

Agro-ecosystem services management of Bulgarian farms

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Abstract

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Despite growing environmental issues and importance, research on types and management of agroecosystem services in Bulgaria is at the beginning stage. This article incorporates a holistic interdisciplinary approach, and identifies diverse ecosystem services provided by the Bulgarian farms, and various private, market, collective and public modes of their management. The New Institutional Economics methodology is adapted and analyses made on the base of survey data collected by farm managers. The study has found out that Bulgarian farms maintain or produce a great number of essential ecosystem services among which provisioning food and feed, and conservation of elements of the natural environment prevail. A great variety of private, market, collective and public modes of governance related to agroecosystem services have been used. There is significant differentiation of employed managerial forms depending on the type of ecosystem services and specialization of agricultural holdings. Management of agroecosystem services is associated with a considerable increase in the production and transaction costs of participating farms as well as big socio-economic and environmental effects. All these findings give a new valuable information for decision-makers at all levels for improving public policies and management strategies of farms. Holistic frameworks for analysing the system of management of agro-ecosystem services is to be extended and improved which requires collection of “new” type of micro-information on (agro)ecosystem services and forms, factors, efficiency and impacts of their management.

Keywords: ecosystem services; mechanisms and modes of governance; agricultural farms

Introduction

Ecosystem services are products and other benefits that humans receive from natural ecosystems (MEA, 2005). The agricultural ecosystems and their specific “agro-ecosystem” services are widespread in Bulgaria and internationally (IAOC, 2020; EEA, 2015; FAO, 2016). Since the introduction of this concept, (agro)ecosystem services have been intensively promoted, studied, mapped, evaluated, and managed (Adhikari et al., 2013; Allen et al., 2011; Boelee, 2013; De Groot et al., 2002; EEA, 2015; FAO, 2016; INRA, 2017; Gao et al., 2018; Garbach et al., 2014; Gemmill-Herren, 2018; Habib et al., 2016; Kanianska, 2019; Lescourret et al., 2015; Marta-Pedroso et al., 2018; Novikova et al., 2017; Power, 2010; Tsiadouli et al., 2017; Van Oudenhoven, 2020;

Wood et al., 2015; WWF, 2019; Zhan, 2015). Despite growing environmental issues, and increasing public and private interests, the scientific studies in that new area are still a “work in progress”. Research is commonly limited to a certain type of agro-ecosystem services, a particular ecosystem, a single aspect of the management, a specific form or level of governance, specific costs and benefits, etc. In Bulgaria, research on economic and other issues related to agroecosystem services are at the beginning stage and mostly at “conceptual and methodological” level (IAOC, 2020; Yordanov et al., 2017; Nikolov, 2018; Todorova, 2017a; Chipev et al., 2017; Bachev, 2010, 2020; Grigorova and Kazakova, 2008). There are very few studies on modes of governance at the current stage of development (Bachev, 2020, 2021; Todorova, 2017b). This article presents the results of a comprehen-

sive study on ecosystem services provided by the Bulgarian farms and modes and efficiency of their management. The ultimate goal of the study is to assist improvement of public policies, programs and forms of public intervention in agrarian sector, and management strategies of agricultural holdings.

Methods and Data

„Agrarian“ ecosystems and „agrarian“ ecosystem services are those associated with the agricultural „production“ (Bachev, 2020). The hierarchical system of agroecosystems includes multiple levels (from individual farm plot/section, area, micro-region, macro-region, etc.) while their (ecosystem) services are classified into different categories – provisional, economic, recreational, aesthetic, cultural, educational, supporting, biodiversity conservation, water purification and retention, flood and fire protection, climate regulation, etc. (MEA).

The term “management of (agro)ecosystem services” refers to the *management of human actions and behavior* related to preservation, improving and recovery of ecosystems and ecosystem services (Bachev, 2020). The *system of governance* of agro-ecosystem services always includes **the farm** as a key element and the *first level* of management of agro-ecosystems and their services (Figure 1). Other agrarian and not agrarian agents (resource owners, inputs suppliers, wholesale buyers and processors, interests groups, policy-makers, local and national authorities, residence and visitors of rural areas, final consumers, international organizations, etc.) also take part in the management of agroecosystem services at farms, regional, sectoral, national and international levels.

Farmers use diverse mechanisms and modes to manage activity and relations with other agents – *internal* (direct production management, own conviction of farm manager/owner, building reputation, etc.), *market* (free-market price movements, competition, etc.), *contract* (special or inter-linked contracts, etc.), *collective* (cooperation, joint initiatives, etc.), and *public* (public eco-contract, cross-compliance against EU subsidization, etc.) (Figure 1). Detailed presentation of a holistic New Institutional Economics framework for studying and evaluating diverse modes of governance for agro-ecosystem services is done by Bachev (2010, 2020).

In Bulgaria, there are no available (statistical and other) data for the type of agroecosystem service provided by the farms and the forms of management applied. Therefore, a literature review and widespread practices examination has been made to prepare the list of diverse types of ecosystem services maintained or produced by farms, and major forms

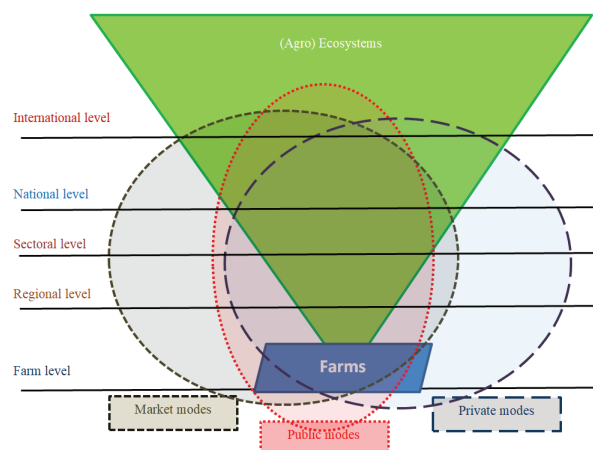


Fig. 1. Levels and modes of management of agroecosystem services

Source: author

of management used. A structured survey is conducted in October 2020 with the managers of 324 “typical” farms of different type, size, specialization, ecological and geographical location. The goal was to collect micro data for identification of ecosystem services “produced” and governing modes employed by agricultural farms. The questionnaire also gives an option to respondents to add specific services provided and managerial forms practiced. The classification of agricultural holdings is done according to official classification in EU. The structure of surveyed farms approximately corresponds to the real structure of holdings in Bulgaria. Almost 60% of surveyed farms are with male managers, around 35% are with female managers, and the rest are partnerships or with group ownerships. The subsectors, regional, national, etc. summaries are arithmetic averages of data provided by the individual farms belonging to respective agro-systems.

Results and Discussion

Structure of ecosystem services provided by Bulgarian farms

The majority of Bulgarian farms participate in the “Production of products (fruits, vegetables, flowers, etc.) for direct human consumption”, which is one of the main “services” of agro-ecosystems in the country (Figure 2). A significant part of the farms also “Produce raw materials (fruits, milk, etc.) for the food industry”. Other “production” services in which a smaller part of the farms participate are “Production of animal feed”, “Own processing of agricultural products”, “Production of seeds, saplings, animals, etc. for

farms”, and “Production of raw materials for cosmetic, textile, energy, etc. industry”. A relatively small part of agricultural producers participate in provision of other “traditional” services such as “Provision of services to other farms and agricultural organizations”, “Provision of services to end-users (riding, fruit picking, etc.)”, “Provision of tourist and restaurant services”, and “Production of bio, wind, solar, etc. energy”. Other important services of the agroecosystems, in

which “supply” a larger part of the agricultural holdings participate are “Hiring workers” and “Providing free access on the farm to outsiders”.

Relatively many of the farms are involved in the protection and preservation of technological, biological, cultural and other heritage – “Preservation of traditional crops and plant varieties”, “Preservation of traditional species and breeds of animals”, “Preservation of traditional methods, technologies

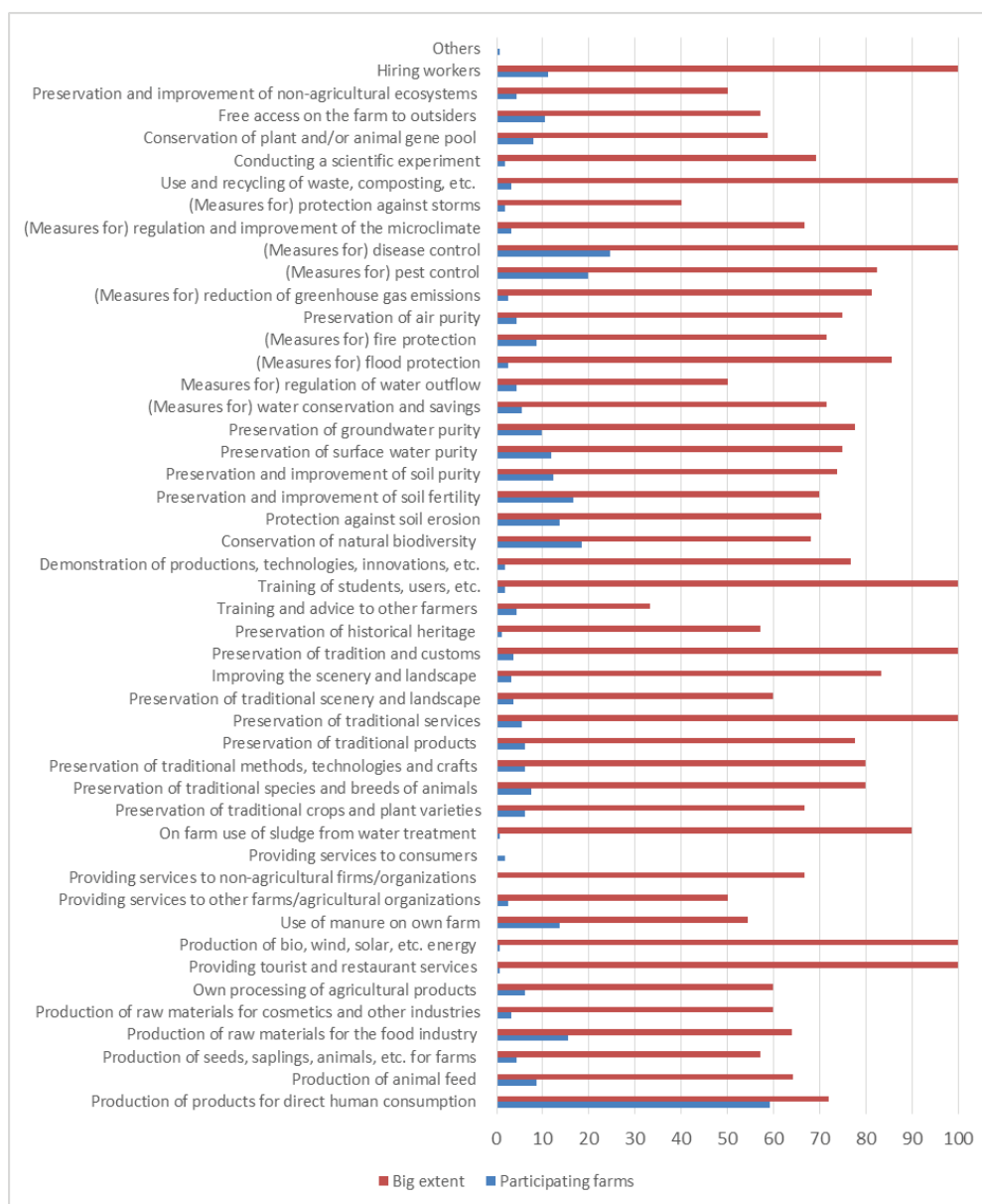


Fig. 2. Share of farms participating in and providing to a big extent diverse ecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

and crafts”, “Preservation of traditional products”, “Preservation of traditional services”, “Preservation of traditions and customs”, and “Preservation of historical heritage”.

The activity of a large part of the agricultural holdings is aimed at preserving, restoring and improving the elements of the natural environment – “Disease control (measures)”, “Pest control (measures)”, “Protection of natural biodiversity”, “Protection and improvement of soil fertility”, “Protection from soil erosion”, “Protection and improvement of soil purity”, “Protection of surface water”, “Protection of groundwater purity”, “Fire protection (measures)”, and “Protection of plant and/or animal gene pool”. A relatively smaller part of the farms are involved in “(Measures for) water conservation and saving”, “(Measures for) regulation of the correct outflow of water”, “Preservation of air quality”, “Preservation of traditional scenery and landscape”, “Improvement (aesthetics, aroma, land use, etc.) of scenery and landscape”, “(Measures for) regulation and improvement of the microclimate”, “Flood protection (measures)”, and “Greenhouse gas emission reduction (measures)”, and “(Measures) for storm protection”.

Essential ecosystem services of many farms are the recovery and recycling of “waste” from various activities in the sector and other industries – “Use of manure on the farm”, and to a lesser extent “Reuse and recycling of waste, composting, etc.” and “Use of sludge from water treatment on-farm”. A smaller portion of agricultural producers participates in educational, scientific and innovative ecosystem services such as “Training and advice of other farmers”,

“Training of students, consumers, etc.”, “Demonstration of production, technologies, innovations, etc.”, and “Conducting a scientific experiment”. Agroecosystems also contribute to the “Protection and improvement of non-agricultural (forest, lake, urban, etc.) ecosystems” with around 4% of all farms in the country engaged in such efforts.

The extent of participation of supplying farms in the preservation or production of (agro) ecosystem services is not equal (Figure 2). For most agro-ecosystem services, the holdings involved in the activities do so “To a large extent”. Therefore, “permanent” investments in agri-ecosystem services and “specialization” in the provision of agro-ecosystem services of a certain type by participating farms can be considered. In some agro-ecosystem services, the share of farms involved to a large and small extent is equal – e.g. in the use of manure on the farm, the provision of services to other farms and agricultural organizations, (flood protection) measures, and the hiring of workers. Therefore, a significant proportion of farms are either in the process of initially “entering” (testing, studying, adapting, etc.) in the related agro-ecosystem services, or participate in such a supply as ancillary or related to the main activity. With regard to three types of agro-ecosystem services, most of the farms involved in supply do so to a small extent – on-farm using sludge from water treatment, training of students, consumers, etc., and use and recycling of waste, composting, etc. This is a sign of initial entry into or exit from this activity, or the inefficiency of its further expansion (intensification) by practicing farms. The unequal participation of farmers in the provision of agro-ecosystem services of differ-

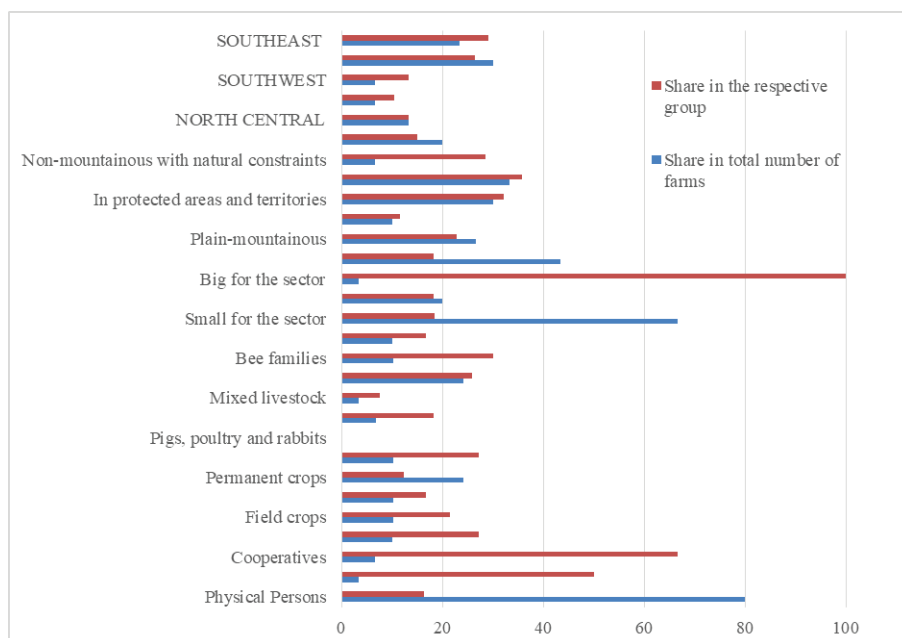


Fig. 3. Share of farms of different type and ecosystems that participate in „Conservation of natural biodiversity“ in the total number of farms in Bulgaria and in the different groups (percentages)

Source: Survey of agricultural producers, 2020

ent types and unlike degrees of involvement in such activities shows the need to take measures to improve, diversify and intensify this activity through training, information, exchange of experience, public incentives, etc.

Our study has found out that there are significant differences and deviations from the average level in the participation in the preservation and provision of agro-ecosystem services of agricultural holdings of different type, in different geographical regions, principle and specific (agro)ecosystems, and different subsector of agricultural production (Bachev, 2021). For instance, protection of “natural biodiversity” is one of the main services of agro-ecosystems in the country, in the supply of which nearly 19% of agricultural holdings are involved. The contribution of farms to activities related to the conservation of natural biodiversity in different types of agro-ecosystems (type and size of farming organization, agricultural sub-sector, principal and particular ecosystems, etc.) is not the same. The largest is the relative share of agricultural producers involved in activities related to the conservation of natural biodiversity, among Cooperatives and Sole traders, in the subsectors Grazing livestock and Beekeeping, with an operational size large for the sector, located in the plain-mountainous regions, mountainous regions with natural constraints, and in protected areas and territories, and the South-East and South-Central regions of the country (Figure 3).

The absolute contribution of farms of different types and ecosystems to the total number of those involved in the conservation of natural biodiversity is also unequal (Figure 3). To the greatest absolute extent contribute to this type of agro-ecosystem service Physical persons, specialized in Permanent crops and Mixed crop-livestock, holdings with Small for the sector size, and Located in Mostly Plain regions, in Mountain Areas with Natural Constraints, in Protected zones and territories, and in the South-Central and North-Western regions of the country.

Mechanisms and modes of management of farms' ecosystem services

A large proportion of Bulgarian farms use some specific mechanisms in making decisions about managing their activities related to agroecosystem services (Figure 4). Furthermore, a different proportion of holdings apply specific mechanisms to manage the various aspects of the activity related to agro-ecosystem services. In the Production of products for direct consumption, all farms use some “special” forms¹. A relatively large part of the farms also uses

specific mechanisms in the management of Soil Protection, Water Protection, Biodiversity Protection, and Landscape and Scenery Protection (20.37%). Fewer farms use specific forms to manage the supply of other types of agro-ecosystem services.

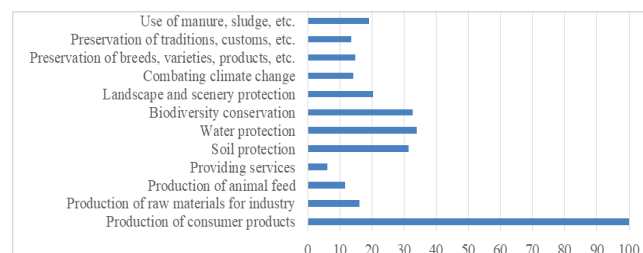


Fig. 4. Share of farms using specific mechanisms for decision-making of activity associated with agroecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

The specific forms and mechanisms applied for the effective governance of different types of agro-ecosystem services are quite different. For most farms, independent internal (*Independently by the farm*) management is essential for the supply of all major agroecosystem services (Figure 5). This form is practiced by the vast majority of farms for agro-ecosystem services with the character of “local or public goods” (inability to sell and protect rights, high specificity and uncertainty, low frequency of exchange with a particular user, etc.) such as Soil protection, Water protection, Biodiversity protection, Landscape and scenery protection, Climate change control, Preservation of breeds, varieties, products, etc., and Use of manure, sludge, etc. This form is least used in making management decisions concerning the production of raw materials for industry, where there is a high dependency (specificity of the product, capacity, delivery time, location, etc.) to a particular buyer(s) and market(s), and needs to use more effective forms of coordination and governance.

Collective decision-making with other farmers and agents is a form that is applied by a good part of holdings in relation to the Preservation of traditions, customs, etc., Production of raw materials for industry, Water protection, Biodiversity protection, Landscape and Scenery protection, and Combating climate change. The collective form for most of these services (with a character of “local or public goods”) is determined by the need for coordinated “collective action” (high dependence of assets and actions) to achieve a certain positive result. The collective organization in the production of raw materials for the industry is most often required by the need for a certain minimum volume and standardization for

¹ The modes and efficiency of governance of this type of activity of Bulgarian farms have been widely studied and presented in academic literature (Bachev, 2010, 2020).

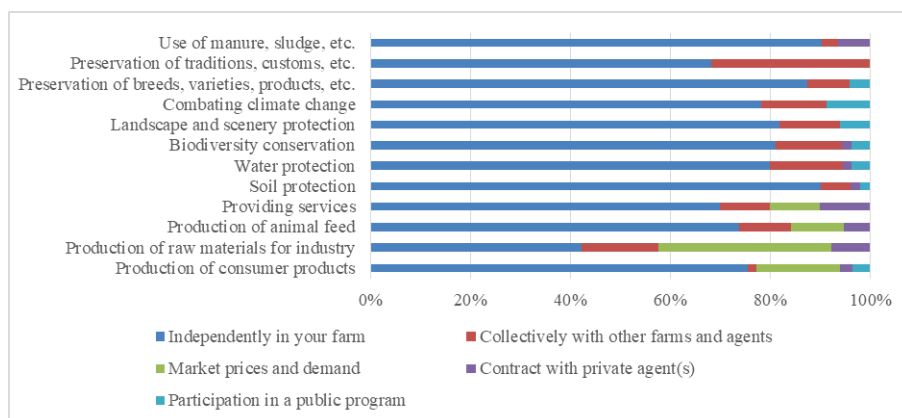


Fig. 5. Mechanisms used in decision-making on farm activities related to different types of agro-ecosystem services in Bulgaria

Source: Survey of agricultural producers, 2020

efficient market or vertically integrated trade (achieving efficiency in wholesale trade, compliance with the requirements of processors for quality, volume and frequency of supplies, etc.) or to oppose an existing (quasi)monopoly, etc.

Market mechanism and market prices and demand are exclusively and widely applied only to traditional (commercial) farming products and services – mostly in the Production of raw materials for industry, Production of products for direct consumption, and in less extent in Production of animal feed, and Provision of services (10%). As mass and standard products are traded, the market works well and there is no need to use a more expensive special form to govern the relationship between supplier and buyer.

A special private form – Contract with a private agent/s is used when it is necessary to regulate in detail the relations of the parties due to high unilateral or bilateral dependency of assets, high frequency of transactions between the same agents, and uncertainty and risk of market trading (specification of the product, delivery time, a form of payment, inter-linked transactions, a guarantee of trade between the parties, etc.). The contractual form is applied by every tenth farm in the provision of services, and a large part of the farms in the production of raw materials for industry, production of animal feed, and the use of manure, sludge, etc.

Public intervention (support) is required when private and market forms cannot fully govern the supply of certain agro-ecosystem services due to public nature, low appropriability, high specificity and uncertainty, etc. Participation in a public program is a form that is applied most by farms in the Fight against climate change, Landscape and scenery protection, and Preservation of breeds, varieties, products, etc.

Depending on the specificity of production (and the production agro-ecosystem), farms with *different specializations* use to unlike extent specific mechanisms for deciding

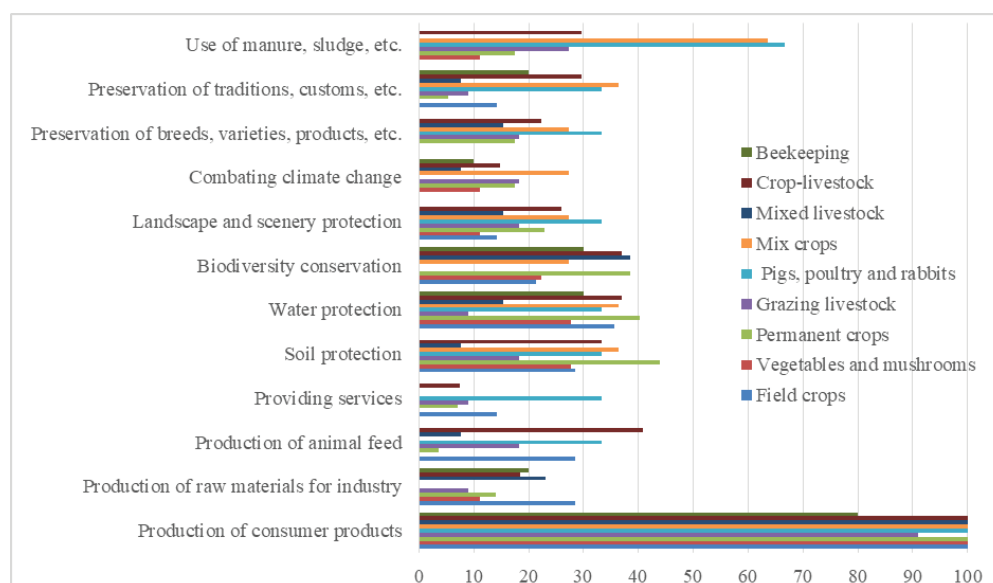
on the activity related to agroecosystem services of different types (Figure 6). The largest share of farms specialized in Field crops use specific mechanisms in the production of raw materials for industry. The most widespread special mechanisms for the production of animal feed are practiced at Mixed crop-livestock holdings. Every third producer in Pigs, Poultry and Rabbits applies similar mechanisms for (standard) services provision. A significant part of the specialized in Permanent crops, and Mix crops need special management mechanisms for soil protection. In water protection, most of the holdings in Permanent crops, Mix crop-livestock and Mix crops adapt special forms.

Farms in Permanent crops, Mixed livestock, and Mixed crop-livestock use the most specific mechanisms for biodiversity conservation. One-third of the specialized holdings in Pigs, poultry and rabbits apply special forms for landscape and scenery protection. The largest part of the farms with Mix crops, and Grazing livestock apply special management in the fight against climate change. For the preservation of breeds, varieties, products, etc. every third farm with Pigs, poultry and rabbits needs such mechanisms. The majority of specialized in Pigs, poultry and rabbits, and Mixed crops apply special mechanisms in making management decisions for the use of manure, sludge, etc.

There is a significant variation in the *type* of specific mechanisms used to make management decisions by farms with different specializations. For example, for the Conservation of natural biodiversity, every third farm specializing in field crops applies Participation in a public program. When managing the supply of the same ecosystem service, two-thirds of the farms with bee colonies and one-third in mixed crops do it Collectively with other farms and agents. Similarly, when managing the fight against climate change, half of the mixed crop-livestock holdings do so Collectively

Fig. 6. Share of farms with different specialization, using specific mechanisms in decision-making on the activity related to agroecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020



with other farmers and agents, while one-fifth of the farms specializing in permanent crops use Participation in a public program.

For some agroecosystem services with a high (capacity, location, product, etc.) specificity to a particular buyer(s) no (free)market forms (Soils protection, Waters protection, Protection of biodiversity, Preservation of landscape and scenery, Combating climate change, Preservation of breeds, varieties, products, etc.) or public forms (Production of raw materials for industry, Production of animal feed, and Services supply), or both market and trilateral with public involvement forms (Preservation of traditions, customs, etc., and Use of manure, sludge, etc.) develop. For the later mostly or exclusively private (internal, contract, collective, etc.) modes are used by all types of farms to govern their activity and relations associated with ecosystem services.

Our study has found no significant differences in specific modes of management of specific agro-ecosystem services applied by farms of different juridical types (Sole Trader, Cooperative, etc.), in different ecosystems (mountainous, plain, etc.) and regions of the country. Thus differentiation of the managerial modes mostly depends on the specificity of the agroecosystem services and the subsector of agricultural production.

Private, collective and market modes

Most of the surveyed farms apply *special private* and *market* forms to govern the supply of agro-ecosystem services. Over 17% of all farms are *certified for organic production*, and a small part combines mixed organic and traditional

production (Figure 7). Formal certification is associated with additional costs for farmers (conversion period, certification, current control, etc.) and consumers (premium to market price), but also brings significant benefits for both parties. Farmers have a formal guarantee for the authenticity of their products, receive a price bonus and public subsidies, develop a reputation and market position for special and high-quality products. Consumers receive a guarantee of authenticity and low-cost acquisition of products related to agri-ecosystem services. The process is controlled by an independent (third) party, which increases trust and reduces transaction costs. This threelateral market-oriented form will become even more important in the future given the growing consumer demand in the country and on international markets, and the further greening of the CAP in the next programming period and increasing incentives to expand organic production in the EU.

Most of the agricultural holdings have a built Reputation for ecologically clean products or are With naturally ecologically clean production. Informal private and collective forms such as *building a "good reputation"* for special quality, products, origins, etc., of certain farms, ecosystems and entire regions are widespread in the country's agricultural practice. In the future, they will continue to effectively manage the relationship between producers and consumers for the supply of agri-ecosystem services. Transaction costs are low, as long-term "personal" relationships ("clientalization", high frequency) develop for trading certain products, primarily in local and regional markets, and opportunism is punished by the cessation of trade and "bad" reputation.

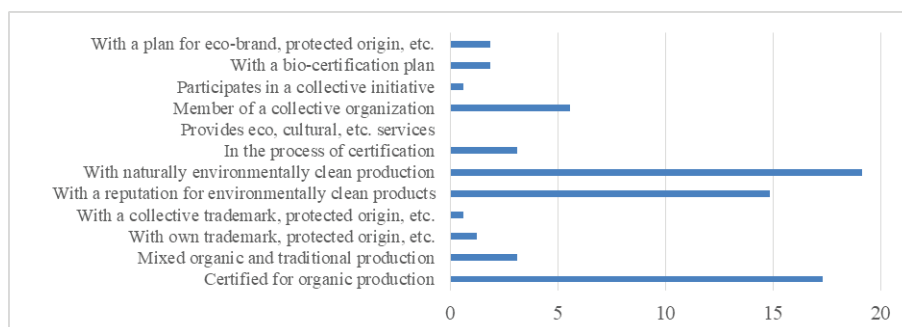


Fig. 7. Share of farms applying diverse private, collective, and market forms for the supply of agro-ecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

Due to high costs (registrations, control, etc.) and low returns, very few farms apply other formal private or collective forms of agri-ecosystem services management. A little over 5% are members of a collective organization, a little over 1% are With own trademark, protected origin, etc., less than 1% participate in a Collective Trademark, Protected Origin, etc. or in a Collective Initiative. However, given the significant transactional benefits (sales to large retail chains, exports, premiums, etc.), the number of farms investing in such special private and market forms is gradually increasing. In the process of certification are 3% of all farms, and With a plan for bio-certification and for eco-brand, protected origin, etc. almost 2% of them.

Nearly three-quarters of farms reported that they participate in some initiative for the protection of ecosystems and ecosystem services. The majority of farms Implement own (private) initiative in this regard (Figure 8) while quite a part of them Implements informal Initiatives of other farms. Almost every tenth reports participating in a State initiative related to the protection of ecosystems and ecosystem services. This *hybrid* (public-private, trilateral) form is also usually associated with receiving certain subsidies or other support in return for certain commitments for improved environmental management. Just over 2% of farms Have a contract with the state to implement such an initiative.

A small share of farms participates in other private and collective formal environmental management initiatives – Formal initiatives of other farms, Initiative of a professional organization, Initiative of a non-governmental organization, Initiative of a cooperative of which they are members, and International initiative. For a small part of the farms, the initiative is of (induced by) Supplier of the farm or by Buyer, and almost 2% of the farms even Have a contract with a private organization for implementation of eco-initiative. All this shows that the effective forms that farms and other stakeholders use to govern their relationships and actions related to environmental protection and agri-ecosystem services are diversifying.

“Providing outside access to farm territory” and “Crops polination” services

Providing external access to the territory of agricultural holdings and plant polination by honey bees are basic form of supply of ecosystem services in agriculture. The share of farms that provide *access to outsiders on their territory* varies depending on the agroecosystem services used (Figure 9). A significant part of the farms allows External visits to the farm, and Collection of information from individuals and institutions. Relatively smaller is the number of farms that allow Passage through the farm. Every tenth farm al-

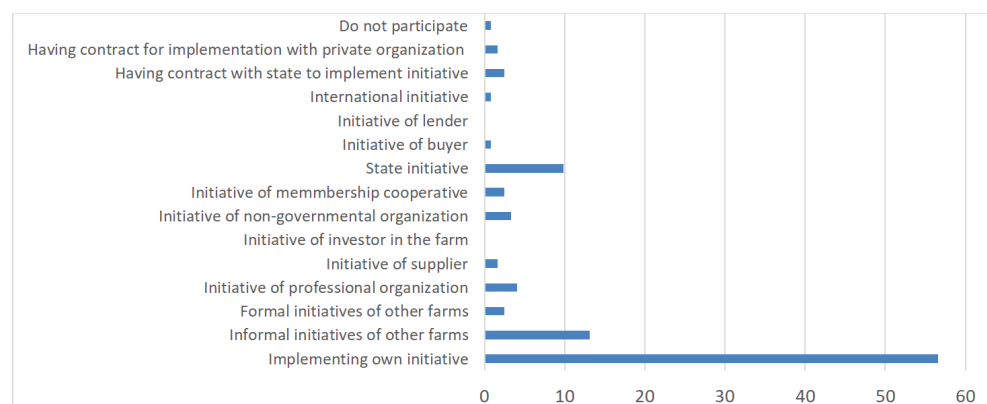
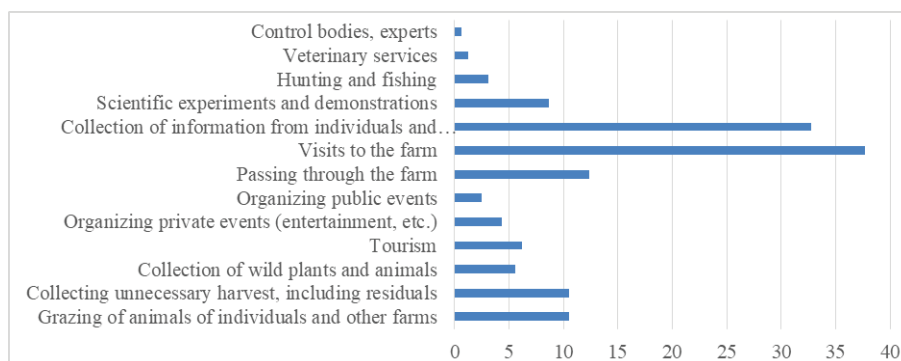


Fig. 8. Share of farms participating in an initiative for the protection of ecosystems and ecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

Fig. 9. Share of farms that provide external access to their territory for using of various ecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020



lows Grazing of animals of other individuals and farms, and Collection of unnecessary for the farm harvest, including residues. Quite a few of the farms also provide their territory for Scientific experiments and demonstrations, Tourism, and Collection of wild plants and animals. To the least extent, the territory of the farms is available for the Organization of private events (entertainment, etc.), Hunting and fishing, and Organization of public events. An insignificant part of the holdings also indicated Other reasons such as Veterinary services, and Control bodies and experts.

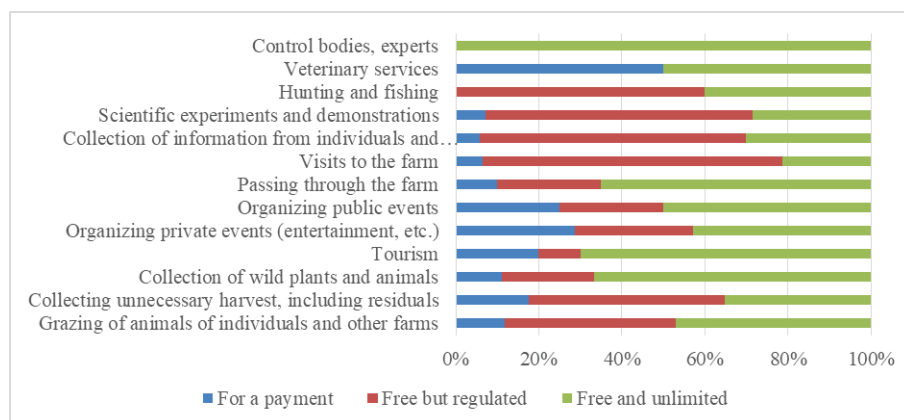
For the different types of external access on the territory of the farms, specific forms for governing the relationship of agents are practiced (Figure 10). *Free and unrestricted access* is the dominant form of providing access to the territory of the farm for Grazing animals of individuals and other farms, Collection of wild plants and animals, Tourism, Organizing private events, Organization of public events, Passage through the farm, Veterinary services, and Control bodies and experts. This form is also practiced by a large number of farms for the Collection of unnecessary harvest, residues, Collection of information from individuals and institutions, Scientific experiments and demonstrations, Visits to the farm, and Hunting and fishing. All these ecosystem services are treated as public goods and their use and consumption

“managed” by providing free and unrestricted access by farms. Most such services are difficult to regulate or exchange as private goods due to high uncertainty and enforcement costs.

In many cases the main form for providing access to the territory for the farm is *Free but regulated* – for Collection of unnecessary crops, residues, Visits to the farm, Collection of information from individuals and institutions, Scientific experiments and demonstrations, and Hunting and fishing. This form is widely used by a large number of farms in allowing access to the territory for Grazing animals of individuals and other farms, Collection of wild plants and animals, Organization of private events, Organizing public events, and Passing through the farm. The use and consumption of this type of agro-ecosystem services are managed through a private form – regulation, and they are provided free of charge by farm owners. The form of free provision is determined either by the additional benefits received by farmers (in case of grazing animals of individuals and other farms, collection of unnecessary crops, residues, collection of wild plants and animals, organization of private and public events, etc.), or from the high enforcement costs – constant control, penalties, disputing through a third party, etc. (in Passing through the farm territory, Hunting and fishing, etc.). Here, regula-

Fig. 10. Type of external access to farm’s territory for use of different ecosystem services in Bulgaria

Source: Survey of agricultural producers, 2020



tion is needed to plan and coordinate external access and/or limit consumption to maintain a sustainable supply.

A portion of farms uses a *market form* of exchange against payment of a price to provide external access to the territory of the farms. This form of sale of services is practiced in grazing animals on individuals and other farms, collection of unnecessary crops, residues, collection of wild plants and animals, tourism, organizing private and public events, passing through the farm, visits to the farm, gathering information from individuals and institutions, scientific experiments and demonstrations, and veterinary services. The market form is preferred because it governs well the supply of “limited” ecosystem services and relationships of counterparts. Market trading is beneficial for both parties, who mutually profit from the transaction, as the terms of exchange are easy for no or low-cost negotiation, control and sanctioning. Here, the classic contract of “spotlike” exchange under standard conditions applies, and payment is made on the spot or in advance to avoid any possible opportunism.

Agricultural holdings with different specializations provide unequal external access on the territory to farms for using different agro-ecosystem services (Figure 11). To the greatest extent outside access to the territory of the farm for grazing animals of individuals and other farms is provided by holdings specialized in Grazing livestock, and Crop-livestock operations. For Harvesting of unnecessary output, incl. residues, most farms providing external access to territory

are among specialized in field crops, and mix crop-livestock. The largest share of crop-livestock farms also allows the collection of wild plants and animals and tourism in their territory. Specialized in grazing livestock to the greatest extent provide external access on the territory of farms for organizing private and public events. Most farms that allow passage through the farm territory are among those specialized in permanent crops, and grazing animals. Most visits to the farm are allowed by farms specializing in grazing animals, and field crops. The largest share of farms that allow the collection of information from individuals and institutions are among those specializing in permanent crops, and grazing animals, and for scientific experiments and demonstrations among specialized in grazing animals and bee families. Every tenth farm with bee families also allows use of territory for hunting and fishing. Therefore, in addition to the product specialization, there is a certain specialization in the provision of agro-ecosystem services related to external access to the farm territory.

Farms with different specializations use unequally different forms for ensuring open access to the territory of farms for the use of ecosystem services. The preferred most efficient mode is (pre)determined by the specificity of production and the use of territory and/or the preferences of owners/managers of the individual farms and the external users of related agro-ecosystem services. For example, for farms specialized in field crops, vegetables and mushrooms, and

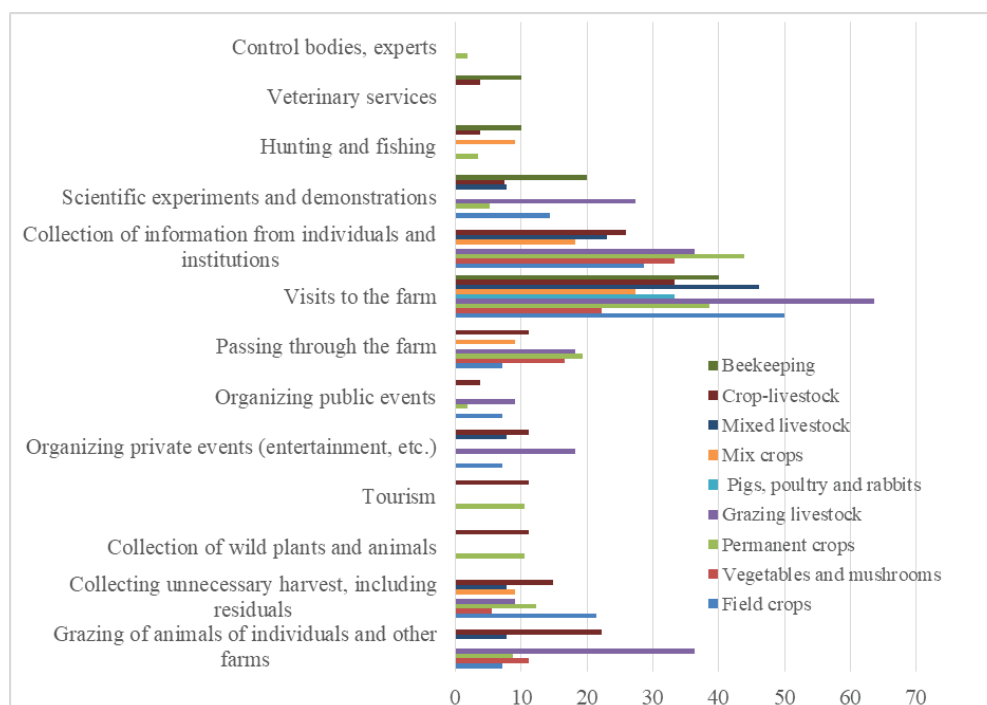
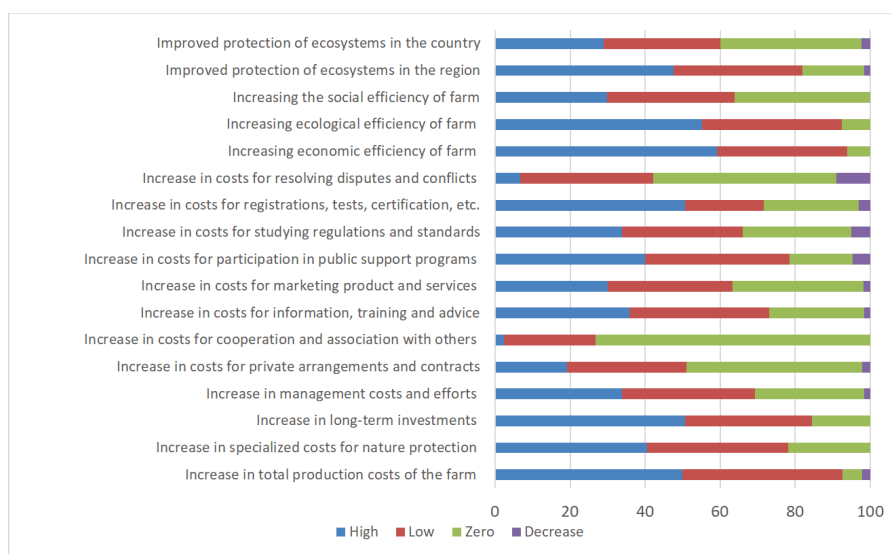


Fig. 11. Share of farms with a different specialization that provides external access to their territory for use of agro-ecosystem services in Bulgaria (percentages)
 Source: Survey of agricultural producers, 2020

Fig. 12. Costs and efficiency of the activity of farms for protection of ecosystems and their services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020



mixed livestock, Free but regulated access is the only form used for providing external access to the territory for grazing animals to individuals and other farms. At the same time, most farms specializing in permanent crops practice Free and Unrestricted Access, while the remaining one-fifth apply for Paid access. Similarly, relations with clients associated with harvesting unnecessary output, incl. residues on the territory of farms specialized in vegetables and mushrooms, grazing livestock and mixed crops are managed entirely on a contractual basis for payment. At the same time, for all other groups of farms, the used form is either Free but regulated or Free and unrestricted access.

Pollination of plants by honeybees is one of the most important agro-ecosystem services. Only 6% of the surveyed farms specialize in beekeeping. At the same time, almost 36% of all farms keep bee colonies as their main or additional activity. The majority of farms keeping bee families (64%) are small with a size between 51 and 150 bee families, and a large part of the rest are micro or self-sufficient farms (29%) farms with a size of up to 50 bee families. Therefore, in addition to service for other farms, bee farms provide basic or additional income to their owners. The farms specialized in bee colonies have an average size of 563.8 bee colonies, and three quarters of these farms are also small in size.

The majority of farms keeping bee colonies (12%) and those specialized in beekeeping (30%) practice *moving hives* near or on the borders of other farms. Therefore, they undertake “active” actions (mobility) to supply the agro-ecosystem service to pollinate the needy farms in permanent crops, vegetables, field crops, essential oils, etc. The benefit is mutual, as beekeepers also need to be close to flowering plantations to increase honey yields and diversify honey range. In both

stationary and mobile beekeeping, no “*payment*” for the service or detailed negotiation of the terms of exchange is practiced, due to the mutual benefit for parties. Specialization of activities in separate types of farms and the free exchange of the service of plant pollination is an effective form, which is confirmed by the fact that only 5% of the holdings specialized in Permanent crops raise bee families. The management of the “*external*” supply of pollination services works well and there is no need for “*internal*” integration of this activity in the majority of those specialized in permanent crops.

Efficiency and importance of farms’ ecosystem services

Protection of ecosystems and their services is associated with an Increase in the total production costs of the farm, Increase of the specialized costs for nature protection, Increase of long-term investments, Increase of management costs and efforts, Growth of the costs of participation in state aid programs, Increase in the costs of studying the regulations and standards, and Increase in the costs of registrations, tests, certification, etc. (Figure 12). Moreover, for the majority of farms this activity leads to a *high* increase in the total production costs of the farm, the specialized costs for nature protection, long-term investments, the costs for participation in state aid programs, and the costs of registrations, tests, certification, etc. At the same time, for only a small part of all farms, environmentally-friendly activity is associated with a *reduction* in the various types of production and transaction costs.

Simultaneously, however, the vast majority of farms report that activities for the protection of ecosystems and their services are also associated with Increasing the economic efficiency of the farm, Increasing the ecological efficiency

of the farm, Increasing the social efficiency of the farm, Improved protection of ecosystems in the region, and Improved protection of ecosystems in the country. At the same time, the majority of farms estimate that their environmentally friendly activity leads to a high increase in the economic efficiency of the farm, the ecological efficiency of the farm, and the protection of ecosystems in the region. None or very

few of the farms indicate that activities for the protection of ecosystems and their services are related to reducing the economic efficiency, environmental and social efficiency of the farm, and the protection of ecosystems in the region and the country. However, a significant share of farm managers believes that their efforts and costs to protect ecosystems and ecosystem services do not lead to changes in the social effi-

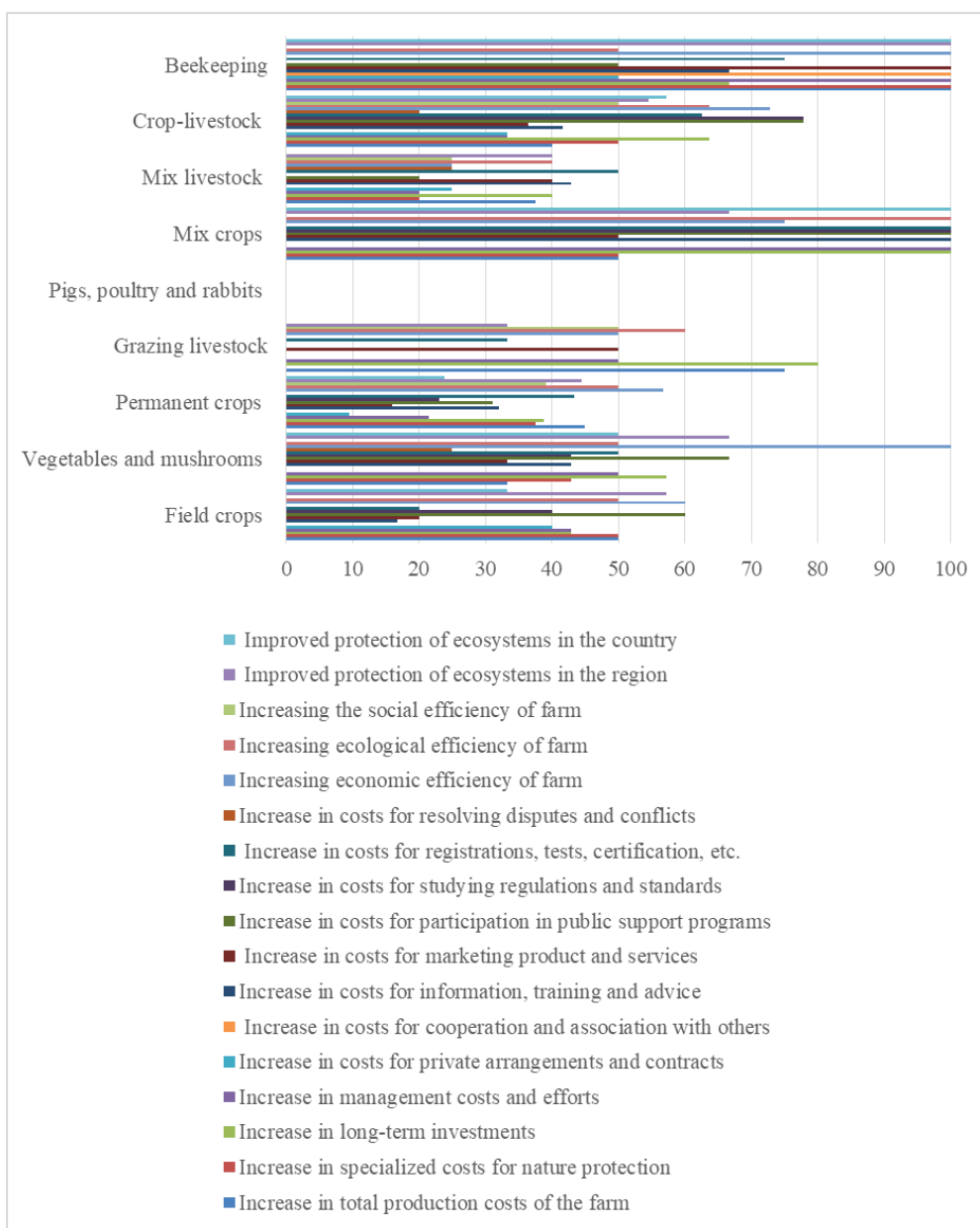


Fig. 13. Share of farms with a *high* increase in costs and efficiency of activity for the protection of ecosystems and their services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

ciency of the farm (36%) and improved protection of ecosystems in the country (38%).

There is significant differentiation in the level of costs and efficiency of farm activities related to the protection of ecosystems and ecosystem services (Figure 13). A high increase in the total production costs of the farm was reported by half of the farms specializing in field crops and mixed crop production, three-quarters of those in grazing animals, and all in bee colonies. The share of farms with a high increase in these costs is the smallest among holdings specialized in vegetables and mushrooms (every third), and none in pigs, poultry and rabbits.

The largest share of farms with a high increase in specialized costs for nature protection are among those specialized in field crops, mixed crops, and crop-livestock production, and bee families. At the same time, relatively few mixed livestock farms report a high increase in this type of cost, and none among specialized in grazing animals and pigs, poultry and rabbits. A high increase in long-term investments for the protection of ecosystems and ecosystem services is most typical for farms specializing in Vegetables and mushrooms, Herbivores, Mixed crop production, Crop-livestock production, and Bee families. The lowest share of farms with high costs of this type is in Permanent crops, and in none farms in Pigs, poultry and rabbits. High increases in management costs and efforts to protect ecosystems and ecosystem services are recorded in most of the farms specializing in Vegetables and Mushrooms and Herbivores, and Mixed crop production and Bee Families. At the same time, relatively few of the farms in Perennials, and Mixed livestock, and none in pigs, poultry and rabbits reported a high increase in these costs.

For a high increase in the costs of private arrangements and contracts related to the protection of ecosystems and ecosystem services, most farms report in Field crops and Bee Families, while in other groups a small number or none have growth in these costs. A high increase in the costs of cooperation and association with others related to the protection of ecosystems and ecosystem services is observed in all farms specializing in beekeeping, while in other categories of farms this type of cost is not typical. The most numerous are the farms with high increase in costs for information, training and advice on ecosystem protection and ecosystem services in those specialized in Mixed crop production, and Bee families, and relatively few in Field crops, and none for Grazing animals, and pigs, poultry and rabbits. The largest share of farms with a high increase in the cost of marketing the product and services related to the protection of ecosystems and ecosystem services is in those specializing in grazing animals and mixed crop production, bee families, rela-

tively few in field crops, and perennials, and none among those in pigs, poultry and rabbits.

Most of the farms report high growth in the costs of participation in state aid programs related to the protection of ecosystems and ecosystem services, among those specialized in field crops, vegetables and mushrooms, mixed crop, and mix crop-livestock production. On the other hand, relatively fewer farms reported similar growth among specialized in perennials and mix livestock, and none of those with grazing animals, and pigs, poultry and rabbits. The high growth of expenditures for studying regulations and standards related to the protection of ecosystems and ecosystem services was noted by the largest number of farms with Mixed crop produces, and Crop-livestock specialization. At the same time, a relatively small proportion of farms specializing in perennials, and none in grazing animals, pigs, poultry and rabbits, mixed livestock and bee colonies reported a similar increase in this costs.

The high growth of expenditures for registrations, tests, certification, etc. related to the protection of ecosystems and ecosystem services is observed in most farms with Mixed Crop Production, Crop-livestock production, and Bee families. This share is lowest on farms in field crops, and on none of those in pigs, poultry and rabbits. High growth in the costs of resolving disputes and conflicts related to the protection of ecosystems and ecosystem services is reported by every fourth farm specializing in Vegetables and Mushrooms and Mixed Livestock and every fifth of those in Bee colonies. However, none of the other holdings reported a similar increase in this type of expenditure.

High increase of the economic efficiency of the farm-related to the protection of ecosystems and ecosystem services is most noted in the farms specialized in Field crops, Vegetables and mushrooms, Mixed crop production, Crop-livestock production, and Bee families, and the least in those in Mixed livestock and none in Pigs, poultry and rabbits. A high increase of the ecological efficiency of the holdings' activity for the protection of ecosystems and ecosystem services is reported by all from Mixed crops farms, and the majority of those with Grazing animals, and Crop and animal husbandry. The lowest share of farms with similar growth is in those specialized in Mixed Livestock, and Pigs, poultry and rabbits. High increasing the social efficiency of the holdings' activity for the protection of ecosystems and ecosystem services is registered by every second farm specializing in Herbivores and Crop-livestock, a smaller part of those in Perennial crops, and Mixed livestock, and from none of the other categories of holdings.

High improved protection of ecosystems in the region, related to the activity of farms for protection of ecosys-

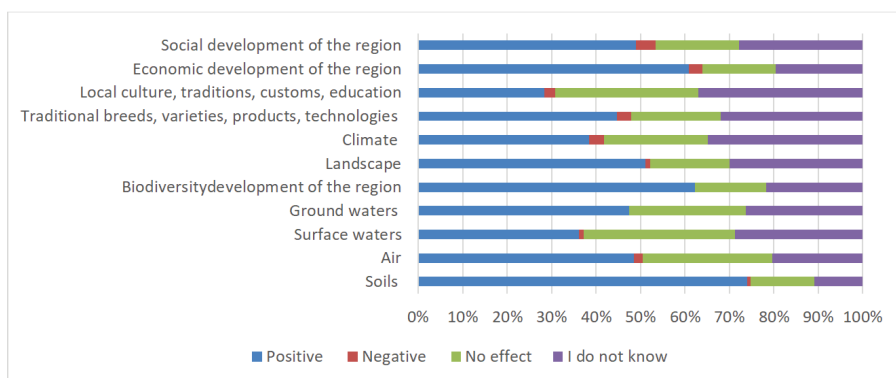


Fig. 14. Effect of farms overall activity on different elements of ecosystems and their services in Bulgaria

Source: Survey of agricultural producers, 2020

tems and ecosystem services is achieved mostly by the farms in Field crops, Vegetables and mushrooms, Mixed crop growing, and Bee families, and relatively the least of those with Grazing animals, and Pigs, poultry and rabbits. High improved protection of ecosystems in the country related to the activities of farms for protection of ecosystems and ecosystem services is reported by all those specializing in Mixed crops and Bee families, and most of those in Mix crop-animal husbandry. The share of farms with a similar effect is the lowest in those specialized in field crops, and perennials, and in none of them in grazing animals, pigs, poultry and rabbits, and mixed animal husbandry.

The vast majority of farm managers estimate that the effect of the overall activity of the farm is positive in terms of soils, biodiversity, landscape, and economic development of the region (Figure 14). Also, the majority of managers believe that the effect is positive in terms of Air, Surfacewaters, Groundwaters, Climate, Traditional breeds, varieties, products, technologies, and Social development of the region, as a relatively smaller part consider a positive effect in terms of Local culture, traditions, customs, education. However, the share of managers who believe that the whole activity of their farm is not associated with any effect on the individual elements of the ecosystem – Soils (14%), Air (29%), Surfacewaters (34%), Groundwaters (26%), Biodiversity (16%), Landscape (18%), Climate (23%), Traditional breeds, varieties, products, technologies (20%), Local culture, traditions, customs, education (32%), Economic (16%) and Social development of the region (19%). In addition, a significant part of managers do not know the effect of the overall activity of agriculture on various elements of the ecosystem – Soils (11%), Air (20%), Surfacewaters (29%), Groundwaters (26%), Biodiversity (22%), Landscape (30%), Climate (35%), Traditional breeds, varieties, products, technologies (32%), Local culture, traditions, customs, educated (37%), Economic development of the region (20%), and Social de-

velopment of the region (28%). The later requires both deepening and expanding independent assessments of the effects of farming on the individual components of ecosystems, and better informing farmers about their negative and/or positive contribution to environmental protection and ecosystem services.

Just over half of the surveyed managers assess the *importance* of their activities for the protection of agro-ecosystems and agro-ecosystem services as High for their farm, and High for themselves (Figure 15). A significant share of managers also believes that their activities for the protection of agro-ecosystems and agro-ecosystem services are of high importance for the region of their farm. There is also a significant number of managers who believe that this activity has a high environmental value, and value for future generations. A relatively smaller part of the managers believes that such activity is of High importance for the community in the region, High market value, and High economic value. At the same time, an insignificant share of managers is convinced that their activity for the protection of agro-ecosystems and agro-ecosystem services has a High contract value, and a High social value or is Without any value, as none of the respondents believes that this activity has a High cultural value.

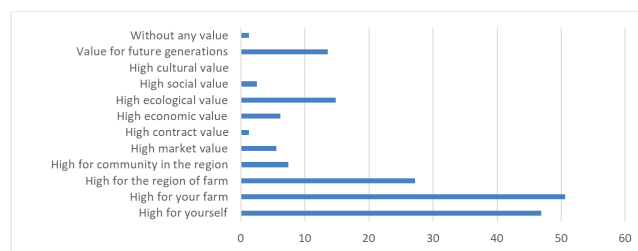


Fig. 15. Assessment of farm managers of the importance of their activity for the protection of agro-ecosystems and agro-ecosystem services in Bulgaria (percentages)

Source: Survey of agricultural producers, 2020

Conclusion

Bulgarian farms maintain or produce a great variety of essential ecosystem services among which provisioning food and feed, and conservation of elements of the natural environment prevail. Diverse private, market, collective and public modes of governance related to farms ecosystem services are used. There is significant differentiation of employed managerial forms depending on the type of ecosystem services and specialization of agricultural holdings. Management of ecosystem services is associated with a considerable increase in the production and transaction costs of participating farms as well as big socio-economic and environmental effects. All these findings give a new valuable information for assisting improvements of public policies, programs and forms of public interventions in agrarian sector, and management strategies of farms of different type.

Suggested holistic framework for analyzing the system of management of agro-ecosystem services is to be extended and improved, and widely and periodically applied in the future. The latter requires systematic in-depth multidisciplinary research in this new area, and collection of “new” type of micro-information on forms, factors, efficiency and impacts of agroecosystem services management. The accuracy of analyzes is to be improved by increasing representativeness through enlarging the number of surveyed farms and related agents, applying statistical methods, special “training” of implementors and participants, etc. as well as improving the official system for collecting agri-environmental information in the country.

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