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ABOUT FORMS, EFFICIENCY AND ASSESSMENT OF ENVIRONMENTAL MANAGEMENT

We suggest a holistic framework for analyzing, assessment and improvement of environmental management using "agrarian sector" as an example. It incorporates an interdisciplinary approach (Economics, Organization, Law, Sociology, Ecology, Technology, Behavioral and Political Sciences) and includes: specification of managerial actors, needs and spectrum of governing modes (institutional environment; private, collective, market, public modes) at different level of decision-making (individual, farm, eco-system, local, regional, national, transnational, global); specification of critical socio-economic, natural, technological, behavioral etc. factors of managerial choice, and feasible spectrum of managerial forms; defining and assessing comparative and absolute efficiency of eco-management forms and system; improvement of forms of public intervention in eco-management.

Keywords: environmental management; agriculture; mechanisms and forms of governance; eco-managment indicators.

Introduction. Modern economy and agrarian sector in particular significantly affect the state and the sustainable exploitation of natural resources being a major factor for environmental degradation (pollution, destruction, extortion) as well an important contributor for the conservation and improvement of natural environment. Consequently, the issues associated with the effective environmental management are among the most topical in public, political, business and academic debates around the globe [Baba *et al.*; Dugos and Dupaz; Defrancesco *et al;* EC; Hagedorn; Hart and Latacz; Mitchell; Peerlingsa and Polman; Reed; Scozzari and Mansouri; UN]. This paper suggests a new holistic framework for assessment and improvement of environmental management in agriculture.

1. Definition and scope of eco-managment

Unlike the literal meaning of the words the *environmental management* means management of activities and behavior of individual agents for preservation and improvement of natural environment and its individual components (soils, waters, landscape, atmosphere, biodiversity, climate, eco-system services). *Environmental management in agriculture* (or agro-eco-management) comprises environmental management associated with agricultural (food, fibber, bio-fuel, raw material, diverse ecosystem and related services) production. It (is to) involves management of the activities, relations, and impacts of diverse *agrarian* (farm managers, resource owners, agricultural labor, etc.) and *non-agrarian* (upstream and downstream businesses, consumers, residents, interest group, etc.) agents. A significant part of the agricultural production is managed and carried out by different type of farms[1] – individual, family, cooperative, corporative, public, hybrid, etc. 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.

In some instances, 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. Very often the eco-management is an integral part of the farm and/or its individual functional areas (investment, labor, land management, crop production and protection). That necessitates to evaluate the comparative and absolute potential (internal incentives, capability, costs, intentions) of different type of agricultural farms (subsistent, family, commissioned, cooperatives, corporation, public, etc.) 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. 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. The environmental 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.). Therefore, a critical moment of the analysis of the agro-eco-management is to identify the personality 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.

Individual agrarian agents (farmland owners, farm entrepreneurs, farm labor, etc.) may have quite diverse interests and strategies in terms of environmental protection. All these interests and strategies are to be carefully analyzed and identified.

According to their ideologies and environmental ethics, the awareness of environmental risks, the managerial and technical ability, the financial capability, some individual agents may have direct natural resources conservation goals. Accordingly these "green" individuals will pursue natural resources conservation strategy in their everyday life and activity. For instance, for the natural resource owners the sustainable exploitation (conservation) of owned assets is often a primary concern and often it determines the type of farms they set up, and other ventures they participate (e.g. group or cooperative farms), or lease out contracts they sign. Similarly, a pro-environment farm entrepreneur establishes green (individual, cooperative, firm) farming structure following own or collective voluntary eco-code of behavior. Finally, farm labor may seek employment in a green cooperative or companies with eco-social responsibility.

Furthermore, in recent years there have been developed a great number of farms and farming enterprises with

[1] there are many instances where agricultural production is integrated by outside agent (processor, retailer, exporter) and carried as a part of larger (industrial, input supply) activity. "Farmers" are hired labor taking part in "internal" non-agricultural division of labor.

a primary or a major mission the environmental conservation and improvement. For instance, in many EU countries the environmental cooperatives have been very popular, there are numerous green agri-firms, etc Nevertheless, most farm structures in the modern world have other goals and pursue other (than natural environment conservation) strategies – e.g. the agri-firms are "profit-oriented" and their primary strategy is to maximize profits for shareholders; the cooperatives are "member-oriented" and carry out strategy to increase benefits for members, etc. However, there have been increasing consumer demands for the environmental conservation, and for the related organic, eco- and specific products from agriculture. Consequently, many market-oriented farms change their behavior in order to meet this growing market demand while keeping traditional (profit-making) strategy.

Finally, in modern societies there are a great number of formal and informal norms and restrictions related to the exploitation of natural resources. For instance, in the EU there is a huge body of environmental legislation and various environmental conservation programs. These institutional rules impose individual agents and farming structures mandatory norms and/or offer incentive to join voluntary schemes aiming at limiting environmental pressure, securing sustainable exploitation of natural resources, preservation of biodiversity, reducing pollution and emission of harmful substances, etc. This new public order modifies the individual strategies and behavior, and eventually leads toward conservation of natural environment.Thus achieving the effective natural environment conservation in agriculture will always be result of implementing of *multiple* voluntary or induced by market, community, public policies etc. individuals, farms, businesses, consumers, and public strategies.

The next step in the analysis is to define the "needs" for eco-management. They are associated with the necessity for building mechanisms for reviling the eco-problems and risks, stimulation of appropriate eco-behavior and cooperation, exchange of information, conflict resolution, payback and minimizing eco-costs, etc. of participating agents. According to (awareness, symmetry, strength, harmonization costs of) the interests of agents associated with the natural environment there are different needs for management of actions. Figure 1 illustrates diverse managerial needs with an example with the agro-ecosystem services. Here the Farm 1 has to manage its *efforts* and *relations* with the 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 the maintaining ecosystem services to that direction. In addition, the Farms 1 and 2 have to coordinate efforts with the agents in the Social system 1 to *mitigate conflicts* with the agents in the Social system 2 (affecting negatively services of the 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 the Ecosystem 2. Moreover, the Farms 1 and 3 have to manage their relations with the Farms 4 and the agents from the Social system 1 (consumers of the services of the Ecosystem 3) and the Social system 2 (consumers and destructors of the Ecosystem 3 services). Finally, the Farm 1 affecting adversely the Ecosystem 4 services is to manage relations with the agents in the Social system 2 (consumers of the Ecosystem 4 services) to reconcile conflicts and secure effective flow of the ecosystem services. Therefore, the Farm 1 is to be involved in *seven* systems of governance in order to assure an effective supply of the services from the ecosystems of which it belongs or affects.

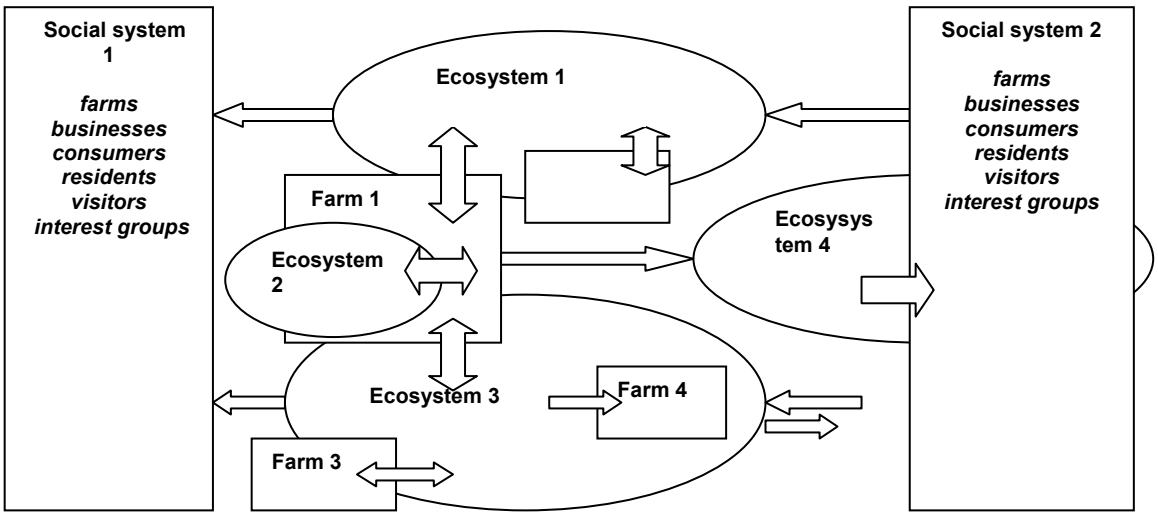

Fig. 1. Management needs for effective supply of agro-ecosystem services

Source: composed by authors' calculations

Next, it is to be analyzed the extent in which the management needs for the environmental management in agriculture is "satisfied" from the existing governance forms and mechanisms. In certain cases, the eco-management in agriculture is entirely archived through the individual actions of autonomous agents (farms) within the Sector "Agriculture". For instance, a good care and sustainable use of privately owned agricultural lands and water sources are typical in a family farm since they are integral part of the strategy for sustainable development of that family enterprise. Similarly, many group farms have a primary goal for sustainable development or are set up as green farms. Even when the individual strategies of farm's components (e.g. a hired labor, a family or a group member) do not coincide with the overall farm strategy, the effective management (the "internal order") is able to achieve the goals for farm's sustainable growth. However, 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 relations between 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 (optimal) required scale for positive eco-impact. The effective environmental management often necessitates concerted (collective) actions and eco-strategies of a number of farms as it is in the case of sustainable use of a common pasture and limited water supply, protection of local biodiversity, effective provision of agro-ecosystem services, etc.

Furthermore, modern farming activity is often profit-oriented and frequently associated with significant positive and/or negative externalities. Implementation of individual strategies of different farmers not always leads to overall conservation of natural resources. That requires a "common" strategy and managing relations (cooperation, reconciling conflicts, recovery of costs) between different farms, and increasingly between the farmers and non-farmers. For example, the adverse effects of agricultural activities on water and air quality are often felt by the residents and businesses in neighborhood and/or more remote regions. Similarly, the agricultural contribution to the ecosystem services benefits a large number of residents, visitors, consumers, businesses, and interest groups requiring certain collective actions for a sustainable supply. In all these instances, the environmental management goes beyond the simple (technical, agronomic, ecological) "relations with the nature" and embraces the governance of relations and collective actions of agents with diverse interests, power positions, awareness, capabilities etc. in large geographical, sectoral, and temporal scales [Bachev 2011a].

What is more, modern environmental management is associated with growing needs for the "additional" actions (monitoring, coordination, investments, etc.) and integral management of natural resources and eco-risks at national and progressively at transnational scale. The later include the water and garbage management, biodiversity conservation, climate change, etc. issues demanding effective regional, nationwide, international, and global governance. For instance, the effective management of the biodiversity "component" of the natural environment includes multilevel (individual, sectoral, national, EU, worldwide) and multilateral initiatives of numerous farmers, businesses, consumers, residents, interests groups, etc. The same is true for the waters, lands, air, ecosystem services, etc. management.Thus the effective conservation of natural environment will be achieved by coordinated collective actions and implementation of *multisectoral* and *multilevel* strategies of individual, family, partnership, private juridical, public juridical, state, etc. agents with diverse immediate goals, positions, capability and interests.

2. Forms and levels of eco-management

The individuals behavior (actions, restriction of actions) are affected and governed by a number of distinct modes and mechanisms of management which include (Figure 2): First, the *institutional environment* (or the "rules of the game") – that is the distribution of rights between individuals, groups, and generations, and the system(s) of enforcement of these rights and rules [Furuboth and Richter; North]. 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 the tradition, culture, religion, ideology, ethical and moral norms, which is to be clarified.

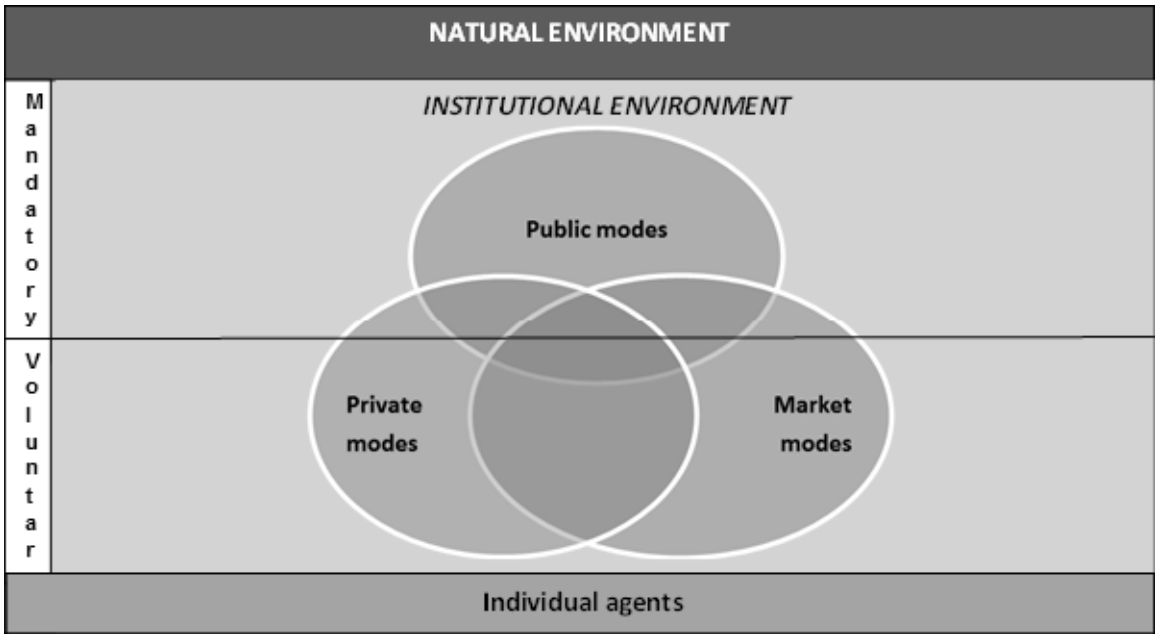

Fig. 2. Modes of environmental management in agriculture

Source: composed by authors' calculations

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 between social groups and regions, responding to ecological and other challenges, etc. Driving forces and the prospects of institutional "development" are to be also specified. The modernization of the institutional environment is initiated by the public (state, community) authority, international actions (agreements, assistance, pressure, etc.), and the private and collective actions of individuals. It is associated with the modernization and/or redistribution of the existing rights; and the evolution of new rights and the emergence of novel (private, public, hybrid) institutions for their enforcement. In modern society a great deal of the individuals' activities and relations are regulated and sanctioned by some (general, specific) formal and informal institutions. However, there is no perfect system of preset "outside rules" that can manage effectively the entire eco-activity of individuals in all possible (and quite specific) circumstances of their life and relations associated with the natural environment.

Second, the *market modes* (the "invisible hand of market") – those are various decentralized initiatives governed by the free market price movements and the market competition – e.g. spotlight exchanges, classical contracts, production and trade of organic products and origins, etc. It is to be analyzed 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 individual agents use (adapt to) markets profiting from the specialization and the mutually beneficial exchange (trade) while their voluntary decentralized actions govern the overall distribution of efforts and resources between activities, sectors, regions, eco-systems, countries, etc. There are many instances of lack of individual incentives, choices and/or unwanted exchanges related to natural environment conservation – e.g. "missing" markets, monopoly and power relations, positive or negative externalities, etc. Consequently, the free market "fails" to manage effectively the entire eco-activity, eco-exchanges, and eco-investments of individuals. Therefore, the cases of "failure" of market are to be determined, which lead to lack or insufficient individual incentives and choice and/or unwanted exchange associated with the environmental protection.

Third, the *private and collective modes* (the "private or collective order") – 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. It is to be determined 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 private mode negotiates "own rules" or accepts (imposed) existing private or collective order, transfers existing rights or gives new rights to counterpart(s), and safeguards absolute and/or contracted rights of agents. In modern society a great part of the agrarian activity is managed by the voluntary initiatives, private negotiations, the "visible hand of the manager", or collective decision-making. Nevertheless, there are many examples of private sector deficiency ("failures") in governing of socially desirable activity such as environmental preservation, eco-system services, etc. The later cases have to be identified and analyzed.

Forth, the *public modes* (the "public order") – 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. Analyses is to be made 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 sanctioning for non-compliance, direct organization of eco- and related activities (state eco-enterprise, scientific research, monitoring, etc.).The role of public (local, national, transnational, etc.) governance has been increasing along with the intensification of activity and exchange, and the growing interdependence of socio-economic and environmental activities. In many cases, the effective management of individual behavior and/or the organization of certain activity through a market mechanism and/or a private negotiation would take a long period of time, be very costly, could not reach a socially desirable scale, or be impossible at all. Thus a centralized public intervention could achieve the willing state faster, cheaper or more efficiently. Nonetheless, there are a great number of "bad" public involvements (inaction, wrong intervention, over-regulation, mismanagement, corruption, etc.) leading to significant problems of sustainable development around the globe [Bachev, 2010]. All these cases of public "failure" are to be identified and analyzed.

Fifth, the *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 is to be identified, analyzed and assessed as well as their complementarities (mutual or multiplication effect) and contradictions between individual forms and mechanisms of agro-eco-management 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.

The efficiency of the individual management modes is quite different since they have unlike potential to: provide adequate eco-information, induce eco-friendly behavior, reconcile eco-conflicts and coordinate the eco-actions of different parties, impact environmental sustainability and mitigate eco-risks, and minimize the overall environment management (conservation, third-party, transaction) costs, for agents with different preferences and capability, and in the specific (socio-economic, natural, etc.) conditions of each eco-system, community, industry, region, and country. For instance, providing appropriate eco-information (by a state agency, NGO, etc.) would be enough to induce voluntary actions by a "green" farmer, while the most commercial enterprises would need outside incentives (such as price premium, cash compensation, punishment, etc.); market prices would usually coordinate well relations between the water suppliers and the users, while the regulation of relations of water polluters and users would require a special private or public order; independent strategies and actions of farms would improve the state of local eco-systems, while dealing with most of the (regional, national, global) eco-challenges requires collective actions in large geographical and temporal scales, etc.

"Governance matters" and depending on the (efficiency of) system of management "put in place" the individual communities and societies achieve quite dissimilar results in the eco-conservation and improvement. Consequently, the extend of conservation of natural environment in agriculture (the type of exploitation of natural resources by agriculture and the agricultural impact on environment) would differ quite substantially in the different stages of development and among the diverse farming structures, eco-systems, regions, and countries.

The analysis of the system and the forms of agro-eco-management is to be done 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. In the later 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.

For each of the elements of the nature the analysis further deepens for sub-components as well. The later are characterized with significant specificity in terms of management forms, factors, and efficiency. For instance, 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 is to bare in mind that a great part 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 often is associated with the negative effects for other aspect, component or element. Therefore, in addition to the "private" efficiency always it is to 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: *farm level* (individual farm, farms of a particular type – family, cooperative, crop, livestock, organic, semi-market, etc.); *eco-system* – individual eco-system (e.g. Danube river basin; Northern Rockies; Dobrudja plain) 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* (Ukrain, California, Australia); *trans-national* (Western Balkans, European Union, global).

Specification of the individual elements of the system of agro-eco-management in each level is to be done 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 for the individual farm or farms of a particular type. For instance, most of the (eco)instruments of the EU CAP do not impact 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. [Bachev, 2010].

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.

3. Factors and efficiency of 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 4). 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 is 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. Likewise, the 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 (type) farm.

Most environmental activity and exchange in agriculture could be managed through a great variety of *alternative* forms. For instance, a "supply of environmental preservation service" could be governed as: voluntary activity of a farmer; though private contracts of the farmer with interested or affected agents; though interlinked contract between the farmer and a supplier or processor; though co-operation (collective action) with other farmers and stakeholders; though (free) market or assisted by a third-party (certifying and controlling agent) trade with special (eco, protected origins, fair-trade, etc.) products; though a public contract specifying farmer's obligations and compensation; though a public order (regulation, taxation, quota for use of resources/emissions, etc.); within a hierarchical public agency or by a hybrid form.

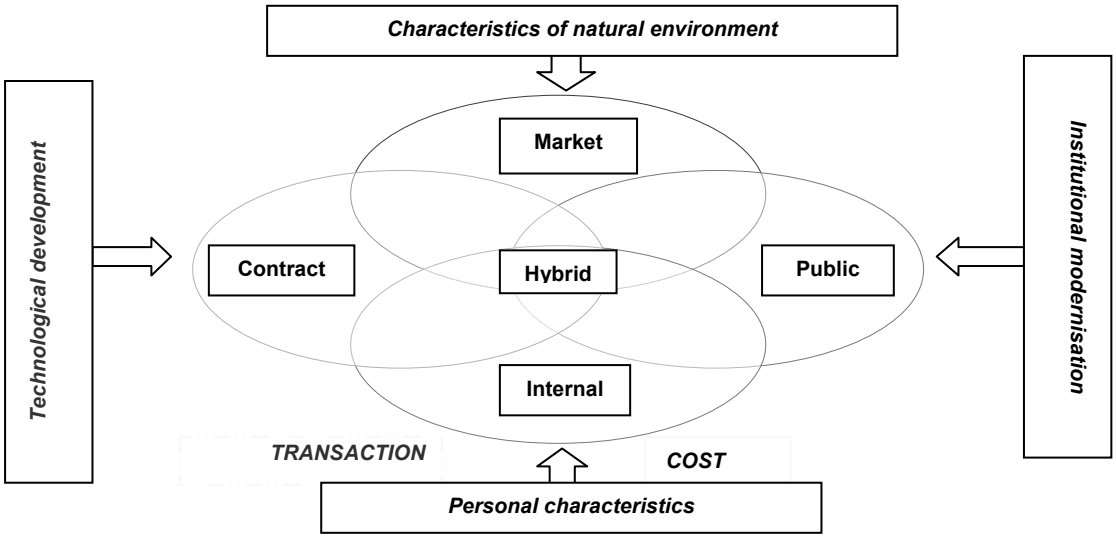

Fig. 4. Factors for managerial and strategy choices for agro-eco-management

Source: composed by authors' calculations

Commonly the natural and the institutional environment evolve very slowly over a long-term periods. Therefore, in the specific natural, socio-economic and institutional environment, the choice of the management mode would depend on a number of key factors including:

- the *personal characteristics of individual agents* – preferences, believes, ideology, knowledge, capability, training, managerial experience, risk-aversion, bounded rationality, tendency for opportunism, reputation, trust, power, etc. For instance, benefits for farmers from the eco-management could range from the monetary or non-monetary income; profit; indirect revenue; to pleasure of involvement in environment and biodiversity preservation activity.
- the *formal and informal institutions* – often the choice of management mode is (pre)determined by the institutional restrictions as some forms for carrying out farming, environmental, etc. activities could be socially unacceptable or illegal. For instance, market trade of farmland, natural resources, and (some) eco-system services are not allowed in many countries.

Furthermore, the institutional environment considerably affects the level of management costs and thus the choice of one or another form of organization. For instance, in conditions of well-working public system of regulations (quality standards, guarantees) and laws and contract enforcement, a preference is given to spotlight and classical (standard) contracts. On the other hand, when rights on major agrarian and natural resources are not defined or not well defined, and the absolute and contracted right effectively enforced, then the high transaction costs could create difficulties (or block) effective eco-management – costly unsolvable disputes between polluting and affected agents, disregards of interests of certain groups or generations, etc. Consequently, the institutional structures for carrying out the agrarian and environmental activities become an important factor, which eventually determines the outcome of the system (the efficiency) and the type of development (the sustainability).

- the *natural and technological factors* – eco-management strongly depends on the type of the environmental challenge (spatial and temporal scale, risks, etc.) and the natural recourses endowment as well as on the development of farming, environmental, monitoring, information, etc. technologies. For instance, management of water resources depends on the advancement of water conservation, use, recycling and monitoring technologies, etc.

In a long-term the state of the natural environment and its individual components, and the associated risks, conflicts and costs, depends on the efficiency of the "established" system of eco-management in a particular society, community, sector, region, economic organization, etc. However, in each specific moment or a shorter-period of analysis not always could be found adequate data and/or determine direct links between the system of agro-eco-management (and its individual forms) and the state of the natural environment. The later 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 on 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.

Also, it is to 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 farms, region, subsector, or country, but other factors as well such as: the impacts of other industries in the country and at 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 for overcoming the socio-economic consequences for the agriculture and other sectors of human activity [Bachev, 2013a]. 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.

The proper understanding the efficiency of agro-eco-management greatly depends on the understanding the role of transaction costs and the governance [Bachev, 2004, 2010, 2013b]. *The problem of "social costs"* does not exist in the conditions of *zero transaction costs*[2] and *well-defined private property rights* [Coase]. Then the state of maximum efficiency is always achieved independent of initial distribution of rights between individuals and the mode of governance. All information for the effective potential of activity and exchange (optimization of resources, meeting various demands, respecting assigned and transferred rights) would be *costlessly* available to everybody. Individuals would costlessly coordinate their activities; define, adapt and implement their strategies, define new rights, and protect their (absolute and contracted) rights[3], and trade owned resources (and rights over them) in mutual benefit with *the same* (*equal) efficiency* over the free market (adapting to price movements), and the private modes of different types (contracts, firms), and the collective decision making (cooperative, association), and in a nationwide hierarchy (a single private or state company). Then the ecological requirements for sustainability and the technological opportunities for economies of scale and scope (the maximum environmental conservation/enhancement and productivity of resources, "internalization of externalities") and the maximum welfare (consumption, conservation of natural resources) would be easily/costlestly achieved[4]. However, when transaction costs are significant, then costless contracting, exchange and protection of individual right is impossible. Therefore, the initial distribution of property rights between individuals and groups, and their good definition and enforcement are critical for the overall efficiency and sustainability. For instance, if the "right on clean and conserved natural environment" is not well-defined, that creates big difficulties for efficient eco-management – costly disputes between polluting and affected agents; not respecting interests of certain groups or generations, etc.

What is more, in the conditions of well-defined rights the eco-management is usually associated with significant transaction costs as well. For example, the agents have costs for identification and protection of various rights (unwanted take overs from others); studying out and complying with diverse institutional restrictions (norms, standards, rules, etc.); collecting needed technological, environmental, etc. information; finding best partners and prices; negotiating conditions of exchange; contract writing and registration; enforcing negotiated terms through monitoring, controlling, measuring and safeguarding; disputing through a court system or another way; adjusting or termination along with the evolving conditions of production and exchange, etc. Therefore, in the "real world" with not completely defined and/or enforced rights, and the positive transaction costs, the *mode* of agro-eco-governance is crucial and eventually (pre)determines the extent of degradation, conservation and improvement of natural environment [Bachev 2010]. That is because the different modes have unequal efficiency (benefits, costs) for governing the same eco-activity in the specific socio-economic and natural environment.

Moreover, often the high transaction costs deteriorate and even block organization of otherwise efficient (mutually-beneficial) for all participants' eco-activity and exchange. It has to be distinguished the transaction from the proper conservation or "production" (agronomic, opportunity, etc.) environmental costs. In modern conditions the later are significant economic costs, which are to be recovered like other technological costs from the beneficiaries of conserved or improved natural environment. Often that is the farmer, who invests for maintaining productivity of the natural resources (soil fertility, water purity, ecosystem services, etc.), and recover these costs similarly to other investments thought flow of future benefits (productivity, profitability, market position, etc.). More frequently, these are other agents, who pay for used eco-services directly (buying eco-products and services) or indirectly (though collective organizations, taxes and fees, etc.).

The effective modes for agro-eco-management optimize the *total* (transaction *and* conservation costs) for agrarian activity – minimizing the transaction costs and allowing (otherwise mutual beneficial) eco-exchange to be carried out in a socially desirable scale, and allowing achievement of minimum/optimum environmental requirement, and/or exploration of pure technological economies of scale and scope of farm, environmental conservation, etc. activities. In very rare cases, there is *only one* practically possible form for governing of natural resources, eco-activity and eco-exchange[5]. However, usually there are a number of *alternative* modes for governing of eco-conservation activity.

Different management modes are alternative but *not equally efficient* modes for the organization of eco-activities. Each form has distinct *advantages* and *disadvantages* to protect eco-rights and investment, coordinate and stimulate socially desirable eco-behavior and activities, explore economies of scale and scope, save production and transaction costs, etc. For instance*, the free market* has a big coordination and incentive advantages ("invisible hand", "power of competition"), and provides "unlimited" opportunities to benefit from the specialization and exchange. However, market management could be associated with a high uncertainty, risk, and costs due to the lack of (asymmetry) of information, low "appropriability" of some rights ("public or collective goods" character), price instability, a great possibility for facing an opportunistic behavior, "missing market" situation, etc.

The special contract form ("private ordering") permits a better coordination and intensification of eco-activity, and safeguards agent's eco-rights and eco-investments. However, it may require large costs for specification (and writing) contract provisions, adjustments with constant changes in conditions, enforcement and disputing of negotiated terms, etc. *The internal organization* allows a greater flexibility and control on activity (direct coordination, adaptation, enforcement, and dispute resolution by a "fiat").

[2] The costs for *governing* relations between individuals – for protection and exchange of individual rights.

[3] When transaction costs are zero then definition (redistribution) of *new rights* of individuals, interests groups, and society as well as effective enforcement of the new rights would be easily achieved.

[4] Presently there is a *principle agreement* ("social contract") for global sustainable development. Nevertheless, depending on the specific social preferences that "social consensus" not always is expressed in maximum environmental conservation and improvement. At certain stages of development a social priority could be given to economic growth at the "price" of certain degradation of natural resources – "over" pollution and emissions, unsustainable exploitation, partial or complete exhaustion.

[5] E.g. in Japanese agriculture with small paddy fields water supply could not be carried out by individual farms (high mutual assets dependency, non separability of use) and since ancient time water supply organization is governed as public projects [Mori].

However, the extension of internal mode beyond family and small-partnership boundaries (allowing achievement of "minimum" technological or ecological requirements; exploration of technological economies of scale and scope, etc.) may command significant costs for development (initiation, design, formal registration, restructuring) and for current management (collective decision making, control on coalition members opportunism, supervision and motivation of hired labor). *The separation of the ownership from the management* (cooperative, corporation, public farm/firm) gives enormous opportunities for growth in productivity, and environmental and management efficiency – "internal" division and specialization of labor; achieving ecosystem's requirements; exploration of economies of scale and scope; introduction of innovation; diversification; risk sharing; investing in product promotion, brand names, relations with customers, counterparts and authorities, etc. However, it could be connected with huge transaction costs for decreasing information asymmetry between management and shareholders, decision-making, controlling opportunism, adaptation, etc. *The cooperative and non-for profit* form also suffers from a low capability for internal long-term investment due to the non-for-profit goals and the non-tradable character of shares (so called "horizon problem"). What is more, the evolution and maintenance of large collective organizations is usual associated with significant costs – for initiating, informing, "collective| decision-making and internal conflict resolution, controlling opportunism of (current and potential) members, modernization, restructuring, liquidation, etc. Finally, *the pubic forms* also command high internal (internal administration and coordination) and outside (for other private and public agents) costs – for establishment, functioning, coordination, controlling, mismanagement, misuse by private and other agents, reorganization, and liquidation. What is more, unlike market and private modes, for public organizations there is no "automatic" mechanism (such as competition) for the selection of (in)effective forms. Here public "decision making" is necessary which is associated with huge costs and time, and often affected by the strong private interests (the power of lobbying groups, politicians and their associates, bureaucrats, employees in the public forms) rather than the efficiency.

Principally the "rational" agents tend to use and/or design such modes for governing their diverse activity and relations which are the *most efficient* in the specific institutional, economic and natural environment – forms *maximizing their overall* (production, ecological, financial, transaction, etc.) *benefits* and *minimizing their overall* (production, environmental, transaction, etc.) costs [Bachev 2010]. However, a result of such *private strategies* and *optimization* of management/activity is not always the most socially effective distribution of resources and the socially desirable (maximum possible) conservation of natural environment. It is well known that the agricultural activity is often associated with significant undesirable negative environmental effects such as soils degradation, waters pollution, biodiversity termination, air pollution, considerable green-house gases emissions, etc.

Therefore, the system of agro-eco-management is *to be improved*, and that frequently necessitates a *public (state) involvement* in the agrarian and environmental management. Nevertheless, the public intervention in (eco)management is not always more effective, since *public failure* is practically possible. Around the globe there are many examples for inappropriate, over, under, delay, or too expensive public intervention at all levels. Often the public intervention either does not correct the market and private sector failures, or "correct| them with higher overall costs.

Thus the *criterion* for assessing the efficiency of agro-eco-management and strategies is to be *whether socially desirable and practically possible environmental goals are realized with the minimum possible overall costs* (direct, indirect, private, public, production, environmental, transaction, etc.). Accordingly, inefficiency is expressed either in *failure to achieve the feasible* (technically, politically, economically, etc.) *environmental goals* (conservation of natural resources, overcoming certain eco-problems, diminishing existing eco-risks, decreasing eco-losses, recovery and improvement of natural environment, etc.) or achieving of set up goals with *more costs comparing to another feasible form of management.* Contemporary socio-economic, institutional and (more often) natural environment are changing very fast and often unpredictably[6]. Consequently, any strategy for the effective environmental management is to be an *adaptive strategy*. Accordingly, dominating and other feasible (market, private, public, hybrid, etc.) forms are to be assessed in terms of their absolute and comparative *(adaptation) potential* to protect eco-rights and investments of agents, assure socially desirable level of environmental conservation (enhancement), minimize overall costs, coordinate and stimulate eco-activities, reconcile conflicts, and recover long-term costs for organizational development in the specific economic, institutional and natural environment.

4. (The most) effective forms for eco-management

Usually "evolution" of the natural and the institutional environment is quite slow and in long periods of time. Therefore, to a great extent the efficiency of the system of agro-eco-management depends on the level of transaction costs. The transaction costs have *behavioral origin*: namely individual's *bounded rationality* and *tendency for opportunism* [Williamson]. The agrarian agents do not possess full information about the system (eco-benefits and costs, effects on others, formal requirements, development trends, etc.) since collection and processing of such information would be either very expensive or impossible (multiple spillover effects and costs in a large geographical and temporal scale, future events, partners intention for cheating, etc.). In order to optimize the decision-making and the activity the agents have to spent costs for "increasing their imperfect rationality" – for monitoring, data collection, analysis, forecasting, training, consulting, etc.

Besides, the economic agents are given to *(pre-contractual, post-contractual, and non-contractual)* opportunism. Accordingly, if there is opportunity for some of the transacting sides to get non-punishably an extra benefit/rent from voluntary or unwanted exchange, he will likely take advantage of that. Usually it is very costly or impossible to distinguish the opportunistic from non-opportunistic behavior because of the bounded rationality of agents. What is more, in the real life there is widespread non-contractual opportunism[7], namely unwanted "exchange" or stealing of rights from a private and/or public agents without any contracting process (because of the lack or asymmetry of information, capability for detection and protection, weak negotiating positions, etc.). Therefore, individual agents have to protect their rights, investments and transactions from the hazard of opportunism through*: ex ante efforts* to find a reliable counterpart and to design efficient mode for partners credible commitments; *ex post investments* for overcoming (through monitoring, controlling, stimulating co-

[6] There have been many financial, economic, food, environmental crisis in recent years inducing fundamental changes in economic structure and institutional rules at local, national, transnational and global scales.

[7] Most economic analysis focused on pre-contractual ("adverse selection") and post-contractual ("moral hazard") opportunism. Widely distributed *non-contractual* opportunism is usually ignored.

operation) of possible opportunism during the contract execution stage; and *permanent efforts/costs* for protection from unwanted non-contractual exchange though safeguarding, diversification, cooperation, court suits, etc.

The eco-opportunism is also widespread in agriculture. For instance, the farmer knows or eventually recognizes that his activity is harmful for the environment, but in order to save additional costs continues to execute risk operations when the negative effects are for other agents (the owners of natural resources, other farms, non-agrarian agents, society as a whole). Similarly, farmer sells conventional products as "organic" and profit price premium from the unaware buyers; or he joins the public agro-eco-programs to get subsidies, but does not comply with the "contracted" eco-obligations[8].

Part of the transaction costs for the eco-management could be determined relatively easily – e.g. costs for licensing, certifications, tests, purchase of information, hiring consultants, payments for guards and lawyers, bribes, etc. However, the assessment of another (a significant) part of the transaction costs in eco-activity is often impossible or very expensive [Bachev, 2011a]. That is why the *Comparative Structural Analysis* is to be employed [Williamson]. This analysis would align eco-activities/transactions (which differ in their attributes) with the governance structures (which differ in their costs and competence) in discriminating (mainly transaction cost economizing) way. Frequency, uncertainty, assets specificity, and appropriability are identified as *critical dimensions* of the eco-activity and transaction[9] – the factors responsible to the variation of transacting costs between alternative modes of management. In the specific socio-economic and natural environment, depending to the *combination* of the critical factors of eco-activities and eco-transactions, there will be *different the most-effective forms* of their management (Figure 5).

The eco-activity and transactions with good appropriability of rights, high certainty, and universal character of investments could be effectively managed by the free market through *spotlight* or *classical contracts*. For instance, there are widespread market modes for selling diverse ecosystem services and eco-products – eco-visits, organic, fair-trade, origins, self-production or self-pick up of yields from customer, eco-education, eco-tourism, eco-restaurants, etc.

The frequent transactions with high appropriability could be effectively managed through a *special contract*. For example, eco-contracts and cooperative agreements between farmers and interested businesses or communities are widely used including a payment for ecosystem services, and leading to production methods (enhanced pasture management, reduced use of agrochemicals, wetland preservation, etc.) protecting water from pollution, mitigating floods and wild fires, etc.

When the uncertainty is high and the assets dependency (specificity) is symmetrical the *relational ("neoclassical") contract* could be used. Since detailed terms of transacting and results are not known at outset (a high uncertainty), a framework (mutual expectations) rather than the specification of obligations of partners is practiced (opportunisms is (self)restricted due to the symmetrical dependency of investments of the partners). A *special contract* forms is also efficient for the rare transactions with a low uncertainty, high specificity and appropriability. The dependent investment could be successfully safeguarded through contract provisions since it is easy to define and enforce the relevant obligations of partners in all possible contingencies (no uncertainty exist).

The transactions and activity with a high frequency, big uncertainty, and great assets specificity have to be managed within *internal organization*. For instance, a good portion of the eco-investments are strongly specific to (certain land plots, eco-systems, etc.) a farm and they can be effectively implemented and "paid-back" within the borders of the particular farm. The high *interdependency* (specificity) of the eco-investments with other farm's assets and activity is the reason that a great part of the agro-eco-management to be executed by the different type of farms – family, co-operative, agri-firms, public, hybrid, etc. There are also cases when the farms and other agents are *specialized in eco-management* and entirely engaged in (aimed at) "keeping natural environment in a good condition" or "recovery or amelioration of natural environment". Here the agricultural activity either "does not exist" (e.g. prolonged follow up) or it is practiced as far as it is required by the purely agronomic, ecological and other (e.g. educational, rehabilitation, etc.) needs. According to the extent of appropriability of the results and the "universal" character of the investments, these type of farms could be market-oriented (selling eco-services to landlords or other buyers), community[10] (funded by communities, interests groups) or public (e.g. for conservation of important eco-systems like national parks, natural phenomenon, etc.). Very often the effective scale of the specific investment in agro-ecosystem services exceeds the borders of the traditional agrarian organizations (family farm, small partnership, etc.). For instance, much of the eco-investments, which are done in one farm (protection of waters and air, biodiversity, etc.) benefit other farms or non-agrarian agents. Often, the dependency of eco-investments of a farm is *unilateral* from the agent benefiting from the positive result.

Besides, the positive impact of the eco-investment often depends on the minimum scale of activity and frequently requires collective action (co-investment). Consequently, the eco-activity/assets of many farms happen to be in a high *mutual-dependency* with the eco-activity/assets of other farms and/or non-agrarian agents in a *large spacial* and often *temporal scale*. Thus, if the specific capital (knowledge, technology, equipment, funding, etc.) cannot be effectively organized within a single organization[11], then effective *external form(s)* is to be used – e.g. joint ownership, interlinks, cooperative, joint investment in labels and origins, lobbying for public intervention, etc. For instance, the environmental cooperatives are very successful in some European countries (like, Finland, Germany, Holland, etc.) where there are strong incentives for cooperation due to the mutual-dependency of farms eco-activity, evolving "market" for eco-services, and widespread application of long-term public eco-contracts for eco-coalition. There is also rapid development of diverse associations of producers around the specific capital invested in eco-products and services, trademarks, advertisement, marketing channels, etc.

Nevertheless, the costs for initiation and maintaining of the collective organization for overcoming the unilateral dependency are usually great (a big number of coalition, different interests of members, opportunism of "free-riding" type) and it is unsustainable or does not evolve at all. That strongly necessitates a *third-party involvement* (non-governmental or state organization) to make such organization possible or more efficient.

[8] Not compliance with the terms of public eco-contracts by farmers is widespread even in some of old member states of EU.

[9] *Frequency, uncertainty",* and *asset specificity* are identified as critical factors of transaction costs by Williamson [Williamson] while *appropriability* added by Bachev and Labonne [Bachev and Labonne].

[10] In response to the unprecedented decrease in number of farms in Japan a "third sector" has developed – in many places community farms are established aiming at conservation of natural environment rather than farming.

[11] coalition made, minimum scale of operations reached, economy of scale and scope explored.

Generic modes	*Critical dimensions of transactions*								
	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; 🚚 – necessity for a third party involvement

Fig. 5. Principle modes for environmental management in agriculture

Source: composed by authors' calculations

The transaction costs analysis let us identify the situations of *market* and *private sector failures*. For instance, serious problems usually arise when the condition of assets specificity is combined with the high uncertainty and the low frequency, and when the appropriability is low. In all these cases, a *third part* (private agent, NGO, public authority, etc.) involvement in the transactions is necessary (through assistance, arbitration, regulation, funding, etc.) in order to make them more efficient or possible at all. The emergence and the unprecedented development of special origins, organic farming and system of fair-trade, are all good examples in that respect. There is increasing consumer's demand (price premium) for these products but their supply could not be met unless an effective *trilateral management* (including independent certification and control) is put in place.

The respect of others rights or granting out additional rights could be managed by *"good will"* or *charity actions*. For instance, a great number of *voluntary* environmental initiatives ("codes of behavior", etc.) have emerged driven by farmers' preferences for eco-production, competition in industries, and responds to the public pressure for a sound environmental management. However, the voluntary and charity initiatives could hardly satisfy the entire social demand especially if they require considerable costs. Besides, the environmental standards are usually "process-based", and the "environmental audit" is not conducted by independent party, which does not guarantee a "performance outcome" [12].

Most environmental management requires large organizations with diversified interests of agents (providers, consumers, destructors, interest groups, etc.). The emergence of special large-members organizations for dealing with the low appropriability is slow and expensive, and they are not sustainable in a long run ("free riding" problem). Therefore, there is a strong need for *a third-party public (Government, local authority, international assistance) intervention* to make such eco-activity possible or more effective [Bachev 2010].

For example, the supply of "environmental goods" by farmers could hardly be governed through private contracts with the individual consumers because of the low appropriability, high uncertainty, and rare character of transacting (high costs for negotiating, contracting, charging all potential consumers, disputing, etc.). At the same time, the supply of additional environmental protection service is very costly (in terms of production and organization costs) and would unlikely be carried out on a voluntary basis. Besides, the financial compensation of farmers by willing consumers through a pure market mode (eco-fee, eco-premium to price, etc.) is also ineffective due to the high information asymmetry, and the massive costs for enforcement, disputing and excluding of "dishonest" users, etc. A third-party mode with a direct public involvement would make that type of transaction effective: on behalf of the consumers the State agency negotiates with the individual farmers a *public contract* for the "environment conservation service", coordinates activities of various agents, provides public payments for compensation of farmers, and controls the implementation of negotiated terms[13].

5. Assessing and designing public modes for environmental management

In modern agriculture there are a *great variety* in forms and efficiency of public intervention in agri-eco-management. In assessment of the public modes for agro-eco-management it has to be taken into account the *overall* (public *and* private) costs for the implementation ***and*** transaction for achievement of the social eco-goals *in comparison with another practically possible form* of intervention. The Discrete Structural Analysis is to be applied which would assist the assessment of the efficiency and the design of forms of public intervention. Depending on the *uncertainty, frequency*, and *necessity for specific investment* of public involvement different form of public intervention will be the most efficient (Figure 6).

Interventions with a low uncertainty and assets specificity would normally require a *smaller public organization* – more regulatory modes, improvement of the general laws and contract enforcement, etc. 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. And when the transactions are characterized with the high assets specificity, 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.

[12] Food safety and environmental scandals proves private schemes often fail (high information asymmetry, opportunism possibility).

[13] *Public eco-contracts* are the most widely used instrument for improving agro-eco-activity in European Union.

Level of Uncertainty, Frequency, and Assets specificity					
Low ←----------→ *High*					
New property rights and enforcements	Public regulations	Public taxation	Public assistance	Public funding	Public provision

Fig. 6. Principle modes for public intervention in environmental management

Source: composed by authors' calculations

Initially, it is necessary to specify the ways to correct existing and emerging eco-problems in market and private sector (difficulties, costs, risks, failures, etc.). The appropriate public involvement would be to create an environment for: decreasing uncertainty surrounding market and private transactions, increasing intensity of exchange and cooperation, protecting private rights and investments, and making private investments less dependent. For instance, the State establishes and enforces quality, safety and eco-standards for the farm inputs and produces, certifies producers and users of natural resources, transfers water management rights to farms associations, sets up minimum farm-gate prices, etc. (Table 1). All these facilitate and intensify private eco-initiatives and (market and private) eco-transactions, and increase efficiency of the economic organizations.

Next, practically possible modes for increasing appropriability of rights, results of activity, and investment have to be considered. The low appropriability is often caused by the unspecified or badly specified private rights [Bachev, 2004]. In that case, the most effective government intervention would be to introduce and enforce *new private property rights* – e.g. rights on natural, biological, and environmental resources; rights on issuing and trading eco-bonds and shares; tradable quotas for polluting; private rights on intellectual agrarian property and origins, etc. That would be efficient when the privatization of resources or the introduction and enforcement of new rights is not associated with significant costs (the uncertainty, recurrence, and level of specific investment are low). Such public intervention effectively transfers the organization of transactions into the market and private management, liberalizes market competition and induces private incentives (and investments) in certain eco-activities. For instance, the tradable permits (quotas) are used to control the overall use of certain resources or level of a particular type of pollution. They give flexibility allowing farmers to trade permits and meet their own requirements according to their adjustment costs, specific conditions of production, etc. That form is efficient when a particular target must be met, and the progressive reduction is dictated through permits while trading allows the compliance to be achieved at least costs (through a private management). Tradable rights could be also used a *market for environmental quality* to develop. The later let private agents to realize new eco-strategy purchasing permits from market and taking them out of market turnover and utilization. In that way environmental quality could be practically raised above initially "planned" (by Government) level, and would not have been achieved without these additional private eco-initiatives.

In other instances, it would be more efficient to put in place *regulations* for trade and utilization of resources, products and services – e.g. standards for labor safety, product quality, environmental performance, animal welfare; norms for using natural resources, introduction of foreign species and GM crops, and (water, soil, air, comfort) contamination; a ban on application of certain chemicals or technologies; regulations for trading ecosystem service protection; foreign trade regimes; mandatory eco-training and licensing of farm operators, etc. The large body of environmental regulations in the European Union and other developed countries aim changing farmer's behavior, and directing toward new strategies, which restrict the negative impact on environment. It makes producers responsible for the "environmental effects" (externalities) of their products or the management of products uses (e.g. waste).

Table 1. **Effective modes for public intervention in environmental management in agriculture**

New property rights and enforcement	Public regulations	Public taxation	Public assistance and support	Public provision
Rights for clean, beautiful environment, biodiversity; Private rights on natural, biological, and environmental resources; Private rights for (non) profit management of natural Tradable quotas (permits) for polluting; Private rights on intellectual property, origins, (protecting) ecosystem services; Rights to issue eco-bonds, shares; Private liability for polluting	Regulations for organic farming; Regulations for trading of protection of ecosystem services; Quotas for emissions and use of products, resources; Regulations for introduction of foreign species, GM crops; Bans for certain activity, use of inputs, technologies; Norms for nutrition and pest management; Regulations for water protection against nitrates pollution; Regulations for biodiversity, landscape management; Licensing for water or agro-system use; Quality, food safely standards; Standards for good farming practices; Mandatory eco-training; Certifications, licensing; Compulsory eco-labeling; Designating environmental vulnerable, reserve zones; Set-aside measures; Inspections, fines, ceasing activities	Tax rebates, exception, breaks; Eco-taxation on emissions, products; Levies on manure surplus; Levies on farming or export for innovation funding; Waste tax	Recommendation,information, demonstration; Direct payments, grants for eco-actions of farms, businesses, communities; Preferential credit; Public eco-contracts; Government purchases (water, other limited resources); Price, farm support for organic production, special origins; Funding eco-training; Assistance in farm, eco-associations; Collecting fees for paying ecosystem service contributors	Research, extension; Market information; Agro-meteorological forecasts; Sanitary and veterinary control, vaccination, prevention measures; Public agency (company) for important ecosystems; Pertaining "precaution principle"; Eco-monitoring; Eco-foresight; Risk assessment

This mode is effective when a general improvement of the performance is desired but it is not possible to dictate what changes (in activities, technologies) is appropriate for a wide range of operators and environmental conditions (a high uncertainty and information asymmetry). When the level of hazard is very high, the outcome is certain and the control is easy, and no flexibility exists (for timing or the nature of socially required result), then the bans or strict limits are the best solution. However, the regulations impose uniform standards for all regardless of the costs for

compliance (adjustment) and give no incentives to over-perform beyond a certain (regulated) level.

In other instances, using the incentives and the restrictions of *tax system* would be the most effective form for public intervention. Different sorts of tax preferences (exception, breaks, credits) are widely used to create favorable conditions for certain (sub)sectors and regions, forms of agrarian organization, or specific types of activities. *The environmental taxation* on emissions or products (inputs or outputs of production) is also applied to reduce the use of harmful substances. Eco-taxes impose the same conditions for all farmers using a particular input and give signals to take into account the "environmental costs" inflicted on the society as a whole (or big communities of affected individuals). Taxing is effective when there is a close link between the activity and the environmental impact, and when there is no immediate need to control the pollution or to meet the targets for reduction. However, an "appropriate" level of the charge is required to stimulate a desirable change in farmers' behavior. Furthermore, some emissions (e.g. nitrogen) vary according to the conditions of application (fertilization with N) and attempting to reflect this in the tax system often results in complexity and high administrating costs.

In some cases, a *public assistance and support* to private organizations is the best mode for intervention. The public *financial* support for environmental actions is the most commonly used instrument for improving the environment performance of farmers. It is easy to find an economic justification for the public payments as a compensation for the provision of an "environmental service" by farmers. However, the share of farms participating in various agri-environmental support schemes (in EU, Japan, USA etc.) has not been significant. That is a result of voluntary (self-selection) character of this mode, which does not attract farmers with the highest environment enhancement costs (the most intensive and damaging environment producers). In some countries the low-rate of farmers' compliance with the environmental contracts is a serious problem[14]. The later cannot be solved by augmented administrative control (enormous enforcement costs) or introducing a bigger penalty (politically and juridical intolerable measure). Principally, it is estimated that the agri-environmental payments are efficient in maintaining the current level of environmental capital but less successful in enhancing the environmental quality. Another disadvantage of "payment system" is that once introduced it is practically difficult ("politically unacceptable") to be stopped when goals are achieved or there are funding difficulties. Moreover, withdraw of subsidies may lead to further environmental harm since it would induce the adverse actions (intensification, return to conventional farming strategies). Other critics of subsidies are associated with their "distortion effect", negative impact on "entry-exit decisions" from polluting industry, unfair advantages to certain sectors in the country or industries in other countries, not considering the total costs (such as transportation and environmental costs, "displacement effect" in other countries).

Often providing public *information, recommendations, training* and *education* to farmers, rural agents, and consumers are the most efficient form since they improve their capability and strategies. In some cases, a *pure public organization* (in-house production, public provision, etc.) will be the most effective one as it is in the case of important agro-ecosystems and national parks; agrarian research, education and extension; agro-meteorological forecasts; border sanitary and veterinary control, interventions by international organizations, etc.Usually, the effective implementation of a long-term environmental conservation strategy requites *combined public intervention* (a governance mix). The necessity of multiple public intervention is caused by the fact that: different natural resources and diverse challenges associated with them need different instruments and form of public intervention; individual modes are effective if they are applied alone with other modes; frequently the combined effect is higher that sum of individual effects; the complementarities (joint effect) of individual forms; restricted potential of some less expensive forms to achieve a certain (but not the entire) level of socially preferred outcome; possibility to get an extra benefits (e.g. "cross-compliance" requirement for participation in public programs); particularity of problems to be tackled; specific critical dimensions of managed activity; uncertainty (little knowledge, experience) associated with the likely impact of new forms; needs for "precaution"; practical capability of the State to organize (administrative potential to control, implement) and fund (direct budget resources and/or international assistance) different modes; and dominating (right, left) policy doctrine.

Besides, the level of an effective public intervention (management) depends on the *scale of ecosystem* and the *type of eco-problem*. There are public involvements, which are to be executed at *local* (farm, agro-ecosystem, community, regional) level, while others require *nationwide* management. There are also activities, which are to be initiated and coordinated at *international* (regional, European, worldwide) level due to the strong necessity for *trans-border actions* (needs for a cooperation in natural resources and environment management, for exploration of economies of scale/scale, for prevention of ecosystem disturbances, for governing of spill-overs, etc.) or consistent (national, local) *government failures*. Often the effective governance of many challenges and risks of agro-ecosystems requite multilevel management with combined actions of different levels, and involving various agents, and different geographical and temporal scale. The public (regulatory, inspecting, provision etc.) modes must have built special mechanisms for *increasing competency* (decrease bounded rationality and powerlessness) of the bureaucrats, beneficiaries, interests groups and public at large as well as *restricting the possible opportunism* (opportunity for cheating, interlinking, abuse of power, corruption) of public officers and other stakeholders. That could be made by training, introducing new monitoring, assessment and communication technologies, increasing transparency (e.g. independent assessment and audit), and involving experts, beneficiaries, and interests groups in management of public modes at all levels. Furthermore, applying *"market like"* mechanisms (competition, auctions) in public projects design, selection and implementation would significantly increase the incentives and decrease the overall costs. Principally, a "pure" public organization should be used as a *last resort* when all other modes do not work effectively [Williamson]. "In-house" public organization has higher (direct and indirect) costs for setting up, running, controlling, reorganization, and liquidation. What is more, unlike market and private forms there is not automatic mechanism (competition) for sorting out the less effective modes[15]. Here a *public "decision making"* is required which is associated with high costs and time, and it is often influenced by strong private interests (power of lobbying groups, policy makers and their associates, employed bureaucrats) rather than the efficiency. What is

[14] 40% of French farmers experience problems implementing public eco-contracts [Dupraz *et al*.].

[15] It is not rare to see highly inefficient but still "sustainable" public organizations around the world.

more, widespread *"inefficiency by design"* of public modes is practiced to secure (rent-taking) positions of certain interest groups, stakeholders, bureaucrats, etc. Along with the development of general *institutional environment* ("The Rule of Law", transparency) and the monitoring, measurement, communication, etc. *technologies*, the efficiency of pro-market modes (regulation, information, recommendation, etc.) and contract forms would get bigger advantages over the internal less flexible public arrangements.

Usually *hybrid modes* (public-private partnership) are much more efficient than the pure public forms given coordination, incentives, and control advantages. In majority of cases, involvement of farmers, farmers organizations and other beneficiaries increases efficiency – decreases asymmetry of information, restricts opportunisms, increases incentives for private costs-sharing, and reduces management costs [Bachev, 2004]. For instance, a hybrid mode would be appropriate for carrying out the supply of preservation of environment, biodiversity, landscape, historical and cultural heritages, etc. That is determined by the farmers information superiority, the strong interlinks of activity with the traditional food production (economy of scope), the high assets specificity to the farm (farmers competence, high cite-specificity of investments to the farm and land), and the spatial interdependency (needs for cooperation of farmers at a regional or wider scale), and not less important – the farm's origin of negative externalities. Furthermore, enforcement of most labor, animal welfare, biodiversity, etc. standards is often very difficult or impossible at all. In all these cases, stimulating and supporting (assisting, training, funding) private voluntary actions are much more effective then the mandatory public modes in terms of incentive, coordination, enforcement, and disputing costs.

If there is a strong need for a third-party public involvement but an effective (government, local authority, international assistance) intervention is not introduced in a due time, then the agrarian "development" is substantially deformed. Consequently, all class of socially needed eco-activities and investment are blocked, natural resources are degradated or pollutes in large scales, sustainability of farms structures in reduces, etc.

6. Assessing efficiency of 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 relations to the extent of realization of practically (technologically, socially, economically, etc.) possible eco-effects and the minimization of overall costs for eco-management. When the effects, costs and efficiency of individual components of eco-management is evaluated it is to be taken into account their different temporal scale, jointness, 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 the 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 the ground waters nitrogen pollution 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 preservation 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, Thai, etc.) agriculture on the climate preservation and/or change. In these instances it is to be used a system of qualitative and quantitative indicators 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-technics; 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 character 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 machineries, 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 farmlands 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, flooding, droughts, hails, frosts, extreme hot and cold days, 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, bad odors and noise in agriculture could be used as indicators for pressure, state, emissions, etc.

In many cases, there is not enough 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. 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 who are necessary for achieving a positive eco-effect, the indicators for eco-state and eco-impacts would be more suitable. Uncompleted list of commonly used indicators for assessing eco-behavior, pressure, state and impact is presented in Table 2.

The assessment of the *comparative* and the *absolute efficiency* of agro-eco-management is to be made. The first one assess 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.

Table 2. **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 yields; Water emission of N and poeticized; Emissions of dust and pollutants; Emissions of odor; 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, hails, 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

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. 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 realization of the plan for restoration of polluted waters and soils, for recycling of wastes, etc.

The criterion for assessment of the costs is weather 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[16]. 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 any case, all (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 is 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, paper works, payments of fees, bribes), *and* costs for community control over and for reorganization of bureaucracy (modernization, liquidation), *and* (opportunity) costs of public inaction. 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 these type are costs for licensing, certifications, tests, purchase of information, registration, hiring consultants, payments for guards and lawyers, lawsuits, bribes, etc. However, another (significant) part of the transaction costs is impossible or very expensive to be separated or determined. Here 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). The effective are structures, which minimize the transaction costs and maximize the transaction costs of the participants in the specific socio-economic, institutional, technological and natural environment [Bache, 2004].

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, it is to be organized interviews 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.

7. Stages in analysis of environmental management and strategies

The analysis and the *improvement* of agro-eco-management and strategies is to include following stages: *First,* assessment of the specific management needs of conservation of natural environment utilized and/or affected by agriculture. The later depends on the particular characteristics of diverse natural resources and ecosystems they are part of, and the number, interests and strategies of related agents. For instance, persistence of serious eco-problems and risks is an indicator that an effective system of eco-management is not put in place. Therefore, trends, factors, problems, and risks associated with the natural environment and its individual elements (land, water, air, biodiversity, eco-systems, climate, etc.) are to be identified. Modern science offers quite precise methods to assess the state of environment, and detect existing, emerging and likely challenges – environmental changes, degradations, destructions and depletion of natural resources, eco-risks, etc. [MEA; Bachev, 2013c]. 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. For instance, there are widespread applications of numerous eco-indicators for pressure, state, respond, and impact as well as for integral assessment of agrarian environmental sustainability [FAO, 2010a]. 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 agriculture in developed and developing countries alike.

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 embrace the system of agro-eco-management and its individual components – *institutional environment* and *various* (formal, informal, market, private,

[16] Often complicate calculations (comparing current and long-term effects, "discounting") similar to long-term investment are needed.

contract, internal, individual, collective, public, specialized, multifunctional, simple, complex, etc.) *forms* for governing eco-activities of agrarian agents (farms of different type). In fact, most analyses are restricted to a certain form (formal, farm, cooperative, public program) ignoring other important, dependent, or complementary modes.

The efficiency of individual modes are to be evaluated in terms of their *strategies* and (comparative) *potential* 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, the efficiency of individual forms cannot be fully understood without analyzing the *complementarities* and/or *contradictions* between different forms and strategies – e.g. the high complementarities between (some) private, market and public forms for eco-management; conflicts between the "gray" and "light" sector of agriculture and natural resources exploitation, etc. Most assessments include only direct, production (eco-recovery, eco-maintenance, eco-enhancement), or program (international assistance, taxpayer) costs. The analysis is to include all (social) costs associated with different forms of eco-management – private, third party, public, current, long-term, production, transaction, etc. In addition to the proper individual and third-party production (technological, agronomic, ecological etc.) costs, the eco-management is usually associated with significant transaction (governance) costs.

The efficiency checks are to be performed periodically even when the system of agro-eco-management seems *"works 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 replaces with more effective private, market or hybrid mode (public-private partnership). Besides, the assessments are usually limited to the absolute efficiency of individual forms of eco-management (related costs, environmental effects) ignoring their comparative efficiencies. The analysis is to incorporate both absolute and comparative (in relation to other feasible modes) efficiency of the diverse management modes. The comprehensive analysis let determine the *deficiencies* ("failures") in dominating market, private, and public modes to manage effectively existing, emerging and likely eco-problems and risks, and specify the *needs for (new) public intervention* in agrarian eco-management. 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.

Third, the *alternative* and practically possible 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. Their comparative (goal achieving, coordinating, stimulating, costs-minimizing, etc.) efficiency to and complementarities with other practically possible modes of public involvement (assistance, public-private partnership, property rights modernization, etc.) is to be assessed, and the best one(s) introduced. The public modes not only support (market *and* private) transaction, but are also associated with significant (public *and* private) costs. Therefore, the assessment is to comprise *all* costs for implementation *and* transaction – 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, paper works, payments of fees, bribes), *and* costs for community control over and for reorganization of bureaucracy (modernization, liquidation), *and* (opportunity) costs of public inaction[17].

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 mitigate specific eco-problems and risks for *each component* of the natural environment (soils waters, air, etc.) and *integrally* for the natural environment as a whole. It is not one time exercise completing in 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 and institutional environment. Besides, the *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 comparative institutional analysis let define the efficiency and the potential of divers mechanisms and modes of management to deal with diverse problems and risks associated with the natural environment. Moreover, it let improve the *design* of the new forms of public intervention according to the specific market, institutional and natural environment of a particular farms, eco-system, region, sub-sector, country, and in terms of the perfection of coordination, adaptation, information, stimulation, restriction of opportunism, controlling (in short – minimizing transaction costs) of participating actors (decision-makers, implementers, beneficiaries, other stakeholders). What is more, that analysis unable us to *predict* likely cases of a *new* public (local, national, international) *failures* 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 (local, international) community about associated risks.

Conclusion. Suggested new interdisciplinary framework would let better understand, assess and improve the eco-management and strategies in the specific market, institutional and natural environment of the individual agents, ecosystems, regions, sub-sectors and countries. However it would require a significant chance in the "traditional" economics logic and widespread practices as well as collection of a new kind of (microeconomics) data.

Giving more public support to multidisciplinary and interdisciplinary research on all aspects and impacts of the

[17] Some of the *environmental losses* are expressed in economic terms (decline in income, replacement and recovery costs, effects on human welfare). Significant part of social value cannot – impact in biodiversity, ecosystems, human health, future generations etc.

eco-management, including factors and forms of eco-management, and their impact on individual and collective eco-behavior and environmental preservation would significantly contribute to the resolution of that problem.

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ПРО ФОРМИ, ЕФЕКТИВНІСТЬ ТА ОЦІНКУ ЕКОЛОГІЧНОГО МЕНЕДЖМЕНТУ

Ми пропонуємо цілісну систему для аналізу, оцінки і поліпшення екологічного менеджменту, використовуючи "аграрний сектор" як приклад. Вона включає в себе міждисциплінарний підхід (економіка, організація, право, соціологія, екологія, технологія, поведінкові та політичні науки) і включає в себе: уточнення управлінських суб'єктів, потреб і спектра регулюючих режимів (інституційного середовища, приватних, колективних, ринкових, громадських режимів) на різних рівнях прийняття рішень (індивідуальних, ферми, екосистеми, на місцевому, регіональному, національному, транснаціональному, глобальному); Специфікація критичних соціально-економічних, природних, технологічних, поведінкових і т.д. факторів управлінського вибору, і можливий спектр управлінських форм; визначення та оцінки порівняльної й абсолютної ефективності форм екологічного менеджменту та системи; вдосконалення форм державного втручання в еко-менеджмент.

Ключові слова. екологічний менеджмент; сільське господарство; механізми і форми управління; показники еко-домоуправління.

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О ФОРМАХ, ЭФФЕКТИВНОСТИ И ОЦЕНКЕ ЭКОЛОГИЧЕСКОГО МЕНЕДЖМЕНТА

Мы предлагаем целостную систему для анализа, оценки и улучшения экологического менеджмента, используя "аграрный сектор" в качестве примера. Она включает в себя междисциплинарный подход (экономика, организация, право, социология, экология, технология, поведенческие и политические науки) и включает в себя: уточнение управленческих субъектов, потребностей и спектра регулирующих режимов (институциональной среды, частных, коллективных, рыночных, общественных режимов) на различных уровнях принятия решений (индивидуальных, фермы, эко-системы, на местном, региональном, национальном, транснациональном, глобальном); Спецификация критических социально-экономических, природных, технологических, поведенческих и т.д. факторов управленческого выбора, и возможный спектр управленческих форм; определения и оценки сравнительной и абсолютной эффективности форм экологического менеджмента и системы; совершенствование форм государственного вмешательства в эко-менеджмент.

Ключевые слова. экологический менеджмент; сельское хозяйство; механизмы и формы управления; показатели эко-домоуправления.