

# Agroforestry in Bulgaria: history, presence status and prospects

Vania Kachova · Georgi Hinkov · Emil Popov ·  
Lyubcho Trichkov · Rosa Mosquera-Losada

Received: 18 November 2015 / Accepted: 20 September 2016  
© Springer Science+Business Media Dordrecht 2016

**Abstract** Agroforestry is a multifunctional, environmentally-friendly and modern system of land use by which we can reach economic, environmental and social benefits for the society. Bulgaria has achieved good results in the establishment of agroforestry practices, such as: protective forest belts, forest farming (agricultural use of forest areas), silvopasture (forest-grassland complexes). Moreover there are also legal basis and political understanding for promoting these types of systems. Missing, however, entire Concept and Strategy of supporting the development of agroforestry in the country. There is a strong need for the introduction and elaboration of best practices and new agroforestry technologies in the country where agricultural areas cover 47 % and forest areas 37 % from the territory. As a modern form of land use, agroforestry is a viable alternative for providing good income for land owners in many areas of the country, particularly these which livelihood are formed by a tobacco-production. Agroforestry can pushed up

agricultural returns by diversification of production and can give many ecological and social benefits for society. The perspectives are targeted at the production of forest fruit tree species with high value tree timber, and forest farming.

**Keywords** Shelterbelts · Silvopasture ·  
Agricultural use · Forest plantation

## Introduction

In the context of the ongoing economic and energy crises affecting global and European market, and the observed climate change, the Social Community is also facing the need to seek new opportunities, economic approaches and mechanisms. Concepts of “Smart Growth”, “Green Economy”, “Smart Farms”, “Climate-Smart Agriculture”, “Smart Cities”, “Green Infrastructure” are widely accepted. Agroforestry (AF) as a system for promoting rural areas development also attracts special attention and funding. The successful use of agroforestry systems leads to steady and proven increase in overall farm production, conservation and improving the soil fertility, positive impact on the local climate, increase of quantity and quality of water resources, enhancement the diversity of local economy etc. (Garett et al. 1994; Nair and Graetz 2004; McAdam et al. 2009; Gold et al. 2013). Improvement of higher

---

V. Kachova (✉) · G. Hinkov · E. Popov  
Forest Research Institute, Bulgarian Academy of  
Sciences, Sofia, Bulgaria  
e-mail: vania\_kachova@abv.bg

L. Trichkov  
Executive Agency of Forestry, Bulgarian Ministry of  
Agriculture and Food, Sofia, Bulgaria

R. Mosquera-Losada  
University of Santiago de Compostela, Lugo, Spain

employment, landscape features and biodiversity, etc. benefits for society have also been accounted (Nair 2014; Tsonkova et al. 2012). Improving the income whilst improving the environment is the benefits that AF provides (Mosquera-Losada et al. 2009).

Bulgaria is also suffering from the consequences of the transition from socialism to democracy and current economic crises. Some of the poorest regions of the European Union are in this country. Establishment of AF practices could be an opportunity. It has been a huge interest in already intensive AF as a science and practice in Bulgaria, dating from the late 80s and early 90s. It has been identified a number of problems for implementing the AF at a field level (Alexandrov et al. 1996; Marinov et al. 2003; Stancheva et al. 2004, 2015). Such problems are the lack of a clear comprehensive strategy and policy at national level, the lack of incentives and subsidies to landowners through adequate funding strategies, and finally, the lack of an overall assessment for the introduction and development of “best practices” and new AF technologies. At the same time, comprehensive theories and concepts about the possibilities of AF have been developed (Peev 1989; Peev and Hinkov 2002b; Stancheva et al. 2004, 2015). Also, it is existing an understanding from leading economists and policy makers governing forestry and agriculture in the country about development of AF in Bulgaria. Emphasis have been placed on the need for a comprehensive concept about development and implementation of AF innovations in the country and on the need for lifting up the AF to the rank of strategic direction as has been carried out in other countries like USA or India.

This paper aims at carrying out an updated analysis of AF practices used in Bulgaria and the current legislation and regulatory framework in order to outline the needs and prospects for development of AF in Bulgaria, according to the European and national priorities.

### Land cover of Bulgaria and management

Bulgaria covers an area of about 11.1 million ha, of which, at the end of 2013, agricultural areas cover 47 %, and forest areas 37 % (Agricultural report 2014). Bulgaria has the highest percentage of territory (34.3 %) after Slovenia, declared as protected areas of the Natura 2000 network. In 2011 has been developed

Regime for Sustainable Management of the forests in this network. The distribution of land cover of Bulgaria is shown in Fig. 1.

Rural areas cover 54 % of the country, and there are living over 37 % of the population. Many of these areas fall in the disadvantaged mountainous areas. The need for investment and new practices for agricultural producing and diversification of agricultural production is particularly high in these areas. Ownership of farmland in Bulgaria is presented at the Fig. 2.

The majority of the registered farms in the country are small and fragmented. Part of these that has less than 0.5 ha is around the 91 % of the total number but they possess only 5.2 % of the utilized agricultural areas (UAA). Farms with more than 100 ha manage over 82.4 % of UAA in the country—data for 2010 (RDP, Bulgaria 2015).

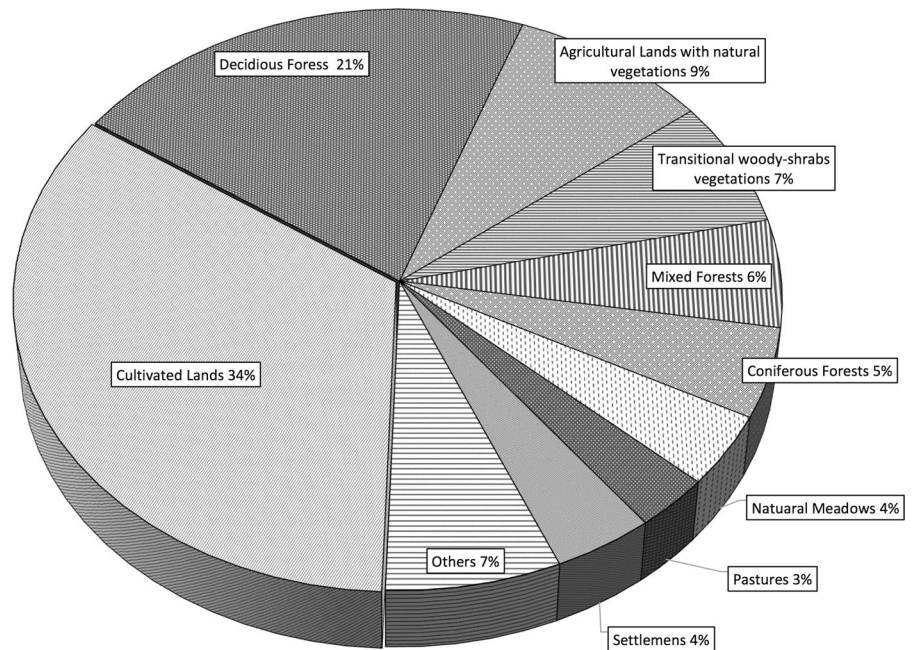
Regarding the structural distribution of agricultural production in Bulgaria, it is mainly represented by the plant growing, which provides more than 60.7 % of the output of the agricultural sector. The main crops are cereals (wheat and maize) and industrial crops (mainly oil—sunflower and rapeseed), followed by barley, rye, oats, millet; and legumes: alfalfa, beans, vetch, peas, lentils, broad bean, soybeans, peanuts. At the end of XVII century the damask rose, particularly Kazanlak rose (*R. damascena* var. *trigintipetala*) was introduced too, and has been famous all over the world. Tobacco is grown as mono-culture in mountainous regions, and now a need of replacement is occurred. Livestock, over the last decade, is presented poorly with less than 27 % of the total output of agricultural sector (Agricultural report 2014). This imbalance in agricultural structure is recognized of the Ministry of Agriculture and are expected financial instruments to be directed to the livestock management.

The forest areas in the country amounted to 4.18 million ha by the end of 2013. Forests for wood production and those with environmental functions are prevailed (61.7 %). Forests with protective and special features, including high stemmed forests and coppice forests are 38.3 % of the national forest fund.

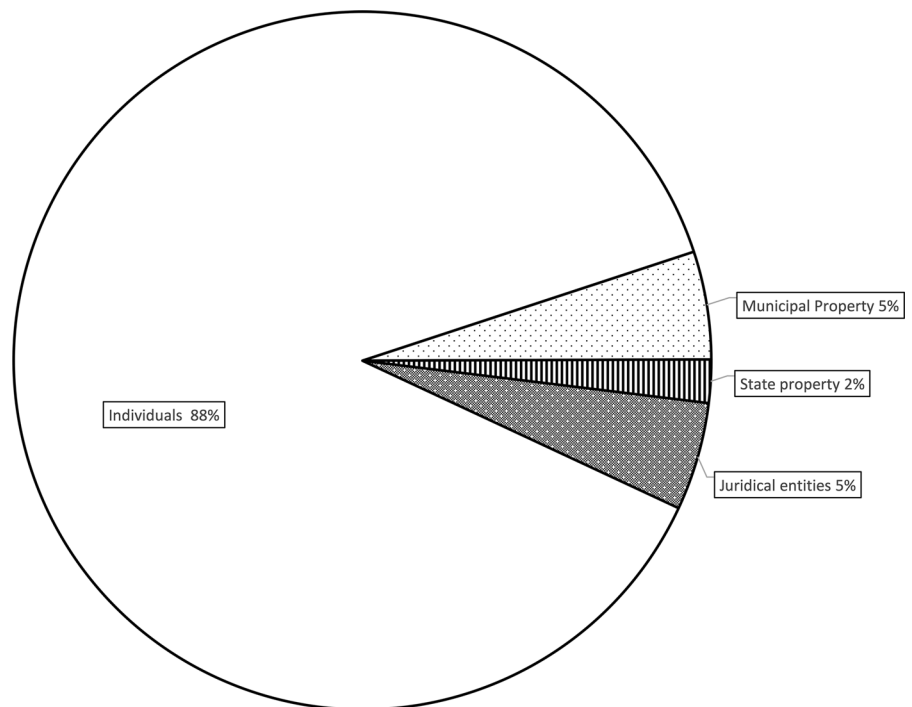
The distribution of forest areas in the Republic of Bulgaria in dependance of property is presented in Fig. 3.

The largest part of forest in Bulgaria is owned to the state (69.5 %) and managed by 6 (six) State Forest Enterprises. Control and management of forests in

**Fig. 1** Land cover of Bulgaria (source from the Ministry of Agricultural and Food)

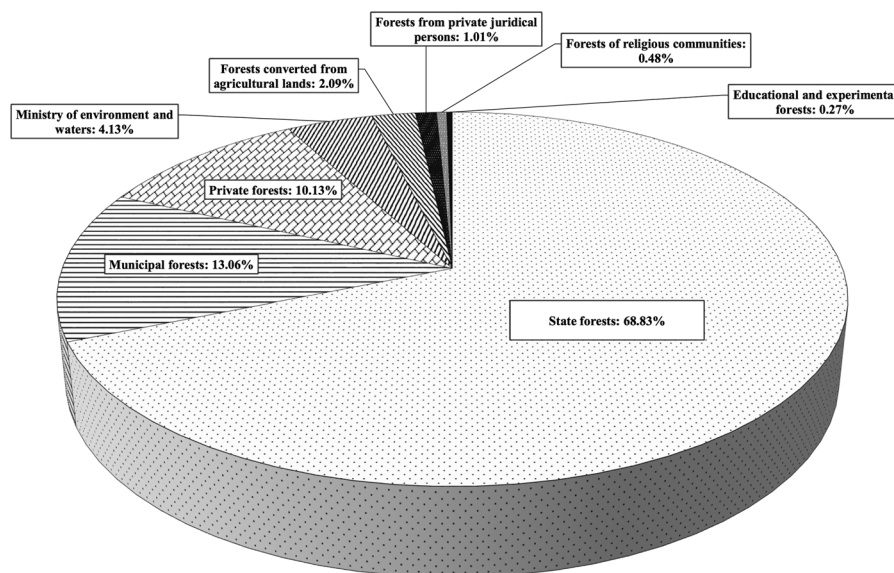


**Fig. 2** Ownership of agricultural lands in % (source from the Executive Agency of Forestry)



Bulgaria are entrusted to the Ministry of Agriculture and Food (MAF) by realization through the Executive Forest Agency. Management functions including utilization, preservation, etc., are, respectively assigned to the owners of forest areas.

Principles for multifunctional economy and usage of the forests, and for protection of their biodiversity are set out in politics of forest management in Bulgaria. Political management of forests is directed toward business and economic benefits for forest



**Fig. 3** Distribution of forest areas (4 180 121 ha) as per types of property at the end of 2013 (source from the Executive Agency of Forestry)

owners, whilst forests are regarded as a national wealth. Through the development of agroforestry productive practices, the profits of the forest sector in the country would be increased, where over 95 % of revenue comes mainly from producing and selling the wood. This would be achieved through diversification of output and the sale of biomass, wastes, forest products, fodders, etc.

#### Current state of agroforestry in Bulgaria

Successful implementation of agroforestry is traditionally known, in Bulgarian forestry and agriculture. Particular successes were achieved in the implementation of *Agricultural uses of forest area*. Agricultural crops are being grown together with tree species either using intercropping techniques, or by planting in open areas prior to their scheduled afforestation (Yakimov et al. 2003). This is a classic type widely used AF system whose ultimate goal is to initiate cultivation of young forest plantations and its conversion into a forest. Planting trees in agricultural lands protect area of erosion and damages have been declared to decrease—Table 1.

Along the Danube poplar plantations with sunflower, cabbage, corn, pepper and eggplant, watermelon and squash, cauliflower; wheat, beans etc., have been established and also plantations of oak, walnut

**Table 1** Correlation between the size of wind erosion damages and the forest cover in agricultural areas (source from Peev et al. 2003)

Forest cover	5	10	15	20	25
Erosion lands (km <sup>2</sup> )	1320	686	490	260	137
% of the total areas	38	21	10	5	3

and alder with corn have been grown. Predominantly arable crops and nitrogen-fixing plants have been used to improve soil fertility. Tree species which are suitable for Bulgarian natural conditions except poplar, are: willow, black locust, oak, plain common and black walnut, ash, red oak, pedunculate oak, linden, hazelnut, almond and pine trees. Through agricultural uses of forest area an increase of production per unit area, a reduction of the cost for afforestation, and a realization of additional income by increasing the variety of products were achieved (Marinov et al. 2003). Improvement of the tree growth conditions and an increase of the use of soil nutrients and water, reducing of the wind and water erosion, enhancing of the resistance to crop diseases or pests, etc., have also been observed (Stancheva et al. 2004). Proper application of this AF practices leads to earlier start in the growth of forest trees; earlier formation of

canopies; receiving a higher total productivity; and to an achieving social acquisitions, such as employment for landless people from different regions of the country (Yakimov et al. 2003).

Another AF, very important for Bulgaria, are *Protected Forest Belts (PFBs)*. Under the Forest Law (2015) “Protective forest belts are linear forest plantations designed to protect soil, civil engineering constructions and urbanized areas and improvement of microclimate”. According to the functions performed PFBs can be classified into several groups (Stancheva et al. 2004), which are summarized in Table 2.

The first forest belts were established in 1925. In the early 50 s of the last century began their broader application as AF practices (Georgiev 1960). Researches on different tree species in the forest shelter belts; effect of different tree compositions and silvicultural measures for increasing agricultural yields; soil moisture ect. have also being carried out (Georgiev and Georgieva 1956; Dimitrov 1970; Peev 1989, 1991; Hinkov 1993; Totev 2002). During the 50 s of the last century, a comprehensive network of 9 state PFBs were established. At the present, there are over 9000 ha PFPs, being most of them concentrated in northeastern Bulgaria. The main purpose of the created forest belts is to protect the fields from strong winds, and to ameliorate the microclimate as happened in Hungary (Takács and Frank 2009). PFBs have been used to improve soils and environmental factors of the neighboring lands and to reduce the adverse effects of rainfall, run-off waters and polluting emissions (Peev 1989, 1991; Yakimov et al. 2003; Stancheva et al. 2004; Marinov et al. 2003). Especially well pronounced is their wind-protective, water-regulating, and snow-retaining effects (Totev 2002; Takács and Frank 2009). In Figs. 4 and 5 are shown

the decreasing of wind speeds in protected by PSB agricultural lands (1) in comparison with unprotected lands.

By shelter belts the yields of crops are increased— Fig. 6.

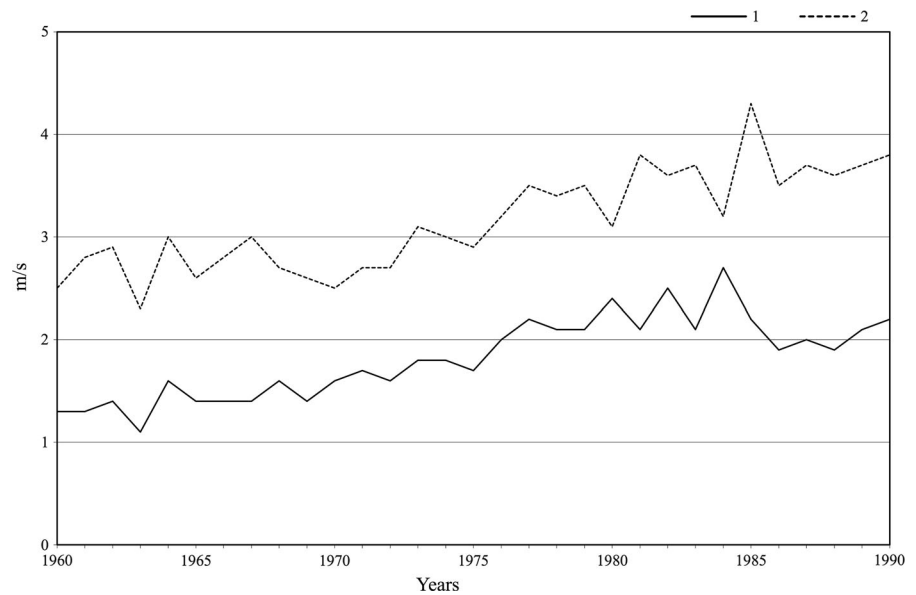
Depending on the functions performed, the PFBs in Bulgaria are divided into several groups: anti-wind, anti-erosion, shelterbelts for protection of water basins, anti-polluting road-protective forest belts, forest belts in urban and industrial areas and others. Studies on the choice of appropriate species have been made (Peev and Hinkov 2000; Stancheva et al. 2004). Main species considered suitable for the local conditions are oak, gleditsia, walnut, plane-tree, lebanese cedar, etc., and associated species: field maple, linden, cherry, wild pear, etc. and shrubs: hawthorn, poultry grapes, sumac, elderberry, oleaster, etc. With regard to the use of agricultural crops, it has been noticed that there are plants more responsive to the influence of PFBs, while others are scarcely affected—Table 3.

But generally, an increase in the yield of agricultural production is being observed (Peev and Hinkov 2000; Peev and Kukularov 1971; Totev et al. 1995). It has been achieved extremely good *environmental benefits* through the PFBs: wind protective effect (reduction of wind speed by 30–40 %); decreasing of soil evaporation by up to 40 %; increasing the air humidity up to 16 %; reduction of daily temperature amplitudes to 3 °C in the surface layer of the air; increasing the duration of snow-detaining period (Dimitrov 1970; Peev 1989; Yakimov et al. 2003; Stancheva 2004); as well as *economic benefits* for society: increasing of crop yields by up to 30 %; increasing in soil moisture up to 10 % and an overall improvement of soil fertility (Peev 1989, 1991; Peev

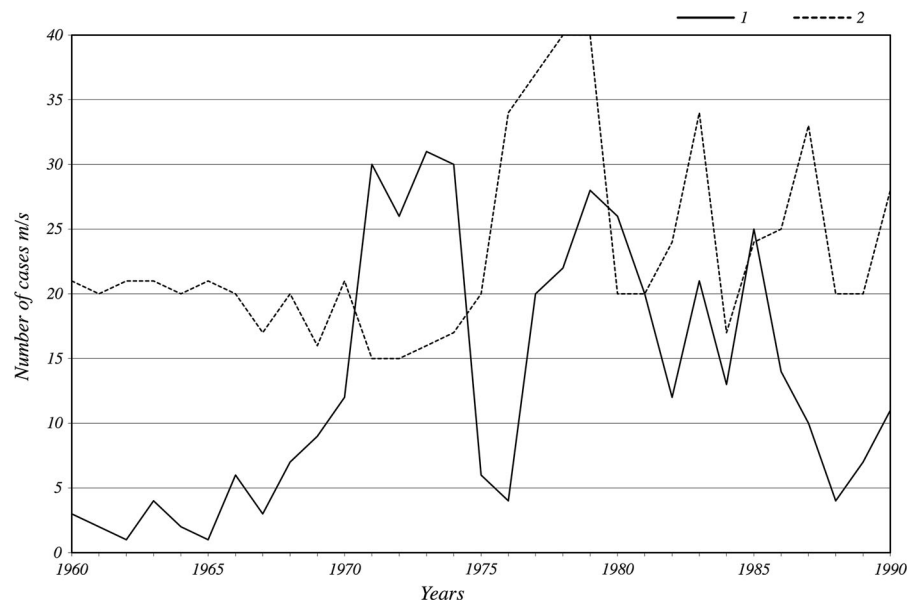
**Table 2** Classifications of PFBs

		Type PFBs						
		Anti-winds	Anti-erosion	Roads protective	Shelterbelts in pastoral areas			In urban and industrial areas
					Grassland protective	Tree partitions	Around stock farm	
Functions	Protection against strong winds	Erosion control; regulation of rainfalls	Protection of roads against blizzards and snowdrifts	Improvement of microclimatic conditions	Increases fertility of grassland	Ensuring places for rest of animals	Improves sanitary—hygienic conditions	Improves landscape and spatial planning; reduction of noise, pollution and heat

**Fig. 4** Average annual wind speed (gross) in protected (1) and unprotected (2) fields (source from Peev and Hinkov 2003)



**Fig. 5** Average of the maximum speed of the strong winds in protected (1) and unprotected (2) fields (source from Peev and Hinkov 2003)



and Hinkov 2000, 2002; Totev 2002; Yakimov et al. 2003) protection of crops from insect and pests by settlement of suitable birds (Yakimov et al. 2003).

Furthermore, the protective belts were designed as *Shelterbelts in line* by planting appropriate tree species (poplar, locust, willow, linden, sycamore, etc.) along ravines, canals, rivers, reservoirs, roads, fields and meadows for stabilization of river banks, flood abatement and achievement other environmental benefits (Stancheva et al. 2004).

In the country, on widespread areas silvopasture or Forest-grassland complexes (FGC), in which tree and shrub plant species are mixed with herbaceous forage crops (“grass mixtures”, etc.), were also created. These areas are used for freely grazing animals. Through FGC organic livestock rearing was developed; a balance in animal nutrition was achieved; and an additional timber production and economic efficiency, environmental friendliness and social benefits for society were obtained (Marinov et al. 2003;

**Fig. 6** Average five years yield of wheat in protected with PFB (1) and unprotected (2) fields (source from Peev and Hinkov 2003)



**Table 3** Grouping of the agricultural plantations according to their tolerance to the influence of the forest shelter belts, expressing in the average long standing and maximal increase

of the yield (in % towards an open field) at entirely effective forest stands (source from Peev et al. 2000)

Group	Low tolerant		Medium tolerant		Strongly tolerant	
	Increase %		Increase %		Increase %	
	Average	Maximum	Average	Maximum	Average	Maximum
Plantations	Oats, rye, sunflower, white bean, vetch-grain, peas-grain, flax-stems		Wheat, maize, barley, potatoes, sugar beet, sunflower-green mass, peas-green mass, flax-grain		Apple, cherry, plums, grape vine, strawberry, tomatoes, peppers, radish, pumpkins, mangold-wurzel, tobacco, water-melons, musk-melons, rape seed, lucerne, vetch-straw, fodder maize, grasses	

Stancheva et al. 2015). Through existing state farms for game-breeding some leaf fodders, fruits and other natural products are being obtained in the forests areas, whilst the grass areas are used for the production of the feed crops and grass masses.

Forest farming agroforestry practice has also being developed in Bulgaria, in which the reconciliation of the naturally and artificially created trees and bushes, and the business of agricultural activities is being established for a longer period of time. Farms are used for the production of edible mushrooms, medicinal plants, fruits (strawberries, raspberries, blackberries, apples, pear, aronia, etc.) bee and oil-bearing crops, ornamental plants, trees and more. This agroforestry practice in Bulgaria has serious achievements in cultivation of fruit-productive forest trees in forest areas. Plantations by walnut (*Juglans regia*), hazel (*Corylus avellana*), almond (*Amygdalus communis*),

wild cherry, rowan and others were created in 60 s and 70 s of the last century. It can be observed fast ageing, damages from drying up etc. in part of the walnut trees, whose area amounted up to 7000 ha now in Bulgaria. Walnuts formed sustainable agroforestry systems and these tree species are desired by farmers due to the high price of wood and the high incomes from fruits provided (Glushkova et al. 2008).

**Policies and legislation**

Bulgaria, as a EU member state, is committed to harmonize its legislation and policies with those of the EU. With regards to agricultural policy, Bulgaria keeps to the principles and accepts the objectives of the Common Agricultural Policy (CAP), which is consistent with the general strategy of the Union—

Europe 2020: for smart, sustainable and inclusive growth. Agroforestry, such as socio-economic and environmentally friendly system for land management is a modern and intelligent form of land use, through which we can overcome such deficiencies observed when other agricultural practices are implemented: desertification, water deficit, significant emissions of greenhouse gases and etc. (Schultz et al. 2004; Sharrow and Ismail 2004; Torralba et al. 2016). Particularly large are the opportunities of agroforestry to be found technological solutions and resource security for the “green economy” to which is facing the modern world (Pollini 2009).

There are multiple policies, strategic and program documents and legislation in Bulgaria, promoting the development of various agroforestry systems. The Law on ownership and usage of agricultural land (LOUAL); the Law for Forest (LF), the Law on Protection of Agricultural Land (LPAL); the Law for supporting agricultural producers (LSAP) etc. are in action nowadays. In LSAP the schemes and measures of direct payments (the single payment per area and scheme for “green payments”, respectively), and also the rules, approvals and implementations of the Rural Development Program (RDP) of Bulgaria are being pointed and being regulated. In LF is regulated and categorized agroforestry system “protective forest belts”, the conditions under which are being grazed livestock in forest areas and the rules for using non-timber products.

In adopted national Programs, Strategies and Plans, has also sections on the opportunities for agroforestry development in Bulgaria, and the needs. The CAP is identified in the National Development Programme: Bulgaria 2020 (NPDB 2012), as a decisive factor for developing of agriculture and for overcoming the low competitiveness and the insufficient market orientation of the farms in Bulgaria.

Activities related to agroforestry, such as organic farming, restoration and maintenance of lands with high natural values, etc. have been supported in the National Agroecological Program of Bulgaria (NAEPB 2007–2013). In the Bulgarian National Action Program for Sustainable land management and combatting with Desertification (NAPSMCD 2007–2013) was written that agroforestry is “multi-functional and ecologically friendly usage of natural resources, through which from the positive biological interaction between joint cultivation of trees and/or

shrubs with agricultural plants and/or domestic animals can be taken advantage and benefits”. In the new national strategy for the forestry sector development NSFSD (2013–2020) (NSFSD 2013) targets related with the increase of the contribution of the forestry sector to the green economy are pointed to overcome the adverse effects of climate change, enhance biological diversity, and deliver renewable energy resources. The Strategic Plan for the development of the Forestry sector SPFSD (2014–2023) (SPFSD 2014) is the other strategic document regulating forestry activities. The results expected are associated with activities in restoration and construction of new shelterbelts, development of non-timber forest product markets, etc.

Virtually there are no specific measures provided funding of agroforestry in Bulgaria in the new RDP (2014–2020), but there are various measures supporting agriculture and forestry for certain activities representing agroforestry themselves. These, are: support for reconstruction and establishment of new shelterbelts; various activities in the field of agroecology; organic farming; erosion control, etc. Activities related to the diversification of production and the restructuring of small farms will be financed, as well as activities for the introduction of new technologies in agroproduction. It is envisaged funding afforestation of degraded and eroded lands and those relating to the preservation and enhancement of soil fertility. Financial means for restoration and maintenance of grasslands with high nature value usually linked to the presence of woody vegetation, control soil erosion, traditional practices for pasture of animals, transhumance, etc. will also be provided.

The agricultural sector in Bulgaria receives financial support by national state schemes, short-term and long-term loans granted by the State Fund “Agriculture” and from commercial banks in realisations of the two pillars of the CAP of EC.

#### Perspectives and opportunities for development of agroforestry in bulgaria

Agroforestry as a combination of forestry and agriculture has been known in Bulgaria for centuries, but as a targeted business activity and modern land usage has been developed in the recent decades. It is considered that, there are opportunities and potential for the development of modern agroforestry in



Bulgaria, taking into account the specific environmental and climatic conditions, characteristics of the local economy and regional traditions. There are possibilities, but has slightly and poorly developed the High Value Trees production, for obtaining a high value timber and nuts. There are serious interests, prospects and intentions of growing of forest fruit trees, such as walnut, cherry and chestnut. Agroforestry systems would allow the usage of appropriate grass and plant species, biological pest control, intensive use of organic and “green” manuring and composting, and physiological regulators. Good practices in this area are essential.

There is a need of well managed Natural and Cultural Value Agroforestry Systems with good maintained grazing woodland and semi-opened pastures in mountainous areas. There is a possibility for the implementation of good agroforestry practices for grazing of animals and for yield of biomass and leaf and grass fodders. In the country has an understanding for their economic and environmental value, as they are in the category of lands with recognized high nature value (HNV).

Natural and climatic conditions of the country are particularly suitable for the development of Forest farming, and in this direction, expectations of a number of land and forest owners are connected, especially in the mountainous areas of the country where livelihood is associated mainly with tobacco production. Establishment of forest farms, however, are still in early stages of development in the country. They can be linked to Rural Tourism as in Italy (Pardini et al. 2002).

Organic forestry production, as a system for the promotion and strengthening of agroecosystems by applying agronomic, biological and mechanical methods also has the potential for development in Bulgaria. Agroforestry practices are combined well with the organic agriculture and in this respect introducing of new practices and innovative technologies are expected.

Establishment of Riparian Agroforestry systems, with a primary function for protection of flood and water erosion of the banks and their stabilization, are also needed in Bulgaria. The Project of the Lower Danube Green Corridor however, signed by Bulgaria, Romania, Ukraine and Moldova as an EU initiative for coordinating the efforts of biodiversity conservation in the downstream of the Danube, has still not found its

decision due to a lack of coordination, consistency and priority. Such large European investments are needed and are expected they to be awarded when detailed problems and the measures for their decision have been defined in its concreteness.

## Conclusion

Requirements for improving the total output of ecosystems, their environmentally sound and sustainable management, and improvement the ecosystem services on the one hand, and on the other hand observed degradation of soil fertility, water deficit, climate change and uncertainty in commodity markets, insist on the necessity for introducing of alternative, intelligent and new forms of land use. Agroforestry will be one such form, both traditional and innovative, which can be successfully applied in relation to overcoming the pointed challenges.

Bulgaria has favorable conditions for the development of agroforestry. It is necessary to focus efforts on the renovation of old and establishment new forest belts; in the construction of riparian buffer agroforestry systems; the introduction of new agroforestry practices in production of high quality wood of forest fruit-productive tree species, etc.

In Bulgaria, the innovations have been identified and comprehensive theories about the possibilities of agroforestry as a science and practice have been developed, and there are educational programs for training of specialists in this field. However, there are no overall strategy and policy, as well as the comprehensive development and application of agroforestry in the country.

In essence, agroforestry is a form of multifunctional, environmentally friendly and sustainable land used management and could provide a good income, employment, economic and social stability of many disadvantaged rural areas in Bulgaria. It is known, that in the country there are areas, where the main livelihood of the local population is the unsustainable tobacco production and the development of agroforestry would be a real alternative and opportunity to provide good income and prosperity. Implementation of best practices and development of agroforestry in these cases would have an extremely important social and environmental impact and contribute to solving the problems accumulated and postponed for years.

## References

- Agricultural report (2014) Annual report on the status and development of agriculture. Ministry of Agriculture and Food, p 216 (in Bulgarian)
- Alexandrov A, Velkov D, Genov K, Asparuhova E (1996) Current problems of the agroforestry as an international direction. Proceedings: Scientific reports at International scientific-technological session “Kontakt 96”, pp 36–40
- RDP, Bulgaria (2014) Draft, Rural Development Programme, Bulgaria, 02.07.2014, CCI 1014BG6RDNP001, p 675, [www.prsr.government.bg](http://www.prsr.government.bg) (in Bulgarian)
- Dimitrov X (1970) The influence of forest shelter-belts on the regime of soil moisture. For Sci VII 3:15–26 (in Bulgarian)
- Georgiev G (1960) Field-protective forest belts in our country. Eds. Government Publisher, Varna, p 205 (in Bulgarian)
- Georgiev G, Georgieva Y (1956) Field-protective Forest Belts surround village of Karvuna—Balchishko and their influence on crops production. Proceedings of Scientific works of Dobrudzha Agricultural Institute, III:279–324 (in Bulgarian)
- Glushkova M, Zhiyanski M, Genov K (2008) Options for utilizations of walnut (*Juglans regia* L.) insustainable agroforestry systems (review). Management and Sustainable Development, Society, Man, Nature, University of Forestry, 1 (19):35–41 (in Bulgarian)
- Gold M, Cernusca M, Hall M (Eds.) (2013) Training manual for applied agroforestry practice. Center for Agroforestry, University of Missouri, p 245
- Hinkov G (1993) Some studies on the Forest Shelterbelts in the region of Knezha. MSc Thesis, University of Forestry, Sofia, p 130 (in Bulgarian)
- Marinov I, Stiptsov V, Rafailov G (2003) Status and perspectives of agroforestry in Bulgaria. Eds. By Bulgarian—Swiss Forest Fondation and Silvica Fondation, Sofia, p 63 (in Bulgarian)
- McAdam J, Burgess P, Graves A, Rigueiro-Rodríguez A, Mosquera-Losada MR (2009) Classifications and functions of agroforestry systems in Europe. In: Rigueiro-Rodríguez A, McAdam J, Mosquera-Losada MR (eds) Agroforestry in Europe current status and future prospects. Springer Science + Business Media B.V, Dordrecht, pp 21–41
- Mosquera-Losada MR, McAdam J, Romero-Franco R, Santiago-Freijanes J, Rigueiro-Rodríguez A (2009) Definitions and components of agroforestry practices in Europe. In: Rigueiro-Rodríguez A, McAdam J, Mosquera-Losada MR (Eds.), Agroforestry in Europe. Current status and Future Prospects, Springer, pp 3–19
- NAEPB 2007–2013 (2006) National Agroecological Program of Bulgaria. VI Draft, Ministry of Environment and Waters, European Agricultural Fund for Rural Development, p 46 (in Bulgarian)
- Nair PKR (2014) Agroforestry: practices and systems. *Encycl Agric Food Syst* 2014:97–128
- Nair VD, Graetz D (2004) Agroforestry as an approach to minimizing nutrient loss from heavily fertilized soils: the Florida experience. *Agrofor Syst* 61–62:269–279
- NAPSMCD 2007–2013 (2007) National Action Program for Sustainable Land management and combatation with Desertification. Ministry of Environment and Waters, Ministry of Agriculture and Food, Agricultural organization of the United Nation (FAO), Global Environmental Fund, p 156 (in Bulgarian)
- NPDB (2012) National Plan for Development: Bulgaria 2020. The Council of Ministers, Decision №1057 on 20.12.2012, p 283 (in Bulgarian)
- NSFSD 2013–2020 (2013) National Strategy for Forestry sector Development in Bulgaria. Ministry of Agriculture and Food, p 207 (in Bulgarian)
- Pardini, A, Mosquera MR, Rigueiro A (2002) Land management to develop naturalistic tourism. In Proceedings of the V International Farming Systems Association Symposium, Firenze, 8–11 April 2002, Eds. Cristovão A, Omodei Zorini L, OpenURL
- Peev B (1989) Wind-protective and Microclimatic Effectiveness of the Forest Shelterbelts. Professorship Thesis, University of Forestry, Sofia, p 296 (in Bulgarian)
- Peev B (1991) The Ecological Role of Shelterbelts in Republic of Bulgaria. The 2-nd International Congress of Windbreaks and Agroforestry. Ridgtown, Canada, p 8
- Peev B, Hinkov G (2000) Agro-productive efficiency of the Forest Shelterbelts. Proceedings: 75 Years of Forestry Education in Bulgaria, section: Forestry Management, Sofia, Eds: Publish House of the University of Forestry, pp 447–456 (in Bulgarian)
- Peev B, Hinkov G (2002) Concepts of agroforestry in Bulgaria. Round table “Potential possibilities for agroforestry in Bulgaria”, 24–25 September, MAF, EAF, BFPS „Silvica”, Fondation “Intercooperation” Bern, Svishtov, p 10
- Peev B, Hinkov G (2003) Consequences from the destroying of forest shelter belts. International scientific conference “75 years of the Forest Research Institute of Bulgarian Academy of Sciences”, Proceedings, Volume I, Sofia, 1–5 October 2003, 237–241. ISBN: 954–90896-6-5 (in Bulgarian)
- Peev B, Hinkov G, Kazandzhiev V (2003) About the estimation of the wind erosion. Proceeding, Scientific Papers, International Scientific Conference “50 Years University of Forestry”, Session Ecology and Environment Protection, University of Forestry, 1–2 April 2003, Sofia, pp 51–54 (in Bulgarian)
- Pollini J (2009) Agroforestry and the search for alternatives to slash-and-burn cultivation: From technological optimism to a political economy of deforestation. *Agric Ecosyst Environ* 133(1–2):48–60
- Schultz R, Isenhardt T, Simpkins W, Colletti J (2004) Riparian forest buffers in agroecosystems—lessons learned from the Bear Creek Watershed, central Iowa, USA. *Agrofor Syst* 61:35–50
- Sharrow SH, Ismail S (2004) Carbon and nitrogen storage in agroforests, tree plantations, and pastures in western Oregon, USA. *Agrofor Syst* 60:123–130
- SPFSD (2014) 2014–2023 Strategic Plan for Forestry Sector Development in Bulgaria. Ministry of Agriculture and food, Executive agency of Forestry, p 121 (in Bulgarian)
- Stancheva, J, Petkova K, Bencheva S, Bencheva S, Broshtilova M, Broshtilov K, Tsvetkova N (2004) Agroforestry. Sofia, p 239 (in Bulgarian)
- Stancheva J, Petkova K, Bencheva S (2015) Agroforestry. Sofia, Eds. “Avangard Prima”, p 225

- Takács V, Frank N (2009) The traditions, resources and potential of forest growing and multipurpose shelterbelts in Hungary. In: Rigueiro-Rodríguez A, McAdam J, Mosquera-Losada MR. *Agroforestry in Europe: current status and future prospects*. Springer. pp 415–433
- Torralba M, Fagerholm N, Burgess P, Moreno G, Plieninger T (2016) Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis. *Agric Ecosyst Environ* 230:150–161
- Totev, T (2002) Influence of Field-protective Forest Belts on the yield of agricultural plants. National meeting on the problems of Forest Belts management, 20–21 June, Dobrich. In: *Multifunctional, Environmentally friendly and Sustainable Management of Forests in Bulgaria*, 92–98, Eds. By Bulgarian—Swiss Forest Foundation and Silvica Foundation, Sofia, p 250 (in Bulgarian)
- Tsonkova P, Böhm C, Quinkenstein A, Freese D (2012) Ecological benefits provided by alley cropping systems for production of woody biomass in the temperate region: a review. *Agrofor Syst* 85:133–152. doi:[10.1007/s10457-012-9494-8](https://doi.org/10.1007/s10457-012-9494-8)
- Yakimov, M, Stiptsov V, Kalmukov K, Aleksandrova E, Yonovska I (2003) Agricultural uses of forest area. In: *Agroforestry*, Eds. By Bulgarian—Swiss Forest Foundation and Silvica Foundation, Svishetov, p 22 (in Bulgarian)