Multilevel assessment of agrarian sustainability in Bulgaria

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Abstract

The goal of this study is to unpack sustainability in terms of understanding and evaluation using as a case Bulgarian agriculture. A hierarchical system for assessing agrarian sustainability in Bulgaria at national, regional, sub-sectoral, ecosystem and farm level is proposed. It includes 3 aspects(pillars), 17 principles, 35 criteria, and 46 indicators and reference values for evaluating sustainability as well as approach for their integration and interpretation. Assessment is made of agrarian sustainability in the country at various level using aggregate macro and farm level micro data.

The assessment has found out that there is a considerable differentiation in the level of integral and aspects sustainability of different type of farms, ecosystems, subsectors and regions. Nevertheless, results on the integral agrarian sustainability based on macro aggregate and micro farm data are quite similar. The later indicates that both approaches are reliable and could be simultaneously used according to the level of analysis, needs of decision makers, and available data.

Major factors encouraging improving economic sustainability are market demand and price; direct state subsidies; market competition; financial capability; participation in public support programs; possibility of benefitting immediately; possibility of benefitting in the near future; tax preferences; possibility of benefitting in the long term; and integration with buyers of farm products. Main factors encouraging the enhancement of social sustainability are personal convictions and satisfaction; social recognition of individual contribution; immediate benefits for other people and groups; regional community initiatives and pressure; access to advisory services; European Union policy; and existing regional problems and risks. Important factors encouraging environmental sustainability are problems and risks existing at the global scale; official regulations, standards, and norms; existing regional problems and risks; and European Union policies.

Public policies and instruments that improve economic sustainability of Bulgarian agriculture include: direct area-based payments; national top-ups for products and livestock; modernization of agricultural holdings; green payments; support for semi-market farms. At the same time the impact of national and European policies on social and environmental sustainability is relatively weak.

Having in mind the importance of holistic assessments of this kind for improving agrarian sustainability, farm management and agrarian policies, they are to be expended and their precision and representation increased. The latter requires a closer cooperation between and participation of all interested parties as well as improvement of the precision through enlargement of collected statistical data, number of surveyed farms, and incorporating more "objective" data from field tests and surveys, monitoring, expertise of professionals in the area, etc.

Key words: sustainability, assessment, economic, social, ecological, agriculture, Bulgaria

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Introduction

The issue of understanding and assessing agribusiness sustainability is among the most topical for academicians and practitioners (policy makers, businessmen, stakeholders, etc.) alike (Bachev, 2009, 2010, 2016, 2017, 2018; Bachev et. al., 2016, 2017; Candido et al., 2018; FAO, 2013; Fuentes 2004; Hayati et. al., 2010; Ikerd, 2015; Ivanov et al, 2009; Gliessman, 2016; Gemesi, 2007; Gitau et al., 2009; Jalilian, 2012; Irvin et. al., 2016; Lopez-Ridauira et. al. 2002; Rezear et. al, 2018; Sauvenier et al., 2005; Terziev et al., 2018; Todorova and Treziyska, 2018; VanLoon et al. 2005; Zvyatkova and Sarov, 2018).

Despite enormous progress in the theory and practice of this new evolving area, still there is no consensus on how to assess agrarian sustainability due to diverse understandings, approaches, methods, employed data, etc. In Bulgaria (like in most other countries) comprehensive sustainability assessments are mostly on national (Bachev et. al., 2017) or farm (Bachev, 2017; Bachev and Treziev, 2017) levels while there are practically no in-depth studies on agrarian sustainability at regional, sub-sectoral, ecosystems and farm levels.

The goal of this article is to unpack sustainability in terms of understanding and evaluation using as a case Bulgarian agricultue.

Framework of analysis

In the literature and managerial practice agrarian sustainability is defined in a number of ways and still there is no agreement about what agrarian sustainability is and how to evaluate its level. Major approaches for defining agrarian sustainability could be classified into following groups: sustainability as an *alternative ideology* (Edwards et al.; VanLoon et al.); as a *new (set of) strategy/ies* (Mirovitskaya and Ascher); as a *characteristics of agrarian systems* – e.g. "*ability to satisfy a diverse set of goals through time"* (Brklacich et al.; Hansen), *"ability (potential) of the system to maintain or improve its functions"* (Lopez-Ridaura *et al*; Lewandowski *et al*.); as a *"process of learning about changes and adapting to these changes"* (Raman), etc.

Definition of agrarian sustainability has to be based on the "literal" meaning of that term and perceived as a system characteristics and "ability to continue through time". The characterization of sustainability has to be "system-oriented" while the system is to be clearly specified, including its time and spatial boundaries, components, functions, goals, and importance in the hierarchy. That implies taking into account the diverse socio-economic and environment conservation functions of agrarian sector. Sustainability has to reflect both the internal capability of agriculture to function and adapt as well as the external impact of constantly evolving socio-economic and natural environment. Characterization of sustainability must also be predictive since it deals with future changes rather than the past and only the present. In addition, sustainability has to be a criterion for guiding changes in policies, and farming and consumption practices, agents' behavior, for focusing of research and development priorities, etc. Sustainability is to allow facile and rapid diagnostic, and possibility for intervention through identification and prioritizing restrictions, testing hypothesis, and giving possibility for comprehensive assessments. Finally, sustainability is to be easy to comprehend, calculate, and monitor in everyday activity by various agents without being associated with huge costs.

In this paper sustainability is understood as a "system characteristic" and the ability of agriculture to maintain its economic, ecological and social functions over a long period of time. Agrarian sustainability and its individual aspects have multiple dimensions which are equally important and have to be taken into account: economically viability and efficiency; social

responsibility regarding farmers, workers, other agents, communities, consumers and society; and ecological sustainability. Agrarian sustainability is to be evaluated at multiple levels – national, regional, sectoral, eco-system, and farm[2] levels.

For assessing agrarian sustainability, a hierarchical system of well determined and selected principles, criteria, indicators and reference values are developed (Table 1). **Principles** are the highest hierarchical level associated with the multiple functions of agriculture. They are universal and represent the *states of the sustainability, which are to be maintained or achieved* in the three main Aspects - economic, social and ecological. **Criteria** are more precise from the principles and easily linked with the sustainability Indicators representing a *resulting state of agriculture when the relevant Principle is realized*. **Indicators** are *quantitative and qualitative variables* of different type (activity, input, effect, impact, etc.), *which can be assessed* in relation to a particular Criterion. **Reference values** are the *desirable levels* (absolute, relative, qualitative, etc.) for each *Indicator,* which assist the assessment of the *state and levels of sustainability* as well as give *guidance* for achieving (maintaining, improving) agrarian sustainability. They are determined by the *science, experimentation, statistical, legislative, expert or other appropriate ways*.

Two types (macro and micro) Indicators for assessing the level of agrarian sustainability can be used: *Sector level indicators* for agriculture as a whole, for a particular subsector, a specific region, large ecosystem, type of agrarian organizations etc., which are usual based on *aggregated* data from statistical, official report, survey and other sources; *Farm level indicators*, which are based on *first-hand* data collected from different type of farms and agrarian organizations. These micro indicators are to give credible insights for agrarian sustainability as a whole and can be analyzed or/and further aggregated for different management levels.

Detailed description of the approach, procedures, criteria, etc. for formulating and selecting specific sustainability principles, criteria, indicators and reference values in Bulgarian agriculture is explained in another publication (Bachev, 2018; Bachev et al., 2017)

[2] Unlike other systems where individual parcel (plot) is the first level for assessing sustainability (Sauvenier et al., 2005) we proved that the individual farm is such a level since that is the first managerial level to govern sustainability (Bachev, 2016).

Table 1. System for assessing agrarian sustainability in Bulgaria

Principles	Criteria	Indicators		Description	Reference Values	
		Sector	Farm		Sector	Farm
Economic aspect						
Financial stability	Reducing dependence on subsidies	Share of direct payments in Net Income	Share of direct payments in Gross Value Added	Share of direct payments in GVA of a sector; Share of direct payments in Net Income of farms	Experts estimate/ Trend	Experts estimate/ Trend
	Sufficient liquidity	Ratio of overall liquidity	Ratio of overall liquidity	Final stocks to intermediate consumption; Ratio short-term assets to short-term obligations	Experts estimate/ Trend	Experts estimate/ Trend
			Ratio of quick liquidity	Short-term receivables + profit to short-term obligations	Experts estimate/ Trend	Experts estimate/ Trend
	Minimizing dependence on external capital	Ratio of assets growth to interest paid	Share of owned in total capital	Gross formation to interests paid; Share of owned in total capital	Experts estimate/ Trend	Experts estimate/ Average for the sector
Economic effectiveness	Positive or high profitability	Cost - effectiveness	Cost - effectiveness	Net entrepreneurial income to intermediate consumption; Profit to production costs	Experts estimate/ Trend	Experts estimate/ Average for the sector
		Profitability of capital	Profitability of capital	Entrepreneurial income to total assets; Profit to invested capital	Experts estimate/ Trend	Experts estimate/ Average for the sector
	Maximize or increase labor productivity	Labor productivity	Labor productivity	Gross product/Annual Work Unit	Experts estimate/ Trend	Experts estimate/ Average for the sector
	Maximize or increase land productivity	Productivity of land	Productivity of land	Gross crop output/ha	Experts estimate/ Trend	Experts estimate/ Average for the sector
	Maximize or increase livestock productivity	Livestock productivity	Livestock productivity	Gross livestock output/livestock unit	Experts estimate/ Trend	Experts estimate/ Average for the sector
Competitiveness	Support or increase of marketed output	Share of marketed output	Share of marketed output	Share of marketed in gross output	Experts estimate/ Trend	Experts estimate/ Trend

	Support or increase of sales	Share of imported product in the total agricultural production	Sales growth in the last 3 years	Share of imported in total agricultural output	Experts estimate/ Trend	Experts estimate/ Trend
Adaptability to economic environment	Sufficient adaptability to market environment	Ratio of gross income to fixed costs	Ratio of gross income to fixed costs	Ratio of gross income to fixed costs	Experts estimate/ Trend	Experts estimate/ Trend
	High investment activity	Growth of long-term assets	Investment growth	Growth in funding for long term material assets in gross capital formation	Experts estimate/ Trend	Average for the sector/ Trend
Social aspect						
Welfare of employed in agriculture	Equality of income with other sectors	Ratio of agricultural income to the average income in the country	Ratio of farm income to the average income in the region	Ratio of factor income in the agriculture to average income in the economy; Ratio of net farm income to the average income in the region	Experts estimate/ Trend	Experts estimate/ Trend
	Fair distribution of income in agriculture	Variation of payment of hired labor to factor income	Ratio of payment of hired labor in the farm to average income in the region	Increase in salary of employed in agriculture for 3 years period; Ratio of payment of hired labor in agriculture to the same in the region	Experts estimate/ Trend	Average for the sector/ Trend
	Sufficient satisfaction from farm activity	Variation of employed in agriculture to the entire population	Degree of satisfaction from farm activity	Variation of employed in agriculture to the population in the country in last 3 years; Qualitative assessment of the level of satisfaction that farmers receive from agricultural activity	Trend	Farmers assessment
	Satisfactory working conditions	Correspondence to official norms	Correspondence to official norms	Qualitative assessment of the degree of compliance with the official requirements for safe working conditions	Official norms	Official norms
Conservation of farming	Preservation of the number of family farms	Number of family farms	Existence of a heritor ready to take over of the farm	Share of family farms in all registered farms in the country; The existence of a family member ready to take over the farm	Experts estimate/ Trend	Experts estimate/ Trend
		Share of family labor to all employed	Number of family workers	Number of family members involved in farming activities	Experts estimate/ Trend	Experts estimate/ Trend
		Average age of managers	Age of the manager	Average age of the managers; The age of the owner or the manager of the farm	Experts estimate/ Trend	Farmers assessment/ Trend

	Increasing the knowledge and skills	Share of trained farmers	Level of participation in the training programs	Number of trained by the farmers extension services	Experts estimate/ Trend	Experts estimate/ Trend
		Share of the managers with secondary and higher education	Level of education of the manager	Share of managers with high and secondary education in all managers	Experts estimate/ Trend	Experts estimate/ Trend
	Maintaining and increasing of agrarian education	Number of employed with special agricultural education	Number of employed with special agricultural education	Share of employees in agriculture with specialized education and/ or professional qualification in all employed	Experts estimate/ Trend	Experts estimate/ Trend
Gender equality	Equality in men-women relations	Share of female farm managers	Degree of participation of women in farm management	Share of women involved in the management function in total number of managers in farm	Half/Trend	Half/Trend
Social capital	Participation in professional associations and initiatives	Share of farmers which are members of professional associations	Number of participations in professional associations and initiatives	Share of farmers who are members of professional associations; Number of participations in professional associations and initiatives	Experts estimate/ Trend	Experts estimate At least 1 member of the family
		Share of hired labor members of labor unions	Level of hired labor membership in labor unions	Share of membership in labor unions of all employed in agriculture	Experts estimate/ Trend	Experts estimate/ Trend
	Participation in public management	Number of farmers having public positions	Public position	Number of farmers having public positions such as municipal councilor, mayor, parliament, etc.	Experts estimate/ Trend	Experts estimate/ Trend
	Contribution to the development of regions and communities	Share of farm population in general population	Participation in local initiatives	Share engaged in agricultural production in total population of the country Participation in local initiatives	Experts estimate/ Trend	Experts estimate/ Trend
Adaptability to the social environment	Sufficient ability to respond to the ceasing farming activity and the demographic crisis	Change in gross fixed capital formation to the change in the number of people employed in agriculture	Vacant job positions in the farms to the total number of employed.	Ratio of the change in gross fixed capital formation to the change in the number of employees; Share of vacant job positions in the farm	Experts estimate/ Trend	Experts estimate/ Trend
Ecological aspect						
Air quality	Maintaining and improving air quality	Reduction of CO_2 emissions	Reduction of CO_2 emissions	Growth of carbon emissions for the past three years	Trend	Trend

Land quality	Minimizing soil losses	Soil erosion index	Soil erosion index	Share of farmland with strong water and wind erosion in the total agricultural areas	Scientific norm/ Trend	Scientific norm/ Trend
	Preservation and improvement of soil fertility	Amount of nitrogen fertilization	Amount of nitrogen fertilization	Amount of nitrogen fertilizers used per unit area	Scientific norm/ Trend	Scientific norm/ Average for the sector
		Amount of potassium fertilization	Amount of potassium fertilization	Amount of potassium fertilizers used per unit area	Scientific norm/ Trend	Scientific norm/ Average for the sector
		Amount of phosphorus fertilization	Amount of phosphorus fertilization	Amount of phosphorus fertilizers used per unit area	Scientific norm/ Trend	Scientific norm/ Average for the sector
	Maintaining a balanced land use structure	Share of arable land (without fallow) in total agricultural areas	Share of arable land (without fallow) in total agricultural areas	% of arable land (without fallow) in total agricultural areas	Scientific norm/ Trend	Scientific norm/ Average for the sector
	Preservation of landscape features	Amount of area covering the requirements for “green” direct payments through maintaining landscape elements	Amount of area covering the requirements for “green” direct payments through maintaining landscape elements	Share of areas that meet the requirements for maintaining landscape elements	Planed target/ Trend	Experts estimate/ Trend
Water quality	Maintaining and improving water quality	Index of groundwater pollution	Index of groundwater pollution	Share of ground waters strongly polluted with Nitrates	Scientific norm/ Trend	Scientific norm/ Average for the sector
Effective energy consumption	Minimizing the use of conventional energy	Fuel consumption per unit area	Fuel consumption per unit area	Fuel consumption of the agricultural machinery and for production activities per unit area	Experts estimate/ Trend	Experts estimate/ Average for the sector
		Cost of conventional electric energy per unit of gross output	Cost of conventional electric energy per unit of gross output	Growth in electric energy consumption per unit of production for the last three years	Experts estimate/ Trend	Trend/ Average for the sector
Biodiversity	Maintaining or enhancing natural habitats	Change in the number of habitats	Change in the number of habitats	Number of habitats in the agricultural areas; Presence of protected habitats on the farm	Experts estimate/ Trend	Trend/ Average for the sector

		Share of agricultural land in NATURA 2000 and other protected areas	Share of agricultural land in NATURA 2000 and other protected areas	Share of agricultural lands within the scope of Natura 2000	Planed target/ Trend	Planed target Trend/
	Preserving and improving the biodiversity	Number of cultivated indigenous plant species	Number of cultivated plant species	Number of species cultivated in the farms; Growth in the number of indigenous plant species cultivated by farmers	Experts estimate/ Trend	Trend/ Average for the sector
Animal welfare	Compliance with the principles of animal welfare	Level of compliance with the principles of animal welfare	Level of compliance with the principles of animal welfare	Share of livestock in compliance with the animal welfare requirements; Share of farms in compliance with animal welfare requirements in all livestock farms.	Official norms	Official norms
Implementation of organic production	Increasing the organic production	Share of areas under conversion or certified for organic production	Share of areas under conversion or certified for organic production	Share of areas certified for organic production or undergoing conversion	Planed target/ Trend	Experts estimate/ Trend
Adaptability to the environment	Sufficient adaptability to climate change	Variation in the yield of main crops	Variation in the yield of main crops	Variation in crop yields in 5-year period	Experts estimate/ Trend	Average for the sector/ Trend
		Share of production losses in gross output in livestock sector	Death rate in livestock farms	Ratio of losses to gross output in livestock production; Share of dead animals during the year in the average number of livestock units in the farm during the year	Experts estimate/ Trend	Average for the sector/ Trend

Source: author

For assessing agrarian sustainability at national level available official sources are used – EUROSTAT, DG Agriculture and rural development, National Statistical Institute, Department "Agrostatistics" at the Ministry of Agriculture and Forestry, Ministry of environment and waters etc. For some of the indicators expert assessments are employed.

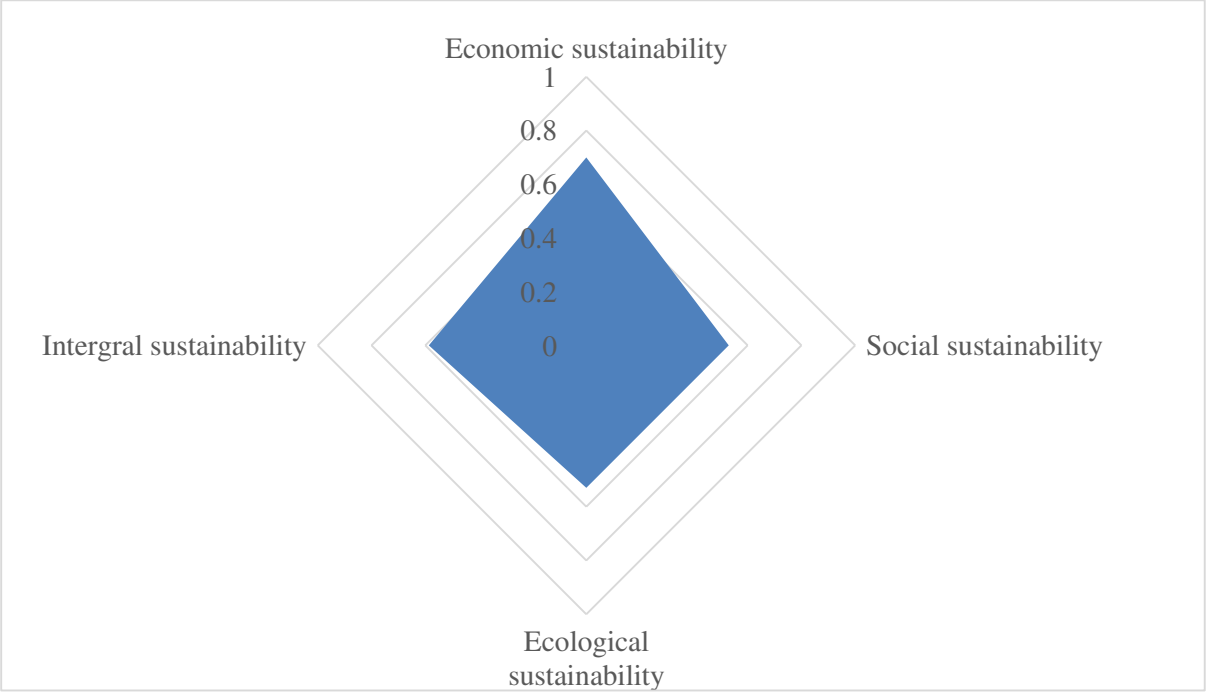
In order to assess the level of sustainability at farm, agro-ecosystem, sub-sector, and regional level in-depth interviews with the managers of 80 farms of different types and locations in 4 major regions of Bulgaria were held in 2017. "Typical" for the different regions, subsector and eco-system farms are identified with assistance of main associations of agricultural producers (National Association of Grain Producers, National Union of Gardeners, Union of Breeders, etc.), state agencies (National Agricultural Advisory Service, Executive Agency for Vine and Wine, etc.), processing, bio-certification and service organizations, and local government. Farmers of different types were surveyed covering the main types of farms in the regions concerned: different legal types of holdings - natural persons, sole traders, cooperatives, commercial companies, etc. .; farms of different sizes - mainly for self-sufficiency, with small size for the sector, with average size for the sector, with large sizes for the sector; farms in different production specialization - arable crops, vegetables, flowers and mushrooms, perennials, grazing livestock, pigs, poultry and rabbits, mixed crops and mixed livestock breeding; farms in specific geographic and ecological locations The survey included questions related to primary information for calculating economic, social and ecological indicators for agribusiness sustainability.

After calculation of each indicator at national and farm level they were transformed into a unitless index of sustainability. The integral index for a particular criterion, principle, and aspect of sustainability, and the integral sustainability index for each surveyed farm is calculated applying equal weight for each indicator in a particular criterion, of each criterion in a particular principle, and each principle in every aspect of sustainability. The composite sustainability index of a particular type of farm, agro-ecosystem, sub-sector and region is an arithmetic average of the indices of relevant farms belonging to that group. For assessing the level of agribusiness sustainability the following scale defined by the experts is used: 0,85-1 for a high level; 0,50-0,84 for a good level; 0,25-0,49 for a satisfactory level; 0,12-0,24 for an unsatisfactory; 0-0,11 for non-sustainability.

Agrarian sustainability at national and farm level

Assessment based of aggregate statistical etc. data at national level has found out that the Integral sustainability of agriculture in Bulgaria is at good level (index of sustainability 0,59) with a higher level of Economic sustainability (0,7) and lower levels for Social and Ecological sustainability (0,53) (Figure 1).

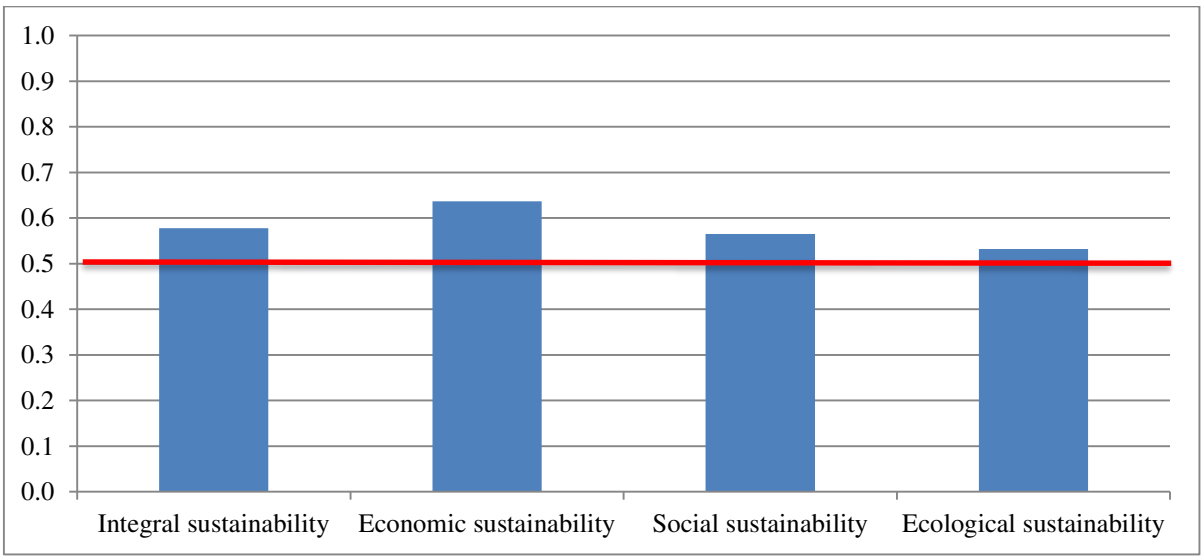
Figure 1. Integral, Economic, Social and Ecological Sustainability of Agrarian in Bulgaria - national level



Source: own calculations, based on NSI, Agrostatistics department

The multi-indicator assessment of agricultural sustainability based on farm data in the analyzed regions shows that the integral indicator of overall sustainability is 0,58, which expresses a good sustainability level of agriculture (Figure 2). The biggest value has the indicator of economic sustainability (0,64), the social sustainability shows lower value (0,57) and the ecological sustainability is close to the unsatisfying value level (0,53). Therefore, the improvement of the last two indicators is critical for maintaining the good agricultural sustainability of the country.

Figure 2. Indicators of integral, economic, social and ecological sustainability of agriculture in analyzed regions of Bulgaria



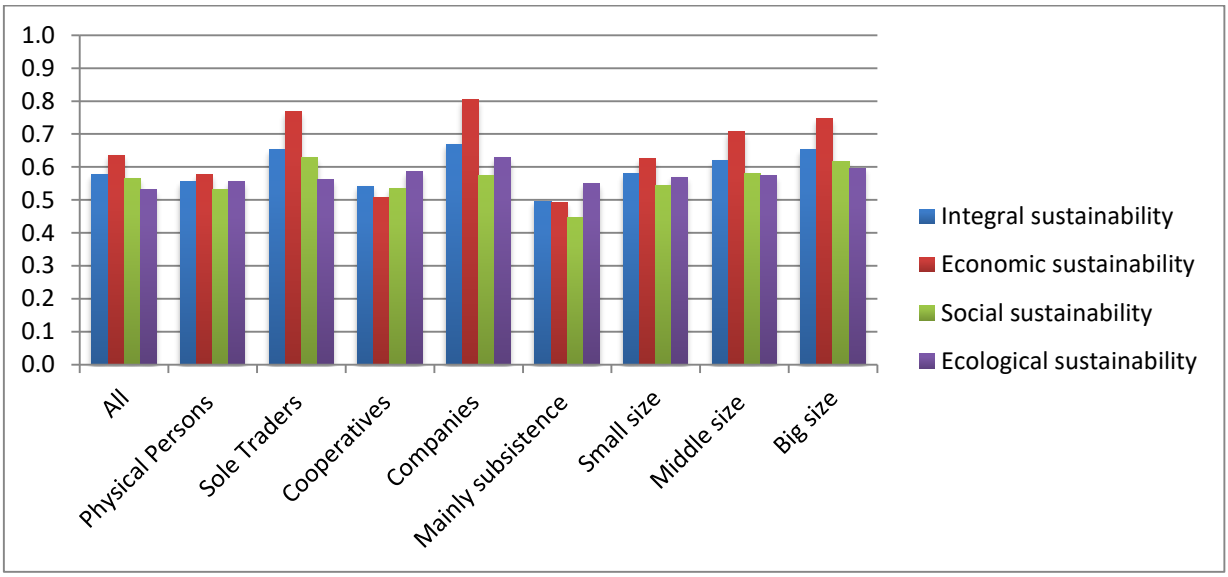
Source: survey with managers of farms, 2017 and author's calculations

Integral assessment results based on the micro (farm) data are similar with the results based on aggregated sectoral (statistical, etc.) data. It means that both approaches are reliable and could be simultaneously used for assessing agrarian sustainability at various level – sector, subsector, region, agro-ecosystem, and farm.

Agrarian sustainability at farm, subsector, ecosystem and regional levels

Different types of farming organizations are characterized with unlike sustainability levels (Figure 3). Among the farms with different juridical status the trade associations show the highest agricultural sustainability (0,67), contribution the most for the agricultural sustainability of the country. In these organizational and management structures the economic (0,8) and ecological (0,63) aspects of agricultural sustainability have the highest levels, while the social sustainability is on average for the country level. The social sustainability is highest for sole traders (0,63), whose integral (0,65) and economic (0,77) sustainability is on the second place and are close to the values of the trade associations.

Figure 3. Agrarian sustainability at farm level in Bulgaria



Source: survey with managers of farms, 2017 and author's calculations

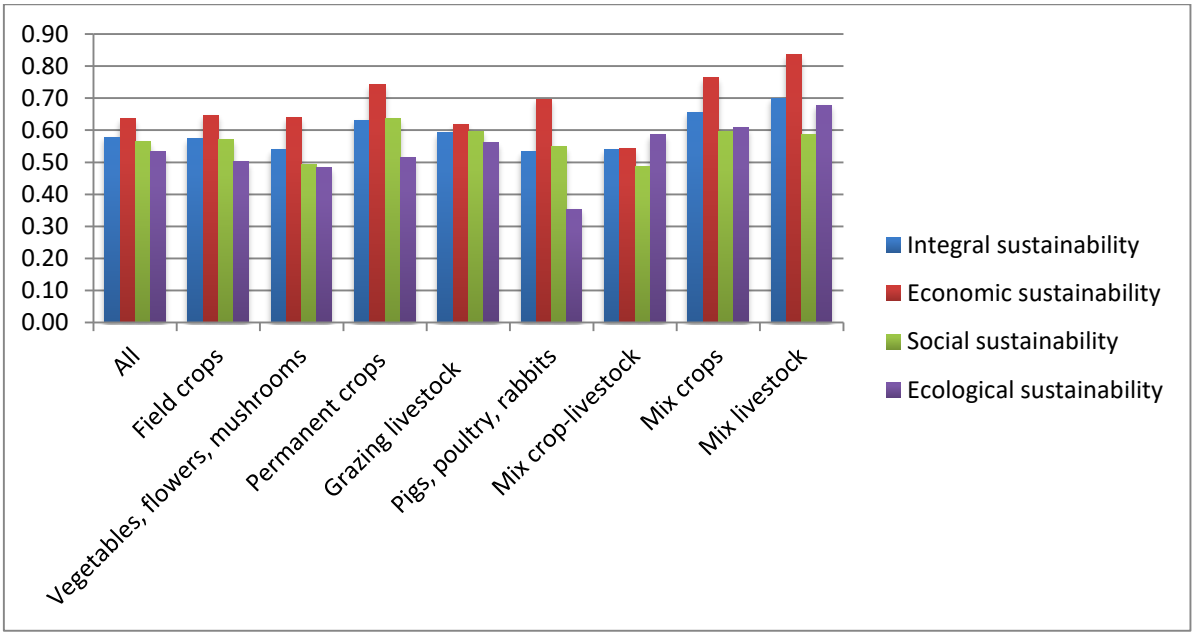
The agricultural production in cooperatives has the lowest integral sustainability (0,54), which economic sustainability (0,51) is on the border with the satisfying level, and the social sustainability is the lowest, the same level as for individuals (0,53). The cooperatives have ecological sustainability of the production on relatively high level (0,59). The agricultural production of individuals has integral sustainability under the average level (0,55) with lower than the average for the economic (0,58) and social (0,53) sustainability.

The agricultural sustainability in farms with different market orientation and sizes is also characterized by different levels and contribution to the integral agricultural sustainability in the country (Figure 3). The highest integral sustainability is shown by the large farms (0,65), having the highest economic (0,75), social (0,62) and ecological (0,6) sustainability. Therefore, these farms contribute in biggest degree for the increase of the integral level of agricultural sustainability in the country. In predominantly self-subsistence farms the agricultural sustainability if low, close to the satisfying level (0,5). In these farms all the aspects of agricultural sustainability have low levels, in comparison to the large and market oriented farms, as the economic (0,49) and social (0,45) sustainability are satisfying. There is a trend to decrease of the levels of integral, economic and social sustainability with the decrease of the

farm sizes. The ecological sustainability of farms with small and medium sizes has the same levels, which are lower than of the bigger farms, but higher than the levels of self-subsistence farms.

Individual sub-sectors also demonstrate diverse level of sustainability (Figure 4). The highest integral sustainability has shown by the mixed livestock-breeding (0,7) and mixed crop-growing (0,66) subsectors, followed by the perennial crops (0,63). Therefore, the mixed livestock-breeding and crop-growing subsectors and those with perennials contribute in highest degree for improving the integral sustainability of Bulgarian agribusiness. From the other hand, the subsectors specialized in pigs, poultry and rabbits (0,53); vegetables, flowers and mushrooms (0,54) and mixed livestock-crops (0,54) have the lowest integral sustainability. This means that they decrease in a biggest degree the integral sustainability in the country.

Figure 9. Agrarian sustainability at sub-sector level in Bulgaria



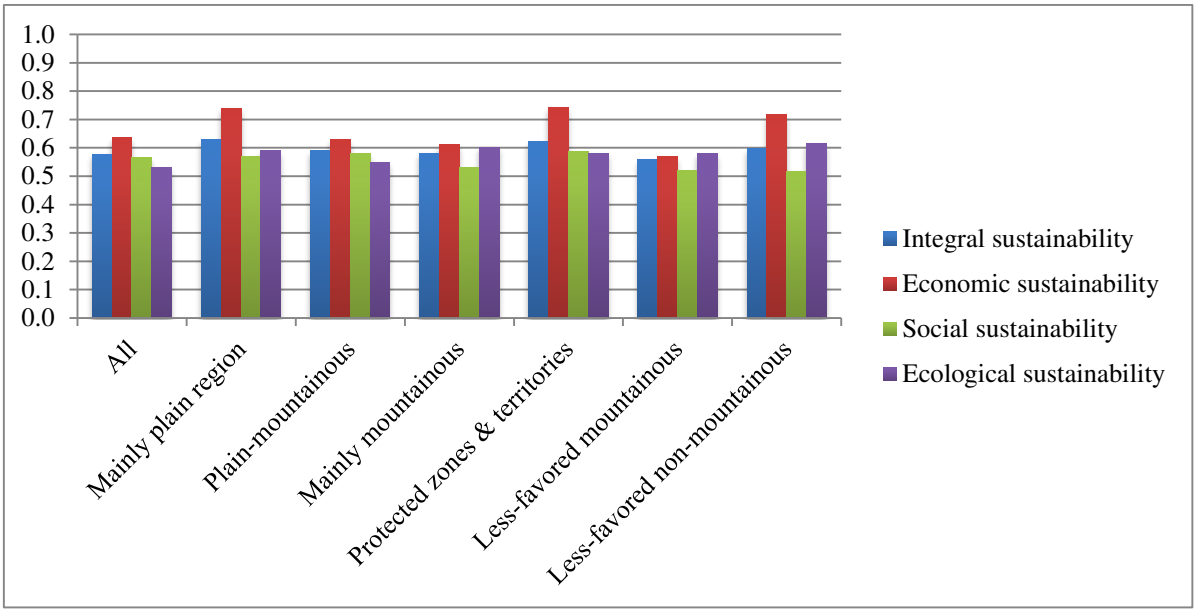
Source: survey with managers of farms, 2017 and author's calculations

Similar to integral sustainability, the sub-sectors with the highest economic sustainability are: mixed livestock breeding (0,84), mixed crop growing (0,76) and perennial crops (0,74). The mixed crop-growing production has the highest ecological sustainability (0,61) and one of the best social sustainability (0,6). The perennial crops sector has high social sustainability (0,64), but lower than the average and almost satisfying ecological sustainability (0,51). The social sustainability of farms specialized in grazing livestock has comparatively high level of social sustainability (0,6). The social sustainability in mixed crop-livestock farms has satisfying level (0,49). The pigs, poultry and rabbits' farms have lowest and satisfying level (0,35), like the farms for vegetables, flowers and mushrooms (0,48). The field crops farms have good, but relatively low ecological sustainability (0,5), close to the satisfying level.

Our assessment determined that there is a considerable differentiation of the level of integral and aspect sustainability in agricultural ecosystems of mail and specific types as well (Figure 5, 6). The highest integral sustainability has the agriculture in the plane regions (0,63), which have also the highest economic sustainability, with the ecosystems in protected zones and territories (0,74). On the other hand, the integral sustainability in mountain regions with natural restrictions is the lowest (0,56). These ecosystems' type has also the lowest (and close to the limits of satisfying level) levels for social sustainability, with the ecosystems in non-

mountain regions with natural restrictions (0,52). Nevertheless, the ecological sustainability of agro-systems in mountain areas with natural restrictions is relatively high (0,58).

Figure 5. Level of sustainability in the main types of agro-ecosystems in Bulgaria

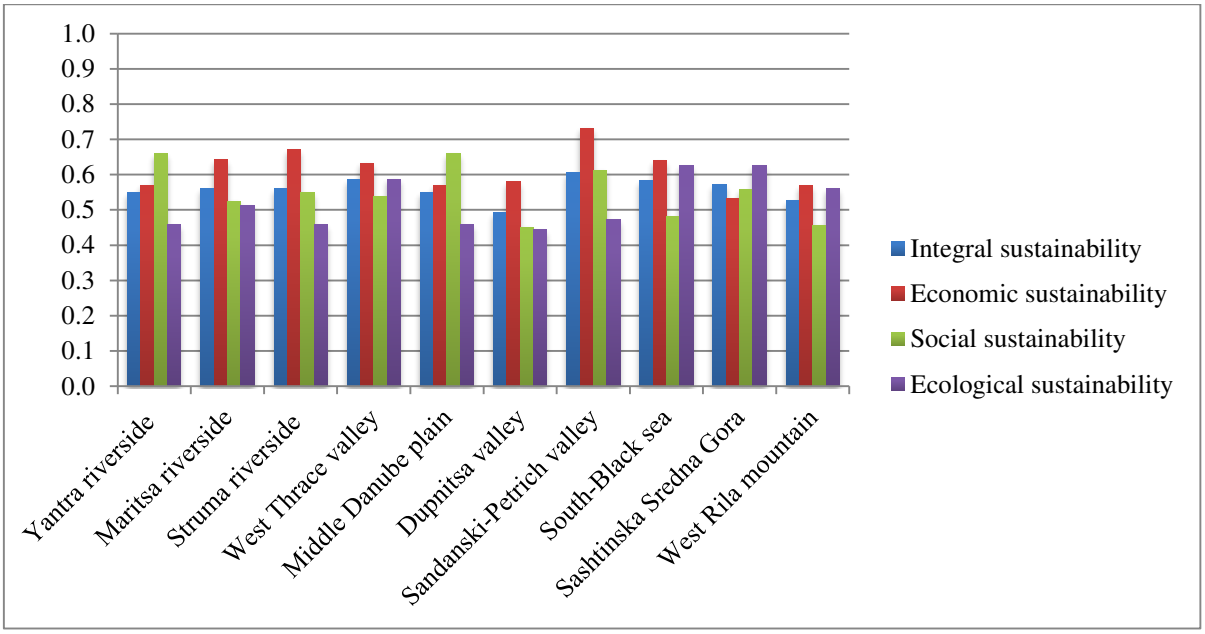


Source: survey with managers of farms, 2017 and author's calculations

The integral sustainability of mountain ecosystems is on a medium level (0,58), but while its economic and social aspects are below the average for the country (respectively 0,61 and 0,53), the level of ecological sustainability is among the highest (0,6). The agricultural sustainability in the protected zones and territories is above the average for the country (0,62), these ecosystems having relatively high economic sustainability (0,74; the highest level of social sustainability (0,59) and good levels for ecological sustainability (0,58). the ecological sustainability in the plane-mountainous regions is the lowest in the country (0,55), and for the non-mountainous regions with natural restrictions it is the highest (0,61).

Similarly, from identified and analyzed 10 specific agro-ecosystems, the highest integral sustainability has Sandanski-Petrich hollow (0,61), with economic sustainability with highest values (0,73), social sustainability with also high values (0,61), while the ecological sustainability is among the lowest in the country and on satisfying level (0,47) (Figure 6). On the other hand, the integral sustainability of agriculture in Dupnitsa hollow is on the lowest level (0,49) and the only one with satisfying level among the analyzed ecosystems. In this ecosystems the levels of social (0,45) and ecological (0,45) sustainability are satisfying and the lowest among the analyzed.

Figure 6. Levels of sustainability in the specific agro-ecosystems in Bulgaria



Source: survey with managers of farms, 2017 and author's calculations

The integral sustainability of agro-ecosystems in the areas alongside the rivers Yantra, Maritsa and Struma is on a relatively low (under the average) level – respectively 0,55, 0,56 и 0,56. However, there is a big differentiation of different aspects of sustainability in these specific ecosystems. For the eco-system alongside Struma river the economic sustainability is on a high level (0,67), while for Yantra riverside it is slightly below the average for the country. On the other hand, the area alongside Yantra has the highest level of social sustainability (0,66), whereas the area alongside Maritsa has the lowest social sustainability and close to the limit of the satisfying level (0,52). For the three riverside ecosystems the ecological sustainability of the sector is below the average values for the country, as for Maritsa riverside the value is on the border of the satisfying level (0,51), and for the other riverside ecosystems – on satisfying level (by 0,46).

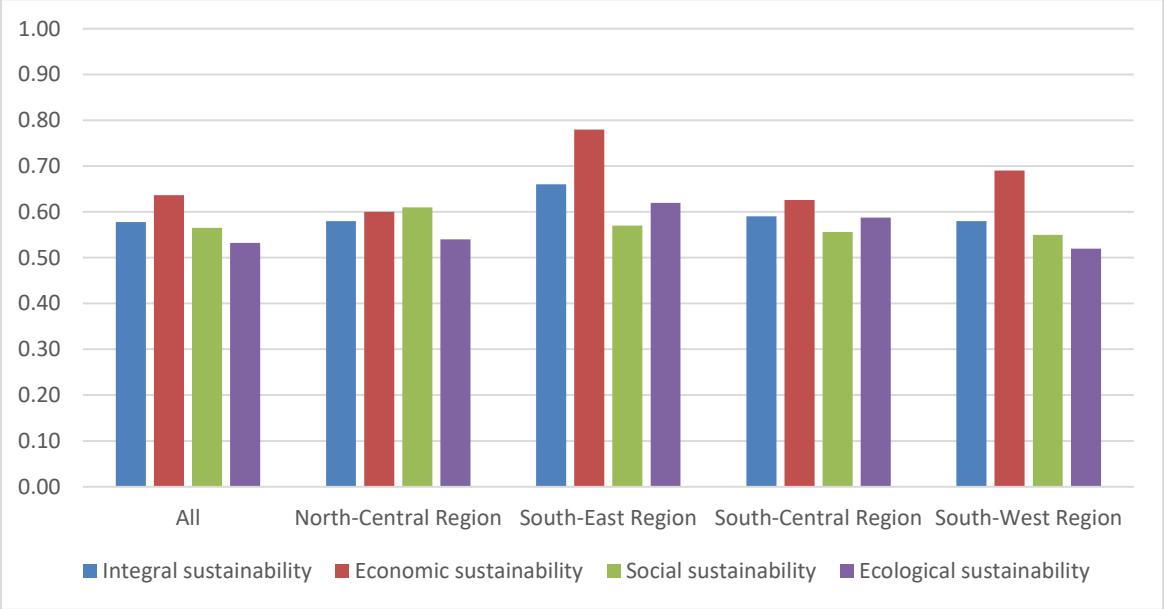
The agro-ecosystem Middle Danube plain has relatively low integral sustainability (0,55), with levels of social sustainability among the highest in the country (0,66), and from ecological aspect on the satisfying level (0,46) and among the lowest for the country. The agriculture in the West Thrace valley has integral sustainability on a relatively high level and over the average for the country (0,59). This agro-ecosystem has good economic sustainability, over the average (0,67), with one of the highest levels of ecological sustainability (0,59), but relatively low and under the average social sustainability (0,54).

Both analyzed specific mountain agro-ecosystems have lower integral sustainability than the average – respectively 0,57 for Sashtinska Sredna Gora, and 0,53 for West Rila mountain. The social (0,56) and the ecological (0,63) sustainability of Sashtinska Sredna Gora are higher than the values of West Rila mountain (respectively on satisfying level 0,46 and good level 0,56), whereas for the economic sustainability is the opposite (0,53 and 0,57). Sashtinska Sredna Gora and South Black sea cost have the highest indicators for ecological sustainability among all analyzed specific ecosystems in the country. The integral sustainability of agriculture of South Black sea is on the average level for the country - 0,58, while the economic sustainability is on a middle level (0,64), the social sustainability is satisfying (0,48), and the ecological is the best of all analyzed (0,63).

Finally, there is a big variation in levels of agricultural sustainability in different geographical and administrative regions of the country (Figure 7). The agribusiness

sustainability has the highest level in the South-East region (0,66), at considerably higher level of economic (0,78) and ecological sustainability (0,62) in comparison to the rest three analyzed regions. The lowest levels of integral sustainability are in the North Central and South-West regions (0,58 each one). The first of mentioned regions has the highest social sustainability (0,61) among the analyzed; under the average economic (0,6) and slightly over the average ecological (0,54) sustainability. The second region has relatively high economic sustainability (0,69) and under the average levels social (0,55) and ecological (0,52) sustainability. South Central region has slightly above the average integral sustainability (0,59) and levels under the average for the economic (0,63) and social (0,56) ones and over the average level for the ecological sustainability (0,59).

Figure 7. Level of agrarian sustainability in different geographical and administrative regions of Bulgaria



Source: survey with managers of farms, 201 7 and author's calculations

Factors for improving agrarian sustainability in Bulgaria

Diverse social, economic, market-related, ideological, and personal factors stimulate or restrict the activities of farming in terms of sustainable operation and development.

According to the managers of surveyed farms, factors encouraging farming enterprises to improve economic sustainability include: market demand and price; direct state subsidies; market competition; financial capability; participation in public support programs; possibility of benefitting immediately; possibility of benefitting in the near future; tax preferences; possibility of benefitting in the long term; and integration with buyers of farm products. Factors considered critical by a smaller proportion of enterprises include: regional community initiatives and pressure; social recognition of individual contribution; pressure and initiatives of interest groups; immediate benefits for other people and groups; and professional training for managers and hired labor.

Factors encouraging the enhancement of social sustainability for the greatest number of farms include: personal convictions and satisfaction; social recognition of individual contribution; immediate benefits for other people and groups; regional community initiatives

and pressure; access to advisory services; European Union policy; and existing regional problems and risks. For a small number of enterprises, important factors encouraging social sustainability include: state control and sanctions; existence of long-term contracts with the state; registration and certification of products and services; tax preferences; and integration with suppliers.

Factors encouraging environmental sustainability include: problems and risks existing at the global scale; official regulations, standards, and norms; existing regional problems and risks; and European Union policies. Significant factors encouraging ecological sustainability for a small number of enterprises include: integration with suppliers; tax preferences; existence of long-term contracts with the state; market demand and price; integration with buyers; market competition; initiatives and pressure from interest groups; partners available for cooperative activities; initiatives of other farmers; and the possibility of garnering immediate benefits.

These motives need to be examined in relation to the modernization of public policy and the establishment of programs for sustainable development of agro-ecosystems in Bulgaria.

This survey has found that current public policies and diverse instruments of public support that improve the economic sustainability of farming enterprises in Bulgaria include: direct area-based payments; national top-ups for products and livestock; modernization of agricultural holdings; green payments; support for semi-market farms. Measures that could considerably improve the economic sustainability of a small number of holdings include: afforestation and restoration of forest; restoration and development of residential areas; stimulation of rural tourism; and the provision of services to residents of rural areas.

The impact that national and European policies have on the social and environmental sustainability of Bulgarian farming enterprises is relatively weak. Instruments that could augment the social sustainability of the majority of farming enterprises include: strategies for local development; the provision of services to residents of rural areas; restoration and development of residential areas; and stimulation of rural tourism. The social sustainability of a small number of holdings could be improved by ecological measures such as: payments for Natura 2000; agricultural environmental payments; and greater support for organic farming.

The most important actions to improve the environmental sustainability of farming enterprises include: green payments; support for organic farming; obligatory standards, norms, rules, and restrictions; and agro-environmental payments. Public instruments that would have the least impact on ecological sustainability of Bulgarian farming enterprises at the current stage of development include: support for setting up micro-enterprises; establishing produce organizations; support for semi-market farms; diversification into non-agricultural activities; support for young farmers; and restoration and development of residential areas

There is a difference shown between individual instruments of public policy and their impact on the sustainability of farming enterprises of different types and agro-eco-systems. Mechanisms and instruments of national and European policy with the greatest impact in improving the sustainability of Bulgarian farming enterprises include:

1) Obligatory standards, norms, rules, and restrictions in terms of the governance of big enterprises and the environmental sustainability of enterprises specializing in pigs, poultry, and rabbits. 2) Direct area-based payments to improve the economic sustainability of: sole traders, cooperatives, companies, holdings of small size for their sector; enterprises specializing in pigs, poultry, and rabbits, mixed crops, and permanent crops; and enterprises located in non-mountainous regions with natural handicaps, those with land in protected zones and territories, the majority of those in mountainous regions, mountainous regions with natural handicaps, and those in the southwest and south-central regions of the country. 3) National top-ups for products and livestock to improve the economic sustainability of: companies, holdings predominantly for subsistence, and those specializing in grazing livestock; the majority of those in mountainous regions, those with land in protected zones and territories, and those located in

the north-central and southwest regions of the country; 4) Green payments to improve the economic sustainability of enterprises located in mountainous regions, those with land in protected zones and territories, and those in the southwest region of the country. 5) Professional training and advice for large enterprises. 6) The modernization of agricultural holdings to improve the economic sustainability of: sole traders and companies; those specializing in mixed livestock and mixed crops; and those located in mountainous regions and in the north-central and south-central regions.7) Support for semi-market farms and the establishment of produce organizations to improve the economic sustainability of holdings predominantly for subsistence.8) Natural handicap payments to farmers in mountainous areas to improve the economic sustainability of farming enterprises located in such areas.

All these data on the real impact that individual mechanisms and instruments of public support have on different aspects of sustainability among Bulgarian farming enterprises need to be taken into account when seeking to improve policies and programs supporting agricultural sectors and enterprises of diverse types and agro-ecosystems.

Conclusion

This first in kind attempt for multilevel assessment of agrarian sustainability in Bulgaria let make some important conclusions about the state of sustainability at national, sub-sectoral, regional, ecosystem and farm levels and factors for its improvment. Elaborated and experimented holistic framework gives a possibility to improve general and aspects sustainability understanding and assessment. That novel approach has to be further discussed, experimented, improved and adapted to the specific conditions and evolution of agricultural systems of various types as well as needs of decision-makers at various levels – farmers, interest's groups, government officials, policy-makers, etc.

There is a considerable differentiation in the level of integral and aspects sustainability of different type of farms, ecosystems, subsectors and regions. Nevertheless, results on the integral agribusiness sustainability based on the micro aggregate and micro farm data are quite similar. The later indicates that both approaches are reliable and could (have to) be simultaneously used according to the level of analysis, needs of decision makers, and available data.

Major factors encouraging improving economic sustainability are market demand and price; direct state subsidies; market competition; financial capability; participation in public support programs; possibility of benefitting immediately; possibility of benefitting in the near future; tax preferences; possibility of benefitting in the long term; and integration with buyers of farm products. Main factors encouraging the enhancement of social sustainability are personal convictions and satisfaction; social recognition of individual contribution; immediate benefits for other people and groups; regional community initiatives and pressure; access to advisory services; European Union policy; and existing regional problems and risks. Important factors encouraging environmental sustainability are problems and risks existing at the global scale; official regulations, standards, and norms; existing regional problems and risks; and European Union policies.

Public policies and instruments that improve economic sustainability of Bulgarian agriculture include: direct area-based payments; national top-ups for products and livestock; modernization of agricultural holdings; green payments; support for semi-market farms. At the same time the impact of national and European policies on social and environmental sustainability is relatively weak.

Having in mind the importance of holistic assessments of this kind for improving agribusiness sustainability, farm management and agrarian policies, they are to be expended and their precision and representation increased. The latter requires a closer cooperation between and participation of all interested parties as well as improvement of the precision

through enlargement of collected statistical data, simple of surveyed farms, and incorporating more "objective" data from field tests and surveys, monitoring, expertise of professionals in the area, etc.

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