fertiliser leakage could have on landscape, biodiversity and habitat.

5 Multifunctionality and the sustainable development of rural areas

The debate on the multifunctionality was revived by the crises in the agricultural sector in the majority of developed countries. This crisis stems from several changes affecting the agricultural world (Hervieu, 2000). Firstly, the fall of farmer population - and the evolution of land use by agriculture. Rapid technological progress in agriculture over the last century has made it possible for a small percentage of the labor force to produce ample food supplies at prices that are significantly lower. Rural populations in many regions of Europe and other developed countries have fallen significantly in recent decades. Moreover, small portion of the national territory is now required to sustain food production. On the other hand, at the demand side quality and safety requirements encourage consumers to ask for more information.

Moreover, the impact of the agriculture on the environment is becoming a concern of an increasingly urban society that progressively affects farmer profession and identity. In this context, all social functions as *viability* of rural areas, social cohesion and cultural heritage become a concern in most developed countries. Social function can be defined under the environmental economics approach. However, qualifying social functions as public goods is open to debate. The question is essentially whether rural areas have an economic value above and beyond their added value in the goods and services they produce? Rude (2000) responds to this question “yes, but.” He recognizes that there are external effects or public goods stemming from the viability of rural areas. Rural viability can be related to agricultural production, but it is not an external effect of agricultural production, as the externality-generating mechanism is employment.

5.1. Multifunctionality as a key concept for a sustainable rural development

The former Common Agricultural Policy (CAP) was oriented to enhance sector productivity bolstering specialization and intensification of EU agriculture. The effects of such a philosophy became evident in the mid-1980s when the burden of food surpluses, environmental hazard and economical inequality between farmers (the 25% of EU farmers were producing the 80% of total production) brought the evidence that more farmers existed than were necessary (Rizov, M., 2004).

In the 1992, the European Commission with the Fifth Action Plan for the Environment showed the intention to develop an agricultural policy consistent with the concept of sustainable development (Evans et al., 2003). Thus the CAP reform of 1992 met the necessity of more sustainability with environmental and financial goals to be pursued though the cutting of funding for production and the support to those farmers unable to compete in an increasingly open market. In the 1999, with the Rural Development Regulation 1257/99, there was a shift of CAP from a sectoral policy of farm commodity support into an integrated policy for rural development and sustainability enhancement. In this context measures were taken to ensure structural adjustment of the sector, support for farms in less favourable areas and payments for agro-environmental activities in the pursuit of sustainable rural development.

“Development is sustainable when it meets the needs of the present generation without compromising the ability of future generations to meet their own needs”: in Our Common Future (World Commission on Environment and Development 1987) the Brundtland Commission introduces the issue of sustainability in the scientific and political debate at the international level. Since then many attempts were carried out to define the concept and, as Rigby and Caceres (2001) reported, at least 386 definitions of sustainability are found in literature. The term sustainability is commonly referred to as a relationship between economic growth, natural resources, and social and cultural values that can continue indefinitely without causing a change in balance among the factors involved. In such a broad view, sustainability *“risks being about everything and therefore, in the end about nothing”* as the Economist wrote after the World Summit on Sustainable Development held in Johannesburg in 2002. In the specific context of the agricultural sector there is the lack of a commonly accepted definition of sustainable agriculture, often thought of as a list of objectives to be taken into account to avoid negative impacts (Evans et al 2003).

An attempt to conceptualise agricultural impact on the natural environment in negative terms was carried out during the last 20 years, with a particular focus on intensification as having the first responsibility for negative effects. In recent years, the positive role played by agriculture in many European areas begun to be investigated not only because of the threat of abandonment but also in the believe that some agricultural management has an active, positive role for local environment and society. In this context, agriculture became multifunctional: it was able to respond to increasingly diverse social demands in terms of environmental services, quality products, cultural amenity etc.

Nowadays there is the common perception of the agriculture benefits widely provided to the environment and society, but it is still difficult to define and conceptualise such benefits. There are many possible interpretations of agricultural multifunctionality varying not only in function of temporal and spatial diversities but also in function of the different points of view from which one analyses it. The multifunctionality contents can in fact be different if we focus on the single farm level provision of functions, or if we analyse the provision of functions of a set of farms, or if we look to a whole rural territory. Moreover, we can focus our attention to different perspectives in which multifunctionality can be addressed: environment, society, landscape, economy assets, cultural issues, all being different contexts affecting the different perceptions of this concept. The multifunctionality complexity calls for an integrated approach able to contextually comprehend the economic, environmental, social and cultural values related to the multifunctionality played by agriculture. In this sense the multifunctionality evaluation has to deal with the problems of the constraints of models in terms of representing complexity.

In the context of rural areas, agriculture is traditionally an important sector that historically consists of a complex patchwork of large, profitable farms coexisting with small, extensive, less competitive and less productive farms and rural holdings. In this specific scenario, does multifunctionality play any specific role in the contribution to rural and sustainable local development?

Rural areas are characterized by having small economies (regional scale) unable to provide the local market with all the demanded goods and services. A small economy also means that to respond to the market requirements for producing efficiently, a rural area tends to be specialized in producing those few goods and services ensuring competitiveness and profits because of competitive advantages. Enhancing agriculture specialization and intensification can then represent a viable track to promote economic growth, while abandonment is the only alternative choice for the non-competitive farms. This solution seems to completely satisfy the market requirement in terms of efficiency. Furthermore, agricultural specialization and intensification does not necessarily mean to create negative impacts nor to totally jeopardize the public goods function of agriculture.

For instance, in Tuscany (Italy), we have many examples of single product based farming systems (olive groves and wine yards) that are still providing a sum of valuable outputs in addition to the commodities supplied to the market, keeping a kind of multifunctional role, that is contributing to shaping countryside along with providing tradi-

tional quality food. Hence, there is a certain degree of multifunctionality provided by such agricultural activities with a positive impact on some elements of local society and environment. Agricultural activities are traditionally important in rural space, and they usually provide a fundamental contribution to rural development. In fact, all these farms contribute to rural development in some way by having effects on the local environment (landscape, hydro geological assets, nature conservation, etc), by preserving some local know how, etc.

In this case, are those farming systems optimising/maximizing the agricultural role played in rural sustainable development, and is it possible to point out any agricultural function specifically addressed to improve such a provision (rural sustainable development)? The first problem to solve is related to the rural development demarcation in respect to multifunctionality, and the connection between the non-commodity output production and the rural development-sustainability pattern.

5.2. Rural development as a public good

From a theoretical point of view, rural development is deeply linked to the level of commodity and non-commodity outputs produced locally. The role of agriculture to promote a rural sustainable development process is then to produce both commodity and non-commodity outputs fulfilling a multifunctional role. Commodity outputs imply economic growth of the community, while non-commodity outputs benefit environment and society. The role of agriculture is then to provide an intricate mix of public and private goods for the market and society. The wider and larger is the combination and the amount of those goods, the higher the level of rural sustainable development reached. In the agricultural sector public good provision commonly occurs together with primary production, with the characteristic of a joint production. In this case, according to Heady (1952), the output can be classified as joint, complementary or competing. Following Vatn (2002) "in the case of complementarity, the production of one good contributes an element of production, which is joint with this first good and required in the making of second good." An example of that in agriculture can be the use of manure, which contributes positively to soil fertility and stability as a joint product of animal rearing, and also enhances future soil productivity as a complementary product. The two productions (joint and complementary) have to find an equilibrium, beyond which they start competing over the common production factor (Heady, 1952).

We then argue that the agriculture contribution to rural development is recognizable as a complementary good.

It is commonly recognized that agriculture plays an irreplaceable role in rural areas in terms of *local* development. Less clear is how the sector develops its functions in terms of rural *sustainable* development. Rural sustainable development arises when the trade off between diversity and specialization/intensification of local agricultural systems maximises the outputs (public and private) that are locally produced. In this sense rural development assumes the characteristic of a complementary product, whose fulfilment relies on the level/variety of private and public good productions and on the diversity of involved actors. Improving the provisions of such complementary goods could represent a viable track to achieve rural development and sustainability. Concerning the issue of rural sustainable development, the dominant problem is thus to demarcate the possible role of agriculture in supporting such processes.

5.3. Diversity as a public function of agriculture

According to Rizov (2004) “rural development policy in the context of the present CAP is closely linked to two concepts: diversity (multifunctionality) and sustainability, as the former is a precondition of the latter.” Heal (1998) and Weitzman (2003) argue “that rural development can be enhanced by achieving optimal diversity of economic activities in the rural communities.” In this sense, multifunctionality (diversity) can be viewed “as a measure of distinctiveness or collective dissimilarity that combines in a complementary, value enhancing way with direct benefits such as use value, existence value, option value etc.” (Rizov 2004). This calls for more integration and a synergistic relationship between different production systems (enterprises) coexisting in the same context even though they have a different economic efficiency. This diversity simultaneously allows a set of different jointness that increases the complementary production.

As Rizov shows “achieving an optimal diversity at community level is a key in the rural development problem”. Obviously the main problem is the identification of the trade-off between diversification and specialization that ensures the agricultural multifunctional role to be addressed with regard to rural development and sustainability.

This Rizov characterization of diversity (multifunctionality) provides the features of

privately provided, pure, non-excludable public goods. Commonly the total level of public goods (rural development) affecting the welfare of rural communities is ascribed to the simple sum of each agent's contribution. "Thus contributing to community development by one farm household always does just as much good as the contribution by another farm household." It then follows that if there is a farm household with a lower opportunity cost in producing public goods, it is sufficient to encourage such a household to enhance development at community level. In such an approach all the contributions by the different farm households are perfect substitutes, implying that when the more efficient household production systems (specializations) prevail, this will bring the most efficient technology for contributing to community development. However, in the rural development context, the contribution by all farm households is necessary to improve community development, regardless of the public good production rate. In such a case, the rural sustainable development can be fully achieved if the development contribution of the more diversified farm household increases, rising the complementary production.

In the specific context of rural areas this means: maintaining the specific countryside character, making the rural community more attractive for living and for tourism by providing a variety of services locally, developing new enterprises according to local comparative advantages, enhancing and empowering the local community, and the use of local traditional knowledge, "all adding up to higher income and welfare."

At community level it is reflected in the generation of higher income and welfare, reduced dependence to urban areas, less vulnerability to adverse trade shock, positive agglomeration-synergic effects, and improved quality of life over time. In that way, rural development also fulfils the sustainability principles. In fact, following Stavins and al. (2003), "an economy is sustainable if and only if it is dynamically efficient and the resulting stream of total welfare functions is not declining over the time." In addition, rural development can be viewed as a public good ensured by the existence of a variety of farming systems at community level. So agriculture as a whole provides within its mixed pattern a great positive effect sustaining rural development, ensuring "an extended set of actors such as peasant or small farmers, wealthy farming class, and counter-urban former dwellers" (Rizov), creating a beneficial agglomeration effect empowering complementary production. In this perspective the threat for rural areas is extending far beyond the specific problems of abandonment, as it includes the risk of incremental changes in farming systems, bringing specialization and homogeneity with negative implications in rural development and sustainability terms.

This diversity-multifunctionality concept can be applied both at farm and sector level. Diversity can be seen, in fact, as a trait of the whole sector consisting of different farming systems producing commodities both for the local and global market, but it also can be seen as a single farm characteristic leading to a mixed production pattern mainly oriented to the local market. These two interpretations of diversity (at farm or sector level) can be used together or separately to analyse the relationship of multifunctional agriculture to rural development. This approach should be developed in the specific case of beef production within the MEA-Scope project.

Beef cattle are, or have been, a very important part of traditional mixed farming, representing a necessary/fundamental element to maintain/develop a sustainable pattern of agriculture in rural areas that provides a multifunctional role and also sound rural development. The place of beef cattle on mixed or extensive cattle farms in mountains and in marginal areas is crucial for the survival of human settlements and natural habitat conservation. In addition, as Evans (2003) noted, beef cattle in comparison to other grazing herds have a positive role, for in fact “beef cattle grazing generates a series of distinct benefits over other forms of grazing” and in function of locality and habitats they show an explicitly positive role on flora biodiversity conservation (Evans 2003)

Beef cattle grazing is thus an important element of a very diversified agriculture with a positive role on landscape and environment, if it is placed in a sustainable pattern of agricultural management, and also within rural sustainable development.

Finally, the market requirement to produce efficiently has trapped agricultural areas between the need of specialization to achieve competitiveness and the abandonment of high-cost production areas, with an increasing exposure of rural areas to exogenous forces (market, culture, transport, etc.). This affects the rural area identity and reduces local opportunities for endogenous driven development, with effects on the sustainability of rural development processes.

Agricultural activities are deeply interlinked with local environments and societies. The development of such a relationship has lasted for a long period accompanying human evolution, therefore the role of the sector is difficultly reduced to the strictly commercial/economic one. Agriculture brings in itself a richness of natural, cultural, and social values that risk to be lost along with the positive effects it produces for the environment and society.

A two-track economy in which commercial farms and non-commercial farms coexist

could be a valid response both to economic and environmental/social concerns, allowing a diversity of farm typology to survive, producing quality products and environmental goods for the local and the external market. The balanced diversity in which more efficient farms produce food or fibre at lower costs while the others specialize in environmental goods, encourages the re-assessment of the multifunctional role of agriculture to enhance the development and the sustainability of local communities.

To conclude this point, we can refer to the interesting approach of Knickel and al. (2000) who suggest to 'map' the functional relationships underlying rural development processes. They develop a methodological approach of the complexity of the rural development processes that specifically relates to multifunctionality. For these authors, rural development "consists of a wide variety of new activities such as the production of high quality and region-specific products, nature conservation and landscape management, agri-tourism and the development of short supply chains" (p.513).

The analysis of rural development takes into account the new interrelations developing at different levels between farming, the rural areas and society at large. For example, at the farm level, key aspects are the interrelationships between different farming activities, the reorganization of existing agricultural practices in order to accommodate new activities, and the mechanisms through which new revenues and/or new forms of cost reduction are realized. At the regional level, these are job creation in rural areas, the interrelations between farms and other rural enterprises, and the contribution of individual activities to the regional economy and to regional employment. Finally, at the global level, key aspects are interrelations between agriculture and society as a whole: new needs and expectations that are articulated for rural areas (recreation activities, environmental services), and more generally the influence of institutional context via public policies.

At this stage, the previous parts of this report imply implementing our multifunctional approach of the European model of agriculture in the following direction: production can not be put on one side, and the other functions of agriculture, like social and environmental aspects, be put on the other side. On the contrary, we have to increase our knowledge about the relationships between the various functions of agriculture and their spatial dimensions for 'mapping' the various patterns of multifunctionality.

The multidimensionality of multifunctional agricultural requires more information about the linkages between different actors in time and in space. This first report attempts to give an overview on the various meanings of the multifunctionality concept.

This is a preliminary step in the MEA-Scope project before analysing its impact on the development of indicators and on the modelling approach.

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