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NATURAL RESOURCES CONSERVATION MANAGEMENT AND STRATEGIES IN AGRICULTURE

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Abstract: This paper suggests a holistic framework for assessment and improvement of management strategies for conservation of natural resources in agriculture. First, it incorporates an interdisciplinary approach (combining Economics, Organization, Law, Sociology, Ecology, Technology, Behavioral and Political Sciences) and presents a modern framework for assessing environmental management and strategies in agriculture including: specification of specific "managerial needs" and spectrum of feasible governance modes (institutional environment; private, collective, market, and public modes) of natural resources conservation at different level of decision-making (individual, farm, eco-system, local, regional, national, transnational, and global); specification of critical socio-economic, natural, technological, behavioral etc. factors of managerial choice, and feasible spectrum of (private, collective, public, international) managerial strategies; assessment of efficiency of diverse management strategies in terms of their potential to protect diverse eco-rights and investments, assure socially desirable level of environmental protection and improvement, minimize overall (implementing, third-party, transaction etc.) costs, coordinate and stimulate eco-activities, meet preferences and reconcile conflicts of individuals etc. Second, it presents evolution and assesses the efficiency of diverse management forms and strategies for conservation of natural resources in Bulgarian agriculture during post-communist transformation and EU integration (institutional, market, private, and public), and evaluates the impacts of EU CAP on environmental sustainability of farms of different juridical type, size, specialization and location. Finally, it suggests recommendations for improvement of public policies, strategies and modes of intervention, and private and collective strategies and actions for effective environmental protection.

1. INTRODUCTION

A significant amount of natural resources (lands, waters, biodiversity, ecosystem services etc.) are part of agricultural systems. Modern agriculture significantly affects the state and sustainable exploitation of natural resources being a major factor for environmental degradation (pollution, destruction, extortion) as well an important contributor for conservation and improvement of natural resources. Therefore, the issues associated with the effective governance and strategies for sustainable exploitation and conservation of natural resources in agriculture are among the most topical in public, political, business and academic debates around the globe (Baba *et al.*; COST; Dobbs and Pretty; Dugos and Dupaz; Defrancesco *et al;* EC; Farmer; Hagedorn; Hart and Latacz; McCanna *et al.*; Peerlingsa and Polman; Reed; Scozzari and Mansouri; UN).

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Despite its importance, the research on governance mechanisms and strategies for natural resources conservation in agriculture is at the beginning stage due to the "newness" of the problem, and the emerging new challenges and risks in recent years (inter-sectors competition for natural resources, global climate change, depletion of non-renewable environmental resources etc.), and the fundamental development of economic theory in the last two and a half decades, and the "lack" of long-term experiences and relevant data for the process and efficiency etc.

Most studies are focused on the specific aspects of natural resource management and strategies (soils, waters, biodiversity, agro-ecosystems services) without studying their relations, complementarities and contradictions. What is more, they are typically restricted to a certain form of governance (eco-product, eco-contract, eco-cooperative, industry eco-initiative, public eco-program), or specific type of farm (family, agri-firm, cooperative), or management level (farm, ecosystem, national), or a particular location (region, ecosystem). Usually they are focused on pure and formal management forms, mechanisms and strategies, while various (and often more efficient) informal and complex forms (integral, interlinked, multilateral, multilevel) are ignored.

Besides, uni-sectoral analyses are broadly used which separate the governance of farming from the management of overall households and rural activities. Moreover, "normative" (to some "ideal model' or "model in another country") rather than a comparative institutional approach between feasible alternatives in the specific socio-economic and natural environment of a certain farm, region, sector, or country is employed. Likewise, the significant social costs associated with the governance, known as transaction costs, are not (or only partially) taken into consideration.

Furthermore, unidisciplinary approaches dominate, and efforts of researchers in economics, organization, law, sociology, agronomy, ecology, technology, and behavioral and political sciences are rarely united to deal with that complex matter. Lastly, there are few studies on specific institutional, economic, ideological, cultural, natural, etc. factors responsible for the big variation among countries, regions, industries, and organizations of agricultural activity.

Consequently, our understanding on the institutional, behavioral, technological, ecological, international, etc. factors of the management and strategies of natural resources conservation in agriculture is impeded. Neither the spectrum of feasible formal, informal, market, private, public, integral, multilateral, transnational, etc. modes of governance can be properly identified, nor their efficiency (potential and limits), complementarities, conflicts, and prospects of development correctly assessed. All these restrict our capability to assist improvement of public policies, strategies, and modes of intervention, and to support individual, business and collective strategies and actions for effective natural resources conservation.

This paper suggests a holistic framework for assessment and improvement of management strategies for conservation of natural resources in agriculture.

First, it incorporates an interdisciplinary approach and presents a modern framework for assessing environmental management and strategies in agriculture.

Second, it presents evolution and assesses the efficiency of diverse management forms and strategies for conservation of natural resources in Bulgarian agriculture during post-communist transformation and European Union (EU) integration, and evaluates the impacts of EU Common Agricultural Policy (CAP) on environmental sustainability of farms of different juridical type, size, specialization and location.

Finally, it suggests recommendations for improvement of public policies, strategies and modes of intervention, and private and collective strategies and actions for effective environmental protection.

2. Framework for analyzing natural resources management and strategies in agriculture

Modes of agro-eco-management and agro-eco-strategies

Environmental management means management of environment preservation and improvement activities of individual agents. Maintaining and amelioration of the state of natural environment and its individual components (air, waters, lands, biodiversity, climate, ecosystem services) requires an effective *social order* (governance) regulating behavior and relations of various agents related to environment - a system of motivation and coordination of (eco)actions which is to induce appropriate behavior[2] of individuals and coordinated actions at group, regional, national, and transnational levels [Bachev, 2010].

Environmental management in agriculture (or agro-eco-management) comprises the environmental management associated with agricultural (food, fibber, fuel, raw material etc.) production. It (is to) involves management of activities, relations, and impacts of diverse *agrarian* (farm managers, resource owners, agricultural labor etc.) and *non-agrarian* (upstream and down-stream businesses, consumers, residents, interest group etc.) agents (Figure 1).

Individual agrarian agents (farmland owners, farm entrepreneurs, farm labor) may have quite diverse strategies in terms of natural resources conservation (Figure 2). According to their ideologies and environmental ethics, awareness of environmental risks, managerial and technical ability, 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 natural resource owners the sustainable exploitation (conservation) of their assets is often a primary concern and often it determines the type of farms they set up, other ventures (e.g. group or cooperative farms) they participate, or lease out contracts they sign. Similarly, a pro-environment farm entrepreneur establishes green (individual, cooperative, firm) farming structure following own or collective voluntary

[2] "pro-environmental" actions, "anti-environmental" inactions.

eco-code of behavior. Finally, farm labor may seek employment in a green cooperative or companies with eco-social responsibility.

Figure 1: Structures of environmental management in agriculture

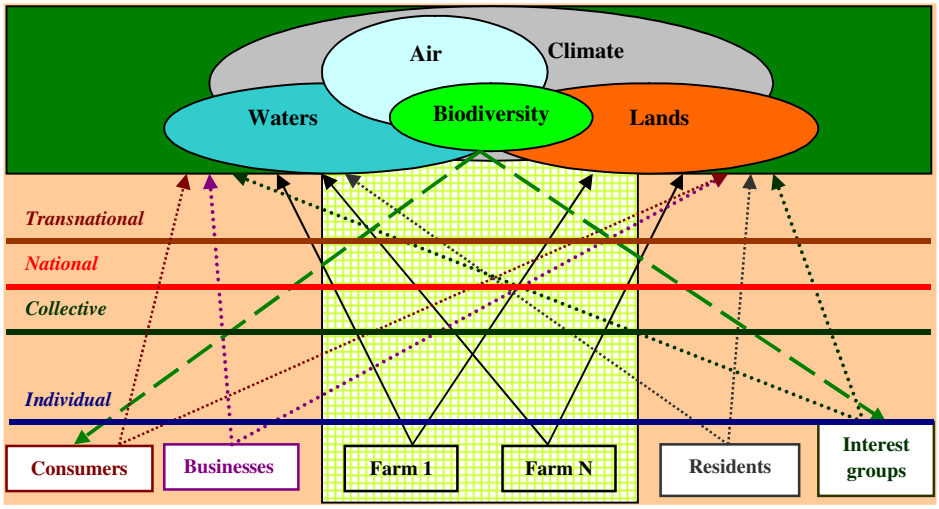
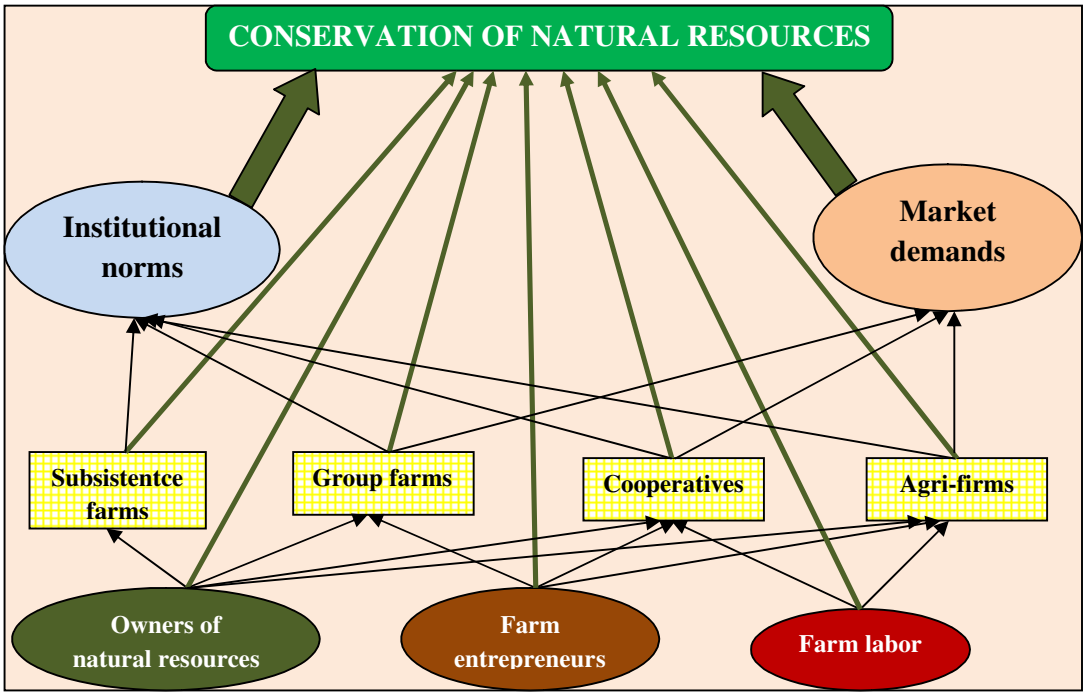


Figure 2: Natural resources management strategies in agriculture



Furthermore, in recent years there have been developed a great number of farms and farming enterprises with a primary or a major mission environmental conservation and improvement. For instance, in many EU countries environmental cooperatives have been very popular there are numerous green agri-firms etc.

Nevertheless, most farm structures in modern world have other goals and pursue other (than natural resources conservation) strategies – e.g. agri-firms are profit-oriented and their primary strategy is to maximize profits for shareholders, cooperatives are member-oriented and carry strategy to increase benefits for members etc. However, there have been increasing consumer demands for environmental conservation, and for 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 exploitation of natural resources. For instance, in 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 individual strategies and behavior and eventually leads toward conservation of natural resources.

Thus achieving the effective natural resources 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.

In certain cases, eco-management in agriculture is entirely archived through individual actions of autonomous agents (farms) within the "Sector Agriculture" (yellow pattern area of Figure 1). 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 a 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 (internal order) is able to achieve the goals for farm's sustainable growth.

However, 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 farmers and non-farmers.

For example, adverse effects of agricultural activities on water and air quality are often felt by residents and businesses in neighborhood or more remote regions. Similarly, agricultural contribution to ecosystem services benefits a large number of residents, visitors, consumers, businesses, and interest groups requiring certain collective actions for sustainable supply. In all these instances, environmental management goes beyond simple (technical,

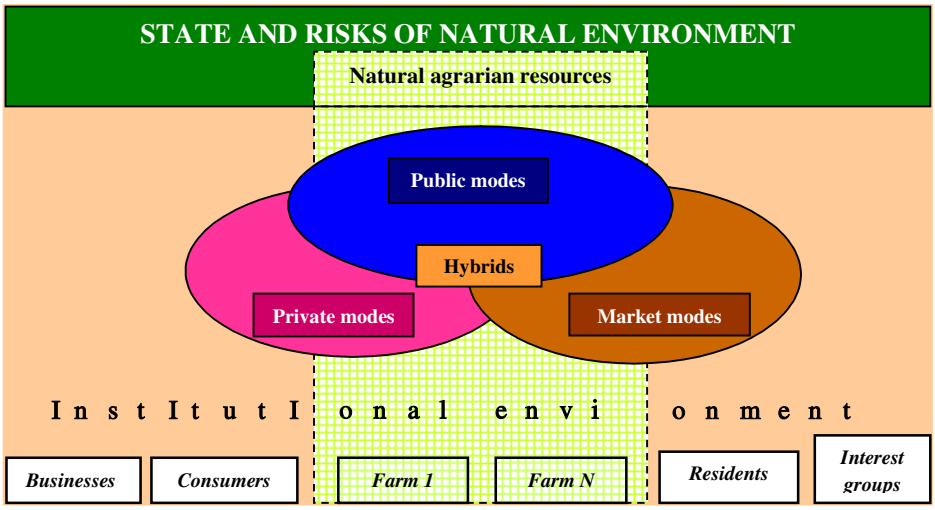
agronomic, ecological) "relations with nature" and embraces the governance of relations and collective actions of agents with diverse interests, power positions, awareness, capabilities etc. in large geographical, sectoral, and temporal scales [Bachev 2011a].

What is more, modern environmental management is associated with growing needs for "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 water and garbage management, biodiversity conservation, climate change etc. issues demanding effective regional, nationwide, international, and global governance. For instance, the effective management of biodiversity "component" of environment includes multilevel (individual, sectoral, national, EU, worldwide) and multilateral initiatives of numerous farmers, businesses, consumers, residents, interests groups etc. (area under green downward arrows, Figure 1). The same is true for waters, lands, air, ecosystem services etc. management.

Thus effective conservation of natural resources 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.

Individuals behavior (actions, restriction of actions) are affected and governed by a number of distinct modes and mechanisms of management which include (Figure 3):

Figure 3: Modes of environmental management in agriculture



First, *institutional environment* ("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 spectrum of rights could embrace material assets, natural resources, intangibles, certain activities, clean environment, food security, intra- and inter-generational justice etc. A part of the rights and rules are constituted by formal laws, regulations, standards, court decisions etc. In addition, there are important informal rules and rights determined by tradition, culture, religion, ideology, ethical and moral norms. Enforcement of rights and rules is done by the state, community pressure, trust, reputation, private modes, and self-enforcement.

Institutions and institutional modernization create dissimilar incentives, restrictions and costs for maintaining and improving 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.

The institutional "development" is initiated by the public (state, community) authority, international actions (agreements, assistance, pressure), 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 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, *market modes* ("invisible hand of market") – those are various decentralized initiatives governed by free market price movements and the market competition – e.g. spotlight exchanges, classical contracts, production and trade of organic products and origins etc.

The importance of free market for the coordination (direction, correction) and stimulation of economic activities, exchanges and allocation of resources is among fundamentals of the Economic theory. Individual agents use (adapt to) markets profiting from the specialization and 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. Nevertheless, there are many instances of lack of individual incentives, choices and/or unwanted exchanges related to conservation of natural environment - e.g. missing markets, monopoly and power relations, positive or negative externalities etc. Consequently, free market "fails" to manage effectively the entire eco-activity, exchanges, and investments of individuals.

Third, *private modes* ("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.

Individual agents take advantage of economic, market, institutional etc. opportunities and deal with institutional and market deficiency by selecting or designing mutually beneficial private modes (rules) for governing their behavior, relations and exchanges. The private mode negotiates own rules or accepts (imposes) existing private or collective order, transfers existing rights or gives new rights to counterpart(s), and safeguards absolute and/or contracted rights. In modern society a great part of the agrarian activity is managed by voluntary initiatives, private negotiations, "visible hand of the manager", or collective decision-making. Nevertheless, there are many examples of private sector deficiency in governing of socially desirable activity such as environmental preservation, eco-system services etc.

Forth, *public modes* ("public order") – these are various forms of public (community, government, international) intervention in market and private sectors - e.g. public guidance, public regulation, public taxation, public assistance, public funding, public provision, property right modernization etc.

The role of public (local, national, and transnational) governance has been increasing along with the intensification of activity and exchange, and growing interdependence of socio-economic and environmental activities. In many cases, effective management of individual behavior and/or 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) leading to significant problems of sustainable development around the globe [Bachev, 2010].

Fifth, *hybrid forms* – some combination of the above three modes.

The efficiency of 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 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) conditions of each eco-system, community, industry, region, and country. For instance, appropriate eco-information would be enough to induce voluntary actions by a "green" farmer, while most commercial enterprises would need outside incentives (price premium, cash compensation, punishment); market prices would usually coordinate well relations between water suppliers and users, while 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 (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 eco-conservation and improvement. Consequently, the extend of conservation of natural resources in agriculture (type of exploitation of natural resources by agriculture and the agricultural impact on environment) would differ quite substantially in different stages of development and among diverse farming structures, eco-systems, regions, and countries.

Needs and factors of natural resources management and strategies in agriculture

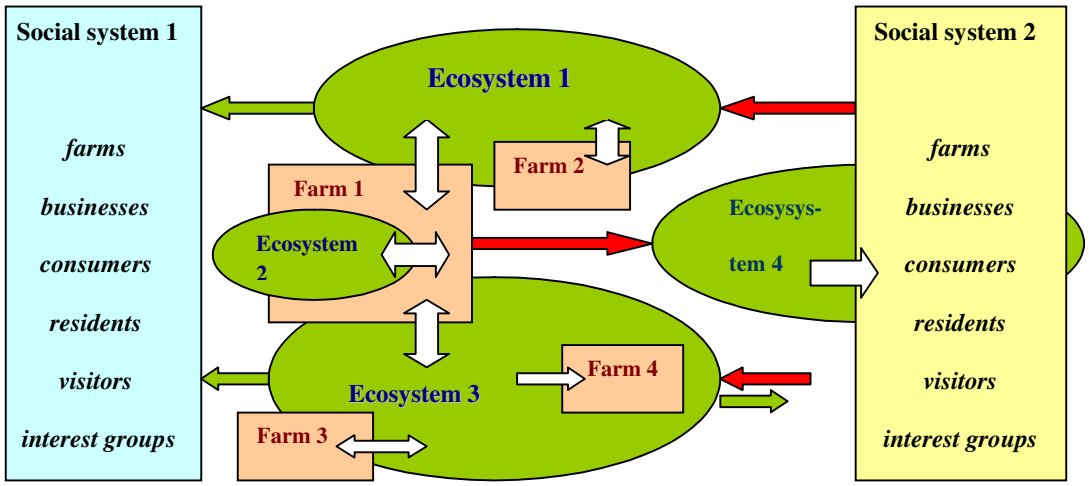
According to (awareness, symmetry, strength, harmonization costs of) interests of agents associated with natural resources there are different *needs for management of actions*. For instance, Figure 4 presents management needs for effective supply of agro-ecosystem services. Here Farm 1 has to manage its *efforts* and *relations* with the Farm 2 since both

receive services from the Ecosystem 1 and affect (positively or negatively) service supply of that ecosystem.

Besides, both farms are to manage their relations with consumers of services from Ecosystem 1 (agents in Social system 1) to meet *total demand* and *compensate costs* for maintaining ecosystem services to that direction. In addition, Farms 1 and 2 have to coordinate efforts with agents in Social system 1 to *mitigate conflicts* with agents in Social system 2 (affecting negatively services of Ecosystem 1).

Furthermore, Farm 1 is to manage its relations with Farm 3 for effective service supply from Ecosystem 3, and manage its interaction with Ecosystem 2. Moreover, Farms 1 and 3 have to manage their relations with Farms 4 and agents from Social system 1 (consumers of services of the Ecosystem 3) and Social system 2 (consumers and destructors of Ecosystem 3 services).

Figure 4: Management needs for effective supply of agro-ecosystem services



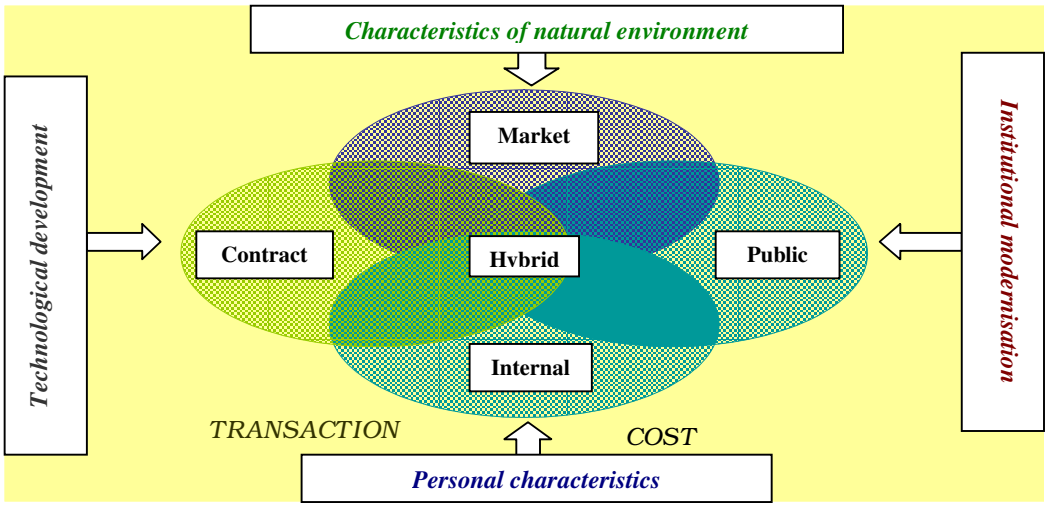
Finally, Farm 1 affecting adversely the Ecosystem 4 services is to manage relations with agents in Social system 2 (consumers of Ecosystem 4 services) to reconcile conflicts and secure effective flow of ecosystem services. Therefore, the Farm 1 is to be involved in *seven* systems of governance in order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

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 cooperation (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) products; though a public contract specifying farmer's obligations and compensation; though a public order (regulation, taxation, quota for use of resources/emissions); within a hierarchical public agency or by a hybrid form.

Commonly natural and institutional environment evolve very slowly over a long-term periods. Therefore, in the specific natural, socio-economic and institutional environment, the choice of management mode would depend on a number of key factors including (Figure 5):

- *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 eco-management could range from monetary or non-monetary income; profit; indirect revenue; to pleasure of involvement in environment and biodiversity preservation activity.

Figure 5: Factors for managerial and strategy choices for agro-eco-management



- *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.

Furthermore, 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 absolute and contracted right effectively enforced, then high transaction costs could create difficulties (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 agrarian and environmental activities become an important factor, which eventually determines the outcome of the system (efficiency) and the type of development (sustainability).

- *natural and technological factors* - eco-management strongly depends on the type of environmental challenge (spatial and temporal scale, risks etc.) and 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.

Efficiency of agro-eco-management and strategies

The problem of "social costs" does not exist in the conditions of *zero transaction costs*[3] and *well defined private property rights* [Coase]. Then the stahe 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[4], and trade owned resources (and rights over them) in mutual benefit with *the same* (*equal) efficiency* over free market (adapting to price movements), and private modes of different types (contracts, firms), and collective decision making (cooperative, association), and in a nationwide hierarchy (a single private or state company). Then ecological requirements for sustainability and 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[5].

However, when transaction costs are significant, then costless contracting, exchange and protection of individual right is impossible. Therefore, initial distribution of property rights between individuals and groups, and their good definition and enforcement are critical for overall efficiency and sustainability. For instance, if the "right for clean and conserved natural environment" is not well-defined, that creates big difficulties foe efficient eco-management – costly disputes between polluting and affected agents; not respecting interests of certain groups or generations etc.

What is more, in conditions of well-defined rights, eco-management is usually associated with significant transaction costs. For example, 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); 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 evolving conditions of production and exchange etc.

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

[4] 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 achived.

[5] 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 the social priority could be given to the economc growth at the "price" of certain degradation of natural respources - „over" pollution and emmisisions, unsustainable expoitation, partial or complete exsouthion (termination).

Therefore, in the real world with not completely defined and/or enforced rights, and positive transaction costs, the *mode* of agro-eco-governance is crucial and eventually (pre)determine the extent of degradation, conservation and improvement of natural resources [Bachev 2010]. That is because 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 organisation of otherwise efficient (mutually-beneficial) for all participants eco-activity and exchange.

It has to be distinguished the transaction from the proper conservation/"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/improved natural environment. Often that is the farmer, who invest for maintaining productivity of natural resources (soil fertility, water purity, ecosystem services), 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 organisations, taxes and fees etc.).

The effective modes for agro-eco-management optimise the *total* (transaction *and* conservation costs) for agrarian activity – minimizing 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[6]. 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-behaviour and activities, explore economies of scale and scope, save production and transaction costs. For instance*, the free market* has a big coordination and incentive advantages ("invisible hand", "power of competition"), and provides "unlimited" opportunities to benefit from specialization and exchange. However, market management could be associated with a high uncertainty, risk, and costs due to lack of (asymmetry) of information, low "appropriability" of some rights ("public good" character), price instability, a great possibility for facing an opportunistic behaviour, "missing market" situation etc.

The special contract form ("private ordering") permits a better coordination and intensification of eco-activity, and safeguard of 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.

[6] For instance, in Japanese agriculture with small-scale paddy fiels organization of water supply could not be carried out by individual farms (high mutual assets dependency, non separability of water use). Therefore, since ancient time organization of water supply is governed as a public projects [Mori].

The internal organization allows a greater flexibility and control on activity (direct coordination, adaptation, enforcement, and dispute resolution by a fiat). However, 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) 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 labour).

The separation of the ownership from the management (cooperative, corporation, public farm/firm) gives enormous opportunities for growth in productivity, environmental and management efficiency – internal division and specialization of labour; 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. 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 non-for-profit goals and non-tradable character of shares (so called "horizon problem"). What is more, evolution and maintenance of large collective organisations is usual associated with significant costs – for initiating, informing, "collective| decision-making and internal conflict resolution, controlling opportunism of (current and potential) members, modernisation, restructuring, liquidation.

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, reorganisation, and liquidation. What is more, unlike market and private modes, for public organisations there is no automatic mechanism (competition) for selection of ineffective forms. Here it is necessary public "decision making" which is associated with huge costs and time, and often affected by strong private interests (power of lobbying groups, politicians and their associates, bureaucrats, employees in the public forms) rather than 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 resources. It is well-known that agricultural activity is often associated with significant undesirable negative environmental effects – 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 *public (state) involvement* in agrarian and environmental management. Nevertheless, 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 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 feasible* (technically, politically, economically) *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.*

Modern socio-economic, institutional and (more often) natural environment in changing very fast and often unpredictably[7]. Consequently, any strategy for effective management of natural resources conservation is to be *adaptive strategy*. Accordingly, dominating and other feasible (market, private, public, hybrid) forms are to be assessed in terms of their absolute and comparative *(adaptation) potential* of 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.

(The most) effective forms for agro-eco-management

Usually "evolution" of natural and 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 will depend on the level of transaction costs.

The transaction costs have *behavioral origin*: namely individual's *bounded rationality* and *tendency for opportunism* [Williamson]. 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 spilovers effects and costs in large geographical and temporal scale, future events, partners intention for cheating etc.). In order to optimize the decision-making and 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 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 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[8], namely unwanted "exchange" or stealing of rights from a private and/or public agents without any contracting process (because of lack or asymmetry of information, capability for detection and protection, weak negotiating positions etc.).

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

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

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

Eco-opportunism is also widespread in agriculture. For instance, the farmer knows or eventually recognises that his activity is harmful for environment, but in order to save additional costs continues to execute risk operations when the negative effects are for other agents (owners of natural resources, other farms, non-agrarian agents, society as a whole). Or farmer sells conventional products as "organic" and profit price premium from unaware buyers; or he joins the public agro-eco-programs to get subsidies, but does not comply with contracted eco-obligations[9].

Part of the transaction costs for 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, assessment of another (significant) part of transaction costs in eco-activity is often impossible or very expensive [Bachev, 2011a]. That is why *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 eco-activity and transaction[10] - 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 critical factors of eco-activities and eco-transactions, there will be *different the most-effective forms* of their management (Figure 6).

Eco-activity and transactions with good appropriability of rights, high certainty, and universal character of investments could be effectively managed by 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[11], eco-education, eco-tourism, eco-restaurants etc.

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.

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

[10] *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].

[11] These type of services are very popular for residents of big Japanese cities.

Figure 6: Principle modes for environmental management in agriculture

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	Y	Y							
Special contract form			Y			Y			
Internal organization					Y		Y		
Third-party involvement				🚑				🚑	
Public intervention									🚑

Y - the most effective mode; 🚑 - necessity for a third party involvement

When uncertainty is high and 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 a specification of obligations of partners is practiced (opportunisms is (self)restricted due to the symmetrical dependency of investments of partners). A special contract forms is also efficient for rare transactions with a low uncertainty, high specificity and appropriability. Dependent investment could be successfully safeguarded through contract provisions since it is easy to define and enforce relevant obligations of partners in all possible contingencies (no uncertainty exist).

Transactions and activity with high frequency, big uncertainty, and great assets specificity have to be managed within *internal organization*. For instance, a good portion of eco-investments are strongly specific to (certain land plots, eco-systems etc.) a farm and can be effectively implemented and "paid-back" within the borders of the particular farm.

The high *interdependency* (specificity) of eco-investments with other farm's assets and activity is the reason a great part of agro-eco-management to be executed by different type of farms – family, cooperative, agri-firms, public, hybrid. Despite that there are cases when farms and other agents are *specialised in eco-management* and are entirely engaged in (aimed at) "keeping natural resources in a good condition" or "recovery or amelioration of natural environment". Here agricultural activity either does not exist (e.g. prolonged follow up) or it is practiced as far as it is required by purely agronomic, ecological and other (e.g. educational, rehabilitation etc.) needs. According to the extent of appropriability of results and the universal character of investments, these farms could be market-oriented (selling eco-services to landlords or other buyers), community[12] (funded by communities, interests groups) or public (e.g. for conservation of important eco-systems like national parks, natural phenomenon etc.).

[12] In responre to the unprecedented decrease in number of farms in Japan a "third sector" has developed - in many places community farms are estanblished aiming at conservation of natural environment rather than farming.

Very often the effective scale of specific investment in agro-ecosystem services exceeds the borders of traditional agrarian organisations (family farm, small partnership). For instance, much of eco-investments, which are done in one farm (protection of waters and air, biodiversity etc.) benefit other farms or non-agrarian agents. Often, dependency of eco-investments of a farm is *unilateral* from the agent benefiting from the positive result. Besides, the positive impact of eco0investment often depends on the minimum scale of activity and frequently requires collective action (co0investment). Consequently, eco-activity/assets of many farms happen to be in a high *mutual-dependency* with the eco-activity/assets of other farms and other non-agrarian agents in a *large spacial* and often *temporal scale*.

This if specific capital (knowledge, technology, equipment, funding) cannot be effectively organized within a single organization[13], 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, environmental cooperatives are very successful in some European countries where there are strong incentives for cooperation due to the mutual-dependency of farms eco-activity, evolving "market" for eco0services, and widespread application of long-term public eco-contracts for eco-coalition. There is rapid development of diverse association of producers around specific capital invested in eco-products and services, trademarks, advertisement, marketing channels etc.

Nevertheless, costs for initiation and maintaining collective organization for overcoming unilateral dependency are usually great (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 organisation) to make such organisation possible or more efficient.

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

Respecting 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 behaviour") have emerged driven by farmers' preferences for eco-production, competition in industries, and responds to public pressure for a sound environmental management. However, voluntary and charity initiatives could hardly satisfy the entire social demand especially if they require considerable costs. Besides, environmental standards are usually "process-based", and "environmental audit" is not conducted by independent party, which does not guarantee a "performance outcome"[14].

Most environmental management requires large organizations with diversified interests of agents (providers, consumers, destructors, interest groups etc.). Emergence of

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

[14] The huge food safety and environmental pollution scandals in recent years proves that private shceems often fail (high information asymmetry and possibility for opportunism).

special large-members organizations for dealing with low appropriability is slow and expensive, and they are not sustainable in 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, supply of "environmental goods" by farmers could hardly be governed through private contracts with individual consumers because of the low appropriability, high uncertainty, and rare character of transacting (high costs for negotiating, contracting, charging all potential consumers, disputing). 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) is also ineffective due to the high information asymmetry, and massive costs for enforcement, disputing and excluding of "dishonest" users. A third-party mode with a direct public involvement would make that transaction effective: on behalf of the consumers the State agency negotiates with individual farmers a *public contract* for "environment conservation service", coordinates activities of various agents, provides public payments for compensation of farmers, and controls implementation of negotiated terms[15].

Public modes and strategies for management of natural resources in agriculture

In modern agriculture there are a *great variety* in forms and efficiency of public intervention on agri-eco-management[16]. In assessment of public modes for agro-eco-management it has to be taken into account the *overall* (public *and* private) costs for implementation ***and*** transaction for achievement of 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 efficiency and the design of forms and strategies of public intervention. Depending on *uncertainty, frequency*, and *necessity for specific investment* of public involvement different form of public intervention will be the most efficient (Figure 7).

Figure 7: Principle modes for public intervention in environmental management

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

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 uncertainty and assets specificity of transactions increases a *special contract mode* would be necessary – e.g. employment of public contracts for

[15] *Public eco-contracts* are the most widely used instrument for impriving agro-eco-activity in European Union. What is more, further "greening" of the Common Agricultural Policies and augmentation of "eco-subsidies" is planed from 2014 on.

[16] For instance, review of diverse modes of governance of agro-ecosystem services is made by Bachev [2011a].

provision of private services, public funding (subsidies) of private activities, temporary labour contract for carrying out special public programs, leasing out public assets for private management etc. And when transactions are characterized with 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.

Initially, it is necessary to be specifies the ways to correct existing and emerging eco-problems in market and private sector (difficulties, costs, risks, failures). 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, State establishes and enforces quality, safety and eco-standards for 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 economic organizations.

Next, practically possible modes for increasing appropriability of rights and results of activity and investment have to be considered. The low appropriability is often caused by 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 privatization of resources or the introduction and enforcement of new rights is not associated with significant costs (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, 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). What is more, the tradable rights could be used a *market for environmental quality* to develop. The later let private agents to realise new eco-strategy purchasing permits from the market and taking them out of market turnover and utilisation. In that way the environmental quality could be practically raised above the initially "planned" (by the 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 labour 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.

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

The large body of environmental regulations in European Union and other developed countries aim changing farmers behaviour, and directing toward new strategies restricting 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). 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 (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 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 favourable 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' behaviour. Furthermore, some emissions (e.g. nitrogen) vary according to the conditions of application (fertilisation with N) and attempting to reflect this in tax system often result 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 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 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 (most intensive and damaging environment producers). In some countries the low-rate of farmers' compliance with the environmental contracts is a serious problem[17]. The later cannot be solved by augmented administrative control (enormous enforcement costs) or introducing 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) 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 etc.

Usually, effective implementation of a long-term natural resources conservation strategy requites *combined public intervention* (a governance mix). The necessity of

[17] 40% of French farmers experience problems implementing public eco-contracts [Dupraz *et al*.].

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 likely impact of new forms; needs for "precaution"; practical capability of 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 *type of 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) 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 bureaucrats, beneficiaries, interests groups and public at large as well as *restricting 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[18]. 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 more, widespread *"inefficiency by design"* of public modes is practiced to secure (rent-taking) positions of certain interest groups, stakeholders, bureaucrats etc. Along with development of general *institutional environment* ("The Rule of Law", transparency) and monitoring, measurement, communication etc. *technologies*, the efficiency of pro-market modes

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

(regulation, information, recommendation) 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 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, strong interlinks of activity with traditional food production (economy of scope), high assets specificity to the farm (farmers competence, high cite-specificity of investments to the farm and land), and spatial interdependency (needs for cooperation of farmers at a regional or wider scale), and not less important – farm's origin of negative externalities.

Furthermore, enforcement of most labour, 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 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.

Stages in analysis of environmental management and strategies in agriculture

Analysis and *improvement* of public agro-eco-management and strategies is to include following stages (Figure 8):

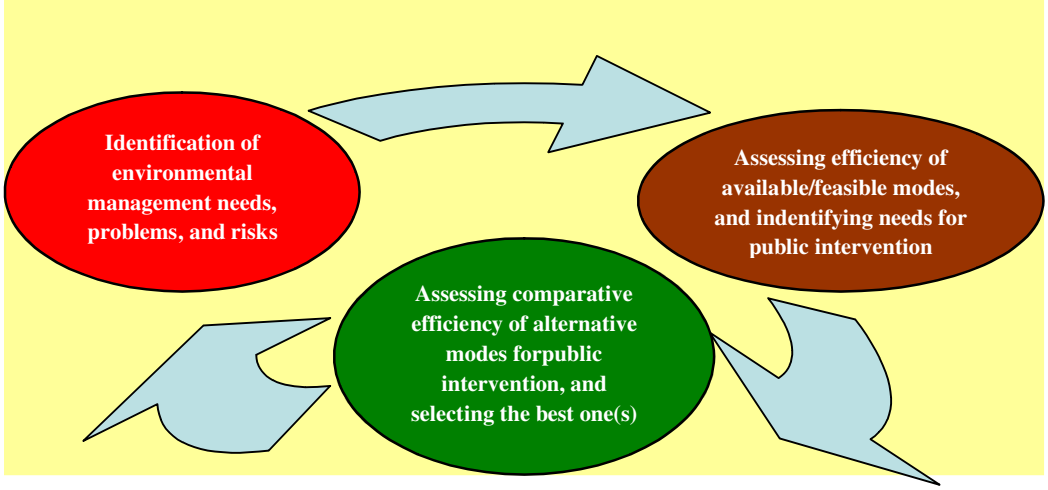
First, assessment of specific management needs of conservation of natural resources utilized and/affected by agriculture. The later depends on particular characteristics of diverse natural resources and ecosystems they are part of, and the number, interests and strategies of related agents (example in Figure 4).

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 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].

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].

Figure 8: Stages in analysis and improvement of public agro-eco-management



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 natural resources conservation. However, usually there are significant or growing environmental problems and risks associated with agriculture in developed and developing countries alike.

Second, assessment is to be made on efficiency and potential of *available* and *other feasible* modes and mechanisms of management for natural resources conservation, and for overcoming 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, 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.

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, 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 etc.

Most assessments include only direct, production (eco-recovery, eco-maintenance, eco-enhancement), or program (international assistance, taxpayer) costs. 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 proper individual and third-party production (technological, agronomic, ecological etc.) costs, the eco-management is usually associated with significant transaction (governance) costs.

Efficiency checks are to be performed periodically even when the system of agro-eco-management *"works well"*. That is because the good conservation of natural resources could be done at *excessive* social costs or *further improvement of environment* may be done at the same social costs. In both cases there is alternative *more efficient* organization of agro-eco-management - e.g. too expensive for 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).

Usually assessments are limited to 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 diverse management modes.

Comprehensive analysis let determine *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; 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, 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 environmental management are to be specified. Their comparative (goal achieving, coordinating, stimulating, costs-minimizing) 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.

Public modes not only support (market *and* private) transaction, but are also associated with significant (public *and* private) costs. Therefore, 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[19].

[19] Some of the *environmental losses* are expressed in economic terms (e.g. decline in income in related industries, replacement and recovery costs, negative effects on human welfare). However, a significant part of the social value cannot be expressed in monetary terms – e.g. negative impact in biodiversity, other ecosystems, human health, future generations etc.

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 modernization of technologies and institutional environment. Besides, *public* (local, national, international) *failure* is also possible (and often prevail) which brings us into the next cycle in 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 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 *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.

3. Evolution of natural resource conservation management and strategies in Bulgarian agriculture

Institutional environment

During most of transition, rights on agrarian resources (farmland, water) and diverse eco-rights (on clean, aesthetic nature; preservation of nature resources, biodiversity) were not defined or were badly defined and enforced (Table 2). Inefficient public enforcement of laws, and absolute and contracted rights was common. That has negative consequences on the development of farming structures and efficiency of eco-management [Bachev, 2010a].

Privatization of farmland and assets of ancient public farms took almost 10 years to complete. During a good part of that period, the management of critical agrarian resources was in ineffective and "temporary" structures (organizations under privatization, liquidation or reorganization; Land commissions etc.) with no interests in effective and sustainable exploitation. Besides, short-term lease of natural resources and material assets was a major form for the farm extension [Bachev, 2010a].

Table 2. Evolution of environmental management in Bulgarian agriculture

Institutions	Private modes	Market modes	Public modes
Post-communist transition (1989-2000)			
Not well defined eco- and resource rights, bad enforcement; Sustainability concept absent	Provisional lease in contracts on natural resources; Unregistered farms; Firms; Cooperatives	Trade with informal brands, origins, and ecosystem services; Free (monopoly) agricultural water pricing	State and cooperative farms; Organization under privatization, liquidation and reorganization; Outdated system of eco-regulations, monitoring and information
Pre-accession to EU (2001-2006)			
Better defined and badly enforced rights on agrarian and eco-resources, and contracts	Unregistered farms; Firms; Cooperatives; Water User Associations; Vertically integrated modes	Trade with formal brands, origins, organic products, and ecosystem services; Free (monopoly) agricultural water pricing	Special Accession Program for Agrarian and Rural Development; Cross-compliance; Environmental regulations, standards, and agencies; Regulations for organic farming; Agricultural Advisory Service
EU membership (since January 1, 2007)			
Well-defined rights, and better enforcement; EU Community Acquis; Collective institutions	Unregistered farms; Firms; Cooperatives; Water User Associations; Vertically integrated modes; NGOs; Codes of behavior; Eco-labels	Trade with formal brands, origins, organic products, and ecosystem services; Free (monopoly) agricultural water pricing; Insurance against natural disasters	EU eco-regulations and standards; EU Operational Programs; National programs for eco-management; National Plan for Agrarian and Rural Development; Direct payments; Advisory Service; Eco-monitoring and assessment; Protected zones (NATURA); Compensations for natural disasters; Mandatory eco-training; Garbage taxation;State companies for Natural Parks/ Support to trans-border initiatives

Out-dated and sectoral system of public policing, regulations and control dominated until recently, which corresponded little to the contemporary needs of eco-management. There was no modern system for monitoring the state of soil, water, and air quality, and credible information on the extent of environmental degradation. There was no awareness of the "concept" of sustainable development and any needs to include it in the public policy, and private and community agenda. The lack of "culture of sustainability" has also impeded the evolution of voluntary measures, and private and collective actions (and institutions) for effective eco-management.

Before the EU accession, country's laws, standards and institutions were harmonized with the Community Acquis. That introduced a modern framework for eco-governance including new rights (restrictions) on protection of environment, integrated territory, water and biodiversity management, preservation of traditional varieties and breeds, animal welfare, polluter pay principle s well as corresponding control, monitoring, and assessment institutions (e.g. Executive Environmental Agency, Hydro-melioration Agency etc.).

The EU accession introduces and enforces a "new order" - strict regulations and control; tough quality and environmental standards; financial support for eco-conservation and market instability etc. Huge European markets are opened which enhances competition and lets local farms explore their comparative advantages (low costs, high quality, specificity and purity of produce) and give strong incentives for investments in farm modernization and conforming to high product, technology and eco-standards.

The external demand, monitoring, pressure, and sanctions by the EU lead to better enforcement of laws and standards. Internal collective actions and social demand for good governance have also got momentum leading to improvement of public management – e.g. success of eco-organizations putting a 5-year ban on GM crops, timely reaction against eco-violation in protected zones, revoking unlawful "exchanges" of valuable public lands etc.

Nevertheless, new "rules of the game" have not been clearly understood by public authorities, private organizations and individuals. There is not yet readiness for effective implementation of new public order because of the lack of information and experience or administrative capacity (lack of comprehension, deficient court system, corruption). Often, enforcement of eco-standards is difficult since costs for detection and penalizing of offenders are high, or there is no direct links between the performance and eco-impact – e.g. banned fields burning after harvesting is still widespread in the country [EEA, 2010].

The institutional modernization has been also associated with new conflicts between diverse private, collective and social interests. However, the results of the public choices have not always been for the advantage of effective eco-management. For instance, strong lobbying efforts of certain private groups and businesses led to a 20% reduction in numbers and 50% reduction in the area of initially identified sites for pan-European network NATURA 2000 [MWE].

Private modes and strategies of eco-management

Newly evolving market and private structures were inefficient in dealing with various economic and eco-issues. Privatization of farmland and assets of ancient public farms took 10 years to complete while some state assets (e.g. irrigation, services etc.) were not effectively reorganised until recently. During much of the period, the management of farmland, land related assets (permanent crops; buildings; irrigation, drainage and flood protection facilities), eco-systems and water-resources, was in ineffective "temporary" structures (organisation under privatisation, liquidation or reorganisation; Privatization Boards, Liquidation Councils, Land Commissions etc.). Sales and long-term lease markets for land and other natural resources did not emerge until 2000, and annual leasing was the major form for management until recently. That was combined with high economic and institutional uncertainty and a big inter-dependency of agrarian assets [Bachev, 2010a].

Much of the farming activities were carried in inefficient and unsustainable structures – public farms, part-time and subsistence farms, production cooperatives, and huge business farms based on provisional lease-in contracts (Table 3). Most livestock holdings are also miniature "unprofessional" breading the majority of animals in the country (Table 4).

Table 3. **Number, size and importance of different farms in Bulgaria**

	Public	Unregistered	Cooperatives	Agro-firms	Total
Number of farms					
1989	2101	1600000	na	na	1602101
1995	1002	1772000	2623	2200	1777000
2000	232	755300	3125	2275	760700
2010		350900	900	6100	357900
Share in number (%)					
1989	0.13	99.9			100
1995		99.7	0.1	0.1	100
2000		99.3	0.4	0.3	100
2010		98.0	0.25	1.7	100
Share in farmland (%)					
1989	89.9	10.1			100
1995	7.2	43.1	37.8	11.9	100
2000	1.7	19.4	60.6	18.4	100
2010		33.5	23.9	42.5	100
Average size (ha)					
1989	2423.1	0.4			3.6
1995	338.3	1.3	800	300	2.8
2000	357.7	0.9	709.9	296.7	4.7
2010		2.9	807	211.6	8.5

Source: National Statistical Institute

Table 4. Number and size of livestock holdings

Type of holdings	Share farms	Share heads	Share farms	Share heads	Share farms	Share heads	Average heads
Dairy cows	***1-2***		***3-9***		***20 and >***		
2003	87.3	56.3	11	23.3	0.6	13.5	1.9
2009	79.6	30.1	14.6	20.0	2.3	36,3	3.3
Buffalo cows							
2003	85.3	47.5	11.4	20.6	1.2	23	2.3
2009	63.5	11.4	21.6	11.5	6.9	60,7	7.3
Ewes	***1-9***		***10-49***		***100 and >***		
2003	56.7	89.3	26	9.6	9.5	0,4	5.9
2009	29.8	82.8	22.6	13.2	33.2	1,7	10
She-goats							
2003	98.2	86.8	1.2	5.8	0.1	3	2.6
2009	96.2	67.3	3.3	20.2	0.01	5	3.1
Breeding pigs	***1-2***		***3-9***		***200 and >***		
2003	87.1	34.5	10.2	14.0	0.2	35.1	3.0
2009	78.8	12.8	14.9	8.8	0.5	57.4	7.8

Source: Ministry of Agriculture and Food

Farms adjustments and intensifying competition have been associated with a significant decrease in number of unregistered, cooperative and livestock holdings without adequate transfer of land, livestock, and environmental management to other structures. Despite some augmentation of average farm size, the share of abandoned agricultural lands and primitive domestic livestock operations has been considerable from the beginning of transition now.

Dominating modes for carrying out farming activities have had little incentives for current and long-term investment to enhance productivity and environmental performance [Bachev, 2008].

The cooperative's big membership makes individual and collective control on management very difficult and costly. That focuses managerial efforts on short-term indicators, gives a great possibility for mismanagement and using cooperatives in the best private (managers and associates) interests. Besides, there are differences in the investment preferences of diverse coops members due to the non-tradable nature of the cooperative shares ("horizon problem"). Given the fact that most members are small shareholders, older in age, and non-permanent employees, the incentives for long-term investment for land improvement, environmental conservation, and renovation of material and biological assets have been low. "Member-oriented" (non-for-profit) nature of the cooperatives also prevents them to adapt to diversified needs of members, and market demand and competition.

On the other hand, small-scale and subsistent farms[20] possess insignificant internal capacity for investment, and small potential to explore economy of scale and scope (big fragmentation and inadequate scale). Besides, they have little incentives for non-productive environment and biodiversity conservation, animal welfare etc. spending. Moreover, there has been neither administrative capacity nor a political will to enforce the quality and eco-standards in that vast informal sector of the economy. Primitive technologies and low compliance with modern agronomic, safety and eco-standards are widespread. Dairy sector is particularly vulnerable since only one-third of holdings meet formal EU standards [MAF].

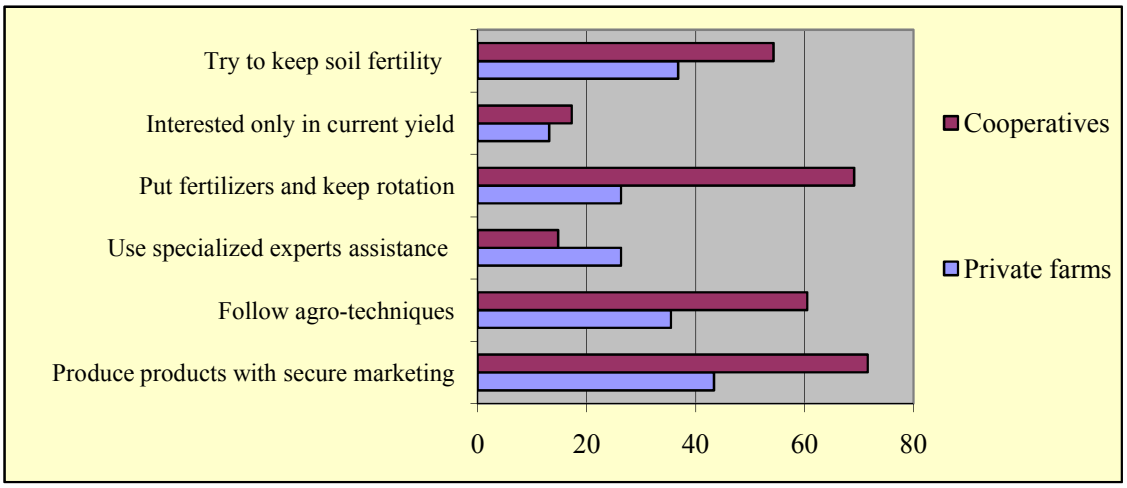
Larger business farms operate mainly on leased land and concentrate on high pay-off investment with a short pay-back period (e.g. cereals, sunflower). They are more sensitive to market demand and institutional regulations since largely benefit or lose from timely adaptation to new standards and market preferences. Besides, these enterprises have higher capacity to fund and adapt to new formal and market requirements. However, until recently, there has been no effective outside (authority, community) pressure for respecting eco-rules by the business enterprises.

Restructuring of commercial farms continues as most of them apply survival tactics ("concentration on products with secure marketing") rather than a long-term strategy toward sustainability (preserving soil fertility, observing crop rotation and agro-techniques requirements) (Figure 9). What is more, a great portion of subsistent, smaller commercial farms and cooperatives are unable to adapt to evolving market, institutional and natural environment – intensified market competition; new EU quality, safety, and eco-standards;

[20] Subsistence and semi-market farms comprise the best part of farms as almost 1 million are involved in farming mostly on a part-time base and for "supplementary" income [MAF].

challenges associated with climate change etc. Our survey has found out that more than a quarter of farms are with a low potential for adaptation to new state and EU quality, safety, and environmental standards, almost 37% of them are less adaptable to market demand, prices and competition, and every other one is inadaptable to evolving natural environment (warning, extreme weather, droughts, floods, etc.).

Figure 9: Share of farms implementing different strategies in Bulgaria (percent)



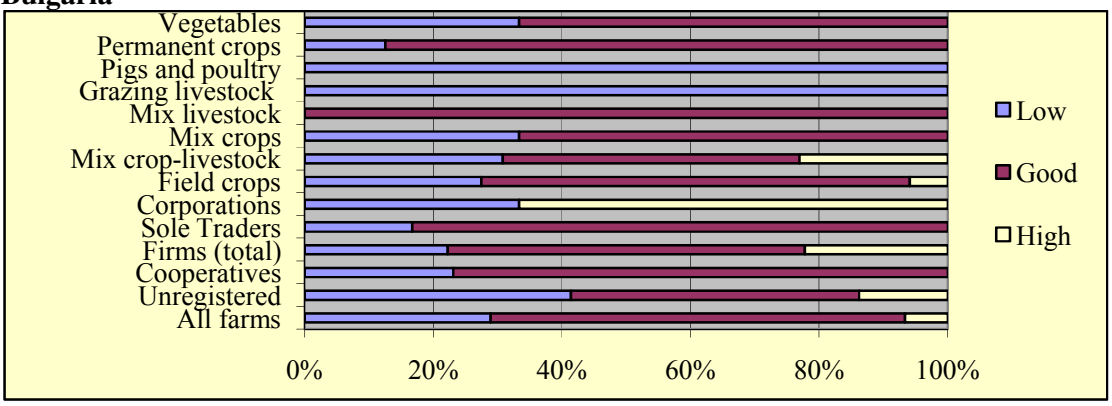
Source: interviews with farm managers, 2010

Medium-term sustainability of farms is estimated as low for unregistered holdings, grazing livestock, and pigs and poultry farms (Figure 10). Less that 7% of all farms "forecast" a high sustainability. A particular type of firms (companies) is the only exception where majority of enterprises envisages being highly sustainable in years to come. The later reflects both the environmental sustainability and the ability of holdings to manage eco-projects.

Smaller size, owner operating and extensive nature of majority of farms let avoid certain problems of large public enterprises from the past such as over-intensification, lost natural landscape, biodiversity, nitrate and pesticide contamination, huge livestock and manure concentration, and uncontrolled erosion. Subsistent and small-scale farming has also revived some traditional and more sustainable technologies, varieties, and products, and avert Mad cow disease and Avian flu epidemic.

Private mode has introduced incentives and possibilities for integral eco-management (including revival of eco- and cultural heritage; anti-pollution, esthetic, an comfort measures), investing in eco-system services, origins, labels, and profiting from inter-dependent activities such as farming, fishing, agro-tourism, processing, and marketing. There are good examples for private introduction and enforcement of quality and eco-standards by individual farms (voluntary and trade initiatives), a vertical integrator (dairy and vine processor, retailer, exporter), or a foreign investor (cereals, oil crops).

Figure 10: Share of farms with different levels of medium-term sustainability in Bulgaria



***Source**: interviews with farm managers, 2010*

Private management is associated with improved environmental stewardship on owned and marketed resources, but less concern to manure and garbage management, over-exploitation of leased and common resources, and contamination of soils, waters and air. The process of farms adaptation leads to intensification of production which could revive or deepen some eco-problems unless a pro-environmental management is put in place. Moreover, free market management of giant and semi-monopoly servicing (water, insurance etc.) companies usually comes with unfavourable pricing and terms for majority of farms.

In 1990s the State monopoly "Irrigation Systems" was reorganized into a Joint-stock company owned by the Ministry of Agriculture and responsible for the management of state assets, provision of irrigation and drinking water, drainage and flood protection. Furthermore, the Union of Water Users was initiated and 176 Water User Associations (WUA) emerged. This collective form was unable to improve efficiency (low incentives, lack of ownership) and deal with monopoly position of 21 semi-autonomous regional branches of Irrigation Systems.

Since 2001 the user-rights on irrigation assets of Irrigation Systems have been freely transferred to newly-reestablished WUA. Around 70 WUA are formed servicing 30% of the total equipped for irrigation area. However, expected "boom" in efficiency from collective management of irrigation has not materialized because of the semi-monopoly situation (terms, pricing) of regional water suppliers, few incentives for water users to innovate facilities and expand irrigation, and uncompleted privatization of state assets (Bachev, 2011).

Evolution of various farmers and eco-associations in the country has been hampered by the big number and diversified interests of agents – a different ownership size, operation, type of farming, preferences, age, and horizon. However, there are few examples for effective agrarian organizations mostly with small-membership and strong common interests of participants (e.g. tobacco, silk-warm, bee-honey etc.). Furthermore, in recent years some environmental organisations have been quite successful in eco-monitoring, campaigns against GM crops cultivation and removal of restrictions in protected areas, and other actions such as garbage cleaning. For instance, among other activities Bulgarian Association of Bird Protection monitors the birds species varieties and numbers in different type of territories.

Market modes

Market-driven organic farming has emerged recently and registered a significant growth. There has been 11 folds increase in the number of organic operators since 2003, and the organic producers comprise the largest part (74%) of the organic operators totaling 432 farms, processors, and traders [EUROSTAT].

There is enormous augmentation of organic areas and livestock but they are a tiny portion of the Utilized Agricultural Area (UAA) and livestock (Table 5). "Fully converted organic areas" accounts for 25.4% of total organic areas with Industrial crops, Pastures and meadows, and Permanent crops comprising the biggest shares of fully converted areas [EUROSTAT]. There are few livestock farms and apiaries certified for bio-production with highest growth in organic goats and sheep, and a lion share of bees. There are also 242677 ha approved for gathering of wild organic fruits and herbs [MAF].

Table 5. Evolution of organic production in Bulgaria

Organic indicators	2003	2004	2005	2006	2007	2008
Farming area, ha % in UAA	650 0.01	1113 0.02	2432 0.05	3061 0.06	11808 0.23	16663 0.33
Wild herbs, fruits, ha	-	-	-	110143	397835	397835
Cattle % in all cattle	na	na	395 0.11	na	395 0.11	470 0.14
Sheep % in all sheep	na	na	294 0.02	na	1690 0.14	2471 0.21
Goats % in all goats	na	na	32 0.01	na	1058 0.12	na
Bees colonies	na	na	23508	na	35747	na

Source: Ministry of Agriculture and Food, EUROSTAT

Organic form has been introduced by business entrepreneurs who managed to organize and fund this new venture arranging independent certification and finding buyers for highly specific output. Produced bio-fruits, vegetables, oil plants, herbs, spices, and honey are mostly for export since a tiny market for organic products exists in the country. The slow development of organic market is caused by the high prices of products, and limited consumer confidence in the authentic character of products and certification.

Eco-labeling of processed farm products (self-regulation) has also appeared but it is perceived more as a part of the marketing strategy of companies rather than a genuine eco-action. What is more, (free) market management of semi-monopoly servicing companies comes with unfavorable pricing and terms for farmers, and only few among them purchase water or insurance against natural disasters (draughts, floods etc).

Public modes

During the transitional period public (Government and local authority) intervention in environmental management was not significant, comprehensive, sustainable, or even related [Bachev, 2008]. Eco-policies were fragmented and reactive to urgent problems (natural disasters) with different agencies responsible for individual aspects of eco-management.

In passed years a number of national programs have been developed to deal with specific eco-challenges such as: preservation of biodiversity and environment; limitation of emissions of Sulphur Dioxide, VOC, Ammonia; waste management; development of water sector; combating climate change; developing organic agriculture; management of lands and fights against desertification; agrarian and rural development etc. National monitoring systems of environment and biodiversity are also set up, and mandatory eco-assessment of public programs introduced. Nevertheless, actual eco-policies rest fragmented and largely reactive to urgent eco-problems (floods, storms, drought) rather that based on a long-term strategy for sustainable development. As a result of inefficient priority setting, management and enforcement (bad coordination, gaps, incompetence, ineffective enforcement, corruption), and administrative capability[21] a minor impact of public programs prevails.

National expenditures for protection and restoration of environment are merely 1.9% of GDP, and agriculture is getting a tiny portion of the total public eco-spending [MEW]. What is more, recent financial and economic crisis further deteriorated funding of public (including environmental) projects. For instance, recultivation of degradated farmlands by MAF was initiated recently but it accounts only for 200-250 ha per year [EEA, 2010]. Similarly, serious eco-challenge is still caused by the state deficiency in storing and disposal of out-of-dated pesticides which are responsible for a good part of all polluted localities in the country [EEA, 2010].

There has been a numerous international (UN, EU, NGOs etc.) assistance projects to "fill the gap" in local failures but they have been limited in scale, unsustainable in time; often overtaken by local groups, funding improperly used; and with no significant positive impact.

Agrarian education and the National Agricultural Advisory Service (NAAS) has not been effectively reorganized and provide modern and continues training on rural development and eco-, climate change, and water-management issues. They do not reach all agents via effective methods of education, advice and information suited to the specific needs of different agents.

Furthermore, the integral approach of soil, water and biodiversity management in planning, funding, management, monitoring, controlling and assessment is not applied, and stakeholders involved in decision-making process at all levels. Neither modern eco-system services, life-cycle, water accounts, and other modern approaches have been incorporated into program management.

Environmental data collection and monitoring have significantly improved in the last few years caching up with the modern EU standards. However, adequate information and independent assessment has not been secured yet and include: agricultural benefits and impacts; waters quality; total costs; eco- and water-foot prints; impacts of climate change; existing and likely risks etc. Nor mechanisms for timely disclosure and effective communication of data to decision-makers, stakeholders and public at large are assured.

[21] e.g. due to organizational and financial reasons Ministry of Water and Environment often does not get the relevant water information from the institutes of Bulgarian Academy of Sciences [EEA, 2010].

Agrarian and environment related research has not been modernized and severely underfunded in last twenty years. Consequently, agro-environmental innovation as well as the understanding of the agricultural use and impacts on natural environment, and various aspects, factors and efficiency of eco-management greatly deterred.

Furthermore, during most of the transition agrarian long-term credit market was practically blocked while newly evolving farming structures left unassisted by the government. Until 2000 the Aggregate Level of Support to Agriculture was close to zero, and very small afterward [Bachev, 2010a]. Besides, the multifunctional role of farming was not recognized, and the provision of "environmental service" funded by society.

There has been enormous progress in public support in recent years – e.g. National Fund Agriculture, EU Special Pre-accession Program for Agrarian and Rural Development (SAPARD), EU CAP measures etc. SAPARD introduced measure "Agro-ecology" but it was not approved by the end 2006 and few projects were actually supported. In 2008 EC suspended SAPARD due to mismanagement and a significant funding lost.

EU accession brought new opportunities for public support to private and collective agrarian and eco-activities. CAP and the National Plan for Agrarian and Rural Development 2007-2013 (NPARD) provide significant funding for EU area-based payments and national top-ups; agro-environmental measures (organic farming, management of agricultural lands with high natural value and handicaps, traditional livestock, protection of soils and water, preservation of landshaft); modernization of farms, processing, and marketing; diversification of activity; infrastructural development; keeping traditions; training etc. Specialized budget of NPARD directed for various eco-measures accounts for 27% of the total. Funding for eco- and other projects is also available from EU Fund LIFE+ and the Operational Programs "Environment", "Fishery and Aquaculture", and "Regional Development".

The "cross-compliance" (with safety, animal-welfare, environmental etc. standards) for receiving a public support has been also introduced. Consequently, area-based direct payments and other subsidies improved farms income and eco-performance, induced farming on abandoned lands, and brought about some amelioration of environmental situation.

However, it becomes difficult to reform the inefficient system of management of public programs. In 2007 no public payment was made for projects associated with NPARD measures but area-based payments for regions with handicaps. Progression in the implementation of public support has been slow and far behind the targets (Table 6). While measures "Setting up of young farmers" and "Payments to farmers in regions with handicaps" are successful, the number of approved and funded projects in other areas is insignificant.

Due to the restrictive criteria[22], lack of formal land management titles, complicated and costly procedures, and widespread mismanagement, the new public support is not effectively utilized and benefits unevenly different farms. Mostly bigger farms participate in public

[22] For area-based payments the minimum farm size is 1 ha (for permanent crops 0.5 ha), and for agro-ecological payments 0.5 ha, while landless livestock holdings are not-eligible for these type of support.

programs because of the superior entrepreneurial experience, available resources, and capability for adaptation to formal requirements and for wining projects.

Table 6. Progress in implementation of 2007-2013 NPARD in Bulgaria (% of target)

Measures	Dec. 31, 2008		Dec. 31, 2009		Dec. 31, 2010	
	Projects	Euro	Projects	Euro	Projects	Euro
111 Training and information	0	-	0	-	na	-
112 Setting up young farmers	11.25	-	55.20	-	99.73	-
121 Modernization of farms	6.77	6.27	27.86	16.09	35.62	25.49
122 Economic value of forests	0	0	0	0	0	0
123 Value to agricultural and forestry products	0	0	0	0	5.81	4.41
141 Semi-subsistence farm	0	-	0	-	3.37	-
142 Producer groups	0	0	0	0	0	0
143 Advice and consultation	3.62	-	9.30	-	24.38	-
211 Payments to mountainous areas with handicaps	40.04	-	43.50	-	43.50	-
212 Payments to other areas with handicaps	100.17	-	107.85	-	107.85	-
214 Environment payments	2.80	-	4.45	-	4.45	-
223 First afforestation	0	-	1.00		1.85	-
226 Restoring forestry	0	-	0.90	-	2.30	-
311 Diversification into non-agricultural activities	0	-	0	-	0.09	0
312 Business development	0	-	0	-	2.09	-
313 Agro and rural tourism	0	0	0	0	0	0
321 Rural services	0	-	4.77	-	8.15	46.19
322 Village development	0	-	18.00	-	19.50	43.07
431-32 Local cooperation	0	-	0	-	7.92	-

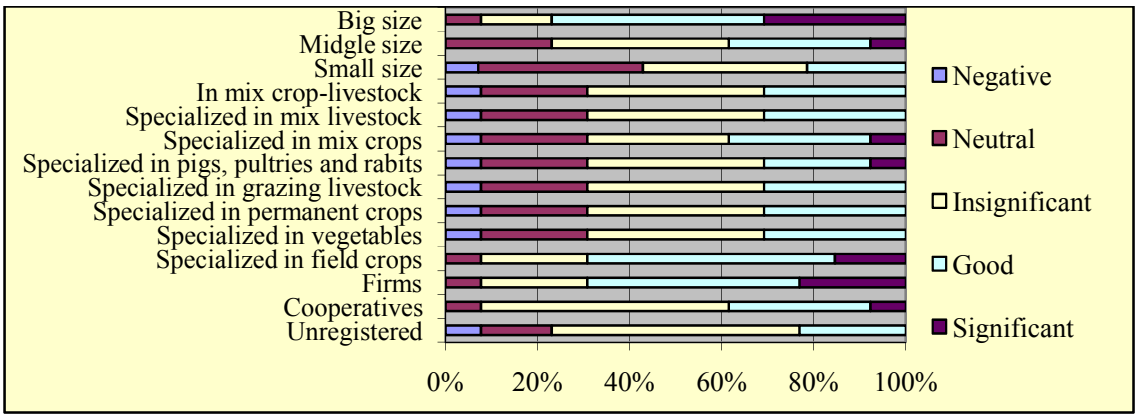
Source: *Ministry of Agriculture and Food*

Up to date experience shows that the bulk of public subsidies go to few large agri-firms and cooperatives specialized in field crops. At the same time, many effective small-scale farms receive no or only a tiny fraction of the public support. For instance, despite it increased number only 24% of all farms currently receive area based payments, and merely 6% of cattle holdings, 4% of sheep and pig holdings, and 3% of poultry farms [MAF]. Moreover, less than 7% of beneficiaries get the lion share (more than 80%) of all direct payments. Similarly, around 2% of the biggest farms (more than 500 ha) manage around 60% of supported by the environmental measures 211 and 212 areas [MAF].

The overall support to agriculture continues to rest low, and a small proportion of farms benefits from public aid most of them being large enterprises from regions with less socio-economic and eco-problems. Experts assessment indicates that there is a good or significant impact of CAP implementation on economic, social and environmental sustainability of large farms, agri-firms, and farms specialized in field crops, while the CAP effect on other type of farms is insignificant or neutral (Figure 11). Therefore, public

assistance further enlarges "transitional" disparities between different farms, sub-sectors, eco-systems, and regions. The minor amount of supported farms and agro-ecosystems, deficiency of clear criteria for eco-performance, and the lack of effective control leads to little contribution of new public (CAP) measures to improvement of eco-situation in the country.

Figure 11: Impact of CAP on economic, social and environmental sustainability of Bulgarian farms



Source: expertise with leading experts, 2012

4. Efficiency of environmental management in agriculture

Land management

A by-product from the new market and private management has been considerable disintensification of agriculture, ease of general eco-pressure and pollution comparing to the pre-reform level.

Market adjustment has been associated with a sharp decline in all crop (but sunflower) and livestock (but goat) productions since 1989[23]. Some traditional crop varieties and livestock breeds have been also recovered. A considerable portion of agricultural lands has been left uncultivated for a long period - in some years abandoned land reached one third of the total [MAF]. In recent years, unutilized farmlands are 10% of the total while fallow land accounts for 9% of the arable land. The average yields for major products shrunk to 40-80% of the pre-reform level.

The number of livestock has also decreased significantly – 51% for cattle, 53% for poultry, 80 % for pigs, and 81% for sheep [MAF]. Consequently, the Aggregate Livestock Index[24] in the country has been one of the smallest in Europe - 0.4 in recent years [EEA, 2010].

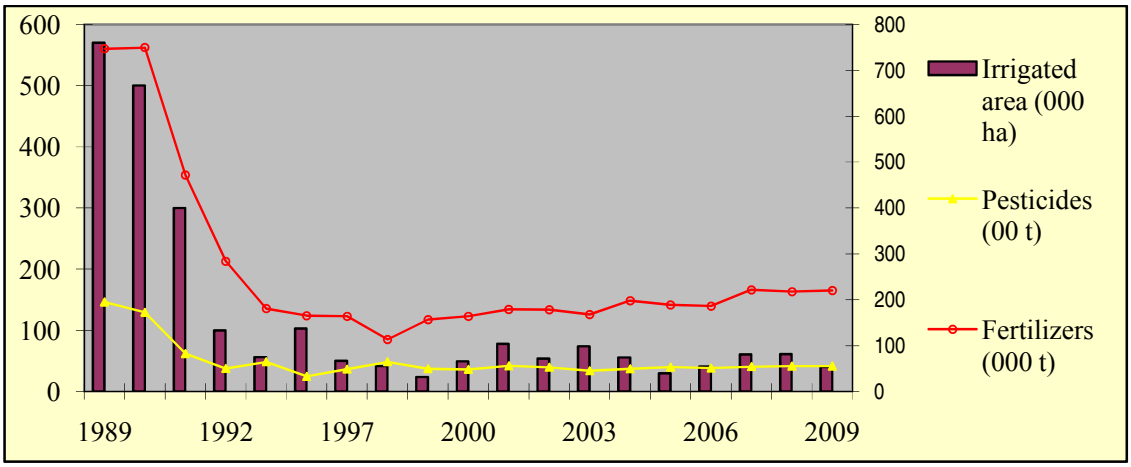
[23] For potatoes by 33%, wheat 50%, corn and burley 60%, tomatoes, Alfalfa hay and table grape 75%, apples 94%, pig meat 82%, cattle meat 77%, sheep and goat meat 72%, poultry meat 51%, cow milk 45%, sheep milk 66%, buffalo milk 59%, wool 85%, eggs 45%, and honey 57% [NSI].

[24] the number of livestock units (equines, cattle, sheep, goats, pigs, poultry and rabbits) per UAA.

Tractors and combines employed in agriculture have diminished by 64%, and now 5.6% of farms own tractors and 0.7% harvesters while 30-40% hire or use them in association [MAF]. All these have relaxed the overall agricultural pressure on the environment.

The amount of fertilizers and pesticides used in agriculture has declined considerably, and now their per ha application is 22% and 31% of the 1989 level (Figure 12). In recent years N, P and K fertilizers are applied for 37.4%, 3.4% and 1.9% of UAA [MAF]. A sharp reduction in chemical use has diminished drastically the risk of chemical contamination of soils, waters, and farm produce. A good part of farm production has got (semi) "organic" character obtaining a good reputation for high quality and safety locally and internationally.

Figure 12: Irrigation and chemical application in Bulgarian agriculture

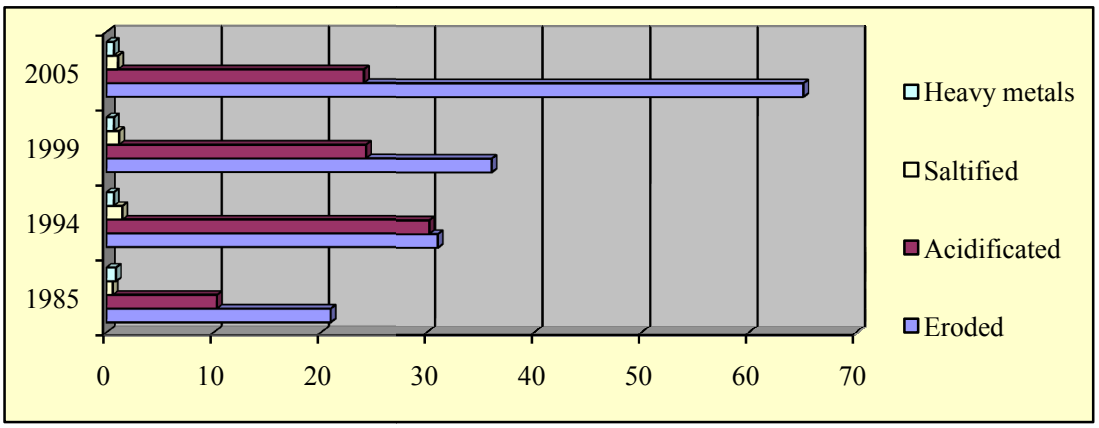


Source: National Statistical Institute

However, a negative rate of fertilizer compensation of N, P, K intakes dominate and average of 23595,4t N, 61033,3t P_20_5 and 184392t K_20 have been irreversibly removed annually from soils since 1990 [EEA, 2010]. Unbalance of nutrient components has been typical with application of 5.3 times less P and 6.7 times less K with the appropriate N rate. What is more, monoculture or simple rotation has been constantly practiced by large operators concentrating on few profitable crops (sunflower, cereals etc.). All these practices further contributed to deterioration of soil quality and soil organic matter content.

There has been considerable increase in farmland affected by acidification (Figure 13). That is a result of the long-term application of specific nitrate fertilizers and unbalanced fertilizer application without adequate input of phosphorus and potassium The share of acidified soil decreased after 1994, but in recent years there is a reverse tendency along with the augmentation of N use. As much as 4.5% of acidified farmlands are with level harmful for crops.

Figure 13: Share of degradated agricultural lands in Bulgaria (percent)



Source: Executive Environment Agency

Fraction of salinized land doubled after 1989 but it is merely 1.1% of the total farmland [EEA, 2010]. Widespread application of primitive irrigation techniques, and inappropriate crop choice, rotation and agro-techniques augment inefficiency of water use and local soil erosion. Since 1990 no effective measures are taken to normalize soil acidity and salinity.

Pollution of soil and water from industrial activities, waste management, and improper farming activities is also a serious environment and health risk. Illegal garbage yards in rural areas have noticeably increased reaching an official figure of 4000 with a real number far bigger than reported amount [EEA, 2010]. Farms contribute extensively to waste "production" with organic and industrial materials contributing significantly to local pollution of air, water, soils, and disturbing population comfort (noise, odor, dirty roads etc.). Nevertheless, data for the last years show that soils in the country are in good ecological state both in terms of organic content and contamination with heavy metals and metalloids. Polluted with heavy metals and pesticides soils represents bellow 1% of the farmlands [EEA, 2010].

Erosion has been a major factor contributing to land degradation (Figure 13). Its progressing level is a result of extreme weather but it has been also adversely affected by the dominant agro-techniques, deficiency of anti-erosion measures, uncontrolled deforestation, and recultivation of permanent grasslands. Due to ineffective management 34% of arable lands are subjected to wind erosion and 64% to water erosion [EEA, 2010]. Since 1990, erosion affects 25-65% of farmland and losses varied from 0.2 to 40 t/ha in different years. Annual losses of earth masses from water erosion are estimated at 145Mt and two-third of it comes from the arable land. Soil losses from water erosion depend on cultivation practices and range from 8 t/y for permanent crops to 48 t/y for arable lands. Losses from wind erosion are around 30 t/y and depend on deforestation, uncontrolled pasture, ineffective crop rotation, plowing pastures etc.

Soil compression affects (mostly) agricultural lands due to untimely transportation and inappropriate agro-techniques (e.g. using heavy machineries when soil moisture is high). It is considered as a threat for soils but no data are available for the extent in agricultural lands.

Water management

Restructuring of farms and production has been accompanied with a sharp reduction in irrigated farmland and a considerable distortion of irrigation facilities (Figure 12). There has been more than 21 folds decline in water used in agriculture comparing to 1989 (Table 7). In recent years, sector "Agriculture, hunting, forestry and fishery" comprises merely 3.2% of the total water use, and 0.3% of generated waste waters [NSI]. All these contribute to a considerable reduction of water stress in the country - since 1990 the Water Exploitation Index declined considerably from 55% (the second in Europe) to 33% [EEA, 2010].

Table 7. Evolution and agricultural use of water resources in Bulgaria

Indicators	1988-1992	1993-1997	1998-2002	2003-2007
Total water resources ($10^9/m^3$/year)	21	21	21	21
Water resources per capita (m^3/inhabitant/year)	2427	2562	2661	2748
Total water withdrawal ($10^9/m^3$/year)	14,04	na	8,674	na
Agricultural water withdrawal ($10^9/m^3$/year)	3,058	0,141	0,144	0,143
Share of agricultural water withdrawal in total (%)	21.78	-	1.66	-
Share of total actual renewable water resources withdrawn by agriculture (%)	14.36	0.66	0.68	0.67
Area equipped for irrigation (1000 ha)	1263	789	622	104,6
Share of cultivated area equipped for irrigation (%)	29.17	17.55	17.36	3.18
Area equipped for irrigation actually irrigated (%)	na	5.42	4.96	51.29

Source: FAO, AQUASTAT

There is a huge reduction of irrigated farmland after 1990 as 2-5% of the irrigation network has been actually used[25]. What is more, a considerable physical distortion of irrigation facilities has taken place affecting most part of the internal canals. As a result the area equipped for irrigation in agriculture substantially decreased. Furthermore, primitive irrigation techniques have been widespread and augmented inefficiency of water use and local soil erosion. Water losses in the irrigation system amount 70% as consequence of the poorly maintained facilities, low efficiency, and water stealing [Alexandrov]. Nevertheless, the overall negative irrigation impact of irrigation on erosion and salinization has been diminished considerably after 1990 [EEA, 2010].

The decline in irrigation has also had a direct harmful effect on crop yields and structure of rotation [Bachev, 2010b]. The level of irrigation depends on the humidity in each year, kind of irrigated crops and water prices. Irrigation has not been effectively used to correct inappropriate seasonal and regional distribution of rainfalls, and mitigate effect of

[25] Irrigation water accounts for the major share in total agricultural water use – 74.2% [NSI].

climate change[26] on farming and land degradation. Farms little capability for adaptation has resulted in huge crop, livestock and property losses during recent droughts and floods.

There has been a considerable amelioration of the quality of surface and ground waters as a result of unintended decrease of negative impact of agriculture and the sharp decline in chemical fertilizers and pesticides application. This trend has diminished drastically the pressure on environment and the risk of chemical contamination of soils and waters.

Nitrate and phosphate content in surface water decreased throughout transition and slightly increase in the last 3 years [EEA, 2010]. Currently only 0.7% of samples exceeds the Ecological Limit Value (ELV) for nitrate. Despite improvement, many water eco-systems are at risk cased by the agricultural emissions in water and increasing application of chemicals. In drinking water around 5% of analyses show deviation of nitrates up to 5 times above the appropriate level [EEA, 2010]. The later is mostly restricted to 400 small residential locations but it is also typical for almost 9% of the big water collection zones. Improper use of nitrate fertilizers, inappropriate crop and livestock practices, and non-compliance with the specific rules for farming in water supply zones, are all responsible for that problem.

Around a quarter of riverlength does not meet the standards for water quality [MAF]. Monitoring of water for irrigation shows that in 45% of samples, the nitrates concentration exceeds contamination limit 2-20 folds [EEA, 2010]. Nitrates are also the most common polluter of ground waters with slight excess over the ecological limit [EEA, 2010]. A moderate concentration of N (bellow 25 mg per liter) in different levels of underground waters dominates with increasing trends in shallow waters and downward trends in others. Besides, around country a tendency for reduction in pesticides concentration in underground water is reported with occasional cases of Triasines over the ELV after 2000. There is further improvement since 2007 and the concentration of pesticides in all samples has been bellow the water quality standards.

Nitrate Vulnerable Zones cover 53% of country's territory and 68% of UAA [MAF]. The lack of effective manure storage capacity and sewer systems in majority of farms, challenge posed by inadequate storage and disposal of expired and prohibited pesticides, and illegal garbage dumps in rural areas, all contributes significantly to the persistence of the problem. Most part of the post-communist livestock activity is carried out by a great number of small and primitive holdings often located within residential borders. Moreover, only 0.1% of the livestock farms possess safe manure-pile sites, around 81% of them use primitive dunghills, and 116 thousands holdings have no facilities at all [MAF]. Besides, decreasing amount of manure has been used for fertilization of merely 0.2% of utilized farmlands in recent years.

[26] Eighteen of the past 21 years are with positive anomalies in average temperatures and there is a trend for increasing soils' water deficiency [EEA, 2010]. According to climate forecasts temperature will continue to increase, rains quantity to decrease, more extreme events (thunderstorms, floods, droughts, hurricane winds) to occur, and water stress experienced around the country.

Serious eco-challenge has been posed by inadequate storage and disposal of expired and prohibited pesticides which amount has augmented since 2001[EEA, 2010]. A good portion of country's polluted localities (28%) is associated with these dangerous chemicals. Despite progression in management (modernization of storehouses, safe capsulation, exporting for deactivation) in the past years there are still 298 abandoned storehouses (57% of all) in 292 locations containing 1956t old pesticides (15.3% of the total amount).

In the last several years a stable amount of nullified sediments from industrial and residential waters have been utilized in agriculture and for recultivation of degradated lands. In 2010 the applied sediments in agriculture and for recultivation of degradated lands (13644t dry content) increased up to 49% share of the totally utilized sediments in the country [EEA, 2010].

Biodiversity management

Since 1990 the amount of protected areas in the country almost doubled [NSI]. Specially introduced rules for agricultural practices in NATURA territories and CAP eco- and other measures additionally created conditions for improvement of biodiversity management.

Furthermore, market and private initiatives led to recovering of some traditional (and more sustainable) livestock breeds and plants varieties as well as introducing new crops and livestock (novel food, industrial and energy crops; exotic animals like ostrich etc.) increasing agricultural biodiversity.

Nevertheless, the widespread lack of proper eco-management has affected negatively biodiversity in some agro- and related ecosystems. For instance, the intensive cereal and industrial crop enterprises have paid little attention to biodiversity protection in enormous fields of operations. On the other hand, considerable portion of farmlands have been left uncultivated for a long time or entirely abandoned, and some agro-ecosystems lost their "agro" character turning into natural ecosystems. That has caused uncontrolled "development" of species allowing development of some of them and suppressing others.

Some of the most valuable ecosystems (natural grassland) have been also severely damaged[27]. Part of the meadows has been left under-grazed or under mowed, and intrusion of shrubs and trees took places. Some fertile semi-natural grasslands have been converted to cultivation of crops, vineyards, or orchards. This has resulted in irreversible disappearance of plant species diversity. In addition, certain municipal and state pastures (with official and/or practical "common access" status) have been degraded by unsustainable use (over-grazing) by private and domestic animals. Besides, a reckless collection of valuable wild plants (berries, herbs, flowers) and animals (snail, snakes, fish) have led to destruction of all natural habitats.

[27] 20% of agricultural lands in Bulgaria are lands of High Nature Value [MAF].

The Index of Birds in Agricultural Lands in the country is negative and for the last 5 years the variety of bird species under monitoring living in agricultural lands has decreased by 10% [EEA, 2010]. The birds in agricultural territories are with the largest amount of diminishing number (including moderate and strong tends) but there are no studies on factors for these trends.

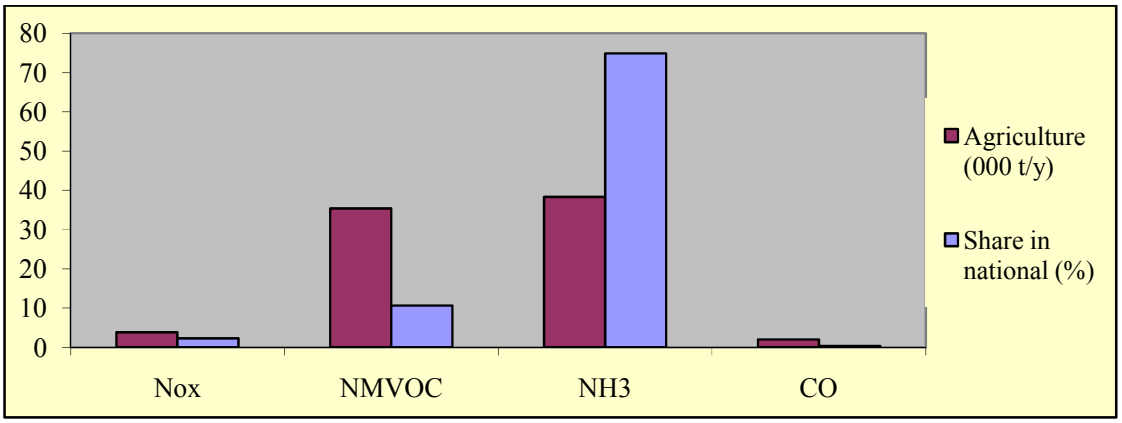
During the last decades there has been significant degrading impacts of agriculture on biodiversity as all 37 typical animal breeds have been endangered, among them 6 are irreversibly extinct, 12 are almost extinct, 16 are endangered, and 3 are potentially endangered [MEW].

Air and green-house gas management

Agriculture practices contribute to dust and odor contamination of air in some areas. Particularly disturbing are the small-scale and domestic livestock operations often located within residential territories (villages, town) and increasing local odor and noise pollution.

Agriculture is also responsible for considerable emissions of certain harmful substances in the air. It releases approximately 75% of Ammonia (NH_3) and 11% of Non-methane organic compounds (NMVOC) in the country (Figure 14). The biggest sources of NH_3 are cattle (dairy cows and buffalo cows) and for NMVOC - one-year crops with fertilization [EEA, 2011]. Agricultural contribution to Nitrogen oxides (NOx) and Carbon monoxide (CO) is insignificant – 2.3% and 0.4% accordingly.

Figure 14: Harmful emissions in air from Bulgarian agriculture (2009)

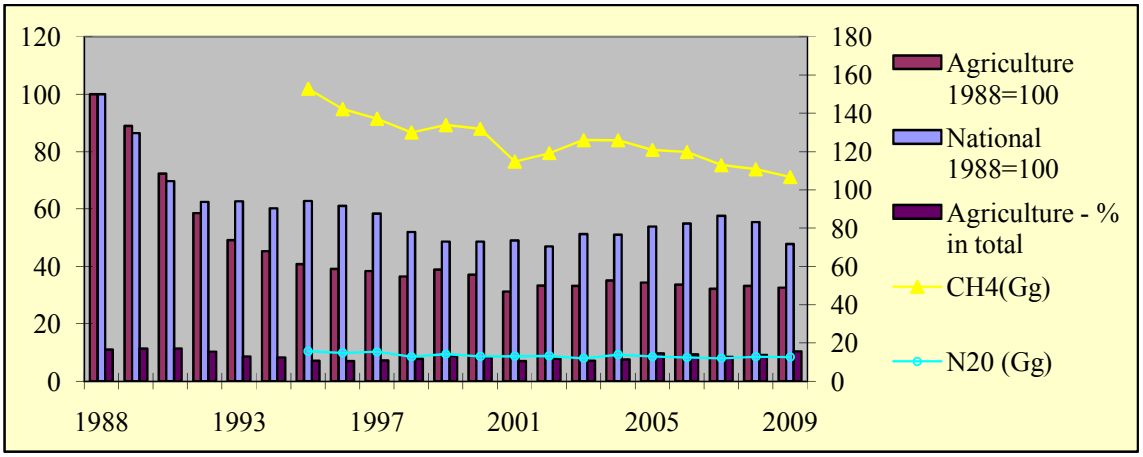


Source: Executive Environment Agency

There has been enormous reduction of overall green-house gas (GHG) emissions from agriculture[28] since 1988 (Figure 15). Moreover, the decline in the sector's contribution has been higher than the national. That has come as "unintentional" outcome of the post-communist restructuring of the sector and the new models of farm management.

[28] GHGs from Agriculture" result from production and processing of agricultural products, soil fertilization, animal manure processing and preservation. Emissions from combustion processes for energy production and from agricultural machines are not reported but they are insignificant amount.

Figure 15: Trends in green-house gas emissions from Bulgarian agriculture



Source: EEA, 2011

During 2000-2004 there was a period of an increase and since then a stable trend for diminishing agricultural GHG emissions. The sector is the second biggest emitter of GHGs contributing between 7-10% of the total amount during the last decade. The main factors of agricultural GHGs have been agricultural soils (56%), enteric fermentation (22%), and manure management (19%) [EEA, 2011].

Agriculture mostly produces N_2O and CH_4 emissions. In the last decade the majority of N_2O emissions comes from agricultural soils, manure management, and fields burning. The methane emission is 36% of the agricultural GHGs and the biggest portion comes from enteric fermentation from domestic livestock and manure management. Reduction of livestock number is responsible for considerable decrease in agricultural CH_4 emission in past years. On the other hand, there is a six-fold increase of CH_4 from rice cultivation since 1999 as a result of the partial recovery of this sub-sector.

Illegal field burning of residues and crops also emits GHGs-precursors which are not significant but they doubled since the period before 1990.

5. Impacts of EU CAP implementation of farms natural resources management and strategies

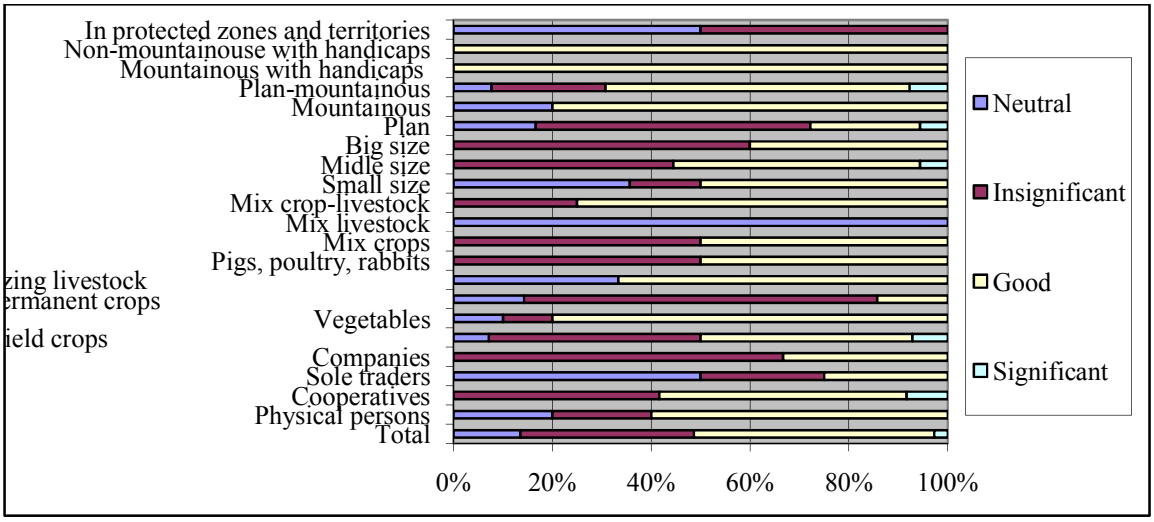
CAP effect on environmental sustainability of farms

According to more than a half of the farm managers[29] *the overall impact* from implementation of different mechanisms and instruments of EU CAP (common market, new standards and regulations, direct payments, NPARD measures etc.) on their environmental sustainability is good (Figure 16). The favorable effect of CAP on eco-sustainability is felt

[29] Survey was carrid in the end of 2012 with the managers of 84 commercial farms. The structure of juridical type, size, specialization and location of surveyed farms corresponds to the real structure of commercial farms in the country.

by all holdings in regions with natural handicaps, four out of five farms specialized in vegetables and located in mountainous regions, three quarters of farms in mix crop-livestock production, more than two-third of holdings with grazing livestock, more than 69% of farms in plain-mountainous regions, 60% of unregistered holdings, more than 58% of agricultural cooperatives, every other farms with small and middle size, in field crops, mix crops, and pig, poultry and rabbits.

Figure 16: Impact of EU CAP on environmental sustainability of Bulgarian farms



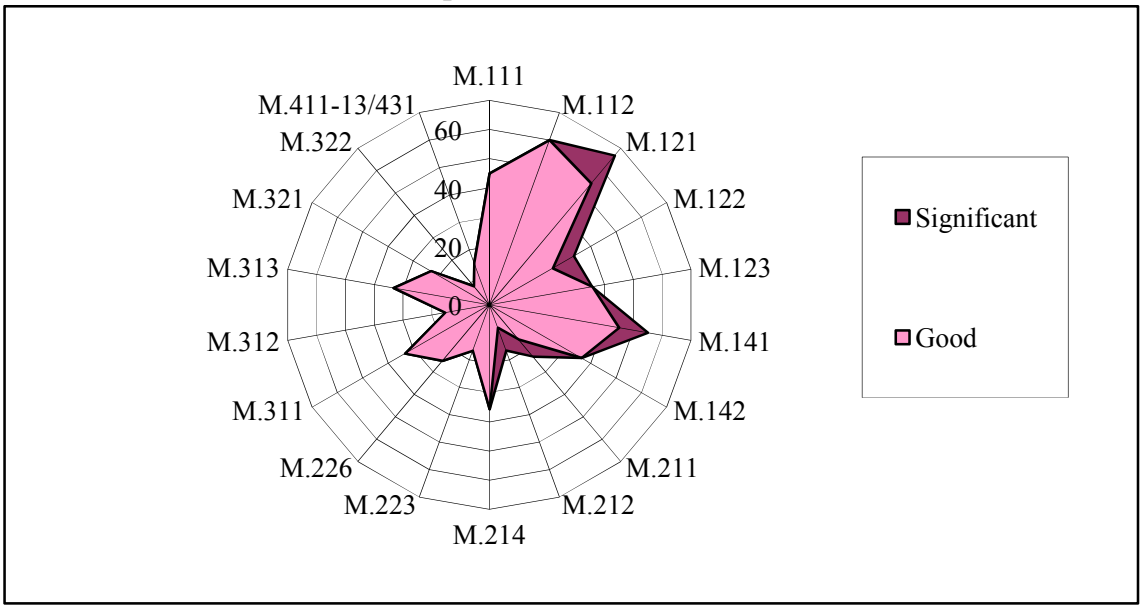
Source: interviews with farm managers, 2012

None of surveyed farms indicates a *negative* impact of CAP of ecological aspects of their activity. Nevertheless, for all farms specialized in mix livestock, those located in protected zones and territories, and for majority of firms with permanent crops, plan regions and big size, the impact from implementation of CAP instruments on environmental sustainability of farms is *insignificant* or *neutral.*

More than third of farms, receiving *agri-environmental payments* (Measure 123) report, that effect of that support on their farm in *good* (Figure 17). Also a good portion of farms with payments for mountainous areas with handicaps (Measure 121) and in areas with handicaps different from mountainous (Measure 122) assess as *good* (accordingly 15,4% and 8,3%) and significant (accordingly 7,7% and 8,3%) the effect on these measure on their holdings.

Nearly a quarter of the managers of farms supported by *„Payments to farmers in mountainous areas with handicaps*" (Measure 211) assess as *good* or *significant* the effect of this public instrument on their farm. The impact of this type of payment is strongest for holdings with small size, unregistered farms, and farms specialized in permanent crops and vegetables. The positive effect of these payments covers two-third of smalls-scale farms, every other of unregistered holdings and specialized in permanent crops, and 40% of farms specialized in vegetables.

Figure 17: Share of Bulgarian farms assessing as good or significant the impact on NPARD measures on their farms (percent)



Source: interviews with farm managers, 2012

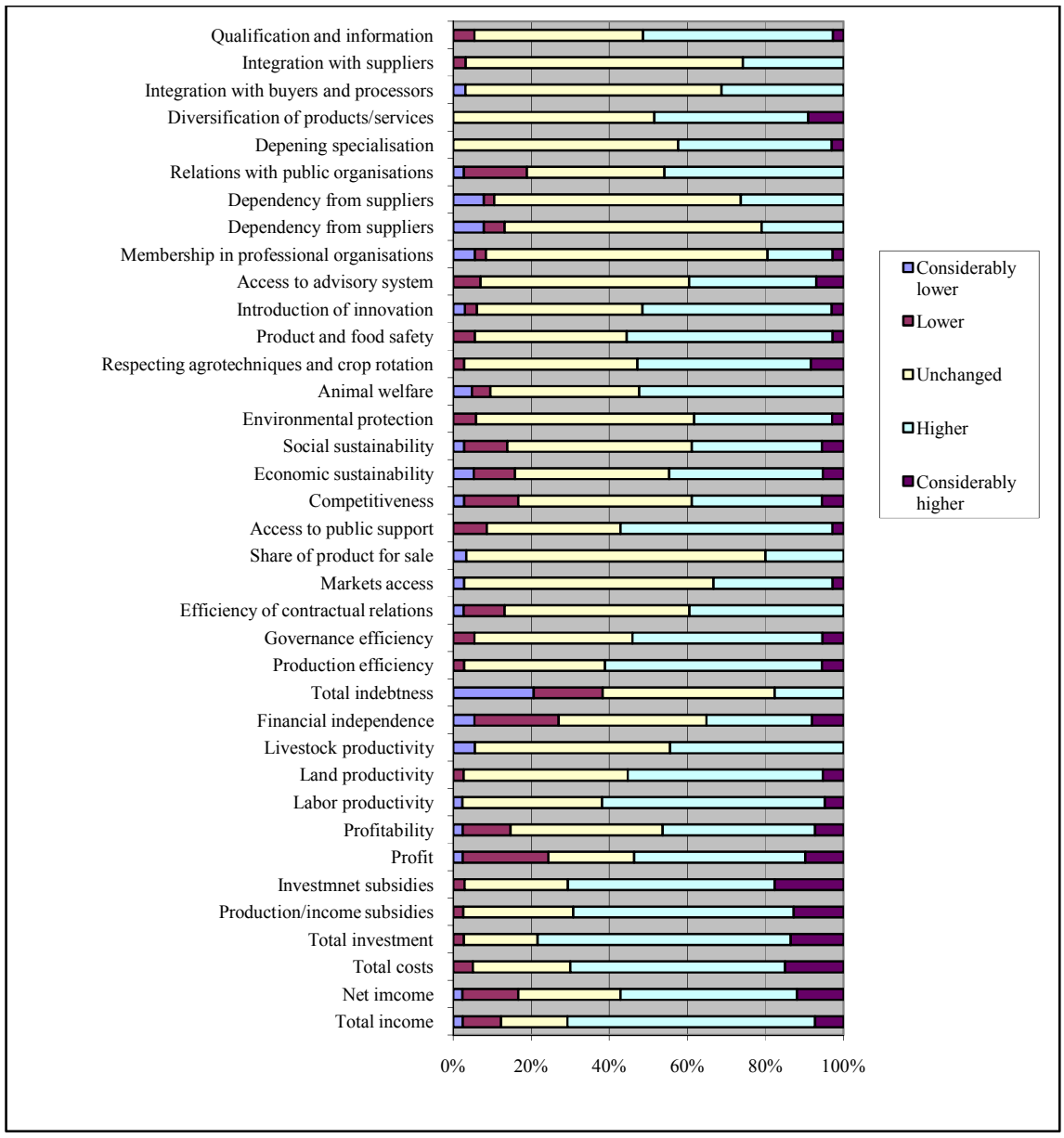
Less than 17% of the managers of surveyed farms supported by *"Payments to farmers in other areas with handicaps"* (Measure 212) evaluate the impact of this instrument as *good* or *significant*.

The effect of *Agri-environmental payments"* (Measure 214) is estimated as *good* by two-third of the managers of cooperatives supported by these payments, and a half of holdings with small size, agri-corporations, and specialized in vegetables and permanent crops, and 40% of farms specialized in field crops, one third of holdings with big size and mix crop-livestock operations, and nearly 29% of unregistered holdings and farms with middle size. The impact of this public instrument on all other farms is either *insignificant* or *neutral* (including for all Sole Traders, and farms specialized in livestock, and holdings in protected zones and territories).

Dynamics of farms indicators comparing to period before CAP implementation

The greatest share of surveyed farms indicates an increased level of a part of the main indicators in the present time comparing to the levels in the period before EU CAP implementation (Figure 18). For instance, *higher* or *considerable higher* is the level of the total income, costs, investments, profit, labor productivity, efficiency of the production and management in the majority of farms. Also the biggest portion of holdings has an improved access to public support, and augmented amount of subsidies for production, income and investment support. At the same time, the share of farms with *lower* total indebtedness comparing to the pre-accession period is 38%, while with a *higher* one bellow 18%.

Figure 18: Levels of farms indicators comparing to level before CAP implementation in Bulgaria



Source: interviews with farm managers

According to the more than a half of farms they have an improved qualification and information, agro-techniques and crop rotation, and livestock conditions, as well as increased product and food safety, and innovation activity comparing to the period before CAP implementation. All that is a direct or indirect result of the favorable impact on different CAP mechanisms on the key aspects of the activities of majority of surveyed farms.

However, a good fraction of farms report *lack of change* in share of sold output, market access, diversification of products and services, deepening of specialization, and in

environmental preservation. Also a big part of farms have no changes in their dependency from suppliers and buyers, increased integration with suppliers and buyers, and improved involvement in professional organizations and access to the agricultural advisory system.

Furthermore, a big portion of holdings do not report changes in the profitability, land and livestock productivity, overall indebtedness and financial independency, efficiency of production, management and contractual relations, competiveness, economic and social sustainability, agro-techniques and crop rotation, livestock conditions, product and food safety, introduction of innovation, qualification and information. Besides, more than a third of farms have no improvement in the relations with state organizations and in the access to public support in comparison to the pre-accession period.

Therefore, implementation of diverse instruments of CAP does not lead to a progressive change in the man indicators of a good part of farms. The later is either due to the lack of positive effect from CAP on a portion of holdings (for example, lack of effective public support) or due to neutralized effect of CAP on other negative factors which could have deteriorated even further the state of farms (in conditions of lack of counterbalancing the existing negative trends CAP instruments).

For a considerable share of farms the current levels of the main indicators is lower or significantly lower comparing to the level before CAP introduction. For instance, 27% of surveyed holdings indicate deteriorated financial independence, more than 24% are with diminished profit, almost 17% are with reduced net income and competitiveness, around 16% are with inferior economic sustainability, almost 15% are with lower profitability, and 14% are with deteriorated social sustainability. Similarly, nearly 19% of farms are with worsened relations with the state organizations, above 13% of them have decreased efficiency of contractual relations, every tenth is with inferior livestock conditions, almost 9% of holdings are with decreased access to public support, and more than 8% are with reduced membership in professional organizations.

All these show that CAP implementation is associated with deterioration of main indicators of a considerable portion of farms. This is either because of the negative effects of CAP on a party of farms, or due to the lack of effective mechanisms for assisting the farms adaptation and for compensating the influence of other negative factors (e.g. competition with heavily subsidized imported products at the national and international markets, high interest rates of bank credits, big market price fluctuations etc.).

Therefore, CAP implementation does not contribute to improvement of natural resources conservation capability and efficiency in a great portion of farms in the country. That necessitates improvement of the CAP implementation through perfection of management public programs, change in design and/or beneficiaries of some CAP instruments, or requires rethinking and reforming individual mechanisms or the policy as a whole.

6. Conclusion and policy recommendations

Our analysis has demonstrated that suggested new framework let better understand, assess and improve natural resources conservation management and strategies in the specific

market, institutional and natural environment of individual farms, ecosystems, regions, sub-sectors and countries.

We have showed that post-communist transition and EU integration has brought about significant changes in environmental management in Bulgarian agriculture. Newly evolved market, private and public governance has led to a significant improvement of eco-management and eco-impacts of agriculture introducing modern eco-standards and public support, enhancing environmental stewardship, disintensifying production, recovering landscape and traditional productions, and diversifying quality, eco-products and services.

Agrarian transition and integration has been also associated with some new challenges such as unsustainable exploitation of natural resources, lost biodiversity, land degradation, water and air contamination etc.

Furthermore, implementation of the "common" EU policies has been having unlike results in the specific "Bulgarian" conditions. Up to date (and likely in a short and medium term) it enlarges income, technological, and eco-discrepancy between different farms, sub-sectors, and regions. In a longer-term eco-hazard(s) caused by agriculture will likely expand unless effective public and private measures are taken to mitigate existing eco-problems and risks. Moreover, the specific structures for management of farming activity (small commercial, semi-market, and subsistence farms, production cooperatives, large business firms) will continue to dominate in years to come and have to incorporate the eco-management needs.

Therefore, a significant improvement of public (Government, EU) interventions in agrarian and eco-management is needed to enhance sustainability of prospective farms and sustainable agrarian and rural development. Implementation of the EU common (agricultural, environmental, regional etc.) policies would have no desired impacts on environmental conservation and improvement unless special measures are taken to improve eco-information and assessments; modernize the system of property rights, public regulations and enforcement; perfect management of public organizations, programs and services; and extend public support to and partnerships with dominating farming (including small-scale and subsistence) structures etc.

Our analysis has identified that the major problems, challenges and risks in eco-management of Bulgarian agriculture at the current state of development are:

- inadequate and/or badly coordinated and funded management strategies for natural resources conservation;

- lack of appropriate information and assessments on eco-pressures, states, impacts and risks available for all farmers and other agents related with natural environment;

- ineffective system of formal property rights (rules) and public enforcement of laws, contracts and official standards;

- farmland degradation (exhaustion, erosion, contamination, compression);

- ineffective water utilization and waters contamination;

- air pollution;

- adverse effect on natural biodiversity;

- poor waste management (burning fields, illegal garbage dumping and yards, ineffective storing and disposal of old chemicals);

- not-motivated, incapable and/or unsustainable farming structures;

- lack of effective eco-organizations able to mitigate existing and emerging eco-conflicts and risks;

- lack of sufficient eco-education in farmers and other stakeholders;

- lack of effective system of eco-innovations;

- ineffective forms of public involvement – inadequate, under or over-intervention; gaps in planning, coordination and regulations; high controversy, unpredictability and costs; insufficient capability and funding; large-scale mismanagement; lack of participation of and partnership with other stakeholders etc.

Therefore, further improvement of institutional environment, public policies and modes of public intervention is necessary to modernize the system of eco-management in agriculture. More particularly public policies and strategies are to be directed to:

First, better integration of environmental (including neglected eco-system services, ground water etc.) policy in agrarian and development policies as effective design and enforcement of long-term eco-measures get a high priority. Up to date most public efforts have been put on addressing urgent socio-economic (e.g. financial) problems while improvement of eco-management is perceived as unimportant. Accordingly, no measures are taken to mitigate or prevent various eco-risks (e.g. impacts of climate change, constant practicing of monoculture, re-intensification etc.). Furthermore, it is to be stability and certainty in eco-policy (long-term public commitment rather than frequent changes) in order to induce effective private and collective actions. For instance, a major reason for low investments in otherwise efficient agricultural green energy (energy crops; manure, biomass and wind energy production) has been the big uncertainty about the long-term policy in the area.

Second, complete application of integral approach of soil, water and biodiversity management in planning, funding, management, monitoring, controlling and assessment at all levels with stakeholders' involvement in decision-making. Moreover, eco-system services, life-cycle, eco-, energy and water accounts and footprints, and other modern approaches are to be incorporated into program design and management at all levels.

Third, improving coordination and efficiency of actions of various public and private agents involved in eco-management. Individual elements and responsibilities in public eco-management are usually divided between various agents and organizations with poor coordination, conflicting interests, and inconsistency, controversies, gaps and inefficiency of actions.

Forth, better defining, regulating and further privatizing (collectivizing) property, user, management, trading, discharge etc. rights and assets related to eco-resources, eco-system services, renewable energy supply, (N, GHG) emissions, waste discharges etc.

Five, employing a greater range of economic instruments including appropriate pricing, quotas, public funding and insurance, taxing, interlinking etc. to improve eco-resources use efficiency and risk-sharing, prevent over-intensification and pressure on natural resources, and support farms adaptation to changing market, institutional and natural environment.

Six, organizationally and financially securing adequate eco-data collection, monitoring, and independent assessment, including agricultural linkages with the state of environment: soil, water and air contamination; impacts on biodiversity; waste production and decomposition; total social costs, energy intensity, eco- (water) foot-print, benefits from farming; effect on eco-conservation and improvement; renewable energy production; impacts of climate change; existing and likely risks etc. What is more, adequate mechanisms to assure timely disclosure and effective communication of available information to decision-makers, stakeholders and public at large are to be put in place.

Seven, better adapting EU CAP and national instruments to the specific Bulgarian conditions through greater support to farm modernization and adaptation, eco-innovations, and prospective business and non-for profit modes; relaxing the EU criteria for semi-market and young farmers; directing funds to prospective (Farm modernization and adaptation, Young farmers, environmental), and unsupported (Organic livestock, restoration of abandoned farmland) measures and organizations (livestock, public academic centers); and better implementing planed eco- measures.

Nine, improving eco-education and training of farmers, administrators, other stakeholders and public at large through modernization of agrarian education and Agricultural Education and Advisory Service. The later are to reach all agents via effective methods of education, advice, and information (TV, radio, on line information; demonstration) suited to their specific needs; set up a system of continues training and sharing experiences; include eco-, water, waste management, climate change and rural development issues; cooperate with other (public and private) academic institutions and private organizations; involve farmers and stakeholders in programs management, implementation and assessment at all levels.

Eight, employing more hybrid (public-private, public-collective) modes given their coordination, incentives, and control advantages. Public organization and enforcement of most eco-standards is very difficult (especially in huge informal sectors and remote areas). Public support to voluntary initiatives of professional, community and non-governmental organizations (informing, training, assisting, funding, risk-sharing), and assistance in cooperation at grass-root, eco-system, watershed, trans-regional, trans-border levels is much more efficient. Accordingly, real participation of farmers and stakeholders in priority setting, management, and assessment of public programs and regulations at all levels is to be institutionalized.

Ten, improving the overall institutional environment and public governance perfecting property rights protection, laws and contracts enforcement, combating against mismanagement and corruption in public sector, removing restrictions for market, private and collective initiatives etc.

Eleven, giving more public support to multidisciplinary and interdisciplinary research on all aspects and impacts of eco-management, including factors and forms of eco-management, and their impact on individual and collective eco-behavior and environmental preservation. Up to date efforts of Ecologists, Technologists, Economists, Law, Sociologists, Behavioral and Political Scientists have been rarely united; most studies focus on individual aspect(s) of sustainability, or certain form(s) of management, or management level, or geographical location. What is more, the governance of farming is usually separated from the management of households and rural activities; and "normative" (to some "ideal" or "model in a foreign country") rather than comparative (between feasible alternatives) approach is broadly employed; and significant social (third-party, recovery, transaction etc.) costs largely ignored. Consequently, institutional, behavioral, economic, ecological, international etc. factors of environmental sustainability are not properly understood, spectrum of feasible management modes properly identified, and efficiency, complementarities, and prospects of development adequately assessed.

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