

About the Governance of Agro-ecosystem Services

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ABSTRACT

(Agro)ecosystem services is a „new“ term, which is rapidly and widely used in academic studies, and policies and business practices around the globe. Nevertheless, studies associated with agroecosystem services and their “management“ are at the beginning stage. This article suggests a holistic framework for defining, evaluating and improving governance system of agro-ecosystem services. Interdisciplinary Theory of Ecosystem Services and New Institutional Economy are adapted, governance of agroecosystem services defined, related agents identified, principle forms and mechanisms classified, efficiency criterion formulated, and stages for analysis and improvement characterized. New approach is based on building up a hierarchy of agro-ecosystems and services of different levels, and assessment of efficiency and complementarities of governance modes and mechanisms corresponding to each level of agroecosystem services „provision“.

INTRODUCTION

The products and the variety of direct and indirect benefits that humans receive from nature and the various ecosystems (agricultural, forest, grass, desert, rural, urban, mountain, lake, river, marine, coastal, etc.) are commonly known as "ecosystem services" (MEA). This „new“ and rapidly enriching category includes different types of products and services of nature and diverse ecosystems - provisional (food for humans and animals, materials and resources for production and livelihoods, etc.), economic, a place for human life and activity, recreational, tourist, aesthetic, cultural, educational, informational, habitat, supporting, biodiversity conservation, water purification and retention, flood and fire protection, climate regulation, etc. In the last two decades, issues related to the understanding, study, evaluation and management of ecosystem services (and „disservices“ or the reduction of those services and agro-ecosystem damages) have been among the most topical in scientific research, politics, and business and farming practices around the world (Adhikari et al.; Allen et al.; Boelee; De Groot et al.; Fremier et al.; FAO; Gao et al.; Garbach et al.; Habib et al.; Lescourret et al.; Laurans and Mermet; MEA; Nunes et al.; Novikova et al.; Marta-Pedroso et al.; Petteri et al.; Power; Scholes et al.; Tsiafouli et al.; Wang et al.; Wood et al.; Zhan). The increased interest in ecosystem services is a result of the fact that this emerging concept allows us better understand the factors and goals of sustainable (agrarian) development. Besides, throughout the world, including EU, ecosystems and their services are constantly degraded as a result of

diverse human activity (UN). This requires public intervention (monitoring, regulation, support, evaluation, etc.) and private and collective action for their preservation, restoration and improvement. Agricultural ecosystems of different types and their specific (agro-ecosystem) services are among the most widespread in the world (EEA; FAO). By definition, „agrarian“ ecosystems and „agrarian“ ecosystem services are those that are related to agrarian „production“, which as a rule is human (social) intervention in the natural order of nature. It is well known that agricultural production makes a significant contribution to the conservation, restoration and enhancement of ecosystems and their services, but also to their degradation and demolition („agricultural disservices“). Therefore, services related to agricultural production and agro-ecosystems are among the most intensively studied, mapped, evaluated, regulated and stimulated. Various public intervention measures (regulations, support, standards, quotas, subsidies, payments, contracts) and programs (land use and landscape development schemes; water management; biodiversity conservation; reduction of greenhouse and other gases; integrated eco-management, etc.) are also implemented, related to their maintenance and improvement. There is also wide spreading various private, business and collective initiatives and forms for „ecological intensification“ and improving the management of (agro) ecosystem services of a given type (s).

Despite the significant progress in this „new“ area, most studies are usually focused on a single agro-ecosystem service, without taking into account synergies, tradeoffs, and the needs

for integrated management of aggregate ecosystem services and disservices. An unidisciplinary approach is broadly applied, with most of the studies limited to „purely“ agronomic, environmental, technological, economic, etc. aspects of management. Studies are limited to a specific form of management (public program, subsidy for eco-activity, quotas for resources or emissions, tax preferences, eco-contracts, eco-cooperatives, industry standards, eco-certification, market trading) or level of management (farm, eco-system, industry, region) without taking into account inter-dependence, complementarity and/or competition of different governing structures. Rich diversity and complementarity of alternative modes of governance (market, contractual, private, collective, public, trilateral, national, transnational) are ignored, while they increasingly „govern“ much of the activity and behavior of agents related to ecosystems. Also widely used are complex forms such as multilateral, multi-level, reciprocal, interlinked, and hybrid forms are not accounted for. Only the public and formal forms and mechanisms of governance are studied, while important informal institutions and organizations are not included in the analysis.

The management of activities related to (agro) ecosystem services is studied in isolation and not as an integral part of the overall management of the agrarian and total activities of farms, rural households, agrarian and related businesses, local authorities, etc. A „normative“ related to some „ideal“ or „model in other countries, industries, regions“ and the „institutionally neutral“ („Nirvana“) approach dominates. Specific formal and informal forms, rules, rights and restrictions, and the efficiency of enforcement and modernization are not taken into account. Agrarian and non-agrarian agents are studied as „perfectly rational“ and „equally interested“ in achieving the common (eco) goals, rather than with different interests, knowledge, skills, capabilities, positions, costs and benefits, etc. „Comparative institutional“ analysis of efficiency of practically possible governance alternatives in the specific socio-economic and natural conditions of a country, region, sector, ecosystem, etc. are not evaluated leading to multiple market, private and public „failures“. Significant interactions between ecosystem services and the system of governance determining „socially preferred“ level of costs and benefits are not specified on appropriate temporal, spatial, institutional and hierarchical scale. „State“ instead of „flow“ of ecosystem services is evaluated, and space-time lags and spillovers not considered. Economic and overall estimates are usually limited to

direct („production“) costs, neglecting significant indirect (third party, social) and „transaction“ costs. As a result, understanding and management of (agro) ecosystem services is deterred. Neither effective scientific support for improving public policies and programs, and individual, business and collective action for sustainable development can be given.

In Bulgaria, with few exceptions (Йорданов; Bachev; Grigorova and Kazakova; Todorova,) there are no systemic studies on governance of agroecosystem services. The goal of this article is to present a holistic approach for defining, analyzing and improving the governance of agro-ecosystem services for the specific conditions of the country.

Definition and Agents of the Governance of (Agro)-Ecosystem Services

Maintaining, restoring and improving the services of (agro) ecosystems requires an effective *social governance* (a good governance) - a system of mechanisms and forms that regulate, coordinate, stimulate and control the behavior, actions and relationships of individual agents related to ecosystems and their services at various levels (Bachev). The system of governance of agro-ecosystem services is a part of the specific system of management of agricultural production and includes: different *agrarian* (farm managers, resource owners, hired labor) and *non-agrarian* (related businesses, consumers, rural residents and visitors, interest groups, administration) agents; and various *mechanisms* and *forms* for governing behavior, activity, relationships of these agents.

The agents of governance of agroecosystem services and the specific type of their relationships, interests, goals, opportunities, position, dependencies, effects and conflicts, are to be properly identified. At the present stage of development, the agricultural production is carried out by different types of farms - individual, family, cooperative, corporate, public, etc. *The farm* is the main organizational unit in agriculture that manages resources, technologies and activities and produces a variety of products, including the positive and negative services of agro-ecosystems. The governance of agro-ecosystem services is an integral part of the management of agricultural farm, and the farm -*the first* (lowest) level for agro-ecosystem services management.

Farm borders rarely coincide with the (agro) ecosystem boundaries. A particular farm usually includes one or more agro-ecosystems (agricultural parcel/section, less frequently entire land in the area), and at the same time it is

a part of one or more different type larger (agro) ecosystems (mountainous, plain, riparian). A major portion of agro-ecosystem services is a “co-production” of a group of independent farms with different capabilities and interests, which necessitates an over (extra)farm management of “collective” actions of different farms in order to effectively supply certain ecosystem services. Individual farm often produces undesirable for other ecosystems “products” (waste, pollution of water, air), necessitating special “management” outside farm gates for stimulating behavior to eliminate or minimize the negative effects.

Farms of different types (self-sufficient, part-time, market-oriented, member-oriented, organic, leisure) have different interests and potential for maintaining agro-ecosystem services. They have different purposes of existence - additional or basic income, profit, leisure, conservation of nature or farm for future generations, etc. Farms also have unequal incentives and opportunities (resources, knowledge, time horizon, positions) for sustainable agriculture. For an individual farm (owner-farmer) there is a “complete” alignment of ecological objectives and possibility for “self-management” of produced and “internally” consumed and commercialized agro-ecosystem services. However, it has no incentive to make an effective contribution to ecosystem services consumed outside the holding as well as opportunities (sizes, resources, positions, time horizon) to realize all eco-functions on an effective scale. The latter requires “outside” intervention (support, compensation, regulation) by the state, a third party, etc., and collective action (cooperation) of many farms to achieve the minimum size for efficient production of agro-ecosystem services of a particular kind. Bigger complex holdings (partnerships, cooperatives, corporations, state farms) have greater opportunities (resources, knowledge, position), but also “internal” conflicts of interests of various agents (owners, managers, hired labor) which requires a special “mechanism” for coordination and stimulation of actions, reconciling interests, resolving conflicts of agents.

Other agents also directly or “indirectly” participate in the management of agro-ecosystem services, imposing appropriate conditions, standards, norms, demand, etc., or providing positive or negative services to farmers: the owners of agricultural resources that are interested in their efficient use and storage; related to agriculture business (inputs suppliers of inputs, buyers) and final consumers. These agents impose socio-economic and

environmental standards, specific support and demands for environmentally sustainable farming. Sometimes the activities of non-agrarian agents adversely affect agro-ecosystem services, and require special “management” for adequate eco-behavior. Residents, visitors of rural areas, and diverse interest groups also “set” conditions (pressure, demand) for environmentally friendly farming and rural areas. The state and local government, international organizations, etc., also support sustainability initiatives and/ or impose mandatory (social, economic, eco) standards for eco-production and consumption.

In some cases, part of agro-ecosystem services can be “managed” through independent actions of individual farms. Often, however, effective eco-management requires coordinated (collective) action by a group of farms, such as the sustainable use of common grassland and limited water supply, protection of local biodiversity, etc. Farming is also often associated with significant (positive and /or negative) externalities which require the management of relationships (co-operation, conflict resolution, cost recovery) between different farms, and growing between farmers and non-farmers. Often, agricultural contribution benefits other ecosystems (supporting and regulating ecosystem services) and a large number of residents, visitors, associated and unrelated businesses, interest groups, future generations, without immediate benefit to “supplying” farmers –e.g. inability to commercialize due to “public” (non-profit) character of agro-ecosystem services, a long time lags and spatial differences (“lack of links”) between investments and benefits received, etc. Then a public intervention (compensation) is required for a sustainable supply of “production” of agro-ecosystem services. In all these cases, management of agro-ecosystem services is far broader than simple (technical, agronomic, environmental) “relationships with nature” and includes governance of relationships and collective actions of agents with diverse interests, power positions, knowledge, capabilities etc. across a wide geographic, industry and time scales. Modern eco-management is increasingly associated with needs for “additional actions” (monitoring, coordination, investment) and integrated management of natural resources and risks nationally and transnationally. The latter includes water and waste management, biodiversity conservation, climate change requiring effective regional, national, and international governance. Unlike management of “pure” agricultural activities (where “simple”

private and market mechanisms work well), effective governance of agro-ecosystem services activities often requires *complex, multilateral, and trilateral* forms and *multi-level* governance. For example, farmer's involvement in "organic product" chain coordinates relationship between producers and final consumers. However, positive impact on agro-ecosystem services will be negligible unless also a form of coordination of relations (collective actions) with other farmers in an area is established.

The Hierarchy of Agro-Ecosystems

Analysis of the system of governance of agro-ecosystem services requires a proper definition of the agro-ecosystem hierarchy and the specific services of each level in a particular country, region, etc. The minimum relatively separate agro-ecosystem in most countries is the *agricultural land plot* or *section* (in case of a closed/built-up area such as livestock barn, green house, beehive, mushroom facility). This (agro)ecosystem contains a number of non-agricultural micro-ecosystems (a lake, anthill, etc.) which contribute to the production of agro-ecosystem services of the farmland plot and larger ecosystems of which they are part, simultaneously using the services of the ecosystem farmland plot and larger agricultural and non-agricultural ecosystems. Like any agro-ecosystem, ecosystem "agricultural land plot/section" produces products and services that are consumed by it, other agricultural and non-agricultural ecosystems, or by humans (production of foods and income, conservation of biodiversity and traditions, aesthetic, educational or scientific value). Often, agro-ecosystems at this level are a source of negative services affecting themselves, other agrarian and non-agricultural ecosystems, and humans (pollution of waters, air, soils, and farm produce, soil erosion). Usually, services at the first hierarchical level of agro-ecosystems are an integral part of the (positive, negative) services of larger agrarian and non-agrarian ecosystems, of which they belong. Like any agro-ecosystem, the agricultural land plot/section consumes or is adversely affected from the "services" of other or larger ecosystems, of which it belongs.

The second distinct hierarchical level of agrarian ecosystems is *land area (землище)*, which is an aggregate of numerous agricultural land plots and sections. At this level, important for the nature and society functions of (agro) ecosystems are often realized, such as: preserving soil fertility, preserving and purifying water, preventing fires and floods, etc. The next relatively distinct level of agroecosystems is *micro-region* which is

characterized by its own agro-ecosystem services. The next hierarchical level of agroecosystems is *macro-region* characterized by its specific (agro) ecosystem services. Some of these (borderline) agro-ecosystems fall into territories of two or more countries. At higher hierarchical levels, agro-ecosystems are grouped into *megaregions* of different types - specific (Black Sea basin, South Europe), sectoral (field crops, permanent crops, grasslands, etc.), generic (plain, semi-mountainous, mountainous, riparian, coastal, urban, rural), etc. Finally, agroecosystems can be grouped in *meta-regions* such as Europe, Northern Hemisphere, etc. Most important contemporary eco-challenges (waste management, global warming, climatic excesses, droughts and fires, torrential rains, floods, spread of diseases and pests, etc.) can only be mitigated by governing ecosystem services at mega and/or meta level.

Despite many conventionalities and uncertainties, the modern science has sufficiently reliable methods to categorize (agro) ecosystems, and to "accurately" identify and "measure" the processes and mechanisms for the production, maintenance, degradation and destruction of (agro) ecosystem services of various kinds, across different spatial and temporal scales (FAO; Fremier et al.; Gao et al.; Gemmill-Herren; Kanianska; MEA; Munang et al.; Petterri et al.; Power; Scholes et al.; Tsiafouli et al.; Woodet al.). In Bulgaria, the system of "Good Agricultural Practices" describes in detail the science-based methods, technologies, behavior, etc. that farmers should follow to keep agro-ecosystems and their services in good condition. The comprehensive identification, categorization and evaluation of the specific services of each particular system is to a subject of a specific interdisciplinary study.

Mechanisms and Modes of Governance of Agro-Ecosystem Services

System of governance of agro-ecosystem services includes several *principle mechanisms* and *forms* that "manage" behavior and activity of individual agents and ultimately determine the level of agro-ecosystem services: First, *institutional environment* ("Rules of the game") – distribution of rights and obligations between individuals, groups and generations, and system of enforcement of rights and rules. Spectrum of rights include tangible and intangible assets, natural resources, activities, clean nature, food and eco-security, internal and inter-generational justice, etc. Enforcement of rights and rules is done by state, social pressure, trust, reputation, private forms, or self-sanctioned by agents. Some rights and rules are determined by formal

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laws, regulations, standards, court decisions, etc. There are also important *informal rules* and *rights* established by tradition, culture, religion, ideology, ethical and moral norms, etc. Institutional “development” is initiated by public (state, community) authorities, international actions (agreements, support, pressure), and private and collective action by individuals. Modern development is characterized by the constant expansion of various eco-rights and obligations, including the granting of welfare rights to animals, wild plants and animals, and to entire ecosystems. Institutions and their modernization create unequal incentives, constraints, costs and conflicts for: protecting and improving agro-ecosystem services, intensifying eco-exchange and cooperation, enhancing eco-productivity, inducing private and collective eco-initiatives and investments, developing new eco- and related rights, reducing eco-disparities between social groups and regions, responding to eco-challenges, fair

distribution of natural resources, etc.

Second, *market forms* (“invisible hand of market”) –diverse decentralized initiatives driven by the movement of “free” market prices and market competition such as: spotlight exchange of eco-products and services, classical contract for purchase, rent or sale, production and trade with special high quality, organic, etc. products and origins, ecosystem services, etc. (Table 1). The importance of the free market for coordinating (directing, correcting) and stimulating activity, exchange and allocation of resources is well known. However, there are many examples of lack of individual incentives, choices and/or unwanted “exchanges” related to environmental conservation and ecosystem services - missing markets, monopoly or power relationships, positive or negative externalities, etc. The free market “fails” in the effective management of the overall eco-activity, exchange and investment of individuals and leads to low environmental sustainability.

Table 1. Market, Private and Collective Modes of Governance of Agro-ecosystem Services

Market forms	Voluntary Private initiatives	Special Private Contract	Special Private Organization
Spotlight sales; Classical contracts; Eco-visits, hunting, fishing, collecting wild plants and animals; Organic products; Special origins and protected origins; “Fair trade” products; Farm-gate Sale; Own harvesting by the client; Farm eco-training; Eco-tourism, horseback riding, fishing; Eco-restaurants	Movements for Sustainable agriculture; Voluntary “Codes for eco-behavior”; Voluntary standards; “Good will”; Charity actions	Eco-contracts and cooperative agreements between farmers and interested businesses or communities involving payment for ecosystem services and resulting in production methods (improved pasture management, reduced use of agro-chemicals, conservation of wetlands), limiting water pollution, protection against floods and fires, etc.; Joint investment in eco-projects and ecosystem services	Family farms; Cooperative farms; Agro companies; Public farms; Eco-associations; Eco-cooperative; Specialized organization for restoration, maintenance and improvement of ecosystem services; Public-private partnerships; Protected Trademarks, Origins, Products, etc.

Third, *private forms* (“private or collective order”) - various private initiatives and special contractual and organizational forms such as: long-term eco-contracts, voluntary eco-actions, voluntary or mandatory codes of eco-behavior, partnerships, eco-cooperatives and associations, trademarks, labels, etc. Conservation of natural resources is part of the management strategy of many agricultural (eco, green) farms. There are also many initiatives by farmers' organizations, industry, retail chains and consumer organizations that are associated with raising the environmental sustainability of agricultural production. Individual agents benefit from economic, market, institutional, etc.

opportunities and overcome institutional and market failures by selecting or designing new profitable private forms (rules) to manage behavior, relationships and exchanges. However, there are many examples of private sector “failure” in managing socially desirable activities such as eco-conservation, conservation of traditional species, production, rural areas, etc.

Fourth, *public forms* (“public order”) - various public (community, state, international) interventions in the market and private sectors such as: public recommendations, regulations, support, taxation, financing, provision, modernization of rights and rules, etc. (Table 2).

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Agrarian and rural development programs are implemented which aim at “proportional” development of agriculture and regions, preserving and improving natural environment, etc. In many cases, effective management of individual activity or organization of certain activities through market mechanisms or private contracting may take a long time, be very expensive, fail to reach socially desirable scale, or not take a place. Centralized public intervention could reach desired state faster, or

more efficiently. Public is “involved” in management of agro-ecosystem services by: providing eco-information and training to private agents, stimulating and (co)financing voluntary activities, imposing mandatory eco-regulations and sanctions, organizing eco and related activities (state-owned eco-enterprise, research, monitoring), etc. However, there are many cases of poor public involvement (inaction, under-intervention, over-regulation) leading to significant problems.

Table2. *Uncomplete Forms of Public Interventions in Agro-ecosystem Services*

New Property Rights and Enforcement	Public Regulations	Public Taxation	Public Support	Public Provision
Rights for a clean and beautiful environment, biodiversity; Private rights on natural, biological and environmental resources; Collective rights over irrigation waters, pastures, etc.; Private rights for profit-oriented management of natural resources; Tradable pollution quotas (permits); Private rights to intellectual products, origins, (protection) of ecosystem services; Rights for issuing eco-bonds, shares in ownership; Private liability for pollution; Provide legal personality rights to a part or entire ecosystems	Regulations for organic farming; Regulations for Trading Ecosystem Services Protection; Emissions and use quotas for products and resources; Regulations for the introduction of alien species, genetically modified crops; Prohibition of certain activities, use of resources and technology; Nutrition and pest management standards; Regulations to protect water from nitrate pollution; Regulations for biodiversity and landscape management; Licensing for the use of water and agro-ecosystems; Rules and quotas for the use of sewage sludge; Quality and safety standards; Standards for good agricultural practices; Compulsory eco-education; Certification and licensing; Mandatory eco-labeling; Identification of threatened areas and reserves; Set-aside measures; Inspections, fines, termination of activity	Tax preferences; Eco-taxes on emissions and products; Fees for overproduction of manure; Fees on manufacturing or export for financing innovation; Waste tax; Farmland tax	Recommendations, information, demonstrations; Direct payments; Subsidies for eco-actions of farms, businesses and communities; Preferential Credit; Public eco-contracts; Government procurement (water and other resources); Price and production aid for organic production and special origins; Financing of eco-education; Assistance for farmers and environmental associations; Collection of fees to pay for provision of ecosystem services	Scientific research; Market information; Agro-meteorological forecasts; Sanitary and veterinary control, vaccinations, preventive measures; Public Agency (Company) for important ecosystems; Applying the “precautionary principle”; Environmental monitoring; Eco-forecasts; Risk Assessment

Fifth, *hybrid forms* - some combination of the above three, such as public-private partnerships, public licensing and inspection of private bio-farms, etc. For example, the supply of many of the ecosystem services by farmers can hardly be managed through private contracts with individual consumers due to the low appropriability, high uncertainty and rare character of transactions (high costs for negotiation, contracting, payment from potential customers, disputing). Supplying eco-services is very expensive (additional production and organizational costs) and is unlikely to be done on a voluntary basis. Financial compensation of farmers by willing consumers through a pure market form (fee, premium) is inefficient due to high information asymmetry and enormous enforcement costs. A trilateral form with direct public involvement makes transactions effective: on behalf of current and future consumers, a state agency negotiates a contract with farmers for eco-conservation service, coordinates activities of various agents, provides public payment to farmers for the eco-service and controls the fulfillment of contractual conditions.

The efficiency of the individual forms of governance of agro-ecosystem services of different types is quite different since they have unequal potential to: provide adequate eco-information, induce positive eco-behavior, resolve eco-conflicts and coordinate eco-activities of different participants, improve environmental sustainability and reduce eco-risks, minimize overall eco-management costs (for conservation, third party, transaction, etc.), for agents with different preferences and opportunities, and in specific (socio-economic, natural) conditions of each eco-system, community, industry, region, and country. For example, a proper eco-information and training is sufficient to induce voluntary action by a “green” farmer, while most commercial enterprises need external incentives (market premium, monetary compensation, penalties); market prices generally coordinate well the relations between suppliers and users of waters, while regulating relationships between water pollutants and users requires a special private or public form; farmers' independent actions improve the condition of local eco-systems, while solving most of (regional, national, global) eco-problems requires collective action on a large scale and time periods, etc. In the long run, the specific system of governance of the agricultural sector and sustainability (pre)determines the type and character of socio-economic development. Depending on the efficiency of the established system of

governance of agro-ecosystem services, individual farms, sub-sectors, regions and countries achieve different results in the conservation, restoration and improvement of ecosystems, and there is a different state of natural resources, level of eco-risks and eco-costs related to the development of agricultural sector, and unequal environmental sustainability of individual farms, sub-sectors, regions, agriculture, and different countries.

Factors for Choice and Efficiency of Governance Mode

In rare cases, there is a single practically possible form of managing activity and relationships associated with a particular agro-ecosystem service.¹ Often, many *alternative* (market, private, public, hybrid) forms of governance are possible – e.g. provision of “biodiversity conservation service” can be managed: as farmer's voluntary activity; through a private contract with interested/affected agent; through interlinked contract with supplier/processor; through cooperation (collective action) with other agents; by trading in (free) market or through supported by a third party (certification body) trade with special (organic, protected, fair-trade) products; through a public contract specifying farmer's obligations and compensations; through a public decree (regulation, resource/emission quotas, taxation); through a hierarchical public agency (company), or through a hybrid form.

There is no single “universal” form for governing all types of agro-ecosystem services equally, effective for all agents in diverse socio-economic and natural conditions (Bachev). *The choice* of managerial mode for a particular service and the development of the system of agro-ecosystem services management depends on various factors. For example, the choice of governing form strongly depends on the *personal characteristics* of the *farmers* and *other participants* in the process - personal preferences, (ethical, religious) views, experience, awareness, training, willingness for association and/or risk-taking, professional and financial capabilities, reputation, trust, tendency for opportunism, power positions, age, eco-innovation, entrepreneurship, leadership, etc. Younger, more educated and innovative farmers are more actively involved in various new forms of management of agro-ecosystems. Specific

¹In Japanese agriculture with scattered rice paddoes, water supply is not be possible by individual farmers (high interdependence, indivisibility use), and from earliest times organization of water retaintion and use is a public project.

benefits for the individual farmer from eco-management take different forms - monetary or non-monetary income, profit, indirect economic benefits, enjoyment of eco-activity, desire to preserve nature for future generations, etc.

Another important factor is the *development of science and technology*, which determine the extent of awareness of the types, factors and importance of ecosystem services, provide more complete information on eco-problems and risks, and positive and negative impact of agricultural practices, provide new opportunities for effective management of activities related to preservation and improvement of services of agro-ecosystems of different kind (precision agriculture, digitalization, automation of monitoring, operations, etc.), etc. Digitization, is revolutionizing the forms of gathering and processing information, sharing know-how, finding trading and coalition partners, “cheap” online marketing of eco-products nationally and transnationally, etc. Development of science and technology is also related to some new challenges for the system of eco-management and control associated with the use of GMOs, artificial intelligence, etc.

Choice of governance form depends on *the state of ecosystems, character of environmental problems and risks*, and socio-economic and ecological *significance* of the service. As a rule, a high social value and a greater environmental risk more easily induce private coalition and more public forms of intervention (standards, subsidies, regulations, etc.). For example, the “big” problems associated with the storage of manure and sewage sludge in Bulgaria led to emergence of a new form - free delivery to using farms by livestock complexes and water supply companies. Choice of management form also strongly depends on *market and public demand* (pressure) for sustainable exploitation of natural resources. The nature of this demand depends on the overall socio-economic development, social importance, and priority (socio-economic and environmental) challenges at the relevant stage. Wealthy consumers and societies are willing to pay more for a wide range of ecosystem services – premium for eco-products and services, generous state and local programs for conservation of nature, cultural and historical heritage, lifestyle, etc. Choice of governance form depends very much on the *character of the service* of the agro-ecosystem, the *relationship between cost and benefits*, and the amount of *time and space lag* between investment and effect. For ecosystem services with immediate benefits to farmer and/or consumer, market and private management works well, while those requiring long-term and

large-scale investments for production of services with “public” goods character, it is required long-term and complex forms.

Evolution of system of eco-management depends on prevailing *institutionally determined eco-rights, norms and obligations*, and *existing and practically possible market, private and public forms* of governance. Management form is often (predetermined) by the institutional constraints, such as some form of farming, environmental, etc. activities are socially unacceptable or illegal. For example, “free” market and private activity in protected areas is not allowed, private ownership and trade in certain natural resources (water, genetic diversity) is not possible, etc. Another important determinant of the system of governance are *public(national, European) policies*², as well as implementation of *international conventions and agreements* on various aspects of environmental sustainability. They create a new (national, European, global) order by introducing new rights and rules, markets and directions for development. The system of eco-management also depends on the “natural” *evolution of the natural environment* (global warming, extreme climate, drought, etc.), which imposes new private, collective and hybrid forms that help confrontation to negative trends and/or effective adaptation to natural (and social) changes.

A “pure” economic factor that determines the choice of governing form is related to the efficiency. Individual governing modes are alternative, but not equally effective forms for organizing activities and transactions associated to a particular agro-ecosystem service. Each of them has specific *advantages and disadvantages* for safeguarding eco-rights and investments, and for coordination and stimulation of socially desirable eco-behavior and activities, for exploration of economies of scale and scope, for minimizing of production and transaction costs³.

In the specific natural and institutional environment, various agents can manage their relations through the *free market* (adapting to market prices), through *negotiation* (agreeing on a “private order”), through *coalition* (collective decision making), in an *internal organization* (“the hand of manager”), through a *public form* or *hybrid organization*. “Rational” agents tend to choose or design *the most effective* forms for governing of their relations that maximize

²“Green” governments give high priority to environmental protection, while others prioritize economic growth.

³Description of advantages and disadvantages of major forms of governance is done previously (Bachev).

benefits and minimize their costs. In the long run, management forms that minimize *transaction* costs ultimately dominate (Williamson).

In the unrealistic conditions of “zero” transaction costs and well-defined private property rights, the state of maximum efficiency is always achieved regardless of the initial allocation of rights between individuals and the form of governance (Coase). All information about the efficient exploitation of natural and technological opportunities and the satisfaction of demand would be *costlessly* available for everybody. Individuals would costlessly coordinate their activities and protect their (absolute and contractual) rights, and “trade” own resources (exchange the rights on them) in the mutual interest with *equal* efficiency in the free market, through private organizations of different types, through collective decision-making, or in a single national hierarchy (company). Then the optimal requirements for environmental sustainability, and the maximum potential for economies of scale and scope (maximum environmental protection /improvement, and productivity of resource, “internalizing externalities”), and improving the well-being (consumption, provision of ecosystem services, etc.) would be easily, costlessly achieved.⁴

However, when transaction costs are significant, then the costless negotiation, exchange and protection of individual rights is impossible. Therefore, the initial distribution of property rights between individuals and groups, and their good definition and enforcement, are critical for overall efficiency and sustainability. For example, if the “right to a clean environment” is not well defined, that creates great difficulties for the effective supply of ecosystem services - costly disputes between the pollutant and affected agents; disregard for the interests of particular groups or generations, etc. Moreover, even when rights are well-defined, the eco-management is usually associated with significant transaction costs. For instance, the agents have the cost of identifying different rights and effectively protecting them (unwanted appropriation by other agents); to study and comply with the various institutional restrictions (rules, standards, rules); to collect the necessary technological, eco- and other information; to find the best partners and prices; to negotiate the terms of the exchange; for writing and registration of contracts; to enforce exchange terms through monitoring, control, measurement

⁴At present stae, there is a *principled agreement* (a “social contract”) for a global sustainable development.

and safeguards; to dispute rights and agreements in court or otherwise; for adaptation or termination of agreements along with the evolution of conditions of production and exchange, etc.

Therefore, in the real world with incompletely defined and/or enforced rights and positive transaction costs, *the form* of agro-environmental governance becomes critical and (pre)determines the extent of degradation, conservation and enhancement of (agro) ecosystems and their services (Bachev). This is because different governance structures have *unequalefficiency* (effect, costs) in organizing the same activities related to the production and consumption of ecosystem services in the specific socio-economic and natural environment. Often, the high transaction costs make it very difficult and even block the organization of otherwise efficient (mutually beneficial) activities and exchanges for all participants⁵.

The effective forms for governing of ecosystem services optimize *the overall* (transaction *and* production costs) of agricultural activity - minimizing transaction costs and allowing (otherwise mutually beneficial) eco-exchange to be realized on a socially desirable scale; allowing the achievement of the minimum/optimal environmental requirements and/or the exploration of purely technological economies of size and scale in farming, eco- and other activities. The “production costs” for the “provision” of agro-eco-services are relatively easy to measure. However, much of the associated transaction costs are difficult or impossible to measure. The (most) effective form of governance is determined through *Discrete Structural Analysis*, according to the (combination of) *critical dimensions*⁶ of activity and transactions (Bachev, Williamson). In a previous publication, we have identified the most effective market, contractual and internal forms of eco-management, depending on the critical factors of transactions and activity (Bachev).

The “rational” agents tend to use and/or design such forms for governing their diverse activities and relationships that are *the most effective* for the specific institutional, economic and natural

⁵Most often, the supplier and the user of agro-ecosystem services are different agents, which implies a transaction (desired or unwanted exchange) between them.

⁶Frequency, uncertainty and asses specifility (Williamson), and appropriability (Bachev) – factors, causing variation of transaction costs between alternative modes of governance.

environment - modes that maximize their *overall* (production, environmental, financial, transactional, etc.) *benefits* and minimizing their *overall* (production, eco-maintaining, transaction, etc.) *costs* (Bachev). However, the result of this *private (and market)* optimization of the management and the activity is not always the most efficient allocation of resources at a social scale and socially desirable (maximum possible) environmental conservation activity. Agricultural activity is often accompanied by significant undesirable negative eco-effects - soil degradation, water pollution, biodiversity destruction, air pollution, significant greenhouse gas emissions, etc., including in EU (EEA). Market and private sector “fail” in effective governance of a significant proportion of transactions associated with agro-ecosystem services with low appropriability, high and unilateral specificity of investment, high uncertainty, and low repetition/frequency. There is a need for a *public intervention (government, international aid) as a third party* to make such eco-activities and transactions possible or more efficient. However, public intervention in (eco-)governance is not always more effective, since *public failure* is actually possible. In the country and around the world, there are many examples for inappropriate, excessive, insufficient, untimely or too expensive public intervention at all levels. Often, public intervention either fails to correct market and private sector failures or “corrects” them at the price of more overall costs.

The criterion for assessing the efficiency of the agro-environmental governance is to be whether the *socially desirable and practically feasible eco-goals (e.g. amount of agro-ecosystem services) are achieved with the lowest possible total cost* (direct, indirect, private, public, production, environmental, transactional etc.). Accordingly, inefficiency is manifested in the *failure to achieve the really possible* (technical, political, economic) *ecological objectives* (overcoming certain eco-problems, minimizing existing eco-risks, reducing eco-losses, restoring and improving the natural environment, increasing agro-ecosystem services, etc.) *or* in achieving the set up goals with *excessive cost compared to another feasible form of governance*.

Stages in the Analysis and Improvement of the Governance System

Analysis and improvement of the system of governance of agro-ecosystem services should include following steps: *First*, trends, factors and risks associated with (agro) ecosystems and the “supply” of agro-ecosystem services must be

identified. Modern science provides sufficiently precise methods for assessing the state of ecosystems of different kind, and for identifying existing, evolving and likely problems (MEA). Moreover, it offers reliable tools for assessing (positive and negative) impact of agriculture on the (“health”) state of nature, its main components, and ecosystem services of various types, including at different spatial and temporal scales. For example, systems of multiple eco-indicators for pressure, state, response, and impact, volume and structure of ecosystem services, integrated assessment of agro-ecosystem services, eco-sustainability of agriculture, etc. are widely applied. The absence of *serious eco-problems, conflicts and risks* is an indicator that an *effective system for governance of agro-ecosystem services exists*. In most cases, however, significant or increasing eco-problems and risks related to agricultural development are observed, as is the case with EU(EEA).

Second, efficiency of *existing and other possible* forms and mechanisms of governance for overcoming existing, evolving and possible eco-problems and risks associated with the services of agroecosystems of every type are to be evaluated. Analysis is to cover the agro-eco-management system and its individual elements - *institutional environment and diverse* (formal, informal, market, private, contract, internal, external, individual, collective, public, simple, complex, etc.) *forms* for governing the activities and relationships of related agents. It is necessary to analyze the “*de facto*” rights over tangible and intangible assets (material and intellectual agrarian and eco-products and services), natural resources, certain activities, clean nature, food and eco-security, internal and inter-generational justice, and etc. that are relevant to the services of agro systems. The efficiency of the system of enforcement of rights and rules by the state, public pressure, trust, reputation, private and collective forms, or by agents themselves have to be also analyzed. The extent to which institutional environment creates incentives, constraints and costs for individual agents and society to preserve, restore and improve agro-ecosystems and their services, to intensify eco-exchange and cooperation of related agents, to increase the productivity of resource use, to induce private and collective eco-initiatives and investments, to develop new eco-rights, to reduce disparities between different (agro) ecosystems, to overcome the socio-economic and environmental problems, conflicts and risks, etc., all are to be assessed.

The assessment of the efficiency of individual market, private, collective, public and hybrid

forms of governance is to incorporate their *absolute* and *comparative potential* for protection and development of eco-rights and investments of agents, to promote the socially desirable level of environmental behavior and activity (agro-ecosystems services), rapid identification of eco-problems and risks, cooperation and resolution of eco-conflicts, and minimization and recovery of total eco-costs (conservation, restoration, improvement, transaction, direct, indirect, private, public). *Complementarity* and/or *contradiction* of different modes of governance are to also be assessed – e.g. high complementarity between (some) private, market and public eco-governance forms; the contradiction between the “gray” and “light” sectors; conflicts between the agrarian and non-agrarian sectors regarding natural resources and ecosystem services, etc. Most of applied forms of agro-management of activity affect more than one aspect of agriculture and agro-ecosystem services. In addition, improvement of one type of agro-ecosystem services (e.g. food production) through a particular form is often associated with negative effects on another type (e.g. conservation of natural biodiversity). Therefore, the *overall efficiency* of a given form, of a particular “package” of instruments or the system of governance as a whole must always be taken into account.

The analysis and evaluation of the system of governance of agroecosystem services is a complex, multidimensional and interdisciplinary process that requires in-depth knowledge of the advantages and disadvantages of specific forms of governance and a detailed characterization of their efficiency (benefits, costs, effects) in the specific conditions of each agricultural agent, agricultural farm, type of farms, ecosystem, sub-sector, region, etc. Quantitative indicators are of little use here and most often a *qualitative* analysis of comparative advantages, disadvantages and net benefits is needed. Even when the system of agro-eco-management and agro-ecosystem services management “*works well*”, periodic *performance (efficiency) checks* have to be made. This is because good environmental protection may have been achieved with *excessive* public expenditures, or it may have been missed a *further improvement* of agro ecosystem services with the *same* social costs. In both cases there is an alternative *more effective* organization of the management of agro-ecosystem services. For example, a costly for the taxpayer public eco-governance (in terms of incentives, overall costs, adaptation and investment potential) can be replaced by a more

effective private, market or hybrid form (public-private partnership).

Third, the *inefficiency* (“failure”) of dominating market, private and public forms is to be detected, and the *needs for new public intervention* in the management of agro-ecosystem services of each kind identified. They may be related to the inability to achieve the socially desirable and practically possible eco-goals, the significant transactional difficulties (costs) for participating agents, the inefficient use of public funds, etc.

Finally, the *alternative forms of new public intervention* that can overcome existing (market, private and public) failure are to be identified; and their *comparative efficiency and complementarity* evaluated, and the *most effective one(s)* selected. It is important to compare only *practically* (technically, economically, politically) *possible* forms of new public intervention in the management of agro-ecosystem services of every kind in specific socio-economic, organizational and natural environment. Public forms not only support (market *and* private) transactions, but they also associated with significant (public and private) costs. Estimates have to include *all* costs of implementation and transaction - direct costs (of taxpayers, supporting institution), *and* transaction costs (of coordination, stimulation, control of opportunism and mismanagement) of bureaucracy, *and* the costs of individuals' participation in the public forms (for adaptation, information, paperwork, fees), *and* the costs of social control over and reorganization (modernization, liquidation) of public forms, *and* (opportunity) “costs” of public inaction⁷.

Proposed analysis is to be made *at different levels of agro-ecosystems* (farm, area, micro-region, macro-region, national, international), depending on the *type of eco-challenge* and the scale of *collective action needed* to eliminate the specific problems and risks associated with agroecosystems and their services. Identification and evaluation of dominating specific forms of governance of agro-ecosystem services of a given type in a particular country, macro and micro-region, etc. is to be a subject to special “micro” multidisciplinary study. They require a multidisciplinary approach and use of diverse information for eco-state, risks, public programs and measures, scientific, statistical and forecast

⁷Some *eco-losses* can be expressed in economic terms (reduction of income, replacement and recovery costs), but significant part of social costs cannot – e.g. impact on biodiversity, human health and life, future generations, etc.

data for development of ecosystems, and collection of new micro and macro information on forms, the costs, factors, effects and intentions of the agents involved in the managing the services of agro-ecosystems at the relevant hierarchical levels.

The analyses and improvement of the governance of agroecosystem services is not a one-off act that ends with a perfect system for governance of agroecosystem services at the final stage. It is a permanent *process* that should improve eco-governance along with the evolution of the natural environment, individual and collective (social) knowledge and preferences, and the modernization of technology and the institutional environment. Moreover, the *public* (local, national, international) *failure* is possible (and often prevail), leading us again to the next cycle of improving the eco-governance in agriculture. In some cases, it is not at all impossible to “affect” the natural environment through (agro) management and the *effective adaptation* is the only possible strategy for overcoming environmental consequences for agricultural and other sectors of human activity. Comparative institutional analysis also allows to *anticipate* probable cases of *new public* (local, national, international) failures as a result of inability to mobilize sufficient political support and necessary resources or ineffective implementation of otherwise “good” policies insocio-economic conditions of a particular country, agroecosystem, etc. As public failure is a *practically feasible option*, its timely detection allows to anticipate the existence or deepening of certain environmental problems and to inform the (local, international) community about the risks involved.

CONCLUSIONS

The study of the forms, factors and efficiency of the governance of agro-ecosystem services is at an early stage. In this “new” area, many traditional economic approaches and models are “not working” well, and multi and interdisciplinary analysis are needed in which economists have to contribute. “Empirical” research is to be initiated to “test” and improve the theory, and effectively support policies and farming strategies and practices. This requires collection of new types of micro and macro information on the personal characteristics of participants in “production” and consumption of agro-ecosystem services, for the type and forms of their relationships, for the specific socio-economic and institutional environment, and for the agro-ecosystems of different types. and their

diverse “services” at different levels and horizons of management.

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