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Costs, Benefits and Obstacles to the Adoption and Retention of Shelterbelts: Regional Perception and Mind Map Analyses for Ukraine

Abstract: The role of shelterbelts within an agricultural landscape is changing significantly. In the past, shelterbelts have been encouraged and established to reduce soil erosion and increase crop yields. Land reform (land privatisation) and advances in production technology led to increases in agricultural holding size. This requires a revision of policy concerning shelterbelt management in rural communities, especially since there is no recent research on community perceptions regarding the adoption and retention of shelterbelts. The specific objective of this research was to identify the public costs, benefits and obstacles from the adoption and retention of shelterbelts. In the summer of 2019, a survey was conducted of territorial communities (hromadas) in Ukraine. It was observed that many of the benefits of shelterbelts were classified as non-economic. Therefore, these benefits are more difficult for the leaders of hromadas to recognise within their management decisions. The costs to hromadas were identified and strongly affected management decisions but the actual monetary costs were not identified. Shelterbelts have the potential to mitigate climate change yet most hromadas do not recognise the social and environmental benefits of shelterbelts within their management decisions.

Keywords: shelterbelts, costs, benefits, obstacles, perception, hromada, adoption, retention

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1. Introduction

Shelterbelts are artificially established linear plantings for protecting agricultural land from the negative influence of natural and anthropogenic factors [1]. They are also known as windbreaks, hedgerows, living hedges, or living fences. The design of forest belts includes different species of trees such as oak, ash, maple, acacia, linden, poplar, etc, and the choice depends on the natural and climatic zone of Ukraine and the purpose of shelterbelts. For example, windbreak shelterbelts usually consist of multi-row trees with dense crowns and high dense undergrowth. An example of shelterbelts within an agricultural landscape is shown in Figure 1.

a)

b)

Fig. 1. Shelterbelts within a Ukrainian agricultural landscape

Source: WWF-Ukraine. https://wwf.ua/our-work/nbs/ (photo a);
Open Forest. https://www.openforest.org.ua/150676/ (photo b) [access: 21.02.2022]

Shelterbelts play unique ecological, economic, and social roles in agricultural landscape and rural territories. Traditionally, they have been used to reduce soil erosion from wind and water, and to increase crop yields [2–8]. The emphasis on these benefits is changing along with the production technologies utilised (i.e., the adoption of zero till, reduced fallowing) [9, 10]. In addition, another benefit from shelterbelts has become more relevant – their potential to play a major role in reducing the impact of climate change through carbon sequestration [11, 12]. The role of

shelterbelts in carbon sequestration is both direct and indirect. In the context of the new climate agreement adopted by the Paris Conference, which declares measures to preserve and increase the volume of sinks and greenhouse gas storage, the role of soil as a terrestrial regulator of carbon and nitrogen cycles is important. In particular, A. Chappel et al. [13] note that soil ranks second after the oceans in terms of accumulated carbon and affects the fluctuations of atmospheric carbon. Degraded soils have a high ability to absorb carbon in the process of restoring their properties. The potential of soils for carbon uptake and retention can be increased due to soil-reproducing methods of agriculture, in particular through the introduction of forest reclamation measures – the restoration and creation of new shelterbelts [14, 15].

Incorporating shelterbelt management into the spatial planning of hromadas[4] has the potential to improve the ecological state of agricultural landscapes and overall improve the efficiency of agriculture that is beneficial to the private landowners, land users (agro-holdings) and society as a whole. The key environmental benefits are the provision of ecological goods and services such as carbon sequestration, providing habitats for pollinators, wild animals, birds and maintenance of biodiversity, protection of soil and water resources, creation of natural barriers to the spread of weeds and pests. The major socio-economic benefits could be represented by the potential for increased property values, improved recreational opportunities, preservation of soil moisture, increased yields, reduced runoff from agricultural activities (including fertilizer and pesticide) and pesticide drift, reduction of thermal stress for crops, animals and people and aesthetic and visual diversity perspective. There are costs associated with shelterbelts. It should be noted that only part of these costs could recoup some of the benefits provided through shelterbelts. Grasping the scope of costs and benefits and obstacles to the adoption and maintenance of shelterbelts in rural territories of hromadas will be advantageous in understanding the current state of the art as well as useful in developing relevant policy related to shelterbelts and their management.

The benefits of shelterbelts are enormous. Shelterbelts, as a "perpetual motion machine", are a permanent, cheap, and extremely effective factor in protecting the land from degradation, obtaining high and sustainable yields, and improving environmental conditions in landscapes.

The potential for increasing crop yields in a shelterbelt system can be up to 20%, pasture productivity up to 25%, dairy production up to 12%. The deviation in forest cover by 1.5% leads to the change in the yield of winter wheat by an average of 29.8%, barley – 37.1%, and oats – 27.2%. The crop yields increase by 0.7–3.5% with afforestation of arable land by every 0.5% [16, 17].

However, shelterbelts have suffered from mismanagement during the 30 years of Ukraine's independence. This led to the destruction of the single shelterbelts

[4] Hromada (Ukrainian: територіальна громада – terytorial'na hromada) is a basic administrative unit division in Ukraine, similar to a municipality.

network in the agricultural landscapes (Fig. 2). Today, field shelterbelts only protect 30% of the agricultural landscapes or 40% by taking into account other types of shelterbelts [18].

a) b)

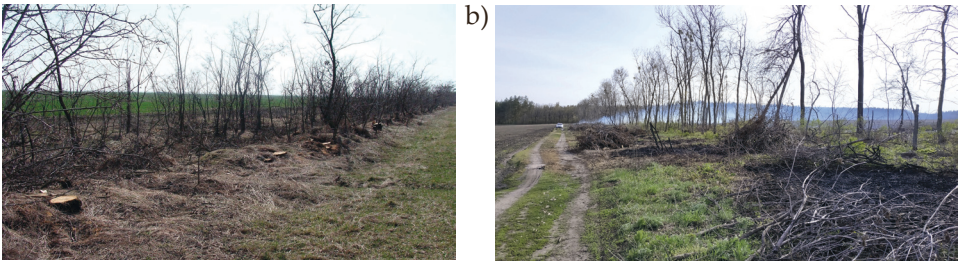

Fig. 2. The consequences of a lack of proper shelterbelt management

Source: Nyzhni Sirohozy.City. https://nsirogozy.city/articles/60688/polezahisni-lisovi-smugi-sirogozschini-proinventarizuyut-do-1-travnya-2020-roku (photo a), Izyum forestry. http://izium-les.at.ua/news/virubka_lisosmug_vide_do_ekologichnogo_likha/2019-04-23-134 (photo b) [access: 21.02.2022]

Despite the threatening nature of active degradation processes, in the agricultural landscapes of Ukraine there is no complete system of shelterbelts. Today, the area of shelterbelts is about 440 000 hectares, of which about 30% are in an unsatisfactory condition [19, 20]. The state program "Forests of Ukraine", which aimed to reconstruct shelterbelts and plant new ones, was unfortunately a failure in terms of implementation. The Laws of Ukraine "On the National Program for the Formation of the National Ecological Network of Ukraine" and "On Land Reclamation" enshrined the establishment of a protective shelterbelt system, but this system has not yet been established because of legal clashes and a lack of funding.

The main reason for the poor condition of shelterbelts is the legal uncertainty of the shelterbelt owners after the land reform. In the early 1990s, shelterbelts were part of the property of collective agricultural enterprises. After land sharing and the privatisation of agricultural land, the land devoted to shelterbelts was transferred from the state to collective ownership. However, collective ownership is absent in the Constitution of Ukraine. Therefore, there was a discrepancy in the rules of land law. As a result, land under shelterbelts and other protective plantations do not have an owner who takes care of them and pays land tax.

From January 2019, it has been legally enshrined that land under shelterbelts located around the agricultural land massifs[5] is transferred to communal ownership of hromadas [21]. In turn, they are allowed to lease such forest belts to agricultural producers with an obligation to maintain and maintain them. According to the sur-

[5] The agricultural land massifs are a set of agricultural and non-agricultural land plots (such as land for field roads, reclamation systems, linear objects, engineering infrastructure facilities, wetlands, other lands located within the land massifs), which have common boundaries and are limited by natural and/or artificial elements of a landscape (e.g., public roads, shelterbelts and other protective plantations, water bodies, etc.) [23].

vey [22], 91.7% of hromadas did not get shelterbelts into ownership. To the best of our knowledge, there is no recent research on the costs, benefits, and obstacles to adoption and retention of shelterbelts faced by hromadas. Of particular concern is how the perception of hromadas affects shelterbelt management decisions in terms of designing effective and efficient policies.

The purpose of this research was to explore the perception of hromadas concerning shelterbelt costs and benefits in rural territories and to identify the factors that influence decisions on their adoption and retention. The identification of factors was based on opinions from hromadas in different oblasts in Ukraine. From this study, factors that influence shelterbelt management were identified to formulate the relevant policy recommendations based on obstacles to future adoption and retention of shelterbelts.

The three main objectives of this research are:

1) identify the economic and non-economic factors that influence hromadas decisions related to shelterbelt adoption and retention,
2) describe the factors (economic and non-economic) that influence shelterbelt adoption and retention,
3) determine potential obstacles to the adoption and retention of shelterbelts based on the surveys of hromadas.

2. Material and Methods

A survey of hromadas in Ukraine was undertaken from July to December 2021 to solicit opinions on the costs, benefits and obstacles related to shelterbelt management. The questionnaire (see: Appendix) consisted of several parts that addressed various aspects related to shelterbelts and their management. A combination of multiple-choice, yes-no questions, Likert-scale questions, and open-ended questions was used. The survey was divided into four main sections, which collected information on (1) the hromadas' shelterbelts, (2) opinions on future shelterbelts management, (3) benefits and costs information, and (4) obstacles to shelterbelts management. The goal of the survey was to identify the costs, benefits and obstacles that influence hromadas' management decisions related to shelterbelts. Different potential factors related to market and non-market costs, benefits and obstacles, including political, economic, agronomic, environmental, and social fields, were included in the survey questionnaire.

The questionnaire was sent to all (1469) of the hromadas in Ukraine with the help of the All-Ukrainian Association of Amalgamated Territorial Hromadas. Questionnaires were not sent to hromadas located in the temporarily occupied territory of the Autonomous Republic of Crimea and in part of the temporarily occupied territories in Donetsk and Luhansk oblasts. Figure 3 shows a map of the locations of the surveyed hromadas in Ukraine. The overall return rate based on the total number of surveys handed out was 5%. This included the participants' deputy heads of the territorial hromadas, specialists in land tenure, economic, environmental, and

agricultural issues. Sixty-eight surveys were returned in total. All of them were useable in the study. The two biggest challenges to getting surveys completed were (1) the quarantine measures due to the spread of the COVID-19, which made it impossible to organise summary face-to-face meetings and (2) developing a comprehensive questionnaire by the internal requirements of the Association.

Fig. 3. Location of surveyed hromadas in Ukraine

The Likert-scale questions were created using the literature review of the benefits, costs, and obstacles of the adoption and retention of shelterbelts. Questions were related to the main type of shelterbelts in Ukrainian rural territories – field shelterbelts. They included both public as well as private benefits and costs to see how the leaders of hromadas regarded each factor in terms of its influence on their management decisions. There were 18 Likert-scale questions, where "5" is highly positive, "4" is positive, "3" is neutral, "2" is negative, and "1" is highly negative. These converted numerical values were used for the correlation analysis.

Prior to the Likert-scale questions, participants were asked to identify the benefits, costs and obstacles of shelterbelts from their own (practical) experience. There were five questions related specifically to field shelterbelts. An example of an open question is "Please describe any other costs related to shelterbelts in hromadas"; "Please describe what prevents hromadas from determining shelterbelt land registration (List all that apply)"; "What benefits do hromadas receive from shelterbelts (List all that apply)?".

Some analyses were done using the data collected in the Likert-scale questions. A mind map visually represented correlation analysis and the descriptive statistical analysis of responses.

A mind map is a chart used to visually arrange information and show the connections between different parts of related data. It is an effective graphic technique [24, 25] that can be used to improve knowledge and clearer thinking and has been applied in economics and business, as well as in environmental engineering [26]. Mind maps can be used as a method to help improve the understanding of difficult interconnections.

The open question responses were analysed by writing out each cost and obstacle identified and recording the total number of respondents who pointed out a specific cost, benefit or obstacle. The most commonly cited obstacles were the lack of funds for the inventory of shelterbelts and registration of ownership rights to them ($n = 33$) and existing gaps in legislation ($n = 17$). Obstacles and benefits were more recognisable and identified more frequently than costs in the open section of the survey.

3. Results and Discussion

3.1. Correlation Analysis and Mind Map

The correlation analysis between the questionnaire factors and a bivariate correlation analysis was undertaken for all the Likert-scale ranking questions to determine which variables had significant levels of association between each other. Figure 4 present the mind map showing the Likert-scale ranking factors and their correlation to the other Likert factors. A bivariate correlation greater than 0.45 (r-value) was used to identify the correlation between the various factors. The mind map in this research was linked to the factors that respondents ranked in the Likert-scale ranking of the questionnaire. The graphic technique to facilitate the understanding of the connections identified from the bivariate correlation analysis was used and represented a way to visualise the underlying connections between the different factors.

A bivariate correlation analysis was conducted of the Likert-scale ranking questions to rate the impact of factors upon one another. The mind map pointed to an interesting connection, namely that the leaders of hromadas seem to unconsciously acknowledge the interconnected nature of the landscape. However, because many of these connections are external to direct community tasks, they are very difficult for leaders to quantify or include in shelterbelt management decisions. The factors with the strongest correlation to each other were the sustainability of agriculture and biodiversity in the landscape ($r = 0.628$) and the beautification of the rural area and landscape biodiversity ($r = 0.607$). The sustainability of agriculture, biodiversity in the landscape and beautification of the rural area are societal benefits that are very difficult to quantify or include in both public and individual (agricultural producers) management decisions.

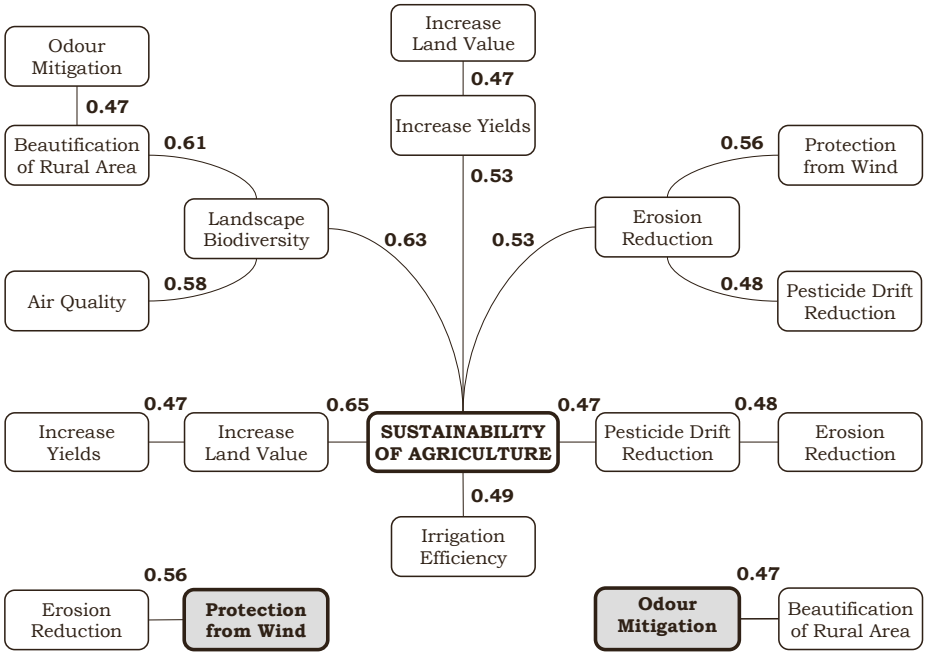

Fig. 4. The mind map of hromadas leaders for the adoption and retention of shelterbelts in their territory community (lines between factors specify an identified correlation and the numbers on the lines are the correlation analysis *r*-values)

Surprisingly, the leaders did not recognize the social (beautification of the rural area through the use of shelterbelts) and environmental factors (reducing wind speeds from shelterbelts) of field shelterbelts as a part of a sustainable agricultural production system. These variables were not significantly correlated to other costs and (or) benefits, which included economic, social or environmental costs and benefits. Thus, reduced wind speeds from shelterbelts was strongly correlated only with reducing soil erosion from wind and water (r = 0.561) and odour mitigation only with the social factor (0.469). Factors such as providing livestock protection and reducing livestock death were not correlated at all to other costs and (or) benefits associated with shelterbelts. This may be explained by the fact that the factors related to livestock are specific and are benefits enjoyed solely by agricultural producers.

Additionally, economic factors were strongly correlated with each other but not with environmental or social factors. It is worth noting that the factors with the strongest correlation to each other, as the biggest economic benefits from shelterbelts, were the sustainability of agriculture and increase of land value (r = 0.649) and the sustainability of agriculture and increase of crop yields (r = 0.527). These economic variables were not significantly correlated to other social, environmental and even economical costs and/or benefits. In contrast, social, environmental (ecological) variables were highly correlated and overlapped with each other. This can be

observed on the mind map by the number of interconnections of factors and influences present in each branching (Fig. 4). These mind map interconnections stressed that hromadas leaders do not recognise direct economic benefits from the environmental (ecological) and social benefits of shelterbelts, which could affect shelterbelt adoption and retention by the community in general.

In addition, the correlations related to the costs for adoption and retention of shelterbelts were not observed. This seems both strange and surprising because 52% of the surveyed hromadas cited that the costs for the adoption and retention of shelterbelts are very high and 21% of hromadas mentioned these costs as high. This may be one of the reasons for the overwhelming majority of hromadas (75% of respondents) not caring for shelterbelts. However, it should be borne in mind that many of the benefits associated with shelterbelts are not captured entirely by the hromadas and therefore do not factor directly into the decision-making process related to shelterbelts.

Collectively, the management decisions of the leaders of hromadas and agricultural producers have an impact on the landscape. However, 49% of respondents strongly believe that agricultural producers should be responsible for the adoption, retention, and creation of field shelterbelts. Meanwhile, 42% are still hesitant about it and thus it is not surprising that 41% ($n = 39$) are ready and willing to hand over full control of shelterbelt adoption and retention to agricultural producers.

Most of the benefits were related to social (non-market) and environmental benefits. Many respondents cited agronomic impacts only from the benefit side. For example, pesticide drift protection, soil erosion control followed by increase of crop yields were cited as benefits or positive impacts on production while the negative influence of shelterbelts on agriculture was ignored (factors such as overlapping of seeding and spraying operations, the threat from large agricultural equipment and land out of production). This may be because hromadas are not directly involved in agriculture.

The majority of hromadas still do not include landscape or environmental (ecological) benefits into their own (social) land management decisions of communities. It seems that the benefits from shelterbelts are not recognised (captured) entirely by hromadas and are only seen as the economic benefits of agricultural producers or external benefits. It should be noted that those hromadas which (will) have a stronger understanding of costs and benefits and include long-term benefits in their decision-making process are more likely to adopt, maintain and retain shelterbelts in an example of win-to-win cooperation with agricultural producers.

If agroforestry (shelterbelt) systems are to be considered as a possible greenhouse gas mitigation tool in Ukraine, new policies and agendas are needed. It will require increasing the awareness of agricultural producers and within hromadas (i.e., leaders, population) about the long-term economic influence of shelterbelts as well as integration into management decisions of social and environmental (ecologic) benefits of shelterbelt adoption and establishment in rural areas through the internalisation of externalities (i.e., through subsidies).

3.2. Likert-scale Ranking of Costs, Benefits, and Obstacles

A summary of Likert-scale ranking of costs, benefits and obstacles for field shelterbelts is shown in Table 1. This table includes the Likert-scale questions and their respective mean, standard deviation and number of replies. Reducing wind speeds (score 4.87 positive) followed by reducing soil erosion from wind and water were recognised as positive benefits by a higher proportion of respondents (score 4.76). On the other side of the range, providing livestock protection and reducing livestock death by shelterbelts (score 2.91) and impact on land value (score 3.72) were the least perceived benefits. Leaders of hromadas recognised that the entire financial burden on shelterbelt adoption and retention (score 4.69) together with the costly inventory procedure of trees and land (score 4.42) were the main obstacles to the adoption and retention of shelterbelts by hromadas. Both of these reasons cause potential obstacles to the future adoption and retention of shelterbelts in hromadas. Sufficiently high SD values show that the respondents are poorly aware of the impact of shelterbelts. So, the respondents do not recognise the interrelation between economic, social and environmental impacts of field shelterbelts, sustainable agricultural production system, and rural development. It should be noted that in the overall analysis, none of the factors had a marked negative impact on decisions associated with field shelterbelts.

Table 1. Summary of field shelterbelt factors ranked by leaders of hromadas surveyed in Ukraine in 2021

Likert-scale factor	Mean*	Standard deviation	No. of responses
Shelterbelts reduce wind speeds	4.87	0.423	67
Shelterbelts increase crop yields	4.21	0.897	67
Shelterbelts impact on irrigation efficiency	3.97	1.000	67
Shelterbelts reduce pesticide drift	4.40	0.818	67
Shelterbelts reduce soil erosion	4.76	0.630	67
Shelterbelts provide livestock protection	2.91	1.177	67
Improved air quality from shelterbelts	4.33	0.877	67
Odour mitigation by shelterbelts	3.90	1.089	67
Beautification of the rural area through the use of shelterbelts	3.79	1.023	67
Species biodiversity (i.e., enhancement of natural insects, protection of wildlife habitat) in shelterbelts in agricultural landscapes	4.43	0.783	67
Shelterbelts increase land value	3.72	1.042	67

Table 1. cont.

Shelterbelts is a part of a sustainable agricultural production system	4.42	0.581	67
The entire burden (costs) of shelterbelt adoption and retention is transferred to the hromada	4.69	0.556	67
Inventory of the trees state and land are very costly	4.49	0.746	67
High costs for the adoption and maintenance of shelterbelts	3.85	0.942	67
Agricultural producers should be fully responsible for the adoption and maintenance of shelterbelts instead of hromada	3.76	1.088	67

* Scores are based on a Likert-scale, where 5 is highly positive, 4 is positive, 3 is neutral, 2 is negative, and 1 is highly negative. A higher score depicts a higher level of agreement.

3.3. Observations from the Open Response Questions on Shelterbelt Costs, Benefits and Obstacles

Generally, the most frequently indicated obstacles in the open comment section of the survey were related to the lack of funds for the inventory of shelterbelts and registration of ownership rights (n = 33) and existing gaps in legislation related to the adoption and retention of shelterbelts by hromadas (n = 17). In addition, the lack of subventions from the government (n = 14) was also indicated as a negative impact on decision-making about the adoption and maintenance of shelterbelts by hromadas. Some respondents (n = 7) highlighted the fact that agricultural producers are the main beneficiary of the agroforestry (shelterbelt) system. Overall, the general identification of costs was lower than the identification of benefits and obstacles. It is worth highlighting that the costs were mainly recognised as financial obstacles for the adoption and retention of shelterbelts by hromadas. Generally, the most commonly discussed/indicated costs were related to the front-end investment required for the registration of shelterbelt ownership rights.

In addition, the open questions collected information from the leaders of hromadas on the direct economic impacts of shelterbelts. Based on the lack of information provided by respondents, it is assumed that many leaders were not well informed on the direct monetary influence linked to shelterbelts. In general, none of the hromadas was able to provide some breakdown of financial detail costs on specific expenditure throughout the lifecycle of shelterbelts. Overall, respondents indicated that these costs are very high and high (21% and 52% respectively). A lack of knowledge and/or experience about the costs associated with shelterbelts (especially related to economic valuations) represents an obstacle to the adoption of shelterbelts by the amalgamated territorial hromadas. It all points to the fact that those hromadas which are deciding to keep or maintain shelterbelts are making decisions more in line with the accepted paradigm of utility. Increasing the understanding and knowledge of the economic implications of shelterbelts has the potential to influence adoption decisions in both the income paradigm and dissemination of innovation paradigm.

4. Conclusions

Shelterbelts continue to be very important in the rural territories of hromadas and Ukrainian agricultural landscapes in general. Leaders of hromadas are very well informed about shelterbelt benefits but there is still a tendency to reduce the area devoted to shelterbelts. This is primarily due to the lack of an actual owner of shelterbelts and the lack of control over them often leads to illegal logging by rural residents to heat their homes. The situation is aggravated by the excessive land lease by agricultural holdings (some of them lease up to 500 000 hectares). Overwhelmingly, agro-holdings do not want to lease field shelterbelts because they only associate them with expenses. Many agro-holdings in Ukraine are shifting from shelterbelt agroforestry systems to the application of technologies for large-scale agriculture operations, such as zero-till. This means that field shelterbelts are no longer a favoured best management practice for most agricultural producers. A reduction in the number of farmers and landowners who cultivate the land themselves may lead to a reduction of field shelterbelts because there will be fewer farmers and associated farms.

Shelterbelts provide multiple benefits to society, but the findings of this research indicated that many of the benefits are not fully understood or recognised by hromadas. This underscores the fact that it is very difficult to expect the leaders of hromadas to recognise economical (landscape), environmental or social benefits and costs in their management decisions, even if such benefits and costs clearly exist. Evidence collected in this research identified the fact that the leaders of hromadas recognised that the entire financial burden on shelterbelt adoption and retention, together with the costly inventory procedure of trees and land, were the main obstacles to their implementation. However, the lack of knowledge on the part of hromadas about the genuine monetary costs and benefits of the environmental and social aspects of the adoption and retention of shelterbelts was also emphasised.

The continued adoption, retention and creation of shelterbelts by amalgamated territorial hromadas, landowners, and agricultural producers (land users) depend much on the state policy. The attention of government policy should be to address the high cost of the retention and adoption of new shelterbelts. As it transpires, this is one of the main obstacles to hromadas retaining and adopting field shelterbelts and should be addressed by a policy to encourage communities, landowners and agricultural producers (land users) to adopt and retain them.

Hromadas strongly believe that agricultural producers should be responsible for the adoption, retention, and creation of field shelterbelts since they get direct benefits from them. Therefore, the majority of hromadas still do not include the benefits of agroforestry (shelterbelt) systems into their long-term (social) land management decisions (policy) for communities. Improving education and awareness about all of the benefits associated with shelterbelts in agricultural landscapes are needed as many hromadas are unaware of them. Continued education and awareness about

the benefits of shelterbelts among Ukrainian hromadas will be substantial for a more common acceptance of new policy programs (i.e., greenhouse gas mitigation program), aimed at improving shelterbelt adoption by territorial hromadas, landowners, and agricultural producers.

In further studies, we should examine the comprehensive perception of landowners and agricultural producers concerning shelterbelt benefits and costs on agricultural farms. Understanding private farm-scale benefits and costs associated with shelterbelts is advantageous for revealing the decision-making process to adopt and retain shelterbelts as well as helpful in designing policy related to their management.

Author Contribution

Andriy Popov: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft preparation, writing – review and editing, visualization, supervision, project administration, funding acquisition.

Vladyslav Tymoshevskyi: validation, writing – original draft preparation, writing – review.

Vadym Poliakh: formal analysis, resources, writing – original draft preparation.

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Appendix A – Blank Copy of the 2021 Survey of Hromadas

Part I

3. Where is the amalgamated territorial community located? _____
4. What is your position? _____
5. When you require information on the adoption and retention of shelterbelts, where do you get it from? Check all that apply.
   ☐ Scientific articles
   ☐ Internet
   ☐ Agricultural industry representatives
   ☐ Other farmers
   ☐ Government extension representatives
   ☐ Public research institutions
   ☐ Other, specify _____
6. What type of shelterbelts does hromada have on its territory? Check all that apply.
   ☐ Field shelterbelts
   ☐ Pasture shelterbelts
   ☐ Shelterbelts around roads
   ☐ Shelterbelts at the ravines
   ☐ Shelterbelts around garden
   ☐ Shelterbelts at the arroyos
   ☐ Shelterbelts at the watercourses
   ☐ Difficult to answer
   ☐ Other, specify _____
7. Does the hromada take care of the shelterbelts? Check all that apply.
   ☐ Yes
   ☐ No
   ☐ Other, specify _____

Part II

8. Does the hromada plan (interested) to provide for use (lease out) field shelterbelts to agricultural producers, farmers, landowners, land users?
   ☐ Yes
   ☐ No
   ☐ Difficult to answer
   ☐ Other, specify _____
9. Is there a need for the hromada to plant new shelterbelts?
   ☐ Yes
   ☐ No
   ☐ Difficult to answer
   ☐ Other, specify _____
10. Does the hromada feel the need to renovate the shelterbelts?
   ☐ Yes
   ☐ No
   ☐ Difficult to answer
   ☐ Other, specify _____

Part III

11. Responsible for the adoption and retention of protective forest belts should be agricultural producers, farmers, landowners and land users instead of the hromada:
    Choose only one option.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
12. The system of field shelterbelts can:
    Choose only one option.
    Reduced wind speeds and protect from drifts (snow, sand, etc.).
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
    Shelterbelts increase crop yields.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
    Using shelterbelts to improve irrigation efficiency.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
    Using shelterbelts to reduce pesticide drift.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative

Shelterbelts reduce soil erosion from wind and water.

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

Providing livestock protection.

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

Improved air quality from shelterbelts.

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

Odour mitigation (i.e., from swine, landfill) by shelterbelts.

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

Shelterbelts play an important social role, beautification of the territory by shelterbelts.

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

Improved restoration and stabilization of ecological balance (i.e. species biodiversity, wildlife habitat, changes to the microclimate).

☐ Highly Positive
☐ Positive
☐ Neutral
☐ Negative
☐ Highly Negative

13. Using shelterbelts provide a sustainable agricultural production system.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
14. Shelterbelts positively influence land values.
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative
15. Costs for the adoption and retention of field shelterbelts are _____:
    ☐ Very high
    ☐ High
    ☐ Neutral
    ☐ Low
    ☐ Very low
16. Please, describe any other costs related to shelterbelts in hromada (List all that apply). _____
17. What benefits hromada receive from shelterbelts (List all that apply). _____
18. Do you think that the benefits associated with shelterbelts are greater than the costs?
    ☐ Highly Positive
    ☐ Positive
    ☐ Neutral
    ☐ Negative
    ☐ Highly Negative

Part IV

19. Please, describe the obstacles to the registration of property rights to land under the shelterbelts (List all that apply). _____
20. Fixation of the state of trees for registration of property rights to land under shelterbelts (registration in the State Land Cadastre) and inventory of land under shelterbelts is a very costly measure (in time and money).
    ☐ Completely agree
    ☐ Rather agree
    ☐ Neutral
    ☐ Rather do not agree
    ☐ Strongly disagree

21. The entire burden (including financial) of solving all national problems related to the registration of property rights to land under shelterbelts is transferred to the territorial hromada (i.e. preparation of land-use planning documentation, correction of errors in the State Land Cadastre, etc.).

    ☐ Completely agree
    ☐ Rather agree
    ☐ Neutral
    ☐ Rather do not agree
    ☐ Strongly disagree

22. The payment of land tax for the use of shelterbelts should be abolished because this is an additional financial burden along with other costs associated with the preparation of the above documentation and shelterbelts retention.

    ☐ Completely agree
    ☐ Rather agree
    ☐ Neutral
    ☐ Rather do not agree
    ☐ Strongly disagree

23. Additional comments and opinions on shelterbelts: _____