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Farmer Perception of Trees in a Semiarid Agroecological Zone[#]

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ARTICLE INFO	ABSTRACT
	Trees in upland, semiarid agroecological zones typically require water efficiency due to low rainfall, cold and dry temperatures as in Niğde Province, Central Anatolia, Türkiye. This study quantitatively assessed farmer perception of ecosystem services and production advantage of trees in a semiarid zone. Forty-nine farmers in Niğde Province were surveyed. The survey evaluated two major factors: ecosystem services and production advantage using eleven indicators. The responses were grouped by age, gender, education, district class (rural and urban) and farm settlement (rural and urban) and were analysed by test of association (χ2) at P≤0.05. Most farmers had knowledge of trees in their environment and mainly supported the perspective that trees were important mainly for cultural and provisioning ecosystem services. However, they held the opinion that having trees on their farmer was a production disadvantage in a semiarid agroecological zone. Although there were no gender differences in their perspectives, there were significant difference by age, education, district class and farm settlement. Farmers in this semiarid agroecological zone seemed more interested in trees with evident ecosystem services and production advantage such as improved crop yield, water efficiency, weed and pest management, ease of harvesting as well as reduced overall production cost. By implication, trees with multiple benefits are required if further planting by farmers is to be encouraged for agroecosystem improvement. In addition, tree choice will be based on farmer perception of the benefits of trees for ecosystem services and production advantage and further research to identify and promote trees that benefits the widest range of agroecosystems.

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Introduction

Low precipitation, extreme temperatures and likelihood of drought characterises semiarid agroecological zones (Çalişkan and Boydak, 2017) and the Central Anatolia Region of Türkiye fits this description with less than 400 mm/year rainfall, subzero cold winter, dry summer, the vegetation dominated by drought tolerant plants, such as those in the genera *Astragalus*, *Acantholimon*, *Alnus*, *Artemisia*, *Elaeagnus*, *Pinus*, *Poplus* and *Querus* (Çalişkan and Boydak, 2017, Kenar et al. 2020).

Based on the Millennium Ecosystem Assessment (MEA) (Dorji et al. 2019), the four categories of ecosystem services are cultural, provisioning, supporting/habitat, regulatory which are linked to community values, such as environmental conservation, wellbeing, socioeconomic, and spiritual sustenance provided by trees. In a study of tree and ecosystem services provided by trees in coffee plantations, Wagner et al. (2019) observed that farmer perception is hinged on the prioritised ecosystem services

and Yang et al. (2020) underpinned the critical management of agroecosystems to the attitude of farmers to ecosystem services. However, the studies that led to these assertions were done with farmers having either a target crop (coffee agroecosystem) or temperate climate such as 800 mm annual rainfall in China. Reviewing the farmland productivity of Zimbabwean semiarid zones, Parwada et al. (2022) opined that trees may improve water supply and water use efficiency as well as nitrogen fixing trees having soil health potentials. However, this opinion had not been tested with farmers in semiarid zones of Zimbabwe.

Farmer perception of trees in Niğde, Central Anatolia, a semiarid zone was quantitatively assessed to understand their knowledge of the trees, connection of trees to the ecosystem services and the possible production or other advantages that trees provide.

Materials and Methods

A questionnaire-based survey was conducted with forty-nine farmers in Niğde Province as guided by the methods of Haines-Young and Potschin (2013) and Dorji et al (2019). Niğde Province, Central Anatolia, Türkiye has six districts, Altunhisar, Bor, Çamardı, Çiflik, Merkez and Ulukişla, and a population of about 400,000 (TUİK, 2020). Altunhisar, Çamardı, Çiflik and Ulukişla were categorised as rural while Bor and Merkez were considered urban in this survey based on their level of urbanisation and industry. Sociodemographics of the farmers included their age, education, gender, district class (residence of the farmers) and farm settlement (location of the farm).

The farmers' knowledge of trees was ascertained by pictorial matching of 12 common trees in Niğde with their names. The trees were alder, apple, black pine, black willow, chinaberry, hawthorn, oak, poplar, Russian olive, sea buckthorn, Turkish fir and weeping willow. Farmer perception was tested through 10 indicators and these were subsequently grouped into two major factors, ecosystem services and production advantage (Table 1) and presented in Likert scale of strongly agree to strongly disagree with corresponding scores of 5 to 1. Cultural and provisioning categories had scores 1-5 having one indicator per category while supporting and regulatory had two indicators each and scores 1-10. The survey questionnaire was written in the Turkish language, data collection was done randomly and responses were grouped based on their sociodemographics for analysis. The ggplot package (Patil, 2018; Brunson, 2019; Koneswarakantha, 2019) on jamovi statistical software (The jamovi project, 2021; R Core Team, 2021) was used for test of association ($\chi 2$) at $P \leq 0.05$.

Results and Discussion

Knowledge of Trees

Most farmers that participated in this study were between 20-50 years old. Two-thirds of the farmers in the study were male, the proportion of male farmers resident in the urban to districts was 48% while 52% resided in the rural districts. Only 7% of the female farmers in this study resided in the rural districts. The high school qualification of the farmers was 40%, vocational qualification (4%) and more than 50% had bachelors and higher degrees Thirty-six farmers could recognise at least six of the 12 trees (P<0.05). Age, gender and district class had no influence on their knowledge of trees (Table 1). All farmers had

recognised apple trees (100%) followed by poplar (91%), black pine (86%), hawthorn (84%), oak (82%), chinaberry (81%) and weeping willow (79%).

Niğde Province is known for apple production in Türkiye (Bozbuğa and Pırlak, 2012) while poplar, oak, black pine, hawthorn and weeping willow are well adapted trees growing commonly in Central Anatolia (Çalişkan and Boydak, 2017; Ertug, 2000) and these are common trees in Niğde Province. Tree knowledge is important to guiding the farmer choice and preference of tree to either be retained or removed (Wagner et al., 2019) and perhaps their ecosystem services (Yang et al. 2020).

Ecosystem Services

There was a strong farmer perception of trees as important for environmental conservation and improved crop yield (Figure 1). Socioeconomic values such as food, fodder and fuel may lead farmers to gravitate towards provisioning ecosystem services (Wagner et al. 2019) in addition to environmental conservation, a community value linked to cultural ecosystem services (Dorji et al. 2019). There was a strong agreement towards trees providing cultural (83%) and provisioning ecosystem services (72%) (Figure 2) while farmers were clearly divided in their opinions on supporting and regulatory ecosystem services. As suggested by Riley (2021), there is perhaps a need to access a wider range of exotic trees with potential to provide ecosystem services in Central Anatolia, Türkiye as it may lead to identifying trees with supporting and regulatory ecosystem services that are adapted to semiarid agroecological zone.

The farmers had varying opinions on the possibility of limited use of fertiliser use and water with trees and this significantly differed (Table 2) with having farms in rural settlements settlements. Although it is suggested that water efficiency is increased in an agroforestry system as tree may theoretically influence water cycling (Parwada et al. 2022), the empirical proofs are limited and the farmers in a semiarid agroecological zone may be unconvinced of this possibility. Also, not many farmers agreed that pest and weed controls could be better achieved with trees on their farms. Tree belts can be used to create buffer zones on and around farms to mitigate pesticide drift (Zaady et al. 2018) and risk of negative impact on pollinators (Vaughan et al. 2017) but not necessarily for reduced use of chemical pest and weed control agent.

Table 1. Factors and indicators tested for farmer perception

Factor	Description	Indicator	Plot code
Knowledge	Can you match the trees to their names?	Tree identification	
Ecosystem Services (ES)	• Cultural ES	• Environment conservation	ES1
	• Provisioning ES	• Crop yield	ES2
	• Supporting ES	• Reduced fertilizer use	ES3
	• Supporting ES	• Reduced water use	ES4
	• Regulatory ES	• Pest control	ES5
	• Regulatory ES	• Weed control	ES6
Production Advantage (PA)	• Farms need the support of trees	• Benefits of trees	PA1
	• Not all trees are beneficial to farms	• Beneficial trees	PA2
	• Planting trees on farms increase cost of crop production	• Production cost	PA3
	• Crop harvesting is made easy by tree planting	• Harvest	PA4

Table 2. Ecosystem services and production advantage by response groups (P≤0.05*)

| Factor	Indicator	Response groups				
		Age	Gender	Education	District class	Farm settlement
Knowledge	Tree identification	0.347	0.224	0.023	0.364	-
Ecosystem Services	• Environment conservation	0.093	0.437	0.512	0.048*	0.186
	• Crop yield	0.387	0.209	0.495	0.061	0.132
	• Reduced fertilizer use	0.881	0.761	0.705	0.151	0.240
	• Reduced water use	0.042*	0.692	0.140	0.122	0.022*
	• Pest control	0.871	0.478	0.004*	0.415	0.627
	• Weed control	0.419	0.105	0.187	0.460	0.600
Production Advantage	• Benefits of trees	0.659	0.417	0.824	0.343	0.661
	• Beneficial trees	0.448	0.257	0.508	0.049*	0.147
	• Production cost	0.504	0.825	<0.001*	0.333	0.192
	• Harvest	0.503	0.552	0.200	0.153	0.017*
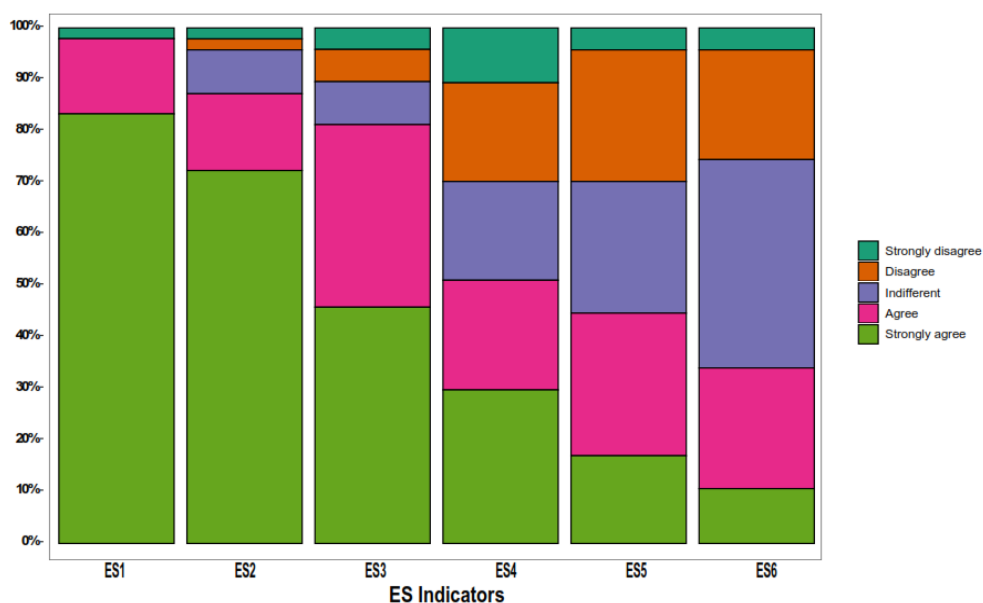
Figure 1. Farmer perception by ecosystem service indicators. ES1, environmental conservation; ES2, crop yield; ES3, reduced fertilizer use; ES4, reduced water use; ES5, pest control; and ES6, weed control (codes defined in Table 1).
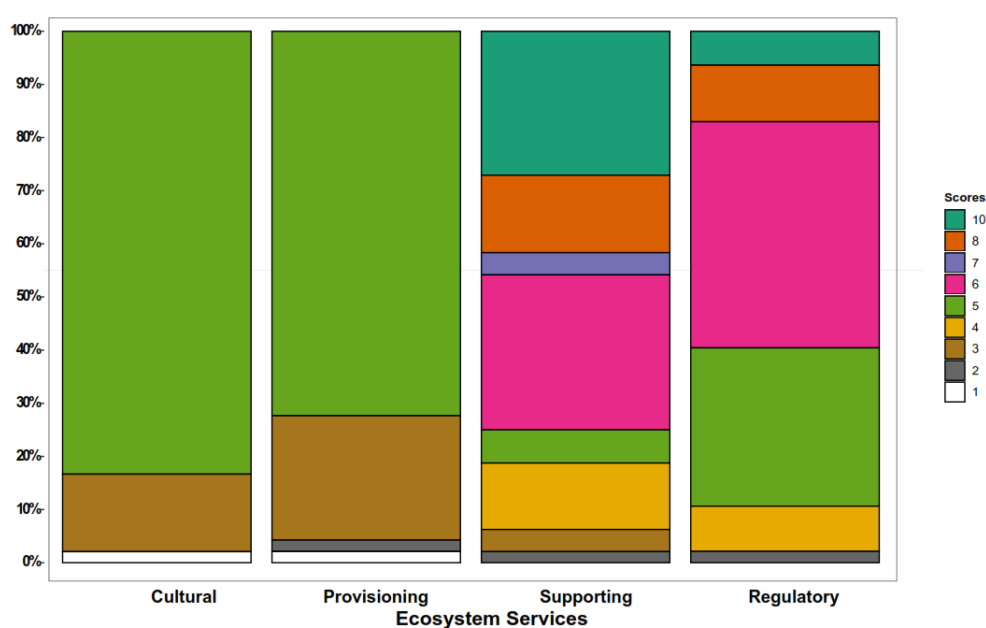

Figure 2. Farmer perception of ecosystem services of trees. Cultural and Provisioning were scored 1-5 each while Supporting and Regulatory were scored 1- 10.
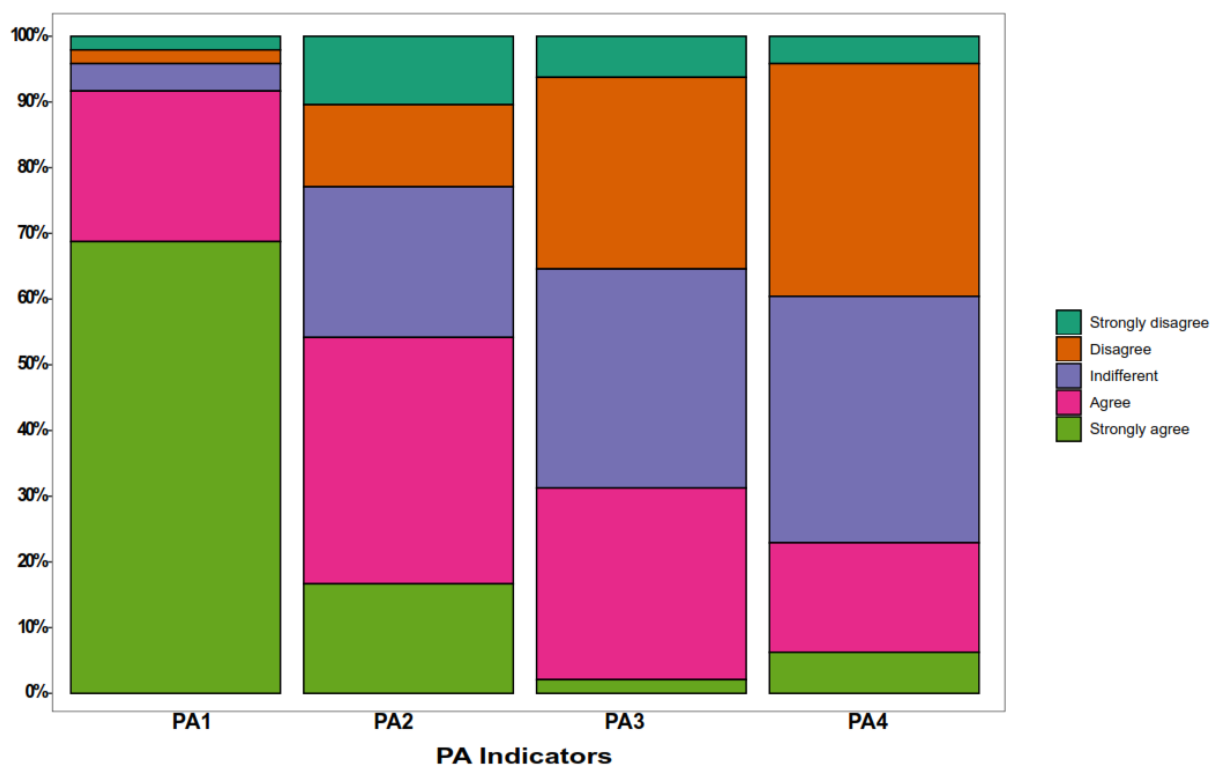
Figure 3. Farmer perception of production advantage. PA1, farms need the support of trees; PA2, not all trees are beneficial to farms; PA3, reduced production cost; and PA4, ease of harvesting (codes defined in Table 1).

Production Advantage

Although many farmers agreed to trees having benefits (Figure 3), they objected to the assertion that trees may provide them some advantage through production cost and ease of harvesting. This agrees with Lehman et al. (2020) which opined that choice of farmers for integrated food and nonfood systems may be influenced by the crop species, production system and agroclimatic zone. Optimum resource utilisation such as water and land with reduced risk of losses due to drought (Golla, 2021) perhaps had shaped the farmer perception of trees as a production disadvantage.

Conclusion

The knowledge of trees and cropping system is pivotal to the farmer perception of their ecosystem services. Possible derivations of production advantage in a semiarid agroecological zone are not widespread as management options are limited by factors such as water efficiency requirement and unfavourable climatic factors.

Cultural and provisioning ecosystem services were identified in this study as paramount to the farmers compared to supporting and regulatory ecosystem services for socioeconomic and environmental conservation considerations. Since cost reduction and ease of harvesting were not perceived as production advantage where trees are planted on the farmlands, there is a need to further understand other factors such as crop types and production systems that may lead to agronomic productivity in a semiarid zone.

By implication, indigenous trees with multiple benefits and drought tolerant exotic actinorrhizal tree species

(Riley, 2021) are required if further planting by farmers is to be encouraged for agroecosystem improvement. Tree choice will be based on farmer perception of the benefits for ecosystem services, production advantage and further research to identify and promote trees that benefits the widest range of agroecosystems.

Acknowledgements

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