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FRAMEWORK FOR ASSESSING AND IMPROVING THE SYSTEM OF AGRO-ECO-MANAGEMENT

This paper suggests a holistic approach for analyzing, assessing and improving the system of eco-management in the modern stage of development of Bulgarian agriculture as a specific system for governing human activity for protection of natural environment. The principal mechanisms and modes of agro-eco-management are specified, the factors for agro-eco-management are identified and stages in improvement are described, which is perceived as a permanent, not a temporary process. Approaches and indicators for assessment are proposed, aiming at minimizing the overall costs for eco-management. The goal is to facilitate the interdisciplinary analyses and estimations in this sphere in order to contribute to improve the social policies, the forms of social intervention and public ecoprograms, as well as the individual, business and collective strategies and activities for sustainable development of this sector under the conditions of a dynamically changing social, economic, institutional and natural environment.

JEL: E6; Q50; Q54

Necessity and importance

Analysis, assessment and improvement of eco-management in agriculture is important since: agricultural activity is simultaneously a major factor for degradation and pollution of natural environment and important contributor for conservation and improvement of nature. Most analyses of eco-management in agriculture focus on pure agronomic, technological and ecological aspects of that activity. Consequently, the major tools and models for environmentally-friendly crop and livestock production are well studied, including for the specific conditions of Bulgarian agriculture.

However, despite the existing “good agronomical and technological models” there is a great diversity in efficiency of eco-activity of different type of farms, sub-sectors of production, regions of an individual country, and in comparison with other countries. Consequently, attention is directed increasingly toward studying the system of management which eventually (pre)determines the eco-behavior of diverse agrarian agents, stimulates the implementation of the good agro-ecological practices, eco-innovations and eco-investment, coordinates eco-activity at eco-system and/or regional level, reconciles evolving eco-conflicts, and determines the positive and negative impacts of agriculture on natural environment.

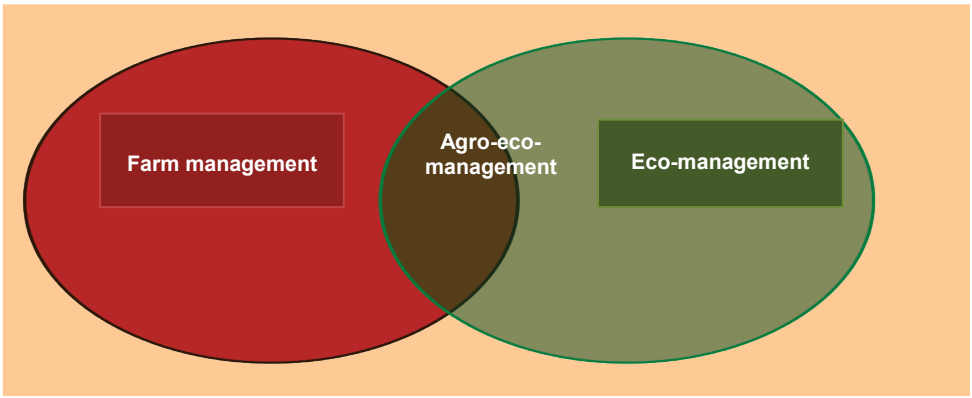
Numerous eco-problems, risks and conflicts associated with the evolution of country’s agriculture, and constantly increasing private and public costs for environment conservation and restoration, require implementation of adequate framework for analyzing the system of agro-eco-management in the different decision-making levels. However, in Bulgaria the analyses of socio-economic aspects of agro-eco-management are at the beginning stage due to lack of studies in the area, absence of methodical framework and adequate information, etc. (Bachev, 2006, 2008, 2009, 2013; Ivanov, et al., 2012; Yovchevska, 2012; Marinova, 2012; Mitova, 2005; Mochurova, 2008; Stankov, et al., 2005; Toteva, 2012; Xadjiev, et al., 2005).

Definition and scope of analysis[1]

The term "environmental management" means the management of the activities and the behavior of individual agents for restoration, preservation and improvement of natural environment and its individual components (soils, waters, landscape, atmosphere, biodiversity, climate, eco-system services). The environmental management in agriculture (or agro-eco-management) is associated with the agricultural production – the management of eco-activities and behavior in the process of production of food, fibber, bio-fuel, raw material, diverse eco-system and related services, etc. A significant part of the agricultural production is managed and carried out by different type of farms – individual, family, cooperative, corporative, public. Therefore, the agro-eco-management is to be studied as an integral part of the system of farm management (along with the management of production, labor, finance, innovation, inputs supply, marketing) and the system of eco-management in the society (Figure 1).[2]

Figure 1

Scope of Agro-eco-management



In some cases, the eco-activities constitute a relatively independent and/or a specialized part of the farming activity as in the case of environmentally-friendly collection, storage and disposal of garbage, organic production, etc. However, very often the eco-management is an integral part of the farm management and/or its individual functional areas (investment, labor, land management, crop production and protection, etc.). That requires to evaluate the comparative and absolute potential (internal incentives, capability, costs, intentions) of different types of agricultural farms

[1] The major theoretic-methodological issues related to agro-eco-management, on which this framework is also based, are presented in detail in our previous publications (Bachev, 2013, 2014).
[2] All figures and tables, presented in the study, are made by the author based on his own calculations.

(subsistent, family, commissioned, cooperatives, corporation, public) for eco-friendly production and innovation, conservation and restoration of natural resources, long-term eco-investment, minimization of direct and indirect negative eco-effects, dealing with major eco-challenges, minimizing eco-costs and risks, effective adaptation, etc. Such an analysis is more complex for the farms with complex internal structure (multimember partnerships, agricultural cooperatives, agrarian corporations, public farms), which are characterized with the division of the ownership from the management, and the many owners and hired labor with diverse interests and eco-culture.

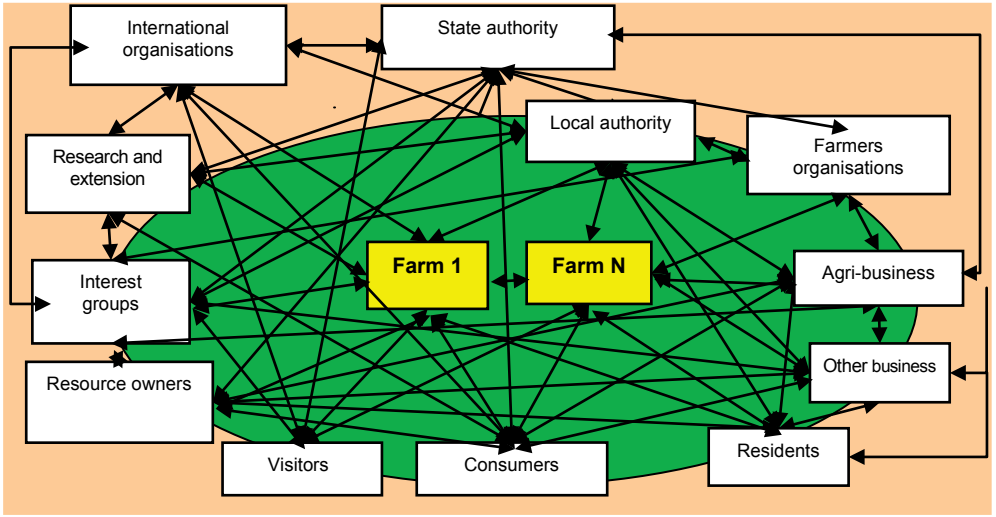
For the upper(farm) levels of management the eco-management is either integrated in the main mechanisms of influence (e.g. requirement for "eco-compliance", "good agricultural practices", etc.) or it is a specialized structure (programs for agro-ecology, mandatory eco-standards, etc.). The entire "system" of agro-eco-management is to be analyzed including: various agents participating in the agro-eco-management; and diverse mechanisms and forms governing the behaviors and relationships of these agents.

Agents and needs of agro-eco-management

The environment protection, restoration and improvement requires an effective private, collective and public order, which is to govern individual (agrarian) agents' behavior and their relations with other agrarian agents (farm managers, resource owners, hired labor) and non-agrarian agents (agrarian and related business, residents of rural areas, consumers of farm products and services, interest groups, state and local authorities, international organizations, etc.).

Figure 2

Agents of Agro-eco-management at Ecosystem Level

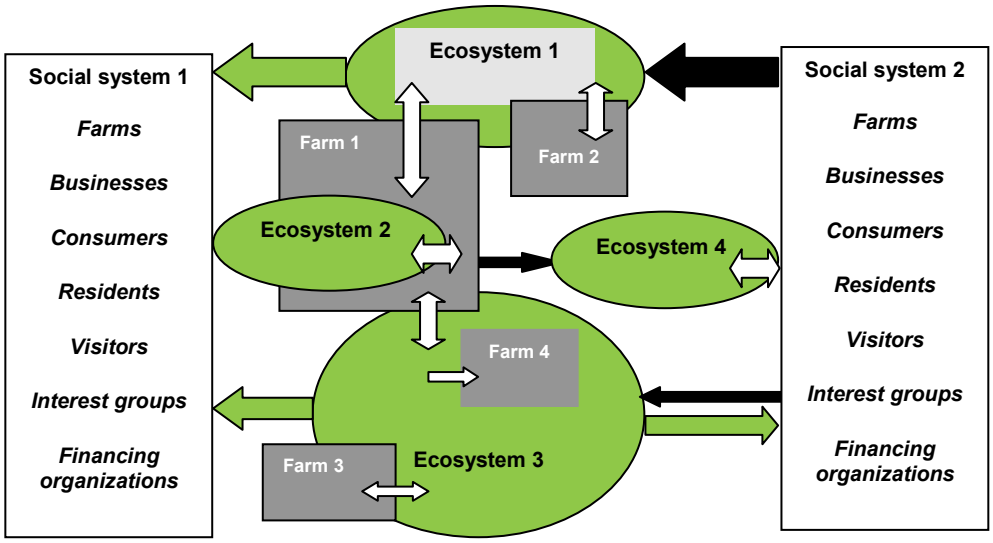


Therefore, a critical moment of the analysis of the agro-eco-management is to identify the identity of agents of agro-eco-management and the specific character of their relations, interests, objectives, power positions, dependence, effects, and conflicts. For instance, Figure 2 presents agents and relations in the agro-eco-management at the ecosystem level. The next step in the analysis is to define the "needs" for eco-management. They are associated with the necessity for building mechanisms for revealing the eco-problems and risks, stimulation of appropriate eco-behavior and cooperation, exchange of information, conflict settling, payback and minimizing eco-costs, etc. of participating agents.

Figure 3 illustrates diverse managerial needs with an example with the agro-ecosystem services (Figure 3).

Figure 3

Governance needs for effective supply of agro-ecosystem services



Farm 1 has to manage its efforts and relations with Farm 2 since both receive services from the Ecosystem 1 and affect (positively or negatively) the service supply of that ecosystem. Besides, both farms are to manage their relations with the consumers of services from the Ecosystem 1 (agents in Social system 1) to meet the total demand and compensate costs for maintaining ecosystem services to that direction. In addition, Farms 1 and 2 have to coordinate efforts with the agents in Social system 1 to mitigate conflicts with the agents in the Social system 2 (affecting negatively services of Ecosystem 1). Furthermore, the Farm 1 is to manage its relations with the Farm 3 for the effective service supply from the Ecosystem 3, and manage its interaction with Ecosystem 2. Moreover, Farms 1 and 3 have to manage their relations with Farms 4 and the agents from Social system 1 (consumers of the

services of Ecosystem 3) and Social system 2 (consumers and destructors of Ecosystem 3 services). Finally, the Farm 1 affecting adversely Ecosystem 4 services is to manage relations with the agents in Social system 2 (consumers of services provided by Ecosystem 4) to settle conflicts and secure effective flow of the ecosystem services. Therefore, Farm 1 is to be involved in seven systems of governance in order to assure an effective supply of the services from the ecosystems which it belongs to or affects.

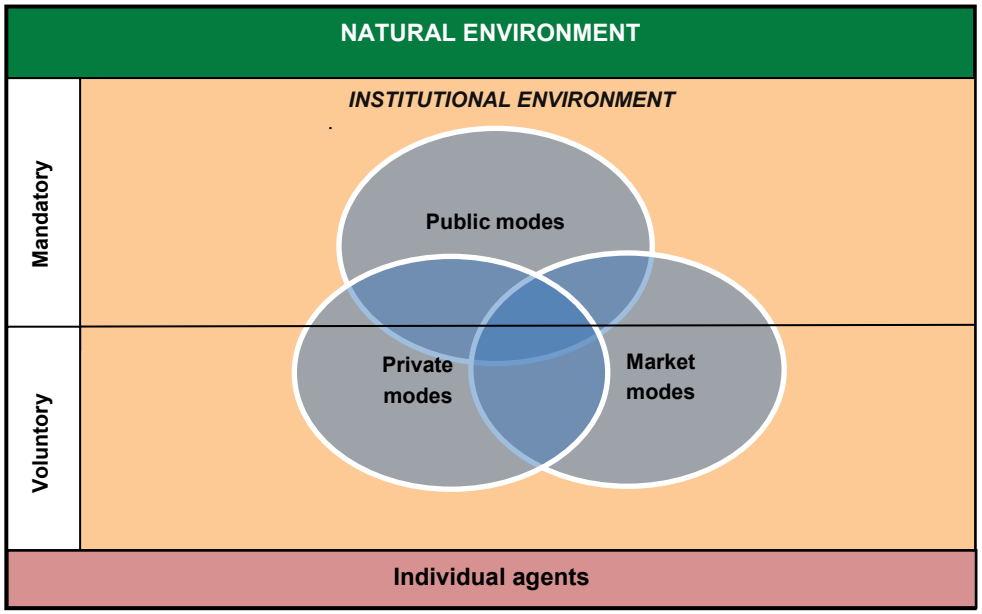
The example demonstrates, that the effective management of agro-eco-activity often requires complex and polyvalent forms, which have to be identified and analyzed. For instance, the inclusion of a farmer in the "organic products" chain coordinates well the relations among the producers and the final consumers. Nevertheless, the positive eco-effect could be minor, if simultaneously a form for the coordination of relations (collective action) with other farmers in a particular region or eco-system is not established to achieve the minimum required scale for positive eco-impact.

Forms and mechanisms of agro-eco-management

The eco-behavior and eco-activity of individual agents is governed (stimulated, directed, coordinated, restricted) by a number of distinct mechanisms and modes (Figure 4).

Figure 4

Modes of eco-management in agriculture



1. *Institutional environment* (or the "rules of the game") - that is the distribution of rights among individuals, groups, and generations, and the system(s) of enforcement

of these rights and rules. The entire spectrum of rights is to be analyzed embracing material assets, natural resources, intangibles, certain activities, clean environment, food security, intra- and inter-generational justice, etc. A part of the rights and rules is constituted by the formal laws, regulations, standards, court decisions, etc. In addition, there are important informal rules and rights determined by tradition, culture, religion, ideology, ethical and moral norms, which is to be clarified. Furthermore, an analysis is to be made on the system of enforcement of the rights and rules done by the state, community pressure, trust, reputation, private modes, and self-enforcement by agents. After that, an assessment is to be made on which extent the institutional environment creates incentives, restrictions and costs for maintaining and improving the natural environment, intensifying eco-exchange and cooperation, increasing eco-productivity, inducing private and collective eco-initiatives, developing new eco- and related rights, decreasing eco-divergence among social groups and regions, responding to ecological challenges, conflicts and risks, etc.

2. *Market modes* – are various decentralized initiatives governed by the free market price movements and the market competition – e.g. spot exchanges, classical contracts, production and trade of organic products and origins, etc. The analysis should cover the extent in which the "free" market contributes to coordination (direction, correction) and stimulation of the eco-activities and eco-exchanges, and the effective allocation of environmental resources. The cases of "failure" of market are to be also determined, which lead to lack or insufficient individual incentives and choice and/or unacceptable exchange associated with the environmental protection. Examples for the latter are missing markets, existence of monopoly or power relations, significant positive or negative externalities, etc.

3. *Private and collective modes* – those are diverse private initiatives, and special contractual and organizational arrangements – e.g. voluntary eco-actions, codes of eco-behavior, eco-contracts, eco-cooperatives, etc. The study should cover the extent in which the individual agents can take advantage of the economic, market, institutional etc. opportunities and deal with the institutional and market deficiency by selecting or designing mutually beneficial private modes (rules) for governing their eco-behavior, relations and exchanges. The cases of private sector failures in governing of socially desirable activity should be identified as well.

4. *Public modes* – these are various forms of public (community, government, international) intervention in the market and private sectors - e.g. public guidance, public regulation, public taxation, public assistance, public funding, public provision, property right modernization, etc. The analysis should focus on existing forms for public "involvement" in the agro-eco-management through provision of eco-information and eco-training for private agents, stimulation and (co)funding of their voluntary actions, enforcement of the obligatory eco-order and sanctions for non-compliance, direct organization of eco- and related activities (state eco-enterprise, scientific research, monitoring, etc.). All cases of public "failure" (inaction, wrong intervention, over-regulation, mismanagement, corruption) are also to be identified which lead to significant problems of sustainable development of the sector.

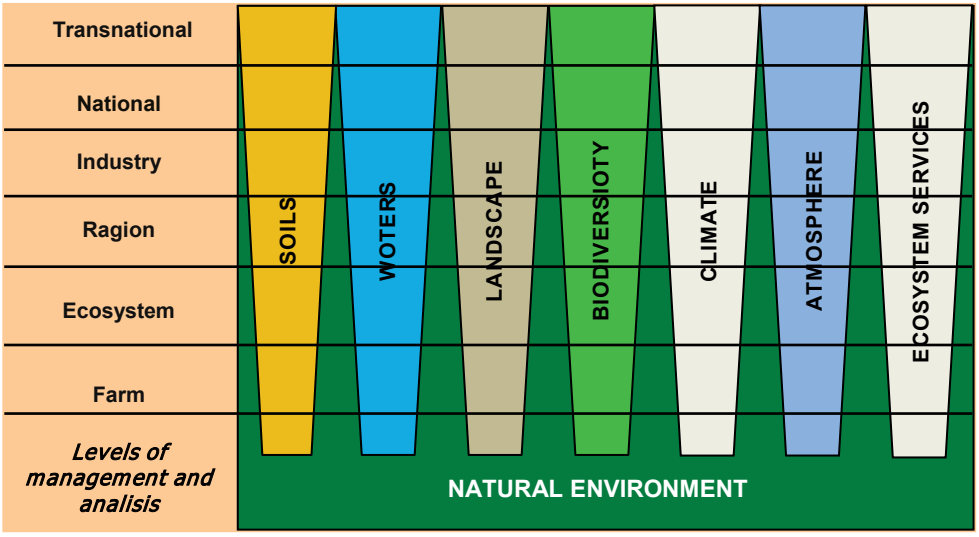
5. *Hybrid forms* – some combination of the above three modes like public-private partnership, public licensing and inspection of private organic farms, etc. All existing and other practically feasible (potential) forms for agro-eco-management should be identified, analyzed and assessed as well as their complementarities (mutual or multiplication effect) and contradictions among individual forms and mechanisms of agro-eco-management should be specified. For instance, often the private (eco)initiatives of individual agents are in "conflict" with each other and/or the interests of third parties; usually, public, collective and private forms are mutually complementary, etc.[3]

Elements and levels of analysis

The analysis of the system and the forms of agro-eco-management is to be implemented for the system as a whole and/or for the individual components of the natural environment – soils, waters, atmosphere, biodiversity, landscape, climate, eco-system services, etc. (Figure 5). In the latter cases, the analysis of relatively independent (sub)systems of management is concerned - agricultural lands, agricultural waters, agricultural emissions, agrarian and related biodiversity, rural landscape, agricultural impact on climate, and agro-ecosystem services.

Figure 5

Components and Levels of Analysis of Agro-eco-management



[3] In our previous publications we have identified and analyzed the major forms and mechanisms of eco-management in the process of post-communist transformation and European integration of Bulgarian agriculture (Bachev, 2008, 2009, 2013).

For each of the elements of the nature the analysis further deepens for sub-components as well. The latter are characterized with significant specifics in terms of management forms, factors, and efficiency. For instance, in Bulgarian conditions as elements of the component "*soils*" could be included cultivated farmland, lands with permanent crops, permanent grasslands and pastures, etc.; for the component "*waters*" – surface waters, ground waters, waters for irrigation, drinking waters, etc.; for the component "*biodiversity*" – agro-biodiversity, natural biodiversity, etc.; for the component "*atmosphere*" and "*climate*" – greenhouse gas emissions, dust, odors, other pollutants, etc.

It should be taken into consideration that a lot of the employed modes of agro-eco-management are integral, and affect two or more relatively independent elements or sub-components of the natural environment. Besides, the improvement of one aspect of the management through a particular form is often associated with the negative effects for another aspect, component or element. Therefore, in addition to the "private" efficiency it should always be taken into account the overall efficiency (direct and indirect effects and costs) of a particular forms or the system of management as a whole.

According to the specific objective the analysis of the system of agro-eco-management is made at different management levels (see Figure 5):

- farm level – individual farm, farms of a particular type (family, cooperative, crop, livestock, organic, semi-market, etc.);
- eco-system – individual eco-system (e.g. Struma River basin, Western Stara Planina) or type of agro-eco-system (plain, mountainous, semi-mountainous, riverside, coastal, etc.);
- regional – major administrative, economic or geographical regions of the country;
- industry (sector) – major sectors and subsectors of agriculture – crop production, livestock production, grain production, horticulture, poultry, dairy cattle, etc.;
- national;
- trans-national – Western Balkans, European Union, global.

The individual components of the system of agro-eco-management at the different levels are to be determined carefully. For instance, at the individual farm level most of the forms of public intervention (mandatory norms and standards, sanction mechanisms, etc.) play a role of "external" environment, while at the national and/or industry level they are internal mechanisms of management. Similarly, some of the dominant forms and mechanisms of management at a national or sectoral level may not be relevant to the individual farm or farms of a particular type. For instance, most of the (eco)instruments of the EU CAP do not influence at all the majority of Bulgarian farms due to the impossibility for participation in public programs (formal restrictions, high costs), low interests, enormous difficulties and costs for detection of non-compliances and for sanction by the authority, etc. At certain level of analysis (e.g. eco-system, region) there may be no specific (formal) structure of management at all, and the agro-eco-management to be "carried out" by other (main) organizations

(e.g. farms and farm organizations) and/or the general system of eco-management in the country.

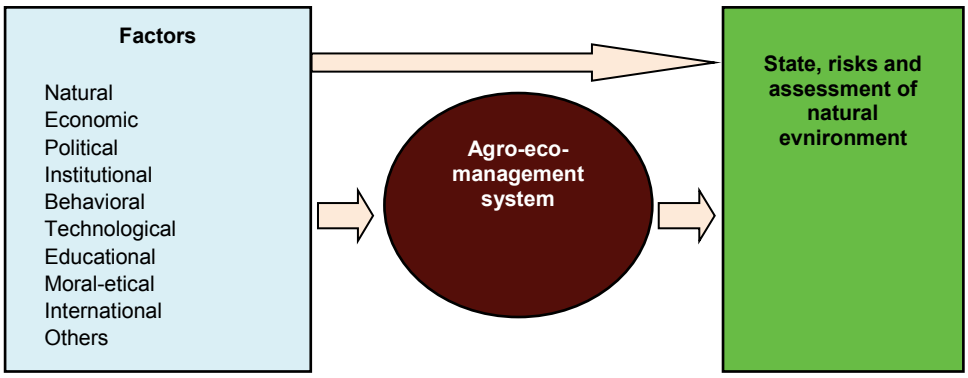
As a rule, the eco-effects and the eco-costs at a particular level and upper management level are not simple sums of those of the composite elements or those at lower levels of management. Therefore, it is to be taken into consideration the necessity for "collective actions" for achieving a minimal ecological and technological size for a positive effect, mutual and multiplication effects and spillovers, contradictory effects and costs, and externalities in different subjects and management levels, in space and time horizon.

Factors of agro-eco-management

The evolution of the system of agro-eco-management and the choice of one or another form of eco-management by agents depend on diverse natural, economic, political, institutional, behavioral, technological, international, etc. factors (Figure 6).

Figure 6

Factors and Efficiency of Agro-eco-management



For instance, the type of the development of agro-eco-management strongly depends on the (eco)preferences and the experiences of farmers and other participants in the process, the extent of degradation and pollution of the natural environment, the social demands and the pressure for sustainable exploitation of natural resources, the economic development and capabilities for eco-investments, the public policies and the implementation/enforcement of international (eco) conventions, the natural evolution of environment, etc. Therefore, the specific factors for agro-eco-management are to be identified and their importance and compatibility at the each stage of agricultural development analyzed.

The experience demonstrates that the natural environment is "valued" less and the good eco-management is not a priority, when there is no institutional stability (unspecified and/or not enforced agrarian, contractual and eco-rights, restructuring,

unsustainable policies, etc.) and when the financial and economic situations of household, farms and the state deteriorate. Monitoring, enforcement and disputing of many of the terms of eco-contracts is extremely difficult (costly) or practically impossible, and therefore supporting voluntary eco-initiatives of farmers is often more effective than the mandatory norms and "contracts". Similarly, due to technological, ecological or socio-economic reasons some of the widely used forms could be impossible for the conditions of a particular subsector, region, eco-system or farm (type).

In the long term the state of the nature and its individual components, and any risks, conflicts and costs associated with them, depend on the efficiency of "established" system of eco-management in the society, community, sector, region, economic organization, etc. (see Figure 6). However, in each specific moment or a shorter-period of analysis there could not always be found adequate data and/or determined direct links between the system of agro-eco-management (and its individual forms) and the state of the natural environment. The latter is caused by:

- the time period (delay) between the management actions ("improvement" of the system of management), and the changes in the eco-behavior of agents, and the positive, negative or neutral effects on the state of natural environment and its individual elements;
- the "impossibility" for adequate assessment of the natural environment and the associated risks and costs, due to the lack of "full" knowledge of the state and the processes of environmental change, the type of correlation with agrarian activities and the new (nano, genetically-modified, etc.) products and technologies, on future costs associated with the deterioration, restoration and conservation of natural environment, etc.;
- insufficient factual data for the extent of eco-degradation and pollution in agriculture due to lack of monitoring, precise measurements, and/or research studies in that area;
- "undervaluation" of the natural resources by individual agents, social groups and/or society as a whole and/or the "lack" of any system of agro-eco-management.

It should also be taken into consideration that the state and the changes in the natural environment are consequences not only of the system of agro-eco-management in a particular farm, region, subsector, or entire country, but other factors as well such as: the impacts of other industries in the country and on international scale, the natural evolution of environment, etc. Consequently, the real improvement or deterioration of the eco-management in a particular farm, group of farms in a region, subsector, or in the country could result in a lack or controversial change in the quality of waters, soils, air, biodiversity and climate. In many cases, it is impossible to "influence" the natural environment through (agro)eco-management at all, and the effective adaptation is the only possible strategy to overcome the socio-economic consequences for the agriculture and other sectors of human activity. Therefore, at all levels of analysis the diverse "external" and "internal" factors are to be identified and their importance estimated in order to assess adequately the efficiency of the system of agro-eco-management and the farm adaptation.

Efficiency of agro-eco-management

The "efficiency of agro-eco-management" represents the specific effectiveness of the analyzed form of management and/or the system as a whole in view of the extent of realization of practically (technologically, socially, economically) possible eco-effects and the minimization of overall costs for eco-management. When the effects, costs and efficiency of individual components of eco-management are evaluated it should take into account their different temporal scale, joitness, complementarity, special and temporal apartness, and the potential for development in the conditions of constantly changing socio-economic and natural environment.

In some cases, it is possible to determine the relation between the eco-action (costs) and the eco-effect in space and time through measurement, statistical (factors) analysis or simulation models. For example, it is possible to determine with a high precision the correlation between the optimization of nitrogen fertilization in farms of a particular region and the decreasing nitrogen pollution in ground waters in the region; the relationship between farms involvement in the public agro-ecological measures and the restoration of biodiversity in participating farms; or the link between improved eco-behavior of farms and the conservation of the natural landscape in rural areas.

However, often it is extremely difficult (too expensive) or practically impossible to monitor, measure, and separate the specific effect (costs) of the individual elements of the management or the entire system. For instance, it is impossible to determine (quantitatively) precisely the positive or the negative impact of the (Bulgarian) agriculture on the climate preservation and/or change. In these cases a system of qualitative and quantitative indicators should be used for characterization of:

• *the state and the dynamics of eco-behavior and/or eco-intention of agents*. For example, the following indicators could be used: extent of application of effective crop-rotation; introduction of good practices for chemical storing, fertilization, crop protection, irrigation and agro-systems; application of good agricultural and ecological practices; introduction of professional eco-codes and standards; transition to eco- or organic production; introduced and registered eco-products and services; amount of costs for environmental protection and restoration; amount and characteristics of eco-investment (e.g. building of modern manure storage site, drop irrigation system, etc.); number and scope of signed private and/or public eco-contracts; membership in eco-cooperatives or associations; number of participants and the scope of public eco-contracts and agro-ecological payments; plans for sustainable land and water exploitation, landscape and biodiversity conservation, system for waste management, etc.

• *the extent and the dynamics of the eco-pressure of agriculture*. Following indicators are appropriate: type of farmland utilization, number and kind of livestock per ha, intensity of water use, quantity and balance of chemical fertilization and crop protection, total and per ha yields for agricultural products, nitrogen and pesticides emissions in waters, emissions of dust, harmful particles, odors, noise

and greenhouses gasses, the system of utilization of farmland and farming (intensive, extensive, ecological), intensity of application of heavy machinery, type of utilization of livestock manure and biomass, amount and type of agricultural waste, number and scope of protected zones, etc.

- *the impact on and/or state of the natural environment and its individual components.* The following indicators can be employed: scale and scope of farmland erosion, scale and scope of degradation (acidification, saltification, pollution, desertification, stuffing) of soils, extent of conservation of the natural landscape, scale and scope of air and waters pollution, number of endangered species, diversity of populations of wild animals and plants, number and size of zones with environmental problems, frequency and type of extreme climate phenomena (storms, rainfalls, floods, droughts, hails, frosts, extreme hot and cold days, etc.); the extend and the pace of postdisaster recovery of natural environment (cleaning land from debris, water drainage, desalination, radioactive decontamination, etc.).

According to the type and the goals of analysis some of (or similar) indicators could be used simultaneously for characterization of the eco-behavior, eco-pressure, eco-state and eco-impact of agriculture. For instance, the increased number of livestock on underutilized pasture or fertilization of exhausted farmlands could express decreased eco-pressure. Similarly, the implementation of good agricultural practices, transition to organic farming, or protected zones, all they could indicate both improved eco-behavior as well as diminished pressure on natural environment. The amount of emissions of chemicals, greenhouse gasses, odors and noise in agriculture could be used as indicators for pressure, state, emissions, etc.

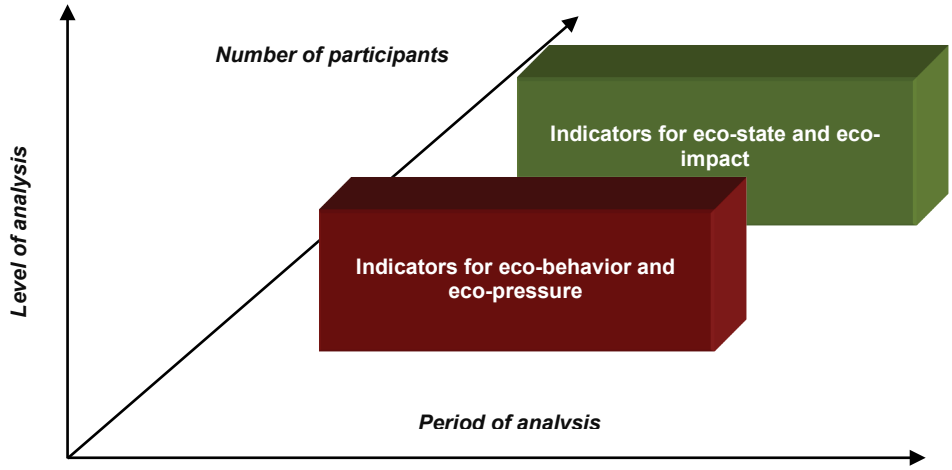
In many cases, there is insufficient information for some (or all) elements of the effects and/or costs, or it is impossible to determine the effective potential of certain forms and mechanisms. Then it is appropriate to apply quantitative analysis as well, which would reveal the specific incentives, costs, effects, obstacles, and capability for improvement of eco-behavior of the diverse participants in the process.

The specific indicators selected will depend on the level of analysis (farm, national, etc.), the type of analysis (particular form or instrument for eco-management, individual component of the natural environment, specific eco-challenges, integral, etc.), and the available (statistical, monitoring, experts, etc.) information in agricultural farms, in other agents of agro-eco-management (farmers and business organizations, Ministry of Agriculture, Ministry of Environment, etc.), and independent sources (Environment monitoring agency, research institutes, etc.).

As a rule, for the current and short-term analysis (a year, planed period), at the lower levels of management (farm), and for a smaller number of participating agents (individual farm or group of farms) mostly indicators for the eco-behavior and eco-pressure would be appropriate (Figure 7). For longer periods of analysis (programs, life-cycle of investment or products), at upper levels of management (sector, eco-system, national), and for a larger number of agents, required to achieve a positive eco-effect, the indicators for eco-state and eco-impacts would be more suitable.

Figure 7

Type of Indicators for Assessing Agro-eco-management Efficiency depending on Level and Time-span of Analysis and Number of Participants



Incomplete list of commonly used and other appropriate indicators for assessing the eco-behavior, eco-pressure, eco-state and eco-impact in agriculture in Bulgaria are presented in Table 1.

The assessments of the comparative and the absolute efficiency of agro-eco-management are to be made. The first one assesses the efficiency of a particular mode or the system as a whole in comparison to another feasible alternative form (system) or with the state before the introduction of the specific form/system of agro-eco-management. For instance, the assessment is made on the comparative efficiency (additional costs, additional farm and ecological effect) of organic farming in relation to the farms with the traditional technology or the state of farming before introduction of that eco-innovation; on private eco-contract in comparison with the participation in eco-cooperative; on public agro-eco-subsidies comparative to the introduction eco-taxes, etc.

At the management decision stage, the analysis of comparative efficiency is a mean for selecting the most-efficient option of eco-management (behavior, investment, cooperation, benefits) between institutionally, financially, and technologically possible alternative forms. Therefore, they are tools for increasing the absolute efficiency of the agro-eco-management. At the project implementation stage, these estimates express the comparative advantages (or disadvantages) of the chosen form for agro-eco-management in relation to the feasible alternatives.

The absolute efficiency assesses the overall effectiveness of a particular form or the entire system in relation to the achievements of standards for environmentally friendly and sustainable agriculture.

Table 1

Indicators for Assessing Eco-behavior, Eco-pressure, Eco-state, Eco-impact

Eco-behavior	Eco-pressure	Eco-state	Eco-impact
●Implementation of effective crop rotation; ●Good practices for chemical storage; ●Good practices for fertilization; ●Good practices for crop protection; ●Good practices for irrigation; ●Good agri-technic practices; ●Good agricultural and ecological practices; ●Professional eco-codes and standards; ●Transition to eco or organic production; ●Introduction of eco-products and services ; ●Registered eco-products and services; ●Expenditures for eco-protection; ●Expenditure for eco-restoration; ●Eco-investment; ●Modern manure storage; ●Drop irrigation; ●Number and scale of private eco-contracts; ●Number and scale of public eco-contracts; ●Eco-cooperation; ●Number of participants and scale of public eco-contracts; ●Number of participants and scale of agri-environmental payments; ●Plans for sustainable land management; ●Plans for sustainable water management; ●Plans for sustainable landscape management; ●Plans for biodiversity protection; ●Systems for waste management	●Size and share of arable land; ●Size and share of permanent crops; ●Size and share of grasslands and pastures; ●Size and share of abandoned land; ●Number and kind of livestock per farmland; ●Intensity of water use; ●Total and per farmland amount of N, K, and P fertilizers; ●Balance of chemical fertilization; ●Total and per farmland amount of chemical crop protection; ●Crop output and yield s; ●Water emission of N and pestisized; ●Emissions of dust and pollutants; ●Emissions of oudor; ●Noise emissions; ●Green-house gas emissions; ●Share of intensive land use and farming; ●Share of extensive land use and farming; ●Share of ecological land use and farming; ●Intensity of heavy machineries; ●Amount and share of manure use; ●Amount and share of biomass use; ●Amount and kind of agricultural wastes; ●Number and scale of protected zones	●Scale and size of water erosion of farmlands; ●Scale and size of wind erosion of farmlands; ●Scale and size of farmland acidification ; ●Scale and size of salinized farmland; ●Scale and size of farmlands polluted with heavy metals etc.; ●Scale and size of farmland desertification; ●Scale and size of pressed farmlands; ●Scale of conservation of natural landscape; ●Kind, size and scale of air pollution; ●Kind, size and scale of ground water pollution; ●Kind, size and scale of surface water pollution; ●Kind, size and scale of drinking water pollution; ●Number of endangered wild habitats; ●Diversity of wild habitat populations; ●Number and scale of zones with eco-problems; ●Frequency and type of extreme climate (storms, floods, droughts, heils, freezes etc.)	● Agricultural impacts on: - soil quality; - water quality; - air quality; - conservation of landscape; - conservation and recovery of biodiversity; - climate changes; - quality of ecosystem services

Here as criterion for assessing the effect is used:

• the contemporary scientifically recommended ecological norms and standards for behavior, pressure, emission, acceptable pollution, balance of fertilization, state of soils, waters, biodiversity, landscape, etc. For instance, achieving the norms for ecologically efficient fertilization and restoration of soil fertility, efficient number of livestock per ha pasture land, limits for minimum pollution of waters for drinking and irrigation; standards for balance of wild species in agro-eco-systems, for storage of manure and other agrarian waste, etc.

• or the planned socio-economic (farm, ecological, etc.) objectives or standards in the program for agro-eco-management. For instance, transition and certification for

the organic and eco-production, number of farms and amount of farmland included in the public measures for agro-ecology; extent of implementation of the plan for restoration of polluted waters and soils, for recycling of wastes, etc.

The criterion for assessment of the costs is whether it is possible to achieve the same goals with less overall costs or it is possible to achieve a higher (ecological, other positive) effect with the same costs.

The evaluation of the sustainability of eco-management for a farm is also made though analysis of the absolute efficiency. For example, the absolute efficiency of public, private or market eco-contract for a particular farm is to be estimated through the additional income from the agro-ecological subsidy, contract cash flow, and/or increased prices of eco-product/service, in relation with the costs for management and implementation of eco-contract terms (including missed benefits from the decreased yields and productivity as a result of transition to the eco-production). The existence of a net benefit (profit) means that the eco-activity is economically efficient for the farm.

The benefits for a particular farm are to be searched in other directions as well. For instance, the improved system of eco-management leads to conservation of natural resources employed in the farm, preserved or improved farm productivity in a longer-term, avoided future costs for compensation of decreased productivity and/or for the restoration of quality of natural resources, preserved or increase value of natural assets of the farm, etc.

At lower levels of analysis (farm, industry) the direct (internal farm, program) and indirect (external and social) eco-costs and effects are to be distinguished. At higher levels of analysis (most) costs and effects are “internal”. In each case, all the (positive, negative, interlinked) effects and the overall social costs associated with individual forms of eco-management are to be taken into account.

The assessment of costs for eco-management is to include:

- purely “production” costs and investment for eco-friendly agriculture, which are associated with the technology of conservation, improvement and restoration of natural environment; and
- the transaction costs, which are associated with the management of relations with other agents – costs of labor, and payments for acquiring information, negotiation, organizational development, registration and protection of eco-rights and products, controlling opportunism, conflicts resolution, adaptation to market and institutional environment, etc.

For instance, in assessment of the public form the overall costs are to be included which usually comprise: direct (tax payer, assistance agency) expenses, and transacting costs of bureaucracy (for coordination, stimulation, control of opportunisms and mismanagement), and costs for individuals’ participation and usage of public modes (adaptation, information, documentation, payments of fees, bribes), and costs for community control over and for reorganization of bureaucracy (modernization, liquidation), and (opportunity) costs of public inaction (negative effects on economy, human and animal health, lost biodiversity, etc.).

A part of the transaction costs could be determined directly, since they are object of a separate (including accountancy) reporting or could be easily specified from the traditional (production, program) costs. Examples for this type are costs for licensing, certifications, tests, purchase of information, registration, hiring consultants, payments for guards and lawyers, lawsuits, bribes, etc. However, it is impossible or very expensive to be separate or determine another (significant) part of the transaction costs. Here the already presented Comparative structural (qualitative) analysis is to be employed which will determine whether the eco-activities and transactions with specific dimensions (frequency, uncertainty, assets specificity, and appropriability) are governed/organized with the most effective mode(s).[4]

In general, the eco-activity and transactions with good (private) appropriability of rights (on products, intellectual property, etc.), high certainty, and universal character of investments could be effectively managed by the free market through spot or classical contracts (Table 2).

Table 2

Principal modes for governing of agro-eco-transactions and activities

Generic modes	*Critical dimensions of transactions/activities*								
	Appropriability								
	High								Low
	Assets Specificity								
	Low				High				
	Uncertainty								
	Low		High		Low		High		
	Frequency								
	High	Low	High	Low	High	Low	High	Low	
Free market	♈	♈							
Special contract form			♈			♈			
Internal organization					♈		♈		
Third-party involvement				🚗				🚗	
Public intervention									🚗

♈ - the most effective mode;
🚗 - a necessity for a third party involvement

The frequent transactions between the same parties, which are characterized by high appropriability could be effectively managed through a special contract. When the uncertainty is high and the assets dependency (specificity) is symmetrical the relational

[4] The effective structures minimize the transaction costs and maximize the transaction benefits of the participants in the particular socio-economic, institutional, technological and natural environment.

("neoclassical") contract could be used. A special contract forms is also efficient for the rare transactions with a low uncertainty, high specificity and appropriability.

Eco-transactions and activity with a high frequency, big uncertainty, and great assets specificity have to be managed within internal organization. When the condition of assets specificity is combined with the high uncertainty and the low frequency (incidental nature) of relations between agents, and when the appropriability is low, a third part (private agent, NGO, public authority) involvement in the transactions.

For instance, the highly specific investment for a particular parner(s) could not be "payed-back" if a transaction is not carried out or is terminated before the effective life-span of assets. At the same time, the high uncertainty and rare character of transactions make it impossible to write and effectively enforce a private contract between the parties. It is a similar situation with many agro-eco-activities, which products have character of "collective" or "public" goods and cannot be managed through pure market and private forms. In all these cases the intervention of a third part (assistance, arbitration, cooperation) is required to enable the implementation of the eco-activity in a socially needed scale.

The Discrete Structural Analysis should often be applied in assessment of the efficiency of forms of public intervention as well. Principally, interventions with a low uncertainty and assets specificity would normally require a smaller public organization - more regulatory modes, improvement of the general laws, contract and standards enforcement, etc. (Table 3).

Table 3

Effective modes for public agro-eco-intervention

Level of Uncertainty, Frequency, and Assets specifics				
Low	←----------		----------→	High
New property rights and enforcement	New public regulations	New taxes	New public support	New public provision

When the uncertainty and assets specificity of transactions increases a special contract mode would be necessary – e.g. employment of public contracts for provision of private services, public funding (subsidies) of private activities, temporary labor contract for carrying out special public programs, leasing out public assets for private management, etc. When the transactions are characterized with the high assets specifics, uncertainty and frequency, then an internal mode and a bigger public organization would be necessary – e.g. permanent public employment contracts, in-house integration of crucial assets in a specialized state agency or public company, etc.

When the aggregation and/or the comparison of data for effects and costs are made it is necessary to correct differences, which are associated with the application of unequal methods of calculation and/or dissimilar precisions in different farms, public agencies and periods of time.

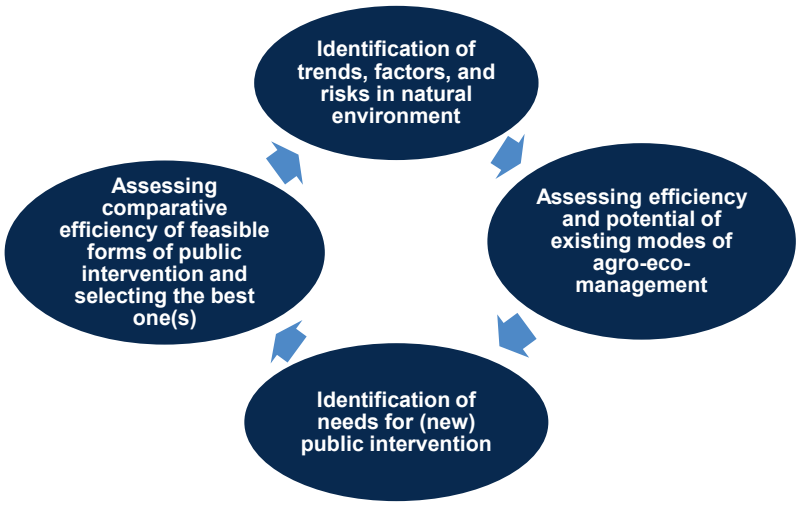
The adequate assessment of efficiency often requires collection of first hand microeconomic, ecological, etc. data from different levels and participants in agro-eco-management as well. For this purpose, interviews should be organized with managers and stakeholders, laboratory tests, scientific experiments, etc. Very often, it is also necessary to use experts' assessments of leading specialists in the area. The selection of the type and the importance of the criterion and indicators for the analysis and assessment of efficiency of the agro-eco-management at different levels are to be done by the experts in the field.

Improvement of the system of agro-eco-management

The improvement of the system of agro-eco-management should include the following stages (Figure 8).

Figure 8

Stages of Improvement of Agro-eco-management System



First, identification of trends, factors and risks associated with natural environment and its major components (soils, waters, air, eco-systems, climate, etc.). Modern science offers quite precise methods to assess the state of environment, and to detect existing, emerging and eventual challenges - environmental changes, degradations, destructions and depletion of natural resources, eco-risks, etc. What is more, science offers reliable instruments to estimate agricultural contribution to and impact on the state ("health") of environment and its different components, including in different spatial and temporal scales. The lack of serious eco-problems, conflicts and risks is an indicator that there is an effective system for eco-management, and therefore there is no need for changing public strategy for environmental conservation.

However, usually there are significant or growing environmental problems and risks associated with the development of agriculture.

Second, assessment is to be made on the efficiency and the potential of available and other feasible modes and mechanisms of management for environmental conservation, and for overcoming the existing, emerging and likely eco-problems and risks associated with agriculture. The analysis is to include the system of agro-eco-management and its individual components – institutional environment and various (formal, informal, market, private, contract, internal, individual, collective, public, specialized, multifunctional, simple, complex, etc.) forms for governing eco-activities of farms of different type and other interested parties. The efficiency of individual modes are to be evaluated in terms of their potential (comparative efficiency) to safeguard and develop agents eco-rights and investments, stimulate socially desirable level of environment protection behavior and activity, rapid detection of eco-problems and risks, cooperation and reconciliation of eco-conflicts, and to save and recover total environmental (conservation, recovery, enhancement, transaction, direct, indirect, private, public etc.) costs.

Furthermore, assessment is to be made on complementarities and/or contradictions between different forms – e.g. the high complementarities between (some) private, market and public forms for eco-management; conflicts between the "gray" and "light" sector of agriculture, etc. The efficiency checks are to be performed periodically even when the system of agro-eco-management seems "to work well". That is because the good conservation of natural resources could be done at excessive social costs or further improvement of the environment may be done at the same social costs. In both cases there is an alternative more efficient organization of agro-eco-management, which is to be introduced. For instance, often the too expensive for the taxpayer "state eco-management" (in terms of incentives, total costs, adaptation and investment potential) could be replaced with more effective private, market or hybrid mode (public-private partnership).

Third, deficiencies ("failures") in dominating the market, private, and public modes is to be determined, and the needs for new public intervention in agro-eco-management identified. They could be associated with the impossibility for achieving socially desirable and practically possible environmental goals, significant transaction difficulties (costs) of participating agents, inefficient utilization of public money and resources, etc.

Finally, the alternative modes for new public intervention able to correct (market, private and public) failures are to be identified, their comparative efficiency and complementarities assessed, and the most efficient one(s) selected. Only technically, economically, and politically feasible modes of new public intervention in the environmental management are to be specified.[5]

[5] Broadly employed forms of public intervention in agro-eco-management, which are used or are appropriate for Bulgarian agriculture are presented and analyzed in our previous publications (Bachev, 2006, 2008, 2013).

Suggested analysis is to be made at different levels (farm, eco-system, regional, sectors, national, international) according to the type of eco-challenge and the scale of collective actions necessary to settle specific eco-problems and risks for each component of the natural environment (soils waters, air, etc.) and completely for the natural environment as a whole. It is not a single exercise to complete at the last stage with a perfect system of eco-management. It is rather a permanent process, which is to improve eco-management along with the evolution of natural environment, individual and communities (social) awareness and preferences, and the modernization of technologies, organizations, and institutional environment. Besides, public (local, national, international) failure is also possible (and often prevail) which brings us into the next cycle in the improvement of eco-management in agriculture.

The suggested analysis enables us to predict possible cases of a new public (local, national, international) failures as well. The latter are due to impossibility to mobilize sufficient political support and necessary resources and/or ineffective implementation of otherwise "good" policies in the specific socio-economic environment of a particular country, region, sub-sector etc. Since public failure is a feasible option its timely detection permits foreseeing the persistence or rising of certain environmental problems, and informing interested agents and community about associated risks.

*

The suggested baselines of a framework should be subject of further development, discussion and adaptation according to needs, goals and levels of analysis, and evolution of the theory and practice in the area. Particular attention is to be given to specification of formal and informal eco-rights and existing institutional restrictions, and operationalization of micro-economic analysis of governing modes and associated transaction costs.

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