ANALYSING INSTITUTIONS, POLICIES, & FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE IN CENTRAL AND EASTERN EUROPEAN COUNTRIES IN TRANSITION

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ABSTRACT

The aim of this paper is to develop a comprehensive conceptual framework for the analysis of institutions, policies and farming systems for agri-environmental sustainability in Central and Eastern European countries in transition. The basic unit of analysis is the 'agri-environmental action scenario'. The action scenario consists of a set of components which together shape the outcomes of an agri-environnmental action situation. The framework consists of 1) the environmental effects of transition, 2) policies, 3) institutions, and 4) farming systems. We aim at characterising these key elements of the framework, their relationship and interactions, and their role in achieving sustainability at the interface between agriculture and the environment. Environmental areas of concern are: water, soil and biodiversity. The paper intends to create a common understanding of basic concepts and a shared conceptual model among the members of the Central and Eastern European Sustainable Agriculture (CEESA) Network. The framework will be adapted according to new insights and findings during the course of research activities of the CEESA research project.

The paper (in its electronic version) includes text marks and hyperlinks for keywords mentioned in the glossary, the entire reference list, as well as for tables and figures.

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INTRODUCTION

This paper seeks to introduce a framework which aims at conceptualising research topics for the study of sustainable agriculture in Central and Eastern European Countries, which are discussed by an international group of researchers from Germany, England, Finland, Latvia, Estonia, Lithuania, Czech Republic, Slovak Republic, Hungary, Romania, Slovenia, Croatia, Bulgaria, Ukraine, and Poland. These research topics belong to the categories of Institutions, Policies and Farming Systems and they are being investigated by a group of scientists who carry out case studies in the above mentioned countries under transition. The paper serves two purposes. The first is to develop a common reference for concepts and terms being used in the research groups. This strongly supports the exchange of knowledge and the communication process among the researchers involved. The second goal is to approach the development of a conceptual framework for the study of sustainable agriculture in countries in transition. Despite the fact that "understanding transition" (KATO, 2000) is an important field of research, this framework goes one step further and focuses on the intersections between agriculture and the environment in transition countries. Each of the authors of this framework belong to one of the working groups of this research project: Institutions of Sustainability, Agri-Environmental Policies and Farming Systems.

1 TRANSITION TOWARDS AGRI-ENVIRONMENTAL SUSTAINABILITY

The objective of our analysis is to understand following issues of the transformation process and its impact on agriculture and the environment:

- What is sustainable agricultural development in the context of the agri-environmental change during transition?
- Which features of the transformation process are obstacles or are beneficial for achieving sustainable agricultural development?
- What changes in policies are required to achieve sustainable agricultural development?
- What changes in institutions are required to achieve sustainability?
- What changes on the farming system's level are required to achieve sustainability?

Historically agriculture is often said to be the beginning of an exploitative relation between man and nature (Heilbroner, 1998; Prugh, 1995; Gowdy, 1998). In Western societies this does not further surprise as the (technological) means to meet our seemingly unlimited wants, especially since the industrial revolution, continuously improved. Recognising the assumption of substitutability (natural capital for man-made capital) in neoclassical economic theory the difference between renewable and non-renewable resources becomes unimportant within the limits of actual substitutability. However, since scientists increasingly recognise that unlimited substitutability is a fiction, the attention was drawn to the concepts of "weak" and "strong sustainability" (Pearce & Atkinson, 1993). By the criterion of weak sustainability it is legitimate and economically rational to cut down a rain forest if the monetary gain from doing so is invested for the benefit of future generations. The "strong sustainability" criterion recognises that there are limits to substitution. Renewable resources should be used at a rate that is lower than the rate of natural regeneration. Non-renewable resources should be used at a rate lower than the rate of increasing technological improvements (such as increased efficiency or the discovery of substitutes). However, strong and weak sustainability are essentially embedded in neoclassical economic theory, where the factor 'land' is returned to the

standard list of primary economic inputs land, labour and capital (Gowdy, 1998). In the following, we will approach he concept of sustainability from the perspective of institutions, policies, and farming systems. It will become clear that there is no universal concept for sustainability. Instead multiple factors contribute to what we consider "sustainable" and these factors are slightly different from the three perspectives mentioned.

Adequate agri - environmental institutions are essential elements for achieving sustainability. Economic sustainability and ecological sustainability, simultaneously need to be achieved for an overall sustainable man – nature relationship. Agricultural production, human health and ecosystem integrity go hand in hand. This requires to organise human action and interaction with nature in a manner that enables living from flows instead of living from stocks. Society needs to re-arrange and diversify the rules and the play of the game. This does not only count for countries in transition but for all countries. This process goes along with the re-arrangement of property rights to land and the landscape, the re-arrangement of human labour by educational measures and training. All these social re-arrangements and reorganisations are effected and influenced by policies, farming systems and institutions, the key components of our framework.

Institutions take a special role in this constellation as they are the essence of social change. Social change means redefining relationships among people and their environment. We define institutions as rules and rule configurations or prescriptions that are commonly used or known to order repetitive, interdependent relationships between individuals, sets of individuals (stakeholders, actors) and between individuals and actors. Just these structures are changing during the transition of the Central and Eastern European countries. How are these structures being re-configured and rebuilt, so that clear property rights conditions are achieved and incentives for environmentally sound investments and production activities are created? How does the process of reconfiguring structures in social and ecological systems towards balance, certainty, and safety, work for the agri-environmental sectors of Central and Eastern European Countries?

Agri-environmental sustainability refers to the ability of institutional arrangements to link/relate (economic, social, ecological) systems to each other, which are of embedded/contained nature and therefore ultimately depend on each other. For defining sustainability it is helpful to think in terms of systems. The overall agri-environmental sustainability goal depends on the sustainability of partial systems connected to the agri-environmental sector. As mentioned by the Enquete Commission of the German Parliament "Protection of Man and the Environment" (Enquete Commission, 2001) sustainability is understood as a regulative idea which requires adequate rules to become effective in the various areas of society. These regulative conditions should enhance strategies of the actors to improve the constant monitoring and supervision of environmental impacts from agriculture. They support strategies to improve participation, co-operation (among farmers but also between farmers and environmentalists) and conflict resolution. In other words, agri-environmental sustainability promotes co-adaptive change. "Co-adaptive" means, "change as a response from signals from each of the systems/components linked to each other". "Change", means restructuring of rule configurations (institutional genotype) and the related shaping of the physical system (institutional phenotype). Institutional sustainability thereby includes evolutionary dimensions of change. Degrees of sustainability are achieved according to the specialisation, effectiveness, relevance and practicability of rules. Degrees of connectivity between systems also relate to degrees of sustainability. The more specialised, relevant, effective and

practicable a set of rules linking and defining systems, the higher the degree of sustainability. "Institutions of sustainability", point out to the fact that (degrees of) sustainability can only be achieved if certain institutional order exists at the various levels of a society. Constellations of rule configurations also contribute to sustainability if they support the ultimate goal to protect the environment for the sake of our common long term survival and the desired quality of life.

Our definition of sustainability takes two key factors into account:
1) the socio-cultural and ethical dimension and
2) the dynamics of system change.

The first factor points out to the unavoidable fact that sustainability will always be subject to a specific ethical/moral setting of those who use/apply the term. The question, which needs to be answered here, is how far can we go and how far do we want/should or have to go concerning the modification or replacement of ecosystems? The ethical setting is certainly determined by economic, social and environmental conditions so that we can probably assume that a peoples struggling for survival will be willing to impose more radical changes on their natural environment (if they have the means to do so) than peoples with full stomachs and full bank accounts. Decisions if or to what extent pre-formulated concepts of sustainable agriculture should be adopted are decisions which need careful, participative consideration of the underlying social, economical and cultural conditions of a country. The limits within sustainability need to be defined can (e.g.) be within the propositions of EU regulations. The essential point made here is that sustainability is not a universally pre-defined concept controlled by an anonymous "big brother" - similar to a central planning agency. The limits within sustainable agriculture takes place are set according to people's wishes, desires, needs, and values and economic necessities/constraints. Because sustainable agriculture, as we understand it, is the result of dynamic forces in a participative and democratic fashion by people for people.

The second factor points out to the fact that systems are not static but dynamic, which means they change over time. Sustainability and change do not contradict in fact they are compliments. Ecosystems and social systems (including economic systems) are sustainable if changes occur in a manner, which allow for co-adaptation and institutional restructuring, instead of sudden collapse. Therefore sustainability is not necessarily (but can be) defined within the boundaries which define specific ecosystems (e.g. forests can be turned into agroforests and agroforests can be turned into gardens). Maintaining and co-managing ecosystems can lead to sustainable agriculture[1] but a specific ecosystem can also be restructured or even newly created in order to achieve sustainable agriculture. On the other hand sustainability needs to be defined within the boundaries of ecosystem carrying capacities. We refer to ecological carrying capacities which are mainly determined by ecological regulation functions (DeGroot, 1994, Table 1) which maintain the resilience of an ecosystem (Berkes & Folke, 1998). In fact, the term 'resilience' should be used in this context, as it stresses the system's dimension of social and ecological interaction more than the term 'sustainability' does. Adaptation is an important

[1] Co-management refers to mutual management practices between the human actor and the ecosystem. Human actors manage ecosystems in a way that they can benefit from the goods and services of the ecosystem in return. The ecosystem is modified and adapted according to human management and, in turn, human management is developed according to desirable long-term returns from the ecosystem. Co-management means mutual adaptation.

feature of sustainability. If institutional arrangements are not able to change to ever-changing (social, economic, cultural, natural) environments sustainability can hardly be achieved.

Adaptation refers to processes whereby a structure is progressively modified to give better performance in a specific environment. The starting point for the modification of structures for improved performance in a (new) environment is the task of optimisation (Holland, 1975, 1998). In our context we could imagine a set of rules being adapted (reformulated or newly created) to ensure long lasting benefits from nature. The adaptive works of the system is constituted by the process of organisation and setting up of rules in order to create improved structures. Thereby it is determined what structures arise in response to the (socio-cultural, economical, ecological) environment. Translating the analogy to the context of our research, we can say that the task of the research activities is to understand (provide information on) the process of organisation, and setting up of rules in order to create improved structures in the agri-environmental action scenario. Improved structures are structures which are established as response to requirements of change. Once repeated actions are required in a specific environment institutional building governance will come about.

The crux of the problem for the process of organisation, and setting up of rules in order to create improved structures is that initially we have incomplete information about which structures most fit. Initially we do not have the experience from similar situations in the past. To reduce this uncertainty, observation and explorative description are unavoidable. Learning from trial and error is also characteristic for this initial phase[2]. Holling et al (1996) further investigate the role of adaptation in social and ecological systems and come to the "grim" conclusion that "human systems of property rights built around deterministic (or stipulated) ecosystem models are not flexible in their application or crafted in light of the temporal or special demands of natural systems. Until modern human institutions are built on ecological dynamism, and designed to flex with natural variability, their principle impact will be to impede nature, not to sustain it."

In the context of our framework, agricultural sustainability takes place at the interface between agriculture and the environment. Agricultural sustainability focuses on an optimal interplay between institutions, farming systems and agri-environmental policies. "Optimal interplay" means, a constellation of institutional, political and farming system structures, which is dynamic, adaptive and which leads to desired outcomes. Agricultural sustainability cannot be achieved independently from socio-cultural characteristics of the actors or the countries under observation. It involves judgements about how to manage resources, to which extent and by whom. What is sustainable for A may be unsustainable for B. Our aim is to understand the necessary and sufficient reasons for agricultural sustainability in countries in transition,. However, we recognise that sustainable agriculture will look quite different in each of the countries observed. These differences can be explained by the different history and the different socio-cultural, political, ecological and economic conditions of the countries under observation.

1.1 Different Types of transition effects on the Environment

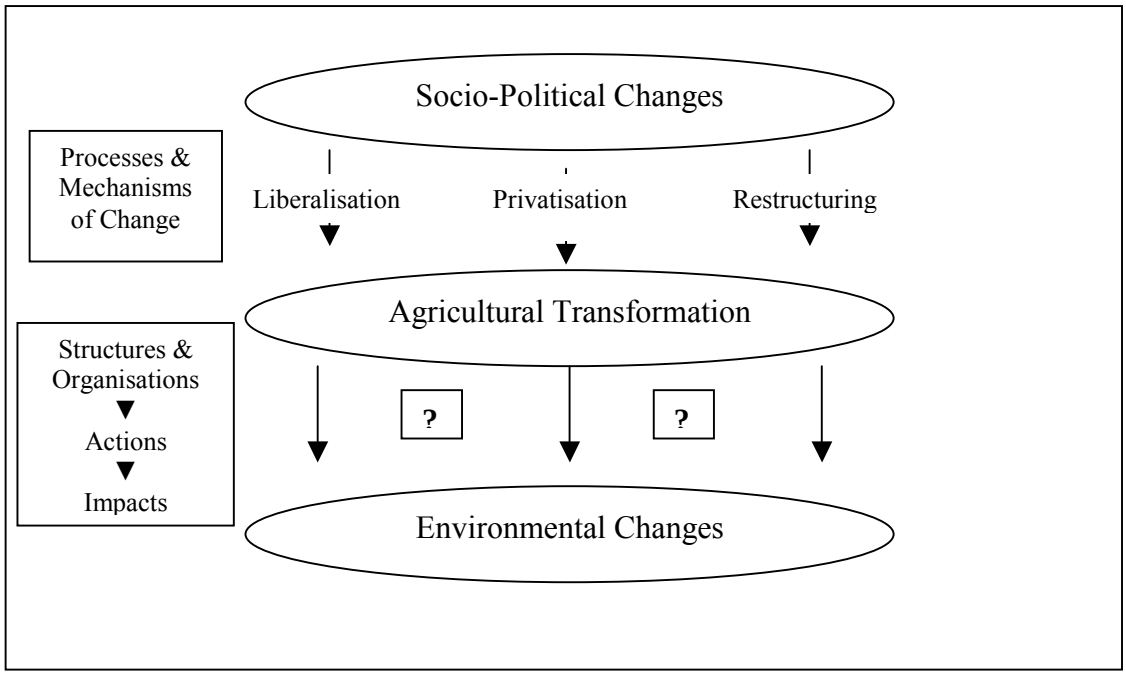
We propose to distinguish between different types of agricultural effects on the environment. Firstly, general environmental impacts, which can be divided into impacts

[2] In the context of CEESA, this is also the reason why the revised case study concept is so important.

caused by land use (e.g. soil compaction or erosion caused by a lack of knowledge on adequate management practices) and impacts resulting from the import of agro-chemicals (fertilisers, pesticides). And secondly, impacts originating from specific change processes in agriculture related to transition. These types of agricultural transition effects on the environment can broadly be categorised as those originating from the past, the present, the future, and mixed effects:

1) Agricultural effects on the environment, which can be explained by history
   - effects as a result of the socialist era, pre-transition effects
2) Agricultural effects on the environment, which are a result of actual transition processes, such as liberalisation, privatisation or restructuring (see Figure 1)
   - which are the relevant transition processes?
   - which impact do they have on the environment?
3) Agricultural effects on the environment, which are a result of EU accession plans
   - which environmental changes can be explained by EU accession processes? (The EU accession process actually may be identified as one important process of transition relevant for environmental change)
4) Mixed agricultural effects on the environment
   - Effects on the environment which explicitly cannot be grouped into one of the previous categories.

FIGURE 1: ENVIRONMENTAL CHANGE RESULTING FROM DIFFERENT TRANSITION EFFECTS



Next, we need to identify specific agricultural impact factors. What we refer to as impact factors are specific actions and agricultural practices which have an effect (positive or negative) on the environmental resources (water, soil, biodiversity). These actions are part of the transactions which consist of action, impact and response. We are especially interested in those actions or missing actions with causal relations to the transition process in Central and Eastern European countries. The lack of maintenance of irrigation (e.g. Bulgaria) or drainage systems (e.g. Latvia) or individual pumping of groundwater are examples of such actions.

1.2 Agriculture and The Environment: Water, Soil and Biodiversity

The "environment" is a too broad area for the study of conditions which could lead to agri-environmental sustainability in transition countries. Therefore the analysis focuses on three environmental assets: water, soil and biodiversity (Figure 2). These environmental assets are linked to agriculture in specific ways. They provide environmental functions (Table 1) which are managed (or mismanaged) by agricultural activities. Agriculture and the environment are not two contradicting features, although they can be mutually destructive. Where man and nature need to co-exist neither nature in its original state nor a nature exploiting agriculture are desirable. Moreover, both extremes do not fulfil our expectations of sustainability. As Bromhead (2000) mentioned, natural sustainable resource management is all about achieving balance. Balance between short run profits and long term production security or balance between upper and lower watersheds.

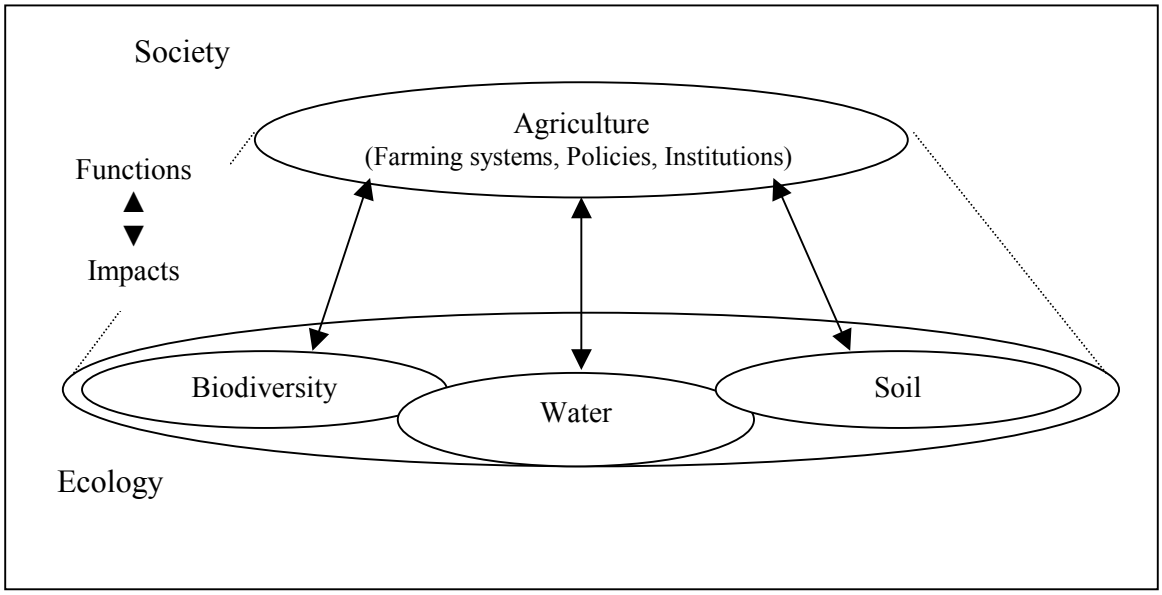
The general task for each country in transition is to develop appropriate institutions on the different levels of society, which lead to sustainable resource management practices. That means, management practices which allow for sufficient, efficient, resource preserving and long lasting agricultural production on the basis of the environmental assets water, soil and biodiversity. As mentioned earlier the conditions, under which sustainable agriculture of such kind can be achieved vary from one country/region to another. Economic interests need to be weighed out (in terms of costs and benefits, winners and losers) with environmental interests. As well as national interests need to be weighed out with international interests.

The OECD used the concept of "Pressure-State-Response" or the later modification "Driving Force-State-Response" to point out to the fact that agriculture can have positive but also negative impacts on the natural environment. Agricultural activities can contribute to environmental benefits such as acting as a sink for greenhouse gases, conserving and also enhancing biodiversity and landscape, and preventing flooding and landslides (OECD, 1999). The term "driving forces" refers to natural environmental processes and factors, biophysical inputs and outputs at the farm level, and economic and societal driving forces. The latter include factors such as incentives or (market) opportunities, cultural attitudes, public pressure that act as driving forces and trigger certain favourable or unfavourable agricultural practices, which then have an effect on the environment.

1.2.1 Water

When addressing agriculture's role in water quality, the total resource should be considered because of the continuum of water described by the hydrologic cycle. From this broader perspective, agriculture should promote practices that prevent or minimise pollution of all parts of the hydrologic cycle and avoid encouraging those that simply shift pollution from one medium to another.

FIGURE 2: AGRICULTURE AND THE ENVIRONMENT



What are the issues? Water resources provide fundamental functions. These functions mainly fall into the category of regulation and production functions (Table 1):

- Biochemical cycling
- Climate regulation
- Water regulation
- Water supply
- Fish production

As mentioned earlier, water resources and water quality is effected by different sectors of society. Apart from agriculture these sectors are mainly the industry and private households. We will focus attention to those effects which originate from agricultural transition processes. Two broad issues can be identified:

1) availability and demand for water
2) water quality issues

Both issues refer to the impact agriculture has on the functions provided by water resources. The first issue especially refers to the availability and demand for irrigation water and the exploitation of water resources (groundwater, river water, water storage reservoirs). Water quality problems related to agriculture mainly refer to the nutrient (especially nitrogen) and pesticide impact on water resources (Kristensen, 2000).

1.2.1.1 WATER QUALITY: A PUBLIC POLICY PERSPECTIVE

Public perception can be a political catalyst that stimulates legislative and executive action and public policies are a reflection of prevailing public values, attitudes, and perceptions of societal problems. Water pollution problems are institutional problems. There are physical and biological dimensions in detecting contamination, tracing the source, defining treatment technologies, monitoring human health consequences, and dealing with polluters as well as consequences of polluted water. The means for reducing water contamination are institutional and include a mix of incentives, rights, and

obligations confronting resource users. Policy is the process by which societal changes are made. Actions are taken when the hazards are apparent. However, policy changes in a democratic society are notoriously reactive, responding to evidence that failure to act could be disastrous. Changes are usually incremental, seldom revolutionary, and any change has winners and losers. Food policies in Europe have been enacted over the past years to influence decisions by farmers and provide them with a measure of economic protection from poor or no yields. By influencing production decisions, these policies indirectly affect water quality. Policies tending to increase the capital intensity of farming place the water resources at greater risk. Land set-aside programmes, whether for supply control or erosion reduction, encourage farmers to work their remaining land more intensively. When operated in conjunction with price and income support programmes for eligible crops, the incentive for intensification can be even greater. Little incentive exists for a farmer to restrict applications of those inputs when the rules encourage greater intensification for that farmer's neighbours and competitors. To the extent that price and income support programmes encourage farmers to plant more of the supported crops, such programmes may discourage crop rotation, non-chemical weed and pest control, and other practices that protect water quality. Rules guiding access to water also influence farmer actions that may affect water quality. With no regulation or price mechanism to guide allocation of water to competing users, there is no particular incentive to exercise stewardship in its use. Water is taken for granted, applied liberally, with only vague limits of reasonable use to guide distribution (Humenik, 1992)

Water contamination is a direct and predictable consequence of a complex fabric of rules and incentives guiding businesses and homeowners seeking legitimate personal or economic goals. In most instances these rules have other purposes: to stabilise farm incomes, to assure access to water, or to encourage economic growth. Changes in performance will require changes in the rules, adjusting the options available to competing water users or the direct user cost of specific options.

Change can be instigated in two basic ways: by eliminating certain options through regulation or by adjusting the anticipated cost or benefit (including non-monetary effects) of an alternative. Taxes, penalties (financial penalties and ineligibility for public programmes), and defined liabilities make those actions less attractive than other alternatives. Data showing health consequences of water pollution can be an incentive for behaviour modification. Examples of compensation for pollution-reducing behaviour include (Humenik, 1992):

(1) tax credits for land left open for ground water recharge,
(2) special interest rates or tax incentives available to farmers who employ low-input or prescription management technologies,
(3) subsidies to help offset uncertainties for a farmer willing to change production practices in the public interest,
(4) cost-sharing to help water users invest in new technologies, and
(5) government support for research and extension efforts by universities and other institutions to develop information that is compelling enough to encourage change. The most direct way to deter the actions that contaminate water is to declare those actions illegal.

However, the development of strong government regulatory programmes alone will probably not solve the environmental problems that are linked to agricultural practices. Because these problems are so diverse and because agricultural practices vary so

widely, the creative, voluntary participation of farmers will be necessary to achieve environmental goals. Farmers will make good partners in national and local pollution control programmes because they are affected first by the problems and are the key for effective solutions. Environmentalists need to recognise that there are limits on the speed and the degree to which agricultural programmes can be altered to achieve environmental goals. It is equally important for the agricultural community to recognise the need to integrate agriculture and environmental policies into a new ethics that places equal emphasis on production and environmental protection.

1.2.2 SOIL

What are the issues? The agricultural use of fertilisers and manure increases the availability of plant-essential elements and thus increases the total yield and/or quality of crops. *Overfertilisation* of nitrogen and phosphorus from commercial fertiliser and manure, or pathogenic microorganisms from manure can also cause water quality problems. At the Organization's Regional Conference for Europe in Tallinn the UN Food and Agriculture Organisation (FAO, 1998) stated that the quality of millions of hectares of agricultural land in Europe is being reduced every year because of continuous soil loss and degradation. FAO estimates that nearly 220 million hectares of land in the European region are moderately or severely degraded, this equals an area four times the size of France. The main factors contributing to land degradation in Europe are the destruction of forests, excessive use of fertilisers, manure and pesticides, inappropriate tillage practices, monoculture and excessive grazing pressure.

Soil erosion occurs mainly when land is exposed to wind and rain through loss of vegetative cover. Flood risks are often dramatically increased due to a loss of vegetative cover and deforestation. Another problem, particularly in more temperate regions in Europe, is that the natural acidity of many soils is made worse by excessive application of manure as well as acid rain produced by heavy industries throughout the region. *Soil acidification* often occurs on sandy or loamy soils. In addition, natural conditions like humid climates and low altitudes of the land can cause water accumulation and soil gleying, as it is the case in Latvia.

Salinity refers to the total concentration of a mixture of soluble salts present in all natural waters. Irrigated water is one of the major sources of increased salinity, which can result in crop yield reductions and water quality degradation. Irrigation in arid or semi-arid regions always degrades water quality and may deplete available ground water. To prevent soil salinity from reaching harmful levels, a portion of this concentrated soil solution must be leached (drained) below the crop root zone. Soil salinity and sodicity damages the drier areas of the region. In Hungary, for example, 25 percent of soils are affected. Salinity may also occur if irrigation schemes are not well managed and not adequately combined with properly maintained drainage schemes.

In 1998, a regional FAO project financed by the Netherlands mapped soil and terrain vulnerability in Central and Eastern Europe, including Belarus, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldavia, Poland, Romania, the Russian Federation, Slovak Republic, and the Ukraine (FAO, 2000). Harmonised soil data for the whole of Europe create a common basis on which policy decisions related to land-use, land management, and environmental protection can be based.

Conceptually, the task of integrating agricultural soil resources into a framework for sustainable agriculture can be facilitated by looking at the functions provided by soils. Kuderna and Blum (2000) point out to the fact that in European climatological zones soils form very slowly (1cm of topsoil in some hundreds of years) and therefore can be regarded as non-renewable resources. The authors distinguish different functions provided by soils, which basically fall into the categories of ecosystem functions already mentioned by DeGroot (1992). These are:

1) ecological functions:
- biomass production
- filtering, buffering, storing and transforming functions
- biological habitat and gene reserve

2) functions related to human activities:
- physical medium (spatial base for economic activities such as waste dumps, recreation areas, roads and fields)
- resource for raw materials (e.g. clay, minerals and water)
- geo-genic and cultural heritage (landscapes, geological and geomorphologic information)

It is difficult to identify clear cause-effect relationships between agricultural land use and its effects on soils. This is mainly due to three reasons (Kuderna and Blum, 2000):

1) Just like in the case of water resources, agriculture is only one of many sectors having an impact on soil and on the functions this resource provides.
2) Soils are buffer systems with high resilience against external impacts. Many agricultural impacts only show effects once the buffering capacity is exceeded and up to that threshold no signals of impacts are visible.
3) Because of the different climatological and other soil formation factors, soils vary even in small areas and therefore agricultural effects on soils differ from region to region.

Kuderna and Blum (2000) give the following overview of reversible and irreversible damages of soils caused by agricultural activities:

- Soil loss by erosion (water, wind)
- Accelerated organic matter decomposition
- Contamination of soils (pesticides)
- Loss of soil biodiversity (soil flora and fauna)
- Overfertilisation of soils
- Salinisation of soils
- Soil compaction

1.2.3 BIODIVERSITY

Biodiversity encompasses all species of plants, animals, and micro-organisms, the genetic variability within these species, and the ecosystems and ecological processes that they form and which sustain them. Biodiversity can be measured at three different levels (Pagiola & Kellenberg, 1997):

(a) landscape diversity which is the variation in the assemblages of habitats across the earth's surface
(b) ecosystem diversity which describes the variation in the assemblages of species
(c) species diversity which refers to the variety of different species; and
(d) genetic diversity which refers to genetic variability within a species.

The Convention on Biological Diversity is a key agreement and a pact among the vast majority of the world's governments, which sets out commitments for maintaining the world's ecological underpinnings as we go about the business of economic development. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.

Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agro-ecosystem: the variety and variability of animals, plants and micro-organisms at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes. The distinctive features of agricultural biodiversity include the following:

- Agricultural biodiversity is essential to satisfy basic human needs for food and livelihood security;
- Agricultural biodiversity is managed by farmers; many components of agricultural biodiversity depend on this human influence; indigenous knowledge and culture are integral parts of the management of agricultural biodiversity;
- There is a great interdependence between countries for the genetic resources for food and agriculture;
- For crops and domestic animals, diversity within species is at least as important as diversity between species and has been greatly expanded through agriculture;
- Because of the degree of human management of agricultural biodiversity, its conservation in production systems is inherently linked to sustainable use;
- Nonetheless, much biological diversity is now conserved ex situ in gene banks or breeders' materials;
- The interaction between the environment, genetic resources and management practices that occurs in situ within agro-ecosystems often contributes to maintaining a dynamic portfolio of agricultural biodiversity.

The Convention on Biological Diversity defines the following 4 dimensions of agricultural biodiversity:

1) **Genetic resources** for food and agriculture, including:
   - Plant genetic resources, including pasture and rangeland species and forest genetic resources of trees that are an integral part of farming systems;
   - Animal genetic resources, including fishery genetic resources, in cases where fish production is part of the farming system, and insect genetic resources;
   - Microbial and fungal genetic resources. These constitute the main units of production in agriculture, including cultivated species, domesticated species and managed wild plants and animals.

2) **Components of agricultural biodiversity** that provide ecological services. These include a diverse range of organisms in agricultural production systems that contribute, at various scales to:
   - Nutrient cycling, decomposition of organic matter and maintenance of soil fertility,
   - Pest and disease regulation,
   - Pollination,
   - Maintenance and enhancement of local wildlife and habitats in their landscape,

- Maintenance of the hydrological cycle,
- Erosion control,
- Climate regulation and carbon sequestration,

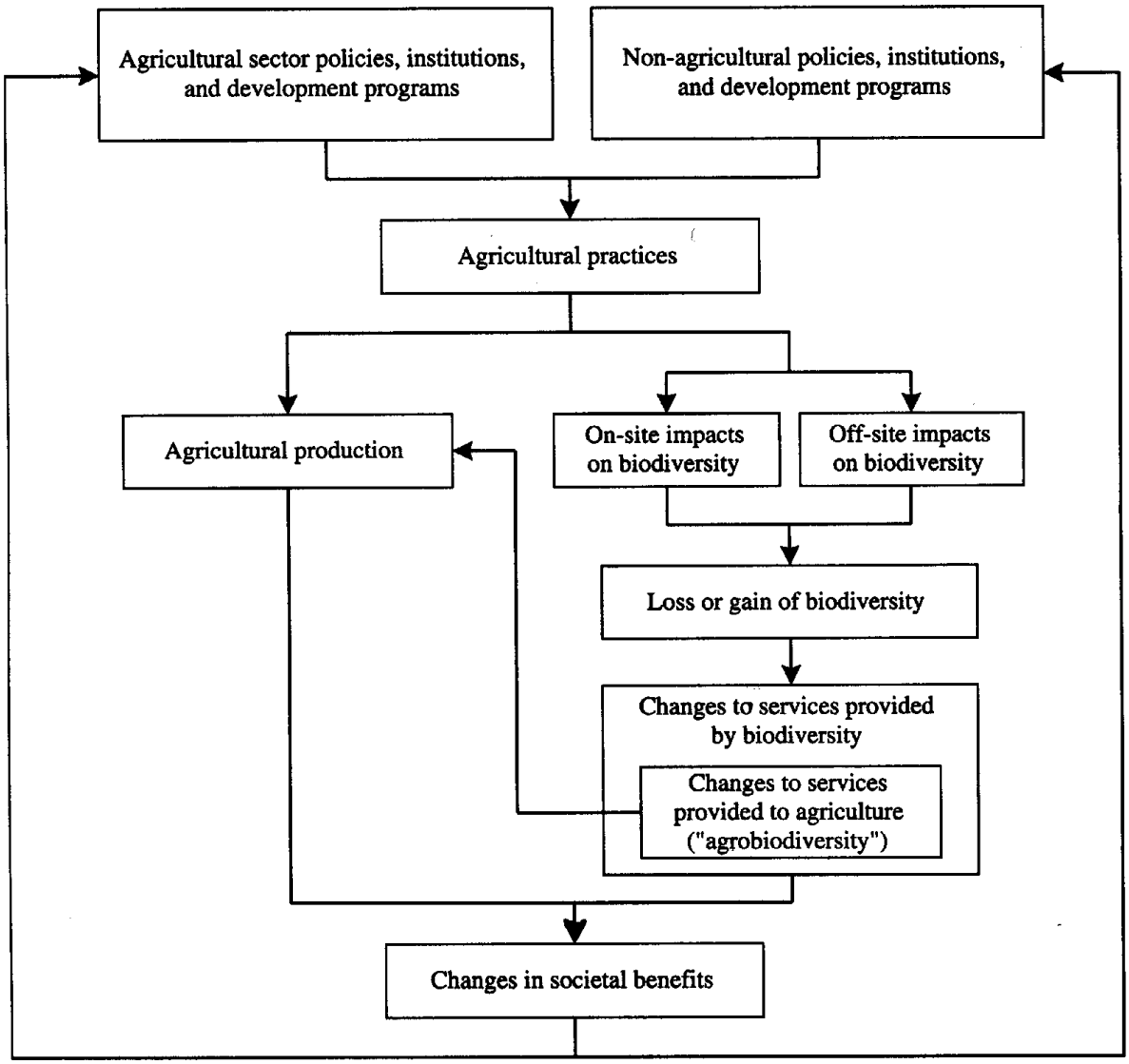
3) **Abiotic factors**, which have a determining effect on these aspects of agricultural biodiversity,
4) **Socio-economic and cultural dimensions** since agricultural biodiversity is largely shaped by human activities and management practices. These include:
   - Traditional and local knowledge of agricultural biodiversity, cultural factors and participatory processes,
   - Tourism associated with agricultural landscapes,
   - Other socio-economic factors.

Within the interaction between agriculture and biodiversity two broad areas of concern can be identified. These refer to either increasing or decreasing agricultural production.
1) The effects from increasing agricultural production:
   - effects of conversion of natural habitat (on-site and off site effects)
   - effects of agricultural intensification (on-site and off-site effects)
2) The effects from decreasing agricultural production:
   - abandonded lands (on-site and off-site effects)

A central cause of conflict between agriculture and biodiversity is that many benefits from biodiversity are either externalities or public goods, so individual farmers have little incentive to take them into consideration when making land use decisions. Our task is to understand the causes of conflict. In this framework we suggest to focus attention to those impacts on biodiversity, which result from agricultural transition processes.

Most decisions affecting the relationship between agriculture and biodiversity are made by individual farmers, not by national planners. The incentive structure under which farmers make decisions about land use is influenced by agricultural and non-agricultural policies, and institutions. The resulting agricultural practices will of course affect agricultural production as well as off-site and on-site biodiversity. Changes in the level of biodiversity translate into losses or gains to society through changes in the level of services provided by biodiversity. An important subset of these services is directly beneficial to agricultural production itself. Pagiola & Kellenberg (1997) developed a framework for the study of the interrelationships between agriculture and biodiversity (Figure 3).

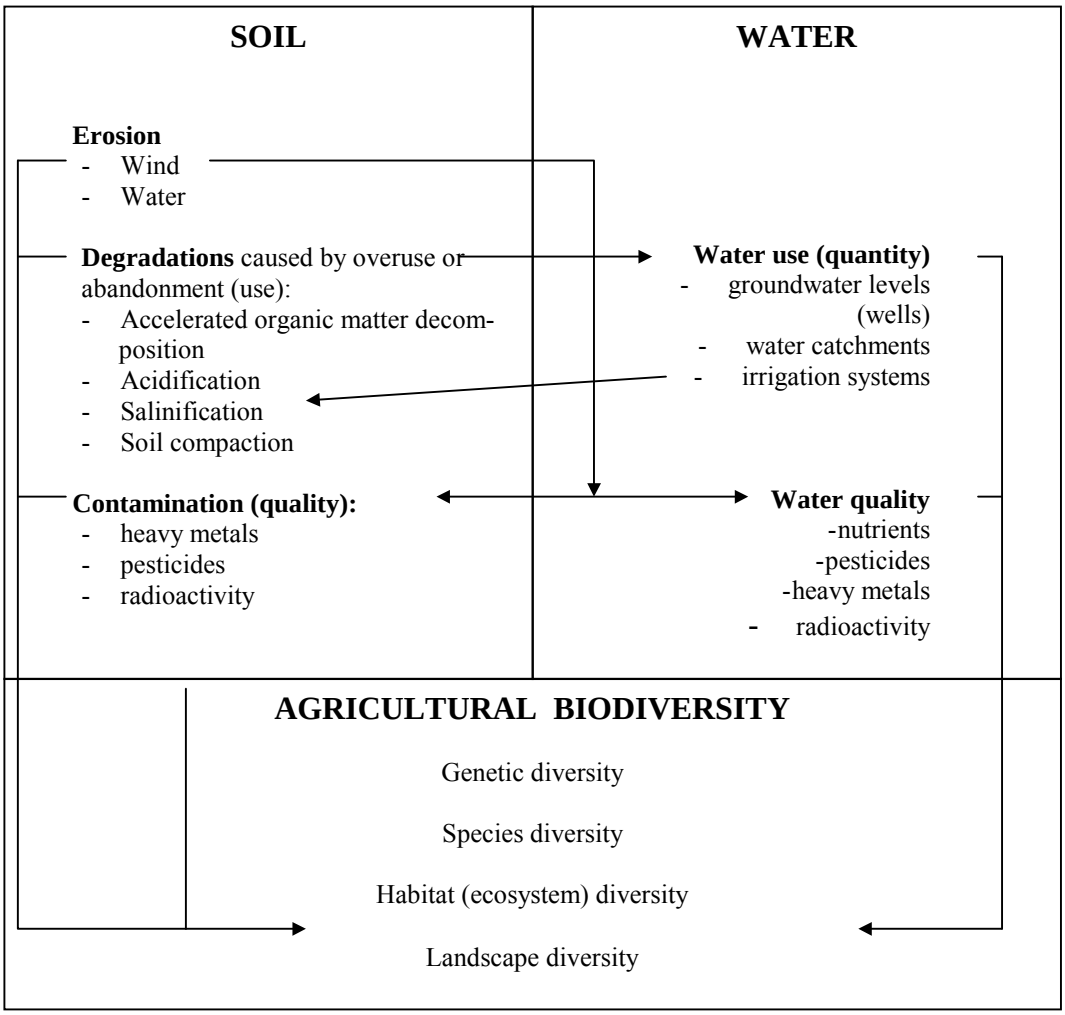
FIGURE 3: CONCEPTUAL FRAMEWORK FOR THE STUDY OF INTERACTIONS BETWEEN AGRICULTURE AND BIODIVERSITY



Source: Pagiola & Kellenberg, 1997

It is obvious that the areas of environmental concern are all interrelated (Figure 4). Sustainable agricultural production can only be achieved if agricultural practices manage to make use of the functions of all three assets: water, air and biodiversity. The functions of soil and water, e.g. are essentially interwoven. Accordingly environmental damage of one of the assets also effects others. The reduction of agricultural diversity, e.g. by inappropriate vegetation covers, directly effect soil erosion and aspects of soil quality. Soil erosion, in turn, has impacts on water quality and reduced water quality effects the diversity of agro-ecosystems.

FIGURE 4: INTERDEPENDENCIES BETWEEN SOIL, WATER AND BIODIVERSITY



Source: Redrawn from Wascher, 2000

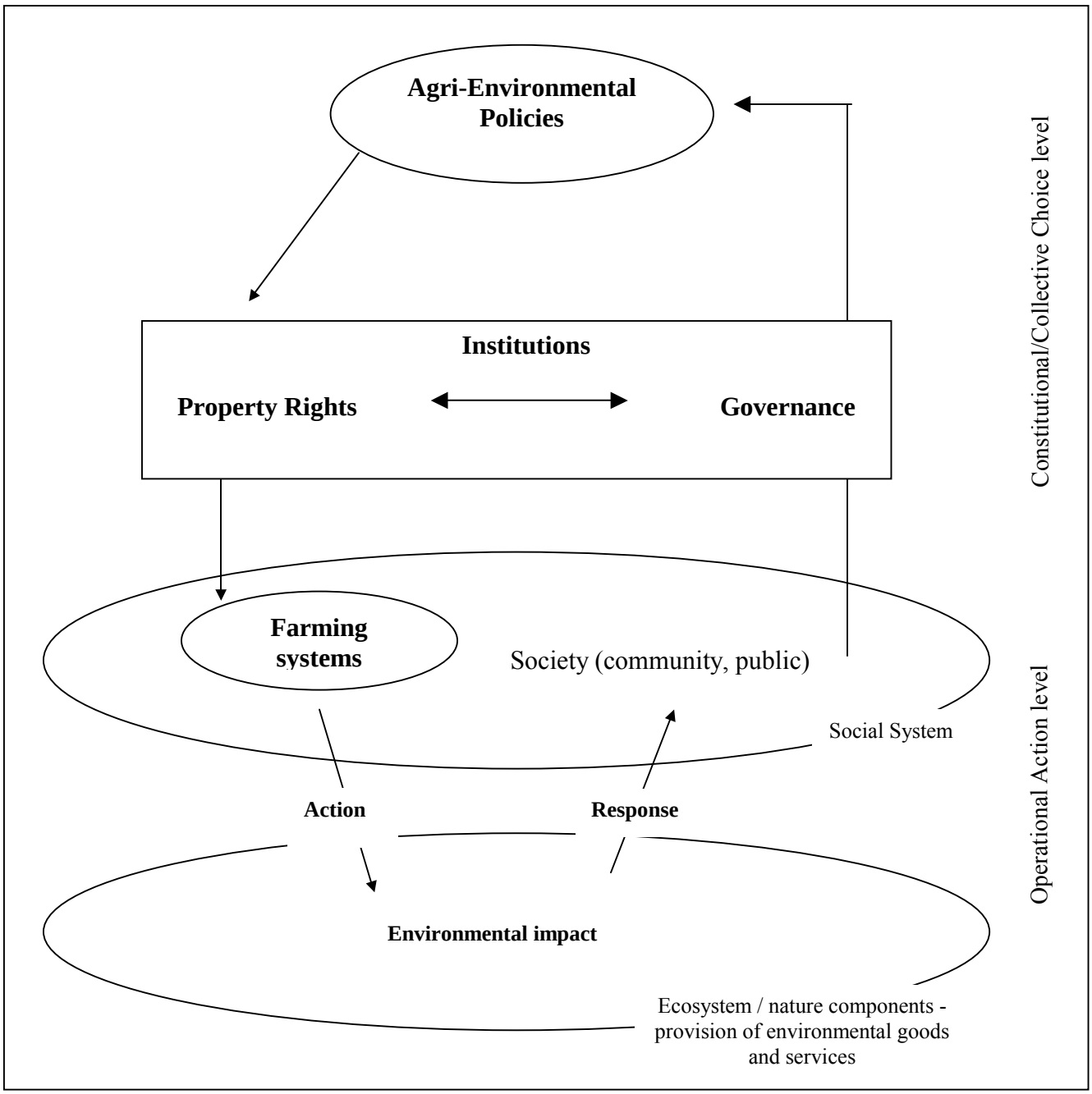
2 KEY ELEMENTS OF THE FRAMEWORK: INSTITUTIONS, POLICIES, AND FARMING SYSTEMS

2.1 INTRODUCTION

Institutions, Policies and Farming Systems are not three from each other unrelated issues. They are nested within each other, overlap and effect each other. Institutions are rules and rule configurations, which determine policies and the functioning of farming systems. Institutions are existent in any kind of human interaction, either formally or as informal institutions, including shared mental models or conventions of people. They are part of policies just as they are part of farming systems. The boundaries between our first three key elements of analysis are vague. However, for the purpose of designing a framework for analysis we set such boundaries around each component. We will create mental boxes and restrict our analysis to those aspects of institutions, policies and farming systems which are relevant to understand agri-environmental sustainability. The fourth element of analysis is the environment. Also here we restrict the analysis to the environment which is effected by agricultural activities, specifically soil, water and bio-

diversity. The general task is to understand the cause-effect relationships between each of the environmental assets (water, soil, biodiversity) and the three dimensions of analysis: institutions, farming systems, and policies. Whereas institutions and policies can be located at the constitutional choice level, farming systems belong to the operational action level – the place where actions and impacts on the environment take place (Figure 5).

FIGURE 5: A CONCEPTUAL FRAMEWORK FOR THE ANALYSIS OF POLICIES, INSTITUTIONS AND FARMING SYSTEMS FOR SUSTAINABILITY – THE AGRI-ENVIRONMENTAL ACTION SCENARIO



As a result of the complexity of the entire research project, the mode of explanation we follow in our research represents a mixture of different conceptions of reality. However, as the CEESA research is based on case studies, we have a tendency to follow inductive instead of deductive ways of explaining. The study of institutions in general assumes the existence of underlying structures, apart from the actual outcomes we can observe (e.g. the impact on the environment). This mode of explanation has been referred to as transcendental realism. According to this conception of reality the world is not only composed of events and our experiences of these events, but also of underlying structures, mechanisms, powers, and interdependencies that exist whether or not detected (Bhaskar, 1978, 1989; Lawson, 1997). Accordingly reality is composed of complex things and systems. Because of their constitution or structure they have the capability of acting or working in specific ways[3]. Structures possess causal powers which, when triggered or released, act as generative mechanisms to determine the actual phenomena observed. This conception of reality is especially relevant when studying institutions[4] in society because institutions are exactly these underlying structures and mechanisms, which are not always evident. From the perspective of transcendental realism, science is no longer confined to the seeking out of constant event conjunctions, instead it aims at identifying and illuminating the structures and mechanisms that govern or facilitate the course of events.

2.2 Institutions of Sustainability

The multiplicity of uses for the key term 'institutions' points out to a problem in the general conception held by different scholars how rules, individual strategies, customs and norms, values and structural aspects of ongoing political systems are related to one another. However, we propose that the concept of 'rules' shall be used as a referent for the term 'institution'. Institutions shape human patterns of behaviour. They restrict human behaviour and, thereby, force humans to interact in certain ways. Rules are prescriptions that are commonly used and known to order repetitive, interdependent relationships between individuals and sets of individuals (stakeholders, actors). These prescriptions refer to actions ("states of the world") which are required/prohibited/permitted. Rules are the result of implicit or explicit efforts by a set of individuals to achieve order, predictability or certainty by (1) creating positions[5], (2) stating how participants enter or leave positions, (3) stating which actions the participants in these positions are required / permitted / forbidden to take, and (4) stating which outcome participants are required / permitted / forbidden to affect (Ostrom, 1994). In fact, "the entire purpose of social institutions is built around the reduction of uncertainty" (Holling et al. 1996). Whereas institutions alone can be defined by sets of rules, the inclusion of people who apply certain sets rules is what makes organisations.

[3] E.g.: Because of its structure a bicycle has the capability of facilitating a ride.

[4] Institutions shape human patterns of behaviour. They restrict human behaviour and thereby force humans to interact in certain ways. Rules are prescriptions that are commonly used and known to order repetitive, interdependent relationships between individuals and sets of individuals (stakeholders, actors). These prescriptions refer to actions ('states of the world'), which are required/prohibited/permitted. Rules are the result of implicit or explicit efforts by a set of individuals to achieve order, predictability or certainty, but also constrain the behaviour of people. Institutions include values, norms, beliefs, shared mental models and commonly agreed upon codes of conduct.

[5] A position is the smallest autonomously acting unit of organisation. Together with the relevant competencies a position has attributes which allows the actor in this position to cope with certain rights and duties.

Institutions may have evolved unplanned or accidentally, organisations however, are the result of deliberate planning in order to achieve certain objectives.

Rules are artefacts, subject to human intervention and change. They are the means by which humans intervene to change the structure of incentives in situations (in our case situations which affect the use of natural assets in agriculture, namely water, soil and biodiversity). To change a situation one must know which set of rules produce the situation. Rules are distinct from physical or behavioural laws. Whereas the former can be changed, the latter cannot. And that is one of the main characteristics of rules. Rules are made by humans for humans, and can be changed by humans. A second characteristic of rules is that they have prescriptive force, which means that the knowledge and acceptance of a rule leads individuals to recognise that, if they break the rule, others may hold them accountable. Formal laws become rules when they are enforced.

Rules do not directly specify behaviour. Instead, configurations of rules affect the structure of a situation in which different actions are selected. Rules specify sets of actions or sets of outcomes, (1) by stating that some actions are forbidden, (2) by stating sets of actions or outcomes, which are permitted, or (3) by requiring specific actions or outcomes. This third type of rule requires that an individual takes only one action without being able to choose from a set of actions. Instead of studying the effect of change of one rule on actions/outcomes, regardless of other rules of relevance, we need to state which other rules are relevant. Which other rules condition the relationships produced by a change in any particular rule? We cannot assume that other rules are controlled and unchanging. If rules combine configurationally rather than individually, in other words, if combinations of rules work differently from isolated rules we need a strategy for analysing combinations of rules.

As mentioned earlier, the study of institutions is the study of rule configurations and it is the study of relations and interdependencies between systems. In other words, institutions are what links/relates systems to each other. Without appropriate institutions agriculture does not produce desirable environmental outcomes, in other words it would be unsustainable. Sustainability also refers to the long-term dynamic congruence or compatibility between the underlying institutional "genotype" and the visible structure of institutions - the "picture" of the systems these institutions produce (institutional "phenotype"), e.g. the specific structure of farming systems[6]. What we have described as levels or "institutional genotype" and "institutional phenotype" is also referred to as the *match* between institutions (social capital) and the unique combination of variables present in any system (physical capital or 'engineering works'). Institutions need to be well matched to the physical, economic, and cultural environment of the relevant system (Ostrom, 1992: 19). Institutions (rules in use) also need to match or be in conformance

[6] The institutional "genotype" refers to the rules in use or the working rules by a set of individuals to organize repetitive activities that produce outcomes effecting these individuals and potentially others. Working rules are those actually used when individuals make choices about actions. They are used to determine who is eligible to make decisions, what actions are allowed or constrained, what procedures must be followed or what information must be provided, and what costs and payoffs will be assigned to individuals (see Chapter 1). Rules in use are not necessarily equated with written laws and therefore they are not directly observable phenomena. Because of that characteristic we chose the term "institutional genotype" in contrast to "institutional phenotype". Excluded in this definition of rules are norms and moral structures-prescriptions that an individual imposes on personal actions without expecting others to impose the same prescriptions.

with formal laws. Both, rules in use and formal laws need to be closely aligned and enforced to achieve sustainability (at least on one level).

However, the match between (invisible) rules in use and visible activities, organisations or formal laws does not mean both are the same at all levels. It is possible to achieve desired outcomes even if working rules vary substantially from rules of law/legislation, especially if legislation is drafted by distant officials in the capital with no contact to the periphery. In this case there is no match between rules in use at the local level and rules prescribed from higher (regional, national, international) levels (Figure 6). Working rules and formal rules are only in conformance at the local level. They are conform with themselves. A minimal requirement for agricultural sustainability is the match between the (invisible) working rules and the visible institutional phenotype (activities, organisations and formal laws) at least on the same level[7]. Rules, which originate from participants of an agri-environmental action scenario (farmers[8]) and which fit into the physical, economic and socio-cultural context, also contribute to institutional agri-environmental sustainability.

If institutions diverge at different levels and if some kind of relationship/interaction or even dependence between the levels is unavoidable, the probability of arising conflicts is high. This is, for example, the case when legislative measures or the redistribution of land forces farmers to practice farming in a way which does not conform to the way they have learnt farming (e.g. vertical cultivation of arable land in hilly regions in Romania) or when these prescriptions cannot be linked in any way to the farmer's understanding of any kind of "good" farming practices. This is also the case when, e.g. prescriptions are formulated which may be understood and generally accepted by the farmers, but which are not feasible because of missing resources and infrastructure for the realisation of these measures. Or, in other words, transaction costs are too high to ensure practicability.

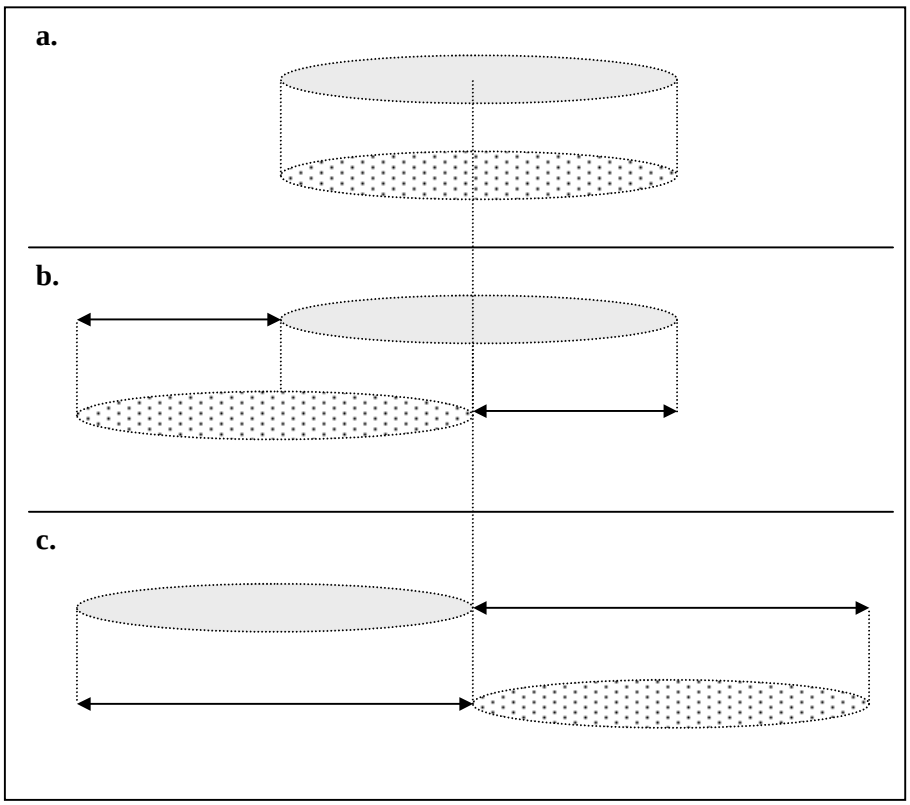
Measurement and monitoring systems support the constant checking between the institutional match ("genotype" and "phenotype") and simultaneously provide a tool for the process of co-adaptation. At farming systems level, sustainability mainly refers to the impact agricultural production has on the ecosystem and to the compatibility between rules/regulations and actual practicability on other (economic, socio-cultural) levels. Matching rule configurations does not want to suggest that e.g. existing traditional farmers' knowledge is sufficient to achieve sustainable rural development once it is actualised at a higher formal/legislative level. An adequate combination of local knowledge (and local institutions) with modern science and technology (and formal laws and regulations) is the key for achieving the goal of agricultural sustainability. What are the rules? How are formal rules and rules in use perceived by participants/actors and how do they fit into their physical, economic, and social (territorial[9]) context of decision-making?

Two levels of decision-making are relevant: the process of formal intentional institution-building at the political level and the process of evolutionary creation of informal rules on community level. Transformation is a huge collective effort performed by a

[7] If not we have chaos.
[8] Maybe as part of their customary law regulations, which are formal but need not be written laws.
[9] The territory is the entire set of the geographical, natural, cultural and socio-economic features of a region.

network of actors on different levels of different economic and political organisations. A common observation is that reforms are often initiated and governed by formal institutions, which in pace of implementation often get complemented or confronted with a network of informal relations which exist between the actors (Hanisch, 2000). In case of confrontation the result is a conflict. In case of formal rules (institutions) being complimentary with informal institutions the result can be effective institutions. The complementation or match of formal and informal institutions is one important prerequisite for agri-environmental sustainability. Sometimes formal rules are not sufficient or not adequate to achieve agri-environmental sustainability, so that they need to be complemented by informal regulations to achieve desirable outcomes. In other cases informal institutions are either not missing or they might have destructive environmental impacts, so that they need to be replaced by formal rules.

FIGURE 6: MATCHING RULE CONFIGURATIONS



Sustainable agriculture can be achieved if the institutional environment is adequately reflected by governance structures leading to the implementation of rules and favourable actions and outcomes at the action level. Governance is the way society as a whole manages the full array of its political, economic, and social affairs. By shaping the incentives individuals and local communities are faced with, governance either facilitates or hinders economic development. If the overall governance structure reinforces the capability of local groups to deal with their own problems user groups will have an incentive to manage their own common-pool resources wisely. Under these circumstances development is likely to be sustainable. Conversely, if local rules are routinely superseded by the policies of higher authorities, then it will be much more difficult to restrain individual appropriators from engaging in opportunistic behaviour. In those circum-

stances any effort to develop the national economy as a whole will rest on shaky foundations at the local level (McGinnis, 1999).

Actors within the agri-environmental action situation are in constant interaction with their ecological, economical, social and cultural environment. This interaction leads to the creation and changing of rules. Participative and democratic structures enable the constant/frequent feedback and adjustment of governance structures towards desired outcomes. This points out to the dynamics of institutional change. But a cycle now (present) is never quite the same as a cycle later. Chaos theory suggests that dynamics are not reversible and cycles are approximate at best. Cyclic agricultural practices e.g. never lead to the same outcomes. Cycles in agriculture rest on iteration (quite similar processes leading to quite similar initial conditions for the next iteration (pers. comm. Oldeman, 1995). Interactions at the agri-environmental action level determine the form of iteration for every new cycle.

2.2.1 Conceptualising Institutions of Sustainability: The Agri-Environmental Action Scenario

The agri-environmental action scenario (AEAS) is a conceptual unit of analysis which is designed for the purpose of studying the key components of this scenario. Key components for the study of institutions of sustainability within this scenario are:

1 Mechanisms for co-ordination (governance)
2 Property Rights
3 The actors involved
4 The transactions between actors and the ecosystem

According to Slangen and Polman (2000), governance structures and the institutional environment are "overlapping". "Overlapping" means that there are no clear boundaries between the mentioned dimensions of the AEAS. This is not only true for governance structures, the institutional environment and actors, but also applies to the entire AEAS. Situations concerning the use of one of environmental assets (water, soil, biodiversity) are determined by different variables/components/determinants and on a deeper level these variables again depend on rules that operate configurationally to affect the structure of a situation. The introduction lists these components and rules. For the purpose of analysing institutions in transition in the agricultural sector Hagedorn (2000) proposes following in categorisation of an agri-environmental action scenario, which can be used to analyse the institutional setting of an AEAS[10]:

2.2.2 Actors

Actors are individuals or groups of individuals who function as a unit whose behaviour is relevant to the outcomes of a specific situation. For matters of analysis assumptions are made and models are created on the actors values, their resources, capabilities for processing information and methods of making choices. The most well-known model of an actor is the *homo oeconomicus.* It is the model of an actor who has complete information, complete and well-ordered preferences and who aims at maximising his net returns when making decisions. Alternatively, one could assume that actors have in-

[10] OSTROM (1992, 1993, 1994) proposed a more detailed categorisation of the action scenario. For this paper, a differentiation in four categories serves the purpose of being more compact. For the interested reader we suggest to refer to the literature mentioned.

complete information, are bounded by values, norms and limited information processing capabilities, make mistakes and learn.

Hagedorn (2000) proposes the following characteristics of actors that effect their behaviour:

1 *Individual actor's socio-cultural configuration*. Values, norms, beliefs assigned to the environment, attitudes towards and perceptions of agri-environmental issues/actions. This configuration is of course also a result of the socio-cultural containment (embeddedness) of the actor within a community, network, neighbourhood, nation, etc.
2 *Individual actor's configuration as perceived by others*. Reputation for reliability, trustworthiness, credibility, committedness, competence.
3 *Resources (means) for influencing strategies at one level*, which are needed to maintain relationships or to achieve acceptance of own interests (time, access to information and networks, information collection and processing capacities), as well as *resources for influencing processes at other levels* where no direct participation is possible (political decision making, policy implementation). Actors have the possibility to enforce their interests/demands through electoral control, party competition, unions, collective action and representations or positions in bureaucracies, ministries, parliamentary committees or agrarian policy networks.
4 *Information processing capabilities*, including methods and criteria for selecting an action

2.2.3 Properties of Transactions

Transactions can have positive or negative effects on the environment. We can distinguish environmental problem producing transactions and environmental problem solving transactions. A farmer's production activities can involve both types of transactions. If over-fertilisation effects the groundwater and pollutes lakes, this is a negative transaction. If land cultivation contributes to landscape biodiversity, this is a positive transaction. Transactions could be defined as direct or indirect actions with positive or negative transboundary effects. The term "transboundary" means e.g. that actions of an individual effect the environment (passing from one element of the social system to the ecosystem) and thereby also effect the public.

The underlying assumptions about the individual for the analysis of transactions, is the assumption of an individual's bounded rationality in an environment of incomplete information and imperfect information processing capabilities of the individual. Under those conditions all individuals can make mistakes in choosing the right strategies to achieve certain goals. The interaction between available information and institutional arrangements (rules that people use for relating to one another) strongly affects how people achieve their goals. Co-ordination and information processes are continuously ongoing activities of institutional building. All transaction activities involve transaction costs (e.g. negotiating, concluding and implementing contractual arrangements). The level of transaction costs associated with co-ordination activities depends on the characteristics of the actors, the specific kind of agri-environmental action scenario, and the type of institutional arrangement (governance structure) used to organise decision-making. Common property resources (see next chapter) are the result of prohibitive

transaction costs of establishing and enforcing exclusive (private) rights over an (environmental) asset. The evolution of governance structures and organisational structures of firms can also be explained by favourable transaction costs (Williamson, 1999).

Hagedorn (2000) identifies the main properties of transactions that prohibit or favour institutional sustainability as follows:

1 *Excludability* of actors from access/use of the environmental goods or services.
2 *Rivalry* among actors/users of environmental goods to different degrees according to the public good character (pure/impure public goods).
3 *Asset specificity* in case long-term investments have been made by land users
- by taking care of a certain biotop or species by adequate practices (site specificity),
- by investing sunk costs in nature conservation, e.g. planting hedges (capital specificity,
- by collecting and developing specific knowledge about nature.
4 *Seperability.* Because of the jointness of production of environmental goods provided by farmers governance structures need to be able to co-ordinate activities of a group of land owners. This could e.g. involve incentives provided by political agencies (agri-environmental policy payments) for a group of farmers instead for individual farmers.
5 *Frequency of transactions* (referring to different utilisation patterns, e.g. single resource utilisation of forest or annual resource utilisation during cropping seasons). More frequently recurring transactions increase the incentive to invest in governance structures and thereby decrease transaction costs.
6 *Uncertainty* is closely connected to complexity. The players in an action situation do not know for sure whether, which or when environmental problems will occur, how they will occur and who will be effected. The reduction of uncertainty(e.g. by monitoring systems) causes transaction costs.
7 *Complexity* refers to the causal interconnectedness of ecosystems. Because of lack of knowledge concerning the causes and effects of human impact to the environment opportunistic behaviour appears.
8 *Heterogeneity and variability* refers to the differences of site and situation (e.g. soil quality differences or climatic differences between vegetation periods) of an action situation. Transaction costs tend to increase the more specific/specialised the design of strategies and measures for the co-ordination of an agri-environment situation becomes.
9 *Legitimacy* refers to the moral/normative dimension of actor's views about transactions. Some transactions may make sense economically or ecologically, but they are not compatible with the actor's views of what is right and wrong.

2.2.4 Property Rights to Agricultural Nature Components

Property rights are the product of rules. For every right an individual holds, rules exist that authorise or require particular actions in exercising that property right. If one individual has a right often some other individual has a commensurate duty to observe that right. A property right is enforceable authority to undertake particular actions related to a specific domain (Commons, 1968). Well established and enforced property rights are

significant because they give security/certainty that the right holder's access, withdrawal, management, alienation or exclusion[11] will be recognised in the future by potential competitors for these rights (Hanna et al., 1996). The secure control of resources is a critical component of a sound economic system. Full control is however a non-existent state of affairs, because in reality people who generate systems of property rights are constrained by history, ignorance, and transaction costs. Property rights relate to the right to use resources. Property rights as used in New Institutional Economics include social norms and thereby the concept is a broader concept than the legal concept of property rights. Social acceptance, reciprocity, voluntarity, and social isolation for violators of accepted codes of conduct are examples of the constraints on the use of so-called private property (Eggertsson, 1990).

Hagedorn (2000) clarifies that property rights should not be misunderstood as the distribution of disposition rights on physical entities (material goods), but rights to nature components or ecological attributes. Actors merely attribute negative or positive values to physical good. This is the case because the holder of the right is either favoured by benefit streams or burdened by costs that are connected to the physical good. These nature components are also referred to as environmental functions by DeGroot (1992). Table 1 gives an overview of these environmental functions and the benefits they provide to the right holder. Property is not an object. It can be seen as a bundle of rights defining the relation between those owing a property, the property itself, and the rest of society. Property is thus a threefold social institution that describes the relation between the revenue (or income) from the object, the holder of the rights and the duties that others are obliged to perform. Bromley (1991) sees property as a social relation that defines the property holder with respect to something of value (the benefits stream) against all others. He uses the term *property regimes* to express this social relation. Regimes, after all, are human artefacts reflecting instrumental origins, and a property regime is fundamentally instrumental in nature. Property regimes include different rights. Eggertsson (1990: 34) makes a distinction between three categories of property rights. First, there are the rights to use an asset - user right - which define the potential uses of an asset that are legitimate for an individual, including the rights to transform physically or even to destroy an asset. Second, there is the right to earn income from an asset and contract over the terms with other individuals. Third, there is the right to transfer ownership over an asset permanently to another party – that is, to alienate or sell an asset: transfer right.

An important question in the property rights theory is who has the power of control over the residual income in institutional arrangements like a contract. According to the property rights approach in the contract theory which Hart (1995) called the incomplete contract theory it is the owner of the asset in question who has residual control rights over that asset: the rights to decide all usages of the asset in any way not inconsistent with prior contract, custom or law. The residual rights of control determine who has the authority to approve changes in procedures or innovations in uncontracted contingencies (Hart et al., 1997). The residual income is the income that remains after all agreed contractual payments have been effected.

[11] Property rights include the rights of management (the right to regulate internal use patterns and transform the resource by making improvements), exclusion (the right to determine who has access and who does not), alienation (the right to sell or lease management and exclusion rights).

CLASSIFICATION, STRUCTURING AND OTHER ISSUES OF PROPERTY RIGHTS

Bromley (1991: 31) distinguishes four types of property regimes: state property, private property, common property, and non-property (Table 2). All these types of property regimes are possible for land and water. The relation between ownership and user can take different shapes. The owner is not always the user. Farmers can be (private or common) owners, but they can also be tenants. A private owner has not only the full private ownership, but also the complete residual control rights. Full private ownership means freedom from any obligation to the government other than the payment of taxes and the observance of land use controls imposed in the public interest. Private owners (private, government or a group) can also lease the land to farmers. The type of lease contract depends on the legal requirements regarding duration, a fixed or variable rent, or sharecropping.

The two most important ways of leasing land are lease contracts with fixed rents and sharecropping. Lease contracts with fixed rents are common in Western Europe where there is hardly any sharecropping. Sharecropping is prevalent in low-income countries such as the developing countries. It is also a very common lease form in the US. There are various types of sharecropping, such as sharing yields sharing costs of inputs, and combinations of these. Sharecropping contracts may be interesting because of the opportunity for sharing risks, on condition that the costs of sharing the yields - and sometimes also the inputs - are low. A risk-averse farmer will prefer a sharecropping arrangement for reducing the variability in his expected income. High transaction costs limit the concluding of such contracts. Formulating, concluding and enforcing sharecropping contracts in which output and (parts of) the input are shared bring costs with them. In practice, the transaction costs justify choosing fixed rents rather than sharecropping (Eggertsson, 1997: 18).

Property rights can also be categorised according to the conventional right

1) to use an asset which includes the right to transform physically or even to destroy
2) to alter and to earn income from an asset
3) to transfer ownership rights permanently to another party, that is to alienate or sell an asset.

Other categories of property rights can be defined according to different ecological properties of the nature component. Table 1 gives an overview. Each of these property rights is related to particular costs and benefits. The institutional design for the regulation of the rights and duties related to the property rights can be private, collective, state property regimes, or an absence of property rights. The enforcement of property rights involves excluding others from the use of scarce resources. Enforcement of ownership rights usually increases the value of privately owned assets and constitutes one of the cornerstones of market exchange.

TABLE 1: CATEGORIES OF ENVIRONMENTAL FUNCTIONS OR NATURE COMPONENTS AND EXAMPLES

FUNCTION	EXAMPLES
Regulation functions	
R 1 Biochemical cycling	- Maint. of 0_3 for UV-b protection, of $CO_2/0_2$ balance, sulphur (DMS) and iodine recycling
R 2 Climate regulation	- Maint. of favourable climate, prevention of extreme events (storms, drought, flooding)
R 3 Water regulation	- Prevention of run-off damage, flood and storm protection
R 4 Water supply	- Water for drinking irrigation and industrial use
R 5 Soil retention	- Erosion control and prevention, sediment retention
R 6 Soil formation	- Formation of topsoil, maint. of soil fertility
R 7 Bio-energy fixation	- Biomass production (see production functions for direct benefits)
R 8 Nutrient cycling	- Maint. of the availability of essential/elementary nutrients
R 9 Waste treatment	- Pollution control/detoxification, filtering of dust particles, abatement of noise pollution
R 10 Biological control	- Maint. of healthy populations, regulation of pollination, biological pest control
Habitat functions	
H 1 Refugium functions	- Maint. of biological and genetic diversity
H 2 Nursery functions	- Maint. of populations of locally or commercially harvested species
Production functions	
P 1 Food	- Fish, game, fruit, honey, insects (protein), leaves, mushrooms, etc.
P 2 Raw materials	- Wood, skins, plant-fibers, latex, gums, oils, waxes, resins, dyes, hormones, etc.
P 3 Fuel and energy	- Fuelwood, organic matter, biochemicals
P 4 Fodder and fertilizer	- Krill, leaves, litter, animal excrements (e.g. guano)"etc.
P 5 Medicinal resources	- Drugs and pharmaceuticals, chemical models and tools, test animals and assay organisms
P 6 Genetic resources	- Genes to improve crop resistance, medicinal applications industrial applications
P 7 Ornamental resources	- Furs, feathers, ivory, orchids, butterflies, aquarium fish, birds, reptiles, shells, coral, etc.
Information functions	
I 1 Aesthetic information	- Enjoyment of scenery through scenic roads and housing locations
I 2 Recreation	- Enjoyment and recreation through e.g. outdoor sport activities. -
I 3 Cultural and artistic information	- Use of nature in books, magazines, film, photography, paintings, fashion, advertising
I 4 Spiritual and religious information	- Conservation of certain features (landscape elements, old trees, water, animals) that have special religious or historic value.
I 5 Scientific and educational information	- Use of natural areas for (e.g.), basic and applied research, monitoring (bio-indicators), natural science classes

Source: DeGroot, 1997

The costs of enforcing rights are considerably reduced when social norms are held by the public which coincide with the basic structure of rights that are to be enforced (by the state).The disintegration of social norms and (official) state laws can have serious economic consequences[12]. Individuals or groups of individuals may establish structures of property rights which rival those of the state. This is most likely to happen where the enforcement of the state rules is relatively costly[13]. Usually the structure of the property rights is supposed to be reasonable if the rights accrue to those actors who create the design of property rights in the most efficient way. That means that low transaction costs can be an argument to bundle property rights to all components of nature, whereas the distribution of the single rights to different actors (divided property) becomes an issue when transactions costs are low because of the advantage of specialisation and economics of scale. Decisions on how to structure/distribute property rights depends on the specific case. Bundling rights on the manifold components of nature can result in decentralised property rights structures, if there are many land users, like farmers. Dividing rights to land users and other specialised agents can lead to a higher degree of centralisation of property rights. The specific structure of property rights has important consequences for the actor's motivation and participation. Regardless of the fact that property rights structures come along with low transaction costs, social and political side-effects need to be considered for an appropriate design of property rights structures.

Property rights to the different components of nature cannot be used in an isolated way. That means because of the interrelatedness of attributes and processes in ecological systems the distribution of property right needs to consider thisinterdependence. Therefore, "…it might be more appropriate to talk about rights and duties which are conditional upon the use and fulfilment of other rights and duties respectively." (Hagedorn, 2000)

2.2.5 Governance Structures for Agri-Environmental Co-ordination

Governance structures are mechanisms which co-ordinate relationships between actors and thereby influence their action selection. In hierarchies, e.g. action is compulsorily selected by an authority on a higher level, whereas in markets action selection is based on voluntary bilateral agreements between individuals or groups of individuals. Governance structures are forms or mechanisms of co-ordination and strategies for the implementation of rules. Governance structures substantially contribute to transformation activities, which are directed towards changing one state of affairs into another. These can be knowledge and information systems, ensuring and monitoring systems, mechanisms for bargaining and conflict resolution, or incentives and opportunities to promote innovative learning. In contrast to the term *government*, governance is the "play of the game" – the actual capacity to control and manage resources through formal and informal social norms, values, rules, etc. and through consensus and co-operation between local agents. Government and its policies are only a part of local governance. Governance structures are based on institutions. However, the rule configurations underlying governance structures are at a more fundamental level (constitutional choice rules,

[12] We have referred to the opposite phenomena as the "compatibility" or "congruence" between institutional genotype and institutional phenotype, the congruence of social rules or norms and legal structures (laws), or the "match" between (invisible) rules in use and formal laws or visible activities.

[13] The Mafia in Russia, Italy, USA or other countries are good examples for the disintegration of social norms and state rules. These anti-state structures resemble the functioning of a state in many ways. Their operations hide in the shadow of high transaction costs.

Figure 8). The processes, which are constrained by this type of rules, include modification of rules and negotiation or mediation.

TABLE 2: TYPES OF PROPERTY RIGHT REGIMES, OWNER RIGHTS AND DUTIES

Regime type	**Owner**	**Owner rights**	**Owner duties**	**Explanations**
State property	Individual	Socially acceptable uses; control of access	Avoidance of socially unacceptable uses	Individuals have *duty* to observe use/access rules determined by controlling/managing agency. Agencies have *right* to determine use/access rules
Private property	Collective	Exclusion of non-owners	Maintenance, constrain rates of use	Individuals have *right* to undertake socially acceptable uses, and have *duty* to refrain from socially unacceptable uses. Others (called 'non-owners') have *duty* to refrain from preventing socially acceptable uses, and have a *right* to expect that only socially acceptable uses will occur
Common property	Citizens	Determine rules	Maintain social objectives	The management group (the 'owners') has the *right* to exclude non-members, and non-members have *duty* to abide by exclusion. Individual members of the management group (the 'co-owners') have both *rights* and *duties* with respect to use rates and maintenance of the thing owned
Non-property	None	Capture	None	No defined group of users or 'owners' and benefit stream is available to anyone. Individuals have both *privilege* and *no right* with respect to use rates and maintenance of the asset. The asset is an 'open access resource'

Source: Bromley (1991), Hanna (1996)

Organisational structures of governance systems can be:
- Markets
- Hierarchies
- Hybrid forms
- Horizontal non-market co-ordination (e.g. co-operatives)

They include the following different institutional dimensions to varying degrees:
- Knowledge and information systems
- Methods and infrastructures for measuring, monitoring and evaluating environmental damages and benefits (e.g. laboratories, monitoring systems)
- Mechanisms for conflict resolution and mediation
- Strategies for reflexivity, for reinforcing self-organisation, interest harmonisation, and innovation

Davis and North (1971) suggest to differentiate between institutional environment and institutional arrangements. The institutional environment includes man-made constraints that structure political, economic, and social interactions. These consist of informal constraints (sanctions, taboos, customs, traditions, and norms or codes of conduct), and formal rules (constitutions, laws, property rights). The institutional environ-

ment does not only delineate the rules of the game within which the institutional arrangements actually operate, but also prescribes the rules of conduct within which human actions take place.

Institutional arrangements, also called governance structures, are mechanisms for coordinating economic transactions. The demand for sustainable agriculture implies that the rules of the game for the agricultural sector are changing. These consist of formal and informal rules. It means that the agricultural sector has to evolve new institutional arrangements to meet changes in the institutional environment. An institutional arrangement or governance structure is a way of implementing the rules of the games as they are defined by the institutional environment (Slangen, 1999). This interplay between institutional environment and arrangements is also referred to as the "match" between rules on different levels (Figure 6). Another difference is that the institutional environment operates at a higher level of generalisation than markets and organisations. It delineates the rules of the game within which such 'governance structures' actually operate. The institutions of governance operate at the level of individual transactions, whereas the institutional environment is more concerned with the composed levels of activity. A third difference is that the institutional environment facilitates and supports the working of the institutional arrangements.

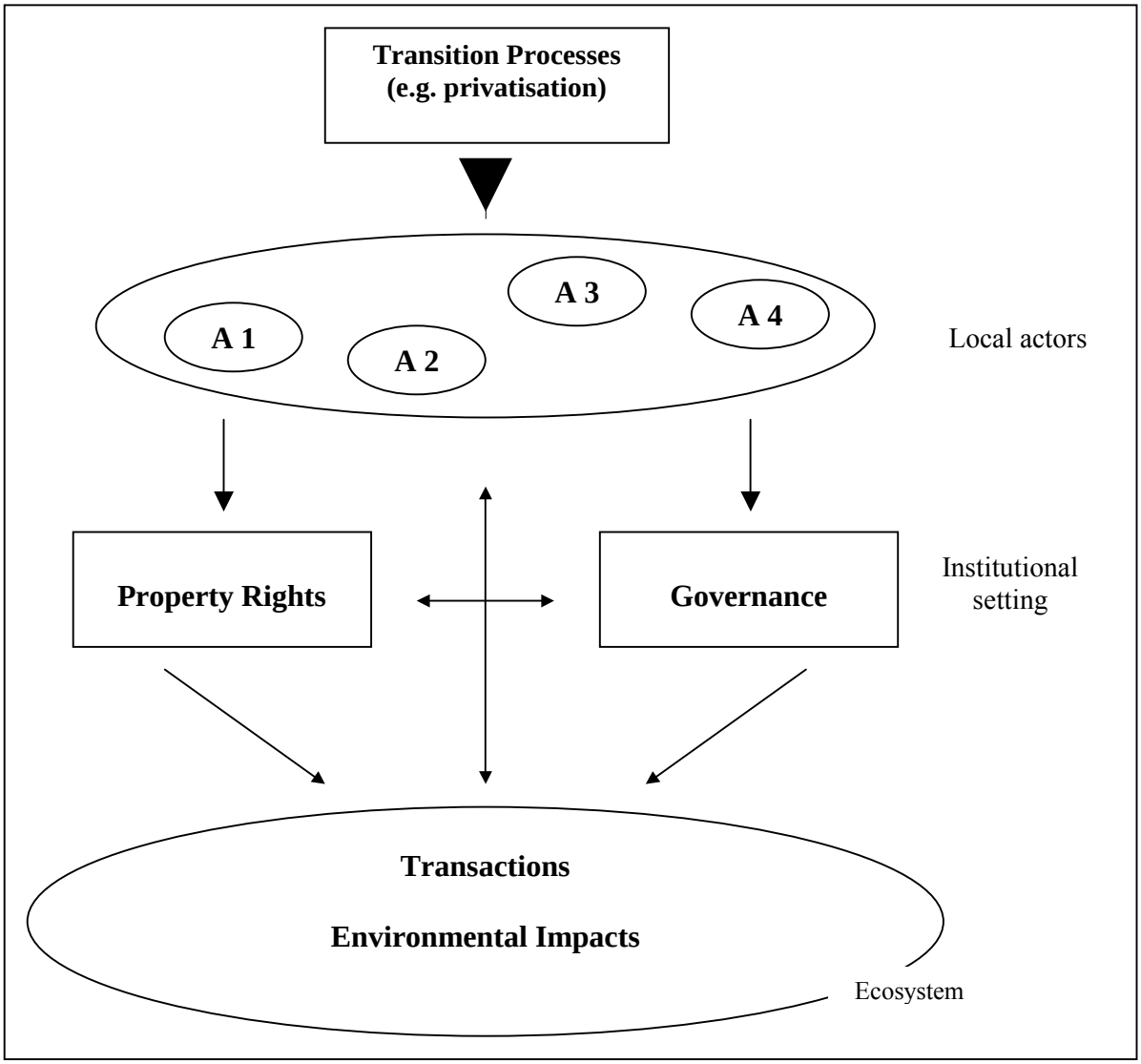
2.2.6 Analysing and Designing Institutions of Sustainability

According to the topics mentioned above we propose a framework for the analysis of institutions as it is shown in Figure 7. This framework is kept simple but includes all relevant issues for the analysis of institutions of sustainability on the basis of case study research (Yin, 1994). The framework was developed in co-operation with researchers from Czech Republic, Romania, Bulgaria, and Latvia. It will be adapted to the specific cases in each country. The research is designed for an empirical approach. Sufficient time is spent on the explorative and descriptive phases. After having identified the main research questions, the components of the framework and their interrelationships, hypotheses will be formulated. In a next step, variables, measures and techniques are identified. Applied techniques for data collection can be the conduct of interviews, direct observation, participant observation, documentation and others. The main techniques for data collection ad analysis will be qualitative (Miles & Huberman, 1994).

The difficulty in establishing instructions for the design of institutions is the fact that situations for which the design of institutions are intended, continuously change. Imagine you found a way to put the pieces of a puzzle together, but in the next moment the pieces have already changed their shape. There is no single way of institutional design and the process never ends. It is a never-ending process in a complex, dynamic and uncertain environment and it is difficult to pinpoint the specific set of measures, which actually lead to favourable/unfavourable outcomes.

Establishing new rules and changing old rules needs to take into account the general 'nested' character of rule configurations at different levels. Actual strategies for action are constrained by day-to-day decision rules (operational rules). Operational rules are constrained by collective choice rules, which influence processes such as management and policymaking. These collective choice rules are constrained by constitutional choice rules, which include processes such as governance, modification of rules and negotiation or mediation (Ostrom, 1992).

FIGURE 7: FRAMEWORK FOR THE ANALYSIS OF INSTITUTIONS OF SUSTAINABILITY

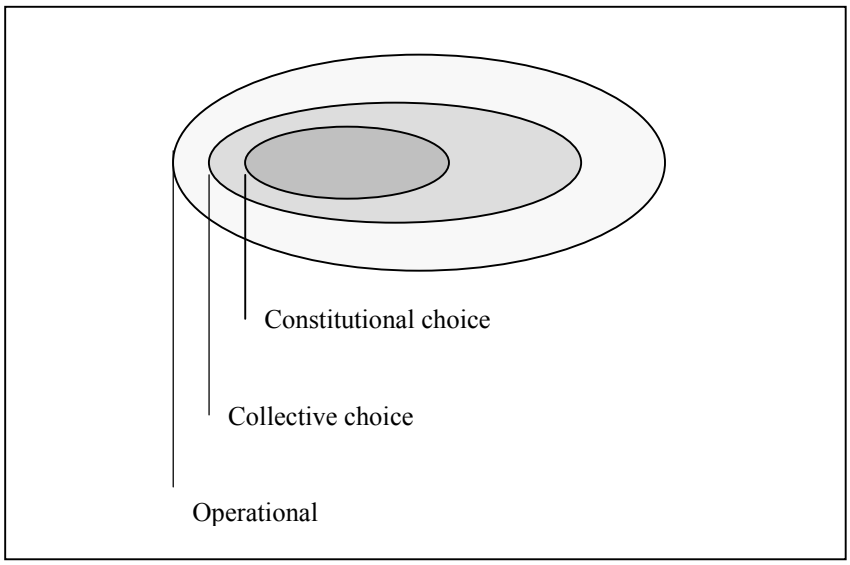


Source: Illustration developed during the "Institutions of Sustainable Agriculture" Workshop, Feb 5-10, 2001, Berlin

The process of institutional design has the following features and can be achieved by:
- creating new forms of relationships
- involving actors of all levels (officials, farmers, agencies, NGOs, etc.)
- enhancing capabilities for self-organisation
- carrying out questioning and long-term observation of organised actions

Institutional design includes the identification of formal rules or laws and procedures as well as the informal rules. It intends to fill the gaps of formal rules by formalising 'rules in use'. That includes matching visible activities and formal rules with invisible institutions. Institutional design also means identifying and analysing the operational level: What is happening? Why? Which physical and institutional constraints exist? What options are available to change existing constraints?

FIGURE 8: DIFFERENT LEVELS OF RULE CONFIGURATIONS



Source: Ostrom, 1994

Some important options in creating institutions of sustainability are:

5) Applying effective incentives is crucial to institutional design. Relevant sets of incentives need to be found to push the process of institutional building. Incentives can be: desirable working conditions, pride in workmanship, feeling of participation in important events, satisfaction in social relations, conformity to habitual practices.
6) Reducing transaction costs and creating favourable cost-benefit structures for specific agri-environmental sustainability enhancing actions (making actions of institutional building worthwhile).
7) Identifying and applying appropriate monitoring and evaluation mechanisms.
8) Developing criteria for the performance of institutions

From previous chapters it may be tempting to conclude that all what is needed to achieve sustainable agriculture is the match between institutional genotype and institutional genotype (in other words: to implement existing rules at local level or to create formal rules from informal rules). Although this is an important criteria for building institutions, it is not sufficient and it can actually lead to just the opposite than the desired outcomes. We can easily imagine a situation in which farmers apply certain practices, which are adapted to their social and economic environment and well supported by legislative structures (a situation of institutional match), but which ultimately lead to environmental deterioration. Getting used to and adapting to a centrally planned economy and society in which the negative effects of environmental degradation do not directly effect the performance of a society could be the reason for such situation. The representatives of such a system will claim, not without reason, that this system is sustainable (at least during their time period of argumentation).

Therefore, we need additional agri-environmental performance criteria. The choice of these criteria is necessarily a process of valuation in which specific conditions of each country/region need to be considered by those who develop the criteria. For example, a country, which is less dependent on agricultural production might be more comfortable

with high quality, ecologically produced food than a country, which aims at achieving self-sufficiency in agricultural production. The latter type of countries often argue that they cannot afford to produce environmentally friendly as long as they have not reached a certain level of basic economic performance (self-sufficiency) that allows them to invest in downstream industries and export. The costs of environmental pollution are then "automatically" allocated to the (global) public – a typical common resource dilemma. However, within a community of states, such as the EU, the situation of countries considerably changes. Countries now have the hypothetical option to produce environmentally friendly even though their economies are highly dependent on agricultural production. As mentioned, the choice of criteria for agri-environmental performance is a process of valuation and it will be a choice that places more importance either to the "agri-" component or the "environment" component of institutional performance. Some criteria are proposed by Ostrom et al. (1994):

- Economic efficiency
- Equity
- Accountability
- Adaptability
- Costs

3 AGRI-ENVIRONMENTAL POLICIES

The aim of the policy strand of the CEESA research project is to understand in what way the objectives directed towards environmental protection will be taken into account in the reform of agricultural policy and organisations involved in the restructuring of agriculture. The research focuses on mainly agricultural and environmental policies. Crucial questions are whether or not governments pay sufficient attention to the necessity of agri-environmental policies, whether or not there is a discrepancy between existing legal regulations and their implementation by the administrative units, and if EU enlargement will result in a transfer of institutions and instruments.

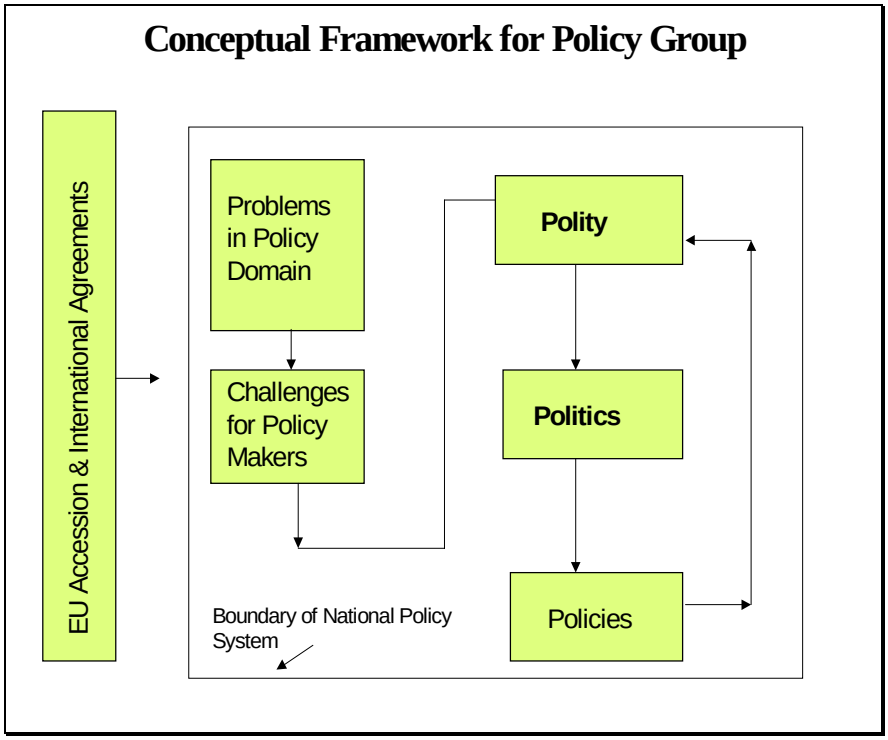
The policy working group has three formal tasks:

(1) to assess the environmental impact of current policies affecting the agricultural sectors,
(2) to anticipate the impact of EU policies, pre-accession policies and international agreements on the sustainability of agriculture, and
(3) to elaborate alternative national policy instruments to promote sustainable agricultural development (Gorton, 2000).

3.1 DEFINITION OF POLITY, POLITICS AND POLICY

In contrast to polity (which refers to the nature of political organisation in terms of the body of actors involved in the system of government), and politics (which refers to the interplay between these actors, their strategies, alliances and appeals made by these actors), policies refers to courses of action and commitments (laws, directives, financial incentives) which emerge out of political interactions (Figure 9).

FIGURE 9: THE CEESA RESEARCH CONCEPT FROM THE POLICY PERSPECTIVE



3.2 POLICY SYSTEM

The sphere of the policy working group covers the policy system which includes:

- policy (e.g. laws, programmes, strategies, plans);
- policy instruments, i.e. means to achieve or implement policy objectives (e.g. legal controls, penalties, taxes, charges, incentives, advice, training, etc.);
- organisations that formulate and implement policy (e.g. ministries, agencies, local and regional government, inspectorates, etc.);
- policy actors - these may be individual actors (e.g. ministers, scientists, conservationists, oligarchs, mayors) or collective actors (e.g. political parties, farming unions, NGOs, grassroots movements, scientific bodies, etc.

3.3 POLICY CYCLE

The policy cycle consists of five stages. Agenda setting refers to the process by which problems come to the attention of governments. Policy formulation refers to the process by which policy options are formulated within government. Decision making refers to the process by which governments adopt a particular course of action or non-action. Policy implementation refers to the process by which governments put policies into effect. Policy evaluation refers to the process by which the results of policies are monitored by both state and societal actors, the result of which may be re-conceptualisation of policy problems and solutions.

Policies are made by policy subsystems consisting of actors dealing with a public problem. The term "actor" includes both states and societal actors, some of whom are inten-

sively involved in the policy process while others are only marginally so. Policy subsystems are forums where actors discuss policy issues and persuade and bargain in pursuit of their interests. During the course of their interaction with the other actors, they often give up or modify their objectives in return for concessions from other members of the subsystem. These interactions, however, occur in the context of various institutional arrangements surrounding the policy process and affecting how the actors pursue their interests and ideas and the extent to which their efforts succeed.

To explain variations and change, social science seeks to understand the influence and interaction of social, economic and political processes, and the study of public policy explores the confluence of factors that shape public decision making. John (1998) argues that the way to explain how political systems make and implement policy is to specify the interests, resources, interrelationships, constraints and norms of the actors under study. For Working Group B the aim is to identify these intents, resources, constraints and norms with regard to policy making in response to specific agri-environmental problems.

3.4 Links to Institutions and Farming Systems

The following characteristics of policies should be seen in the context of institutions and farming systems, i.e. the entire CEESA project, which is illustrated in Figure 5:

- Policies effect actor's behaviour and strategies (and indirectly outcomes).
- Policies do not provide governance directly.
- Public policy is essentially concerned with modifying the institutional arrangements that situate individual economic agents in the larger economic structure (Bromley, 1991).
- Policies at all political levels provide incentives, constraints and bureaucracies and this mixture is specific and often unknown.
- Policies do not interact directly with farmers. Instead policies interact with some local formal institution (or bureaucracy), which is actually responsible for the local delivery of policy.

Institutions develop and implement policy; policy is shaped by existing and feasible institutions, which pose constraints and offer opportunities for progress. Policies and institutions therefore have highly complementary roles in the establishment of frameworks and strategies for sustainable agricultural development.

The implementation of policy has important links to the existing institutions in each country, for example, property rights to agricultural land and other resources. Characteristics such as farm ownership and management structures are important in that they affect numbers of relevant economic agents, with regard to policy implementation, with implications, thus for policy-related transaction costs (related to communication, monitoring and enforcement), and ultimately for policy efficiency. Consequently, sustainable agricultural policy must take account of existing institutions, and the potential for (or likelihood of) change in these.

3.5 METHODOLOGY

The current state of agri-environmental regulations, policy networks and implementation in the Central and Eastern European Countries (CEECs) will be audited in terms of both structural and cultural dimensions.

3.5.1 POLICY NETWORKS AND DISCOURSE ANALYSIS

Attention is paid to understanding the motivations and mindsets of key actors involved in decision making and implementation and the differences between spatial levels (international, national, and local), i.e. the cultural dimensions. An attempt will be made to understand differing conceptualisations of the nature of sustainable agriculture and agri-environmental problems and their prominence in the development of agricultural policy as a whole. Instead of beginning with a rigid definition as to what sustainable development is, it is thought more fruitful to understand the individual representations of the issue given by key policy actors. In this way sustainable development and agri-environmental problems are words and concepts understood and used by people reflecting the mental constructs of their interaction with what is "visible" and "what must be responded to" (Moscovici, 1984). The methodological approach this leads to is discourse analysis.

The formation and implementation of agri-environmental policy is inevitably embedded within the various decision makers' social world, not just in terms of objective structures (factors of production, the configuration of economies) but also with subjective configurations such as cultural backgrounds and inherited practices. Social phenomena emerge from both the "objectivity of the first order", constituted by the distribution of material resources and means of appropriation of species of capital (cultural, symbolic, social and economic) and in the "objectivity of the second order": mental systems of classification, that function as templates for the practical activities (conduct, thoughts, feelings, and judgements) of social agents (Bourdieu, 1977; Bourdieu and Wacquant, 1992).
Discourse analysis is networks-oriented. The interactions between actors will be studied with special attention to linkages between the various spatial levels:

- local level linkages, e.g. production and environmental co-operatives to maintain ecological networks, prevent habitat fragmentation, produce and disseminate knowledge, relationships with other spatial levels in terms of power over decision making and enforcement;
- national-level linkages, the structures of national policy making, coalitions between pressure groups, government agencies and stakeholders;
- international linkages, e.g. relationships with the EU.

Within periods of rapid structural change, the objective conditions of the material and social environment will not be the same for the new generation. What Bourdieu (1977) refers to as the habitus (i.e. the habitual or typical condition of a system) will therefore change with each historical discontinuity in a direction that attempts a compromise with material conditions. However, this compromise can never be "neutral" as the perception of objective conditions is itself engendered and filtered through the habitus. Changes in the habitus will thus reflect structural changes, the habitus of previous generations and how historical changes are perceived and reacted to on the basis of the prevailing habitus.

In understanding the evolution of agricultural and agri-environmental policy it is necessary to conceptualise the transition process as such as a period of historical discontinuity. In this period the field of agricultural policy has changed markedly in terms of the agents involved, their relative positions of strength, the value of different forms of capital and the disposition of key actors.

In addition to examining the structure of policy for sustainable agricultural development and motivations underlying this structure, the dynamics of policy development must be considered. The aim of governments in both CEECs and in EU member states is that the CEECs should become a full members of the EU, for both economic and political reasons. Given that the structural and agricultural policies are the largest in the EU in terms of budgetary expenditure, and the lower levels of economic prosperity in the CEECs, the agricultural and rural sector is an important focus for analysis and deliberation in the pre-accession period.

4 FARMING SYSTEMS

Farming Systems Research (FSR) can be defined as a diagnostic process: a basket of methods for researchers to elicit a better understanding of farm households, family decisions and decision-making processes. FSR assesses the natural, sociological, cultural, policy and institutional environment that influences decision processes at farm level. Its applications use this understanding to increase the efficiency in the use of human and budgetary resources for agricultural development, including research, extension and policy formulation (Collinson, 2000: 1).

Hart (2000: 44) has briefly described the history of the Farming System Research. Farming Systems Research has evolved from the development of better cropping systems and better agricultural ecosystems. At first researchers began to include interactions between crops and livestock. It became clear that farmers manage farms in which e.g. a cropping system is only one of the farm subsystems. With growing recognition of farms as real systems with their own unique structure and function, the researches also started to look at such factors like off-farm employment and complex objectives of farm families, which were seen as important as agronomic considerations. As a natural development farming systems were later linked to regional systems. This resulted in the change of performance criteria applied. In addition to measures of partial productivity (like yield per hectare), more comprehensive measures of productivity, stability and sustainability were developed. At the same time the group of target beneficiaries increased from farmers to farmers, women and next generation raising up the question of equity.

In the course of time the complexity of FSR has increased particularly due to three reasons. Firstly, the analysis has to take into account the dynamics of farming systems in responding to widening market opportunities and threats. Secondly, the goals of individual farmers, their community and society at large have to be reconciled, particularly with respect to environmental sustainability. Thirdly, there are strong interactions between technology adoption and policy manipulation (Collinson 2000: 53-54).

4.1 Defining Farming Systems

Characterisation is an important step in the FSR process. The term characterisation alludes to profiling of discrete units, such as the agro-ecology and the farm enterprise pattern. The characterisation does not assume an understanding of farming system. Since surveying across farming systems may be confusing, the grouping of farmers into types by profiles of the systems they operate takes particular importance. By means of stratification, it seeks to maximise differences between types and minimise sources of variation within them. The profiles do not necessarily have to follow administrative boundaries. Recommendation domains in 1970's were a pioneering step in defining groups of farmers for whom the same changes would be relevant. Since then the links between human actions and environmental degradation have forced further reconciliation between traditional physically based definitions of zones, in terms of climate and soil, and people-based definitions (Collinson 2000: 7).

Thus, a farming system can be defined in different ways for different purposes. The farming system can be defined as the microeconomic unit of analysis for different organisational forms of agricultural production systems. The term refers to a micro-scale entity of agricultural resources, which belong to an agricultural production unit, and the people who are connected to the system. Classically, the economics of farming systems deals with optimising the factors of production: land, labour and capital. The environment is relevant for economic benefits or losses at the farming systems level. The effect of environment are recognised especially when decreasing agricultural returns are the result of negative feedback from the ecosystem (e.g. soil compaction, crop failure because of pests occurring as a result of biodiversity loss) or when farmers are motivated to protect the environment by incentives or other regulations.

A farming system can also be defined as in McConnell and Dillon (1997): "…similar farm types in specific geographical areas or recommendation domains". This definition is particularly useful when analysing physical relations and development. In this paper we include, in addition to natural physical factors, also economic aspects as factors when defining the sustainability of farming systems. This extends the physical concept of farm types to more comprehensive economic units. The farming system consists of similar farm types in a specified environmental context. The endogenous setting is thus a farm type. The exogenous setting includes natural, political and institutional aspects and interactions (Table 3).

Information, knowledge and technological development provide new options for the decision making at farm level. However, expected economic outcomes largely determine which way and to what extent those options will be adopted. The adoption is of course dependent on the goals and targets of decision-makers. In the analysis it is important to notice that the cope of possible decisions of the farm household may be limited in the short run due to earlier decisions (sunk cost).

TABLE 3: FARMS AND THEIR ENVIRONMENT

Environmental (ecological) impacts of farms	**Farm type (a combination of farm and farm household)**	**Production environment, agricultural policy and institutions**
Soil Water Biodiversity Landscape (Air) (Energy)	Resources Production Internal constraints Ownership On-farm consumption Off-farm employment Information and knowledge	Natural conditions Markets Transportation Credits Extension service
Development over time – history, current state, future		

4.2 SUSTAINABLE FARMING SYSTEMS

What factors affect the sustainability of farming systems? While identifying factors affecting sustainability, it may be good to recall the various dimensions of the sustainability concept: sustainability includes not only the environmental dimension but also the economic and social dimensions. Sumelius (2000) has listed several conceptualisations of sustainable farming systems, e.g.:

- A sustainable farming system is a system in which natural resources are managed so that **potential yields** do not decline over time.
- A sustainable farming system is a system in which natural resources are managed so that the **stock of natural resources** do not decline over time.
- A sustainable farming system is one that satisfies minimum conditions of **ecosystem stability and resilience** over time.

According to Tisdell (1995: 118) sustainable (land) management combines technologies, policies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously:

- maintain or enhance production/services (productivity),
- reduce the level of production risk (security),
- protect the potential of natural resources and prevent degradation (of soil and water quality (protection)),
- be economically viable (viability) and
- socially acceptable (acceptability).

As McConnell and Dillon (1997) wrote, "To plan new farms which are profitable is one thing; to plan profitable farms which also make optimal sustainable use of what are finally social resources is yet another". Even more difficult and increasingly important is to develop new or restructured farm systems that have all these desirable properties and, in addition, are compatible with the social environment and not destructive of the physical environment. Also, as evidenced by increasing interest in gender analysis, equity within farm-household systems may also be important from a societal view. Equity is a criterion of social acceptability. This is relevant to evaluation and planning both at the farm level and at the broader social level. The social dimension is important to take into account if the farming system is to be fully sustainable. Some quantifiable measures are needed to check whether a farming system is sustainable or not. Due to the multidimen-

sional nature of the concept of sustainability and the difficulties to determine specific threshold values for these dimensions, it may be even too ambitious to seek the absolute level of sustainability. We should probably be satisfied with the relative ranking of farming systems. In this ranking both the current state and the expected direction of development are important. However, we should also recognise that our assessment is myopic, due to lack of knowledge of future events.

4.3 Measuring Sustainability

In order to operationalise the concept of sustainability a set of criteria has to be defined. Several criteria are defined, since there is seldom one single measure for sustainability. In our case, we reduce our analysis to two basic dimensions, the economic and the environmental performance (Table 4). In the long run these dimensions are obviously highly correlated, but in the short run they may differ significantly from each other. Indicators will be used to operationalise the criteria of performance. The indicators serve as attributes and objectives for decision-making. They also serve as a frame of reference for impact measurement, modelling and assessment of existing and improved farming systems. What finally links agricultural practices and the environment is based on the choice of technology, allocation of production and intensity of production at farm level.

Table 4: Selection of Criteria for Economic and Environmental Performance

Economic Performance		**Indicator or proxy in CEESA project**
Profitability	Short term Long term	Gross margin NPV, profitability indices
Productivity	Short term Long term	Total & partial productivity
Efficiency[a]		Overall, technical and allocative measures
Risk	Stability Diversity Flexibility	Coefficient of variation and changes in interest rate Simpson's diversity index Evaluation of alternatives
Environmental performance		
Soil related	State and pressure	Several options[b] both qualitative and quantitative indicators
Water related	State and pressure	
Biodiversity and landscape related	State and pressure	

[a] Efficiency analysis can also be applied to assess environmental performance.
[b] Bäckman et.al (2001)
Source: Modification of the setting by McConnell & Dillon (1997).

The gross margin is a short-run indicator of profitability for activities or enterprises. At the whole-farm level various measures of profitability are possible. The applicability of the indicator depends on, for example, the data available, the organisation of production and the time perspective considered. The diversity of production is one way of reducing the overall risk of the farm[14]. When the number of activities increases, the farm is likely to be more tolerant against price or yield variations of a single activity. The utilisation

[14] For example, in assessing profitability in combination with risk assessment, higher risks require higher interest rates.

of resources may also improve through diversification. The diversity can be measured through Simpson's diversity index, while flexibility refers to the availability of alternative ways of product disposal. Productivity changes over time. This change is called technical change, when it is related to the shifts of the production function. The productivity may also change through a change in technical efficiency.

Overall input efficiency[15] determines the ratio of minimum cost (best practice frontier) to actual cost of producing given output. This relative performance is determined by comparing the best practice in the reference group and the actual performance of the specific decision-making unit (farm household). Technical input efficiency can be defined as the largest possible equiproportional contraction of inputs such that given output can still be produced. High technical input efficiency indicates that inputs are used with low excess. Allocative input efficiency describes, how much the cost of producing given output could still be reduced by changing input relations according to their relative prices. This can also be determined be dividing the overall input efficiency measure by the technical input efficiency measure. During transition, high variation in efficiency is expected due to sudden changes in ownership and property rights. Also changes in policies create adoption and therefore higher variation in general. Sustainable policies are therefore of importance. Increased knowledge at farm level increases opportunities-for higher productivity and efficiency.

The criteria of environmental performance are defined for specific areas of interest in the CEESA project. These areas are soil, water and biodiversity (including landscape). State indicators describe the environmental conditions observed at a certain time. Thus, measuring a change in the state indicators during a time interval makes it possible to assess the influence of agricultural activities if they can be separated from other influencing factors. Pressure indicators measure the influence of e.g. agricultural activities that builds up over time and leads to environmental change. The areas of soil, water and biodiversity are often interrelated, that is, e.g. an improvement in the area of soil may also improve water quality. In this project we mainly apply indicators published in Wascher (2000) and Bäckman et. al (2001).

4.3.1 Combination of Criteria as a Measure of Sustainability

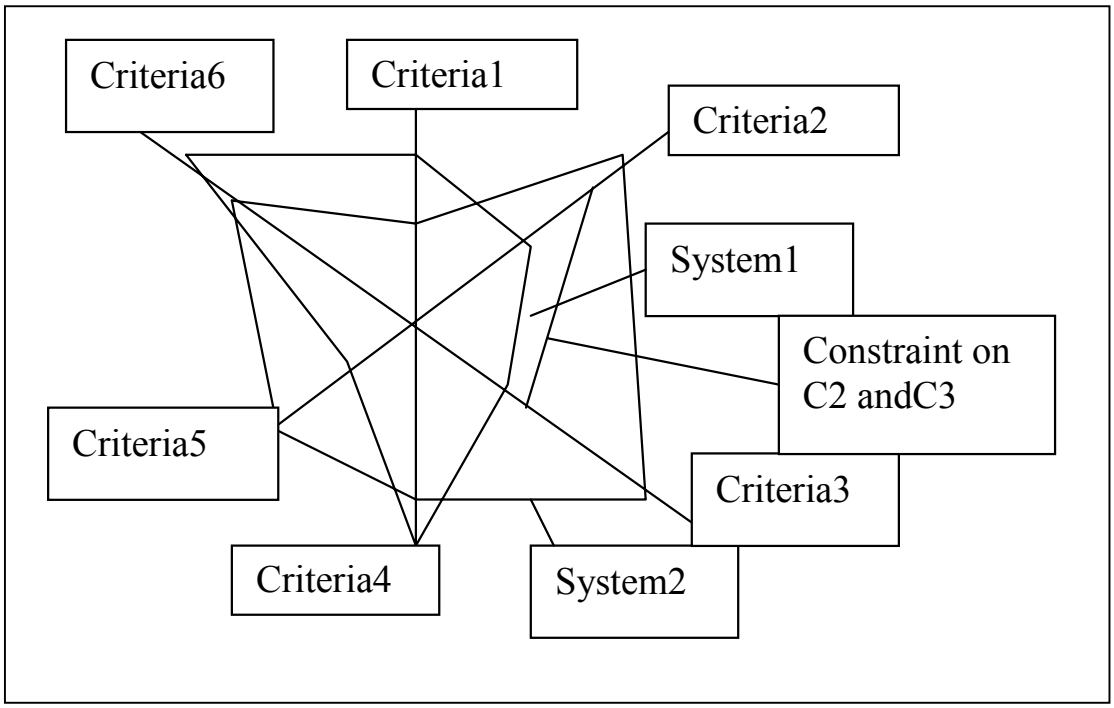
As mentioned earlier, sustainability cannot be directly assessed by a single indicator. Therefore, reasonable comparisons concerning sustainability require that several criteria are taken into account. For this purpose one should be able to determine hierarchical structures and/or relative weights of the criteria. Some of the criteria may be interpreted as hard constraints defining the carrying capacity of the environment. On the other hand, some of the criteria are more like goals, when the deviation from the target becomes important. Trade-offs between criteria may be possible but possibly one criterion has to be fulfilled (like a hard constraint) before the next one will be considered. The problem is that the preferences are not the same for all decision-makers and they may even change over time.

Figure 10 illustrates the problem of comparisons in case of several criteria. In the figure we have six criteria for assessing the sustainability of the systems one and two. As the figure shows each system is better in three of the six criteria. If we are not able to con-

[15] Output efficiencies can be defined in a similar manner, but in that case, we are looking at possible changes in outputs in case of given inputs.

nect relative weights and possible trade-offs to the criteria we cannot rank the systems taking into account all six criteria. The situation changes when the systems face the constraints on criteria two and three. If the constraints are the minimum acceptable values then the only feasible system is the system number two.

FIGURE 10: COMBINATION OF CRITERIA FOR SUSTAINABILITY AT FARM LEVEL

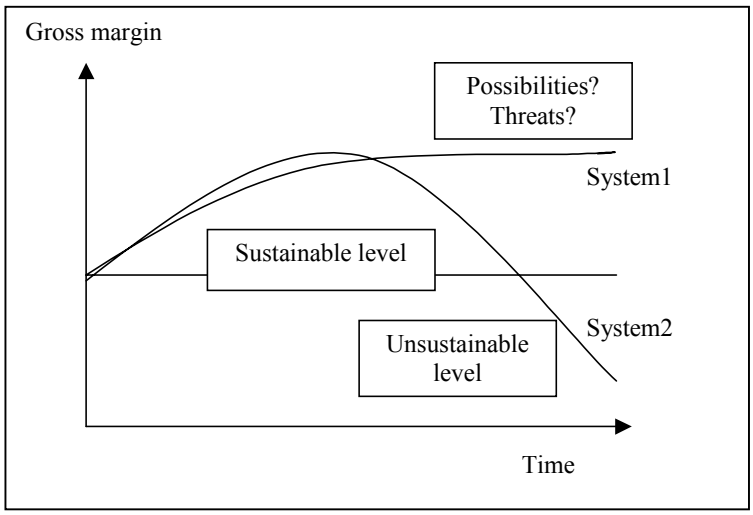


All criteria should also be assessed in the time horizon. Different systems may show different time paths with different states and options. In Figure 11 two systems are compared for gross margin over time. In the short run, system 2 shows a higher gross margin than system number 1 but in the long run the gross margin of system 2 will not maintain at a sustainable level. Due to uncertain prospects for the future, chances and threats for the various options need to be assessed.

4.4 FARMING SYSTEMS AND SUSTAINABLE AGRICULTURAL DEVELOPMENT

Sustainable agriculture implies that productivity does not decline over time, while the destruction of natural resource capital is avoided. In some cases, the increased intensity of agriculture may have negative effects on the environment. The opposite may also be unsustainable if e.g. nutrient depletion leads to impoverishment of the soil. It is also important to maintain the remaining high natural value (HNV) farming systems, which are of high environmental and amenity value in the CEE countries. In the long run, these areas may be very valuable. Some of them may otherwise be lost during transition.

FIGURE 11: TIME AND SUSTAINABILITY OF FARMING SYSTEMS



The farming systems level is probably the most relevant for institutions to become effective because it is here where social and ecological systems interact closely. At this level it can be observed or modelled what is actually being done. From the analysis of decisions concerning production, input and technology one may draw conclusions on the impacts on the environment if indicators have been properly designed. Finally, as a result of the analysis of farming systems it is possible to make recommendations with regard to the use of technology, inputs, production and to reactions to changes in agricultural policies and institutions.

Agricultural and agri-environmental policies are needed in order to envisage sustainable agricultural development (SAD). Furthermore, functioning institutions are necessary in order to implement these policies. However, no policy can be implemented or its impacts evaluated without an understanding of the local agricultural production and of the actual behaviour of the farmers. The farming systems approach is based on the premise that the problems of farmers have to be understood before research is conceptualised and recommendations are developed. Because of this, solutions to their problems have to be based on a proper understanding of their production environments and also of the farm household system, both the biophysical, economic and social dimensions. This involves identifying constraints and development potentials of the farming system. Sometimes, a participatory approach is used, whereby the farmers themselves and key actors are involved in the research process. Sustainable agriculture ultimately depends on the structure of farming systems and on the farming practices. These are influenced by history and external influences. According to Sumelius (2000), due to low profitability farmers in CEE countries have difficulties to take environmental factors into account. Also property rights have to be clearly defined in order to promote long-term investment in farming. Farmers' worldviews, norms, values, ideological orientations etc. also considerably shape the environments in which they act.

CONCLUSIONS

Understanding the complex causalities of environmental impacts of the agricultural sectors of Central and Eastern European countries in transition requires taking institutional, policy and farming systems issues into account. It is a difficult task to merge the research areas of institutions, policies, and farming systems into one comprehensive research programme and it is by no means completed. In creating a common understanding of concepts and terms used and in creating a common analytical framework, we think to have come closer to the goal of such a common research programme. Different historical, ideological and socio-cultural traditions among the researchers of the CEESA network in general and traditions of economic thought, in particular contribute to the diversity and complexity of the research task. Another aim of this paper was to point out to the linkages between institutions, policies and farming systems in order to identify some preconditions for sustainable agri-environmental development in countries in transition.

Those institutions which directly or indirectly regulate agricultural activities and their subsequent environmental impacts at the local level cannot be fully understood without studying institutions at the policy level and from institutions at the farming systems level. The actors' behaviour is not only effected by local norms, conventions, codes of conduct, and traditional knowledge of farming practices but also by policies which modify the larger economic and political context of agricultural actions. Farming systems are located at the interface between social and ecological systems. They evolve and operate under specific historical, political and ecological circumstances. The environmental effects of agriculture in transition countries are therefore not only effects resulting from certain farming practices, rather they are the result of how people organise their economies according to certain belief systems and other institutional dimensions such as policy.

Changes at the level of biodiversity translate into losses or gains to society through changes at the level of services provided by environmental functions. An important subset of these services is directly beneficial to agricultural production itself. However, environmental quality is seldomly deliberately designed by conventional principles of economic efficiency at farm level, instead they effect the environment by unintended externalities. The socialist era of the Central and Eastern European countries gives evidence that other institutions, including ideology, belief and knowledge systems, can have more substantial impact on the environment than the side effects of 'efficiency-institutions'. In order to identify those institutions at policy and farming systems level which correspond with our (vague) conception of sustainability at the interface of social and ecological systems, a conceptualisation such as we have undertaken here, is a necessary first step. Finally, the balanced interplay of the components of this multidimensional, dynamic and complex issue will help to determine the effects agriculture has on the environment.

GLOSSARY

ACTOR

Actors are part of policy subsystems dealing with an actual public problem. The term "actor" includes both states and societal actors, some of which are intensively involved in the policy process while others are only marginally involved. Policy subsystems are forums where actors discuss policy issues and persuade and bargain in pursuit of their interests. During the course of their interaction with the other actors, they often give up or modify their objectives in return for concessions from other members of the subsystem. These interactions, however, occur in the context of various institutional arrangements surrounding the policy process and affecting how the actors pursue their interests and ideas and the extent to which their efforts succeed. In contrast, stakeholders are those parties who have a share or an interest, as in an enterprise and *may* be affected by decisions and actions (e.g., rulemaking).

CAPACITY BUILDING / CAPACITY DEVELOPMENT

Capacity building is a long-term country-specific process during which people learn to improve their problem-solving mechanisms by gaining experience. This process includes the building of organisations and institutional structures which are strengthened during the process. The process of capacity building is goal orientated.

FARMING SYSTEMS

Farming systems research assesses the natural, sociological, cultural, policy and institutional environment that influence decision processes at farm level. Its applications use this understanding to increase the efficiency in the use of human and budgetary resources for agricultural development, including research, extension and policy formulation (Collinson, 2000: 1). Farming system can be defined in different ways for different purposes. The farming system can be defined as the microeconomic unit of analysis for different organisational forms of agricultural production systems. The term refers to a micro-scale entity of agricultural resources, which belong to an agricultural production unit, and the people who are connected to the system. Classically the economics of farming systems deal with optimising the factors of production: land, labour and capital. The environment is relevant for economic benefits or losses at the farming systems level. The agri-environmental effects are recognised especially when decreasing agricultural returns are the result of negative feedback from the ecosystem (e.g. soil compaction, crop failure because of pests occurring as a result of biodiversity loss) or when farmers are motivated to protect the environment by incentives or other regulations. A farming system can also be defined as in McConnell and Dillon (1997): "…similar farm types in specific geographical areas or recommendation domains". This definition is particularly useful when analysing physical relations and development.

GOVERNANCE

Governance structures are a more aggregated level of rules than rules in use, which determine how the rules are put into use or how "the play of the game" goes. Governance is the way society as a whole manages the full array of its political, economic, and social affairs. By shaping the incentives facing individuals and local communities, governance either facilitates or hinders economic development. If the overall governance structure reinforces the capability of local groups to deal with their own problems, then user groups have an incentive to manage their own common-pool resources wisely. Un-

der these circumstances development is likely to be sustainable. Conversely, if local rules are routinely superseded by the policies of higher authorities, then it will be much more difficult to restrain individual appropriators from engaging in opportunistic behaviour. In those circumstances any effort to develop the national economy as a whole will rest on shaky foundations at the local level (McGinnis, 1999).

INSTITUTIONS

The concept of 'rules' shall be used as a referent for the term 'institution'. Institutions shape human patterns of behaviour. They restrict human behaviour and thereby force humans to interact in certain ways. Simulanteously institutions can provide incentives for certain favourable actions. Rules are prescriptions that are commonly used and known to order repetitive, interdependent relationships between individuals and sets of individuals (stakeholders, actors). These prescriptions refer to actions ("states of the world"), which are required/prohibited/permitted. Institutions are the result of implicit or explicit efforts by a set of individuals to achieve order, predictability or certainty. Formal and informal institutions can be distinguished. Whereas formal institutions include, e.g. laws, policy rules, regulations, directives and property rights, informal rules include, e.g. conventions, traditions, codes of conduct, values and norms.

INSTITUTIONAL ARRANGEMENTS

Alternative expression for governance.

INSTITUTIONAL ENVIRONMENT

The institutional environment refers to the framing conditions of formal and informal rules which constrain institutional arrangements. Williamson (1999) refers to the institutional environment as the "rules of the game", whereas the institutional arrangements or governance structures are the "play of the game".

ORGANISATION

There is no universal definition of the term. 'Organisation' refers to different action-oriented (1), instrumental (2), and institutional (3) theoretical categories (Bea & Göbel, 1999). As an action, organisation refers to the process of creating order. Instrumentally, organisation is understood as a long-term regulatory management instrument of, e.g. a company or firm. North (1990) defines an organisation as an, institution including the people benefiting from it. Usually organisations are deliberately established in order to serve the goals of its members (see also Hayek, 1980).

POLICIES

Policies refers to courses of action and commitments (laws, directives, financial incentives) which emerge out of political interactions. In contrast to polity (which refers to the nature of political organisation in terms of the body of actors involved in the system of government), and politics (which refers to the interplay between these actors, their strategies, alliances and appeals made by these actors).

POSITIONS

Positions are places which are taken by the participants of an action scenario (actors). Positions can be held by one or few individuals or by many individuals. Usually there are more participants than positions. Examples of positions are: voters, bosses, leaders, members, etc. Important to mention here is that the we rather focus on the analysis of actions taken by actors who hold a certain position than analysing the personal behav-

iour of individuals independent from the structure of the situation in which they are acting (Ostrom, 1992).

PROPERTY RIGHTS

Property rights refer to rights concerning the use of things and the formal and informal institutions that create them and structure economic transactions (Weimer, 1997). Property rights are the product of rules. For every right an individual holds, rules exist that authorise or require particular actions in exercising that property right. If one individual has a right often some other individual has a commensurate duty to observe that right. A property right is enforceable authority to undertake particular actions related to a specific domain (Commons, 1968). Well established and enforced property rights are significant because they give security/certainty that the right holder's access, withdrawal, management, alienation or exclusion[16] will be recognised in the future by potential competitors for these rights (Hanna et al., 1996). Also Eggertsson (1990) argues, that the secure control of resources is a critical component of a sound economic system. Hagedorn (2000) clarifies, that property rights should not be misunderstood as the distribution of disposition rights on physical entities (material goods), but rights to nature components or ecological attributes. Actors merely attribute negative or positive values to physical good. This is the case because the holder of the right is either favoured by benefit streams or burdened by costs which are connected to the physical good. Bromley (1991) sees property as a social relation that defines the property holder with respect to something of value (the benefits stream) against all others. He uses the term *property regimes* to express this social relation. Regimes, after all, are human artefacts reflecting instrumental origins, and a property regime is fundamentally instrumental in nature. Property regimes include different rights.

RULES

Rules are the fundamental unit for designing social change. Rules are the result from efforts to achieve order and certainty or predictability in human interactions. They specify which actions are permitted or prohibited. Rules can originate from central or local government legislation (formal), or from norms, values and customs (informal). Sets of rules constitute institutions.

TRANSACTIONS

Actions of individuals, groups of individuals or other actors which have positive or negative impact on the environment and thereby (positively or negatively) effect other players within the social system. Transactions can also have direct impact on members of a group without passing the environmental dimension. In the context of agri-environmental sustainability a transaction relates to the interplay between the social and ecological system with direct response to other members of the society. A transaction can be devided into action, environmental impact and response. In New Institutional Economics, transactions usually refer to a technological procedure as the transfer of a good across an interface which is technologically separable, e.g. a transaction takes place in the pin factory whenever the pin changes hand within the factory until it is completed, or as the transfer of property rights, e.g. the transfer of property rights during the execution of a sales contract (Furubotn & Richter, 2000).

[16] Property rights include the rights of management (the right to regulate internal use patterns and transform the resource by making improvements), exclusion (the right to determine who has access and who does not), alienation (the right to sell or lease management and exclusion rights).

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