CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

International Development and Agricultural Economics

Perception of utilization of homegardens by households in the southeast part of Turkey

MASTER'S THESIS

Prague 2022

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Declaration

I hereby declare that I have done this thesis entitled "Perception of utilization of homegardens by households in the southeast part of Turkey" independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA and that this work has not been submitted for any other degree or professional qualification except as specified.

Prague, 22 April 2022

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Hasan Tekin

Acknowledgements

First, I would like to thank my supervisor Ing. Vladimír Verner, Ph.D., for his guidance throughout the whole process. His support and constructive criticism helped to shape this thesis. Furthermore, I would like to thank my wife for supporting me and being the most patient and loving. Lastly, I would like to express my great appreciation to everybody who took the time of their day to fill out the questionnaire and answer honestly. That made this study a reality. It would also be impossible to write this thesis without the support of my family, who knows the area well and helped me with the transportation and contacting farmers.

Abstract

This study investigates the role of homegardens in the livelihood of households from the southeast region in Turkey, more specifically in the Bismil district in Diyarbakir province. The thesis aimed to discover the plant diversity, uses, and socioeconomic factors of traditional homegardens in Southern-East Turkey. Forty interviews with local farmers were held. The questions investigated the use and diversity of food species grown in homegardens, household and homegarden characteristics and the perception of farmers toward homegardens. We used three indices to quantify agrobiodiversity, Shannon-Wiener, Margelef, and Simpson's index. Hierarchical cluster analysis was run to classify homegardens into five groups with similar characteristics (age, size, agrobiodiversity). The student's t-test was applied to determine the difference between commercial and non-commercial homegardens and the location of homegarden at the urban-rural gradient. Furthermore, Pearson correlation was used to define the relationship between household and homegarden characteristics. The result shows that the majority (n=31) homegardens were subsistence-oriented, remaining (n=9) were classified as commercial. The average diversity index value for homegardens in the study area was Shannon-Wiener 1.83, Margalef 1.64 and Simpson's index 2.63. The only significant variables influencing species diversity and richness were location and closeness to the market. Rural gardens had higher Shannon-Wienner species diversity ($P<.034$) than urban ones, Shannon-Wiener diversity ($P<.004$) was also increasing far from market. Interestingly, our results show no statistically significant difference in species diversity between commercial and subsistence homegardens. Owners see their homegardens as a source of healthy and fresh products, while only 35% of respondents answered that species diversity is important for them. Homegardens in the study area play an important social role in the livelihood of local households, contribute to the diet, and more close they are to urban areas, the diversity of species declines.

Keywords: household characteristics, biodiversity indexes, agrobiodiversity, correlation, cluster analysis, market access, urban-rural gradient

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1. Introduction

Homegardens were firstly mentioned in writing occurred in 'Ramayana' and 'Mahabharata', which are two Indian epics. Their work is dated back to 7000 - 4000 B.C. based on the events that have supposedly happened. Both epics mentioned '*Ashok Vatika*', which is equivalent to homegarden (Kumar & Nair 2004). Similarly, there have also been records on homegardens of Java Island from the same age/epoch (Hutterer 1984; Kumar & Nair 2004).

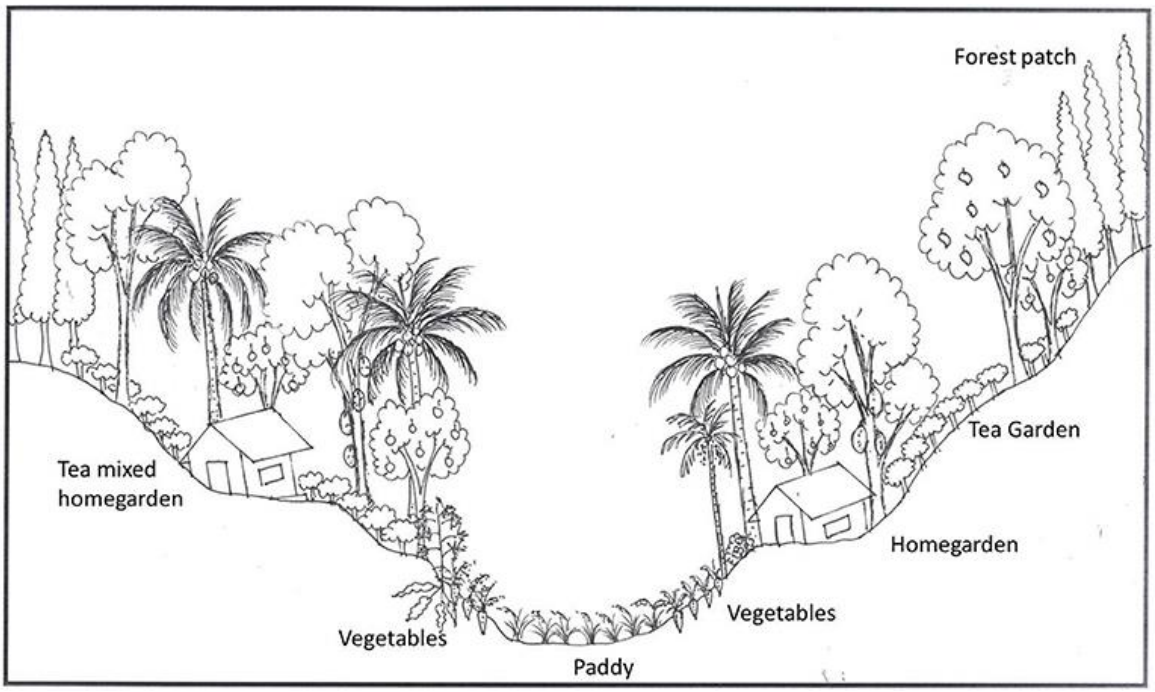

Figure 1 Integration of homgarden into the farming systems

Source: Thamilini et al. 2019

Nevertheless, the history of homegardens could be tracked even more into the history, far before the first writing evidence. Their origin goes back to the Neolithic revolution, when people transformed their livelihood from rather nomadic hunters and gatherers to permanent farmers (Fernandes & Nair 1986). Thus, homegardens should be perceived to be the oldest land-use system. Many other names were related to this farming system based on a particular area, i.e., '*Talun-Kebun*' in Java, '*Shamba*' and '*Chagga*' in East Africa, or '*Huerto*' in Meso-America (Nair 1993). Regardless of the name, homegardens have played a crucial role in various agroecosystems since the

dawn of agriculture (Abdoellah et al. 2006; Hailu & Asfaw 2011). Generally, homegardens are widely recognized as a sustainable agroforestry system characterized by a mixture of trees and crops of various use with domestic animals and located close to family houses (Torquebiau 1992; Kumar & Nair 2004; Peyre et al. 2006; Iskandar et al. 2018). Defined as an agroforestry system, they represent a dynamic, ecologically sound system of natural resource management involving the integration of trees on farms in agricultural landscapes (ICRAF 2008). Farmers acknowledge if they can diversify and sustain production and thus enhance the economic, environmental, and social benefits leading to a positive impact on their living standard, culture, or food security (see, e.g., Fernandes & Nair 1986; Kumar & Nair 2004; Abdoellah et al. 2006; Peyre et al. 2006; Kabir & Webb, 2009; Prihatini et al. 2018).

2. Literature review

2.1 Homegardens as a creadle of agrobiodiversity

The main purpose of homegardens worldwide is to supply a household with food, fodder, vegetables, fruits, construction material, medicine, material etc. Moreover, it can also be a source of additional income (Peyre et al. 2006). In the current globalized world, the pressure on monetary security increases and affects subsistence farmers rather in remote regions (Folke et al. 1997; Deutsch 2004; Kahane et al. 2013). Various studies divide homegardens based on income generated into two types – subsistence and commercial. Historically, homegardens have been designed as subsistence-oriented farming systems, primarily focused on people's household consumption and cultural needs (Soemarwoto 1985; Sherstha et al. 2001; Kabir & Webb 2009; Landon-lane 2011; Semu 2017; Prihatini et al. 2018).

While it is generally recognized that the diversity in the natural world is neglected under an increase of human population pressure on ecosystems, there is minimal knowledge that agrobiodiversity is threatened similarly. Agrobiodiversity is a subgroup of ecological biodiversity which involves plant genetic for food and agricultural product (Negri 2005; Negri & Polegri 2009; Galluzzi et al. 2010).

Such traditional homegardens provide biological conservation and other incorporeal benefits to the owner of the garden, society, and a surrounding ecosystem (Kumar & Nair 2004). Additionally, high plant species diversity may also result in additional income for the household (Wezel & Bender 2003). However, commercial gardens are associated with decreased biodiversity and fewer positive externalities to local regions. Moreover, economic benefits, such as stability of the production and diversity of products, are substituted by specialization on few products and thus, lower biodiversity (Bernholt et al. 2009; Thompson et al. 2009).

However, agrobiodiversity is not just having a positive impact on local agroecosystems. Traditionally diverse homegardens are full of local plant species that are used for a proper diet of household members (Mitchell & Hanstad 2004; George

& Christopher 2009; Bernholt et al. 2009; Vlkova et al. 2011). There is a wide variety of factors associated with diversity, structure, and biophysical features on homegardens e.g., biogeography, elevation, economic requirements (commercial or subsistence), social responses such as tradition, culture, ethnicity, education (Soemerwoto 1987; Mohan Kumar et al. 1994; Millat-e-Mustafa et al. 2000; Trinh et al. 2003; Simons & Leakey 2004; Das & Das 2005; Abdoellah et al. 2006; Semu 2017).

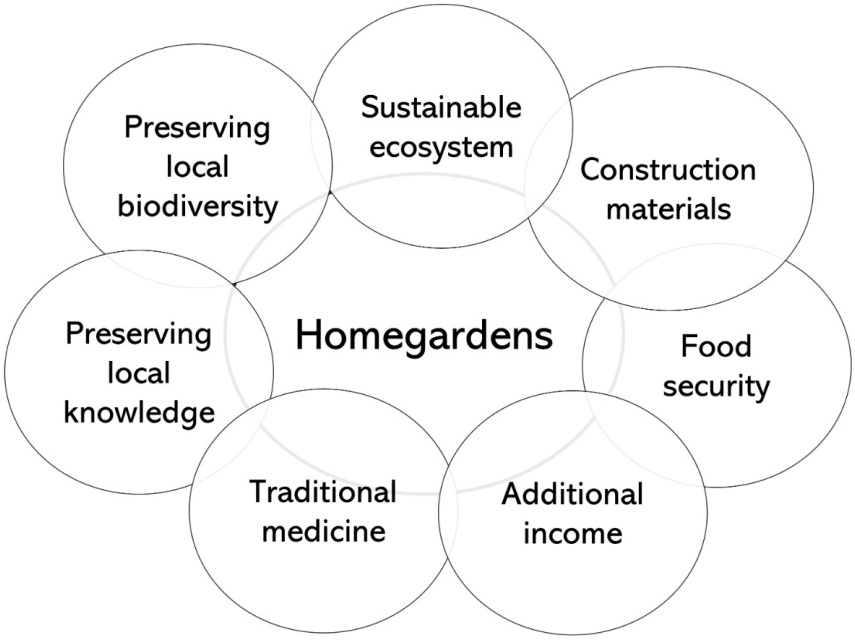

Figure 2 Main benefits of homegardens

Agrobiodiversity has been most of the time thrived by small farmers. On-farm conservation in its fields and orchards is a “dynamic” solution that enables species and local species to continually adapt to their changing environments and is based on the ecosystem's human and biological components. For the indigenous community, food security, health care, and ecosystem resilience are actively focused on maintaining biodiversity, environmental preservation is the goal of increasing the wellbeing of their livelihood (Gari 2001; Galluzi et al. 2010; Bucheli & Bokelmann 2017). Biodiversity preservation provides a sustainable ecosystem and helps to prevent water pollution, odours, health risks, biodiversity loss and many other negative consequences. Biodiversity helps restrain climate change, maintains

ecological balance at the household farm level, ensures food security and increases market opportunities for communities (Swinton et al. 2007; Bucheli & Bokelmann 2017).

2.2 Services provided by homegardens

Food security is defined by the United Nations' Committee on World Food Security, it means that "all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life". Food security is an important reason to cultivate homegardens (Calvet-Mir et al. 2012). During social and economic crises, traditional homegardens help locals survive a crisis, especially when people do not have permanent jobs in rural areas homegardens provide additional income, ensuring food security and solidarity between family and other inputs for the owner (Bassullu & Tolunay 2010). Homegardens in the rural areas are an important factor for the economy and self-sufficiency of many households, especially in the developing countries where income is low (Wezel & Bender 2002).
Homegardens dynamics are changeable. It can be influenced by many factors that affect its structure and composition, whenever socioeconomic factors change, homegardens structure and composition change (Abdoellah 2006; Peyre at al. 2006). Homegardens are evolving together with farmers, their needs, and technological advancement. Cultivated by farmers, homegardens reflect changes in rural development and people's livelihoods over the centuries (Wiersum 2006). For example, in Indonesian rural areas, the subsistence homegardens are more and more becoming market-oriented because of the dynamics in rural transformation. Depending on, homegardens functions and the structure can show different movements (Wiersum 2006).

Homegardens are mainly meeting nutrition for household or income need, but apart from these functions, homegardens also play a significant role. Still, homegardens also play a significant role in nutrition for household or generating income apart from these functions. Still, apart from these functions, homegardens also play a significant role in social roles. For many people who lives in a rural area, homegardens are places for socializing with a member of family and neighbours, place to relax (Abdoellah &

Marten 1986; Soemarwoto & Conway 1992; Abdoellah et al. 2006; Vlkova et al. 2011; Whitney et al. 2017). It is also a sign of social status. If you do not have your own garden and your house is another person's garden, you are considered poor in society (Abdoellah et al. 2006). Homegardens can also serve as a "hobby" like a place of relaxation or give pleasure to the owner of homegardens (Calvet-Mir et al. 2012).

The study has been conducted in Vall Fosca (Catalan) shows us that homegardens offer a wide range of ecosystems beyond the production services where farming systems are mainly managed. The most valuable role of homegardens is providing food, however, in Vall Fosca, the most appreciated is not food production. It is a cultural category of ecosystem services. 95% of the sample believed that homegardens must be preserved for cultural heritage and as a key landscape element (Calvet-Mir et al. 2012).

2.3 Commercialization of homegardens

Commercialization of homegardens can affect plant diversity, soil fertility, soil erosion – in commercial settings mostly are produced in the opposite traditional where a large variety of veggies is cultivated. Traditional veggies with low profitability will be one of the first ones to vanish from homegardens. This can reduce the dietary role of homegardens, providing an additional source of vitamins, minerals, and proteins (Soemarwoto & Conway 1992; Wezel & Bender 2003; Abdoellah 2006; Galhena et al. 2013; Prihatini et al. 2018). Focusing on cash crops through the commercialization of homegardens has resulted in improvement quickly, but its unknown productivity will be sustainable (Abdoellah 2006). The previous study also shows that commercial homegardens decrease diversity and e on the limited number of cash crops. This is an increase in the use of chemical pesticides and fertilizer (Abdoellah & Marten 1986; Abdoellah et al. 2001; Peyre et al. 2006; Prihatini et al. 2018). Commercial homegardens are bigger than subsidized homegardens and farmers mostly plant vegetables, but non-commercial gardens mostly plant ornamental plants (Abdoellah 2006).

Commercialization of homegardens affect socialization- in commercial gardens owner established fences around their homegardens (Abdoellah 2006). This also shows that adverse change in traditional free access, as there was no trespassing in traditional homegardens were also places for a family to gather together socializing with neighbours. Indonesia homegardens show that ecological characteristics and social roles have changed. Traditional homegardens that centuries kept people safe and fed well may not be sustainable without external inputs. (Soemarwoto & Conway 1992; Abdoellah 2006).

2.4 Factors affecting agrobiodiversity in homegardens

Kumar & Nair (2004) found from their study that small gardens located in urban areas present the highest plant species diversity. The plant species of homegardens increase or decrease depending on height, the length of the dry season, the density of household members, and distance to urban areas (Hoogerbrugge & Fresco 1993; Ramachandran Nair 2014).

Homegardens as the name suggests are located close to the family's house. They are mainly found in the rural areas, however, they are becoming more common in urban areas as well. The main difference between rural and urban homegardens is their primary purpose and use, which could lead to different species planted (Mosina et al. 2014). Urban homegardens are helping ecosystem services that improve the quality of air, life, carbon capturing, and society (Dunnett & Qasim 2000; Wu et al. 2003; Van Veenhuzen 2006; Marco et al. 2010).

Other studies found that urban homegardens have a higher diversity of ornamental plants, and the role of homegardens was associated with aesthetics (Nair 1993; Eichemberg et al. 2009) Reichard & White (2001) found similar results that species found in these gardens were for horticultural use except for owner with low income. In the urban and peri-urban areas, the food production purpose of homegardens is not always a priority, while in the rural areas, food production is the main purpose of gardens. On the other hand, homegardens in the urban area with easy market access may lead to commercialization if there is a necessity, and within market proximity and commercialization, species diversity might have an adverse effect (Wezel & Ohl 2005; Abdoellah et al. 2006; Kehlenbeck et al. 2007; Mosina et al. 2014). Food producing

homegardens in the urban areas grow into a tool to help cities become more sustainable and help marginal areas improve the population with additional work opportunities and provide a healthier diet and enriching cultural identity (Van Veenhuzen 2006).

Additionally, many researchers have reported that access to road, altitude, homegarden size, and market access have a significant impact on species diversity and structure of homegardens (Wiersum 1982; Marten & Abdoellah 1988; Soemarwoto & Conway 1991; Kaya et al. 2002; Bernholt et al. 2009; Whitney et al. 2017). Homegardens species diversity and structure can be influence by the market. According to Hoogerbrugge and Fresco (1993), plant species declined in gardens close to the market.

Homegarden age is being recognized as one to strong factor in species diversity as well. Studies found out that within the increase of homegarden new plant species are being added to the garden (Coomes & Ban 2004). In the other hand other studies found that the youngest gardens are more diverse than the older one (Blanckaert et al. 2004; Aguilar-Stoen 2009)

The location far from the market and there was high species diversity documented. Together with increasing availability to the market some studies reported a decrease in the diversity of plant species (Nair 1993; Abdoellah et al. 2006; Peyre et al. 2006; Kabir & Webb 2009).

Male adults contribute with more labour in homegarden, as a result, homegardens are more diverse and income-oriented female-headed home gardens are often more subsistence-oriented and found more diverse (Wiersum 2006; Kabir & Webb 2009).

Cultures have been found to be significant for the biodiversity of ecosystems and mostly people's cultural and economic attitude which can explain differences between neighbouring fields and homegardens (Timothy & Eyzaguirre 2006; Galluzzi et al. 2010; Wakhidah et al. 2020). Tradition and aesthetic preferences play a crucial in determining the overall view on the homegardens. Different crops variety are sustained due to a connotation of each family's traditions – Italian farmers insist

planting species has better taste than another one or is more appropriate on certain time crops or because of aesthetic preferences (Eyzaguirre & Linares 2004; Birol et al. 2005; Smith 2006; Portis et al. 2014; Wakhidah et al. 2020). Income is not the driving factor of the majority of homegardens owners. Usually, if they have a stable source of income outside of agriculture, they are driven by the urge to keep tradition and preserve local customs that they have learnt from a previous generation (Negri 2003; Bernholt et al. 2009).

A diversified supply of produce from orchards throughout the year is often crucial to the livelihood of the poorest and most marginalized groups in developing countries. It might provide small-scale marketing (Galluzzi et al. 2010; Galhena et al. 2013). Annual and bi-annual crops of perennial and semi-perennial plants and wild species under biodiversity pattern enable household members to reach a long-lasting production regularly (daily, weekly, and monthly). This permits household members to reduce the market risks since they will have a wider variety for products (Jamnadass et al. 2013; Bucheli & Bokelmann 2017).

Increasing homegarden size and promoting cultivation will lead to an increase of habitat and thus will increase species diversity across years (Abdoellah et al. 2020). Homegarden size indicates in the study in Indonesia that large homegardens were more diverse than small and medium homegardens. This is because large homegardens could grow more species with many individuals. While small homegardens were narrowed due to size of the homegarden, and they had to choose limited species (Gerhard et al. 2014).

Abebe (2005), found out that the economic status of homegarden and farm size is highly correlated due to increasing farm size would lead to an increasing number of individuals for cash crops, but farm size was not affecting the richness and evenness of the farm. The smallest homegarden size in the urban areas indicates the highest plant species due to limited space forces farmers to plant different species with small numbers and increase diversity (Kumar & Nair 2004).

3. Aim of the thesis

The thesis aims to analyze agrobiodiversity and socioeconomic factors associated with homegardens in Southern-East Turkey.

Specific objectives are:

i) document the diversity and use of food species grown in homegardens
ii) provide household resource analysis
iii) quantify the effect of household and homegarden characteristics on agrobiodiversity
iv) comparison of commercial and subsistence homegardens characteristics

4. Methodology

4.1 Study site characteristics

The research was conducted in Bismil district in Diyarbakir province in southern-east part of Turkey. Bismil district covers an area of 1,737 km^2. Total population of district is 118,592, population is almost equal between male and female there is 59,381 male population and 59,211 female population. Population in the study area is very young 89,243 individual out of 118,592 total population is under age 40. The average household of area is 5.1 and education level is mostly primary school but uneducated literate.

Figure 3 Location of Bismil district

Source: Bismil municipality

The main livelihood of the district is agriculture. In Bismil, which is the largest district of Diyarbakir Province in terms of arable agricultural land, cereals are generally cultivated, but in recent years, the cultivation of other industrial plants, especially cotton, has spread to a very wide area due to the provision of energy opportunities and the dams built in the surrounding area.

Figure 4 Homegarden in the study area as place to socialize with family

Bismil is located in the depression between Mardin and Silvan in the Tigris section of South-eastern Anatolia, Bismil is in the Hazro folded belt, in other words, in the marginal belt of the South-eastern Taurus Mountains. The syncline zone, known as the Bismil depression, through which the Tigris River passes, spreads in the East and West directions. Bismil district, the study area is spread over these three geomorphological units. Bismil and its surroundings, which cover half of the Diyarbakır base, are part of the base's geological and morphological units. Therefore, high geomorphological units (paleocene-eocene) and young (plio-quaternary and quaternary) and old shops which are the location point of the district in the north and south of the district support this thesis. Gongül Hill (1555 m) is the highest point of the study area.

This geomorphological structure belonging to Savur, located on the Mardin plateau, emerged as a result of a ectoparasitic morphography. Surrounded by a folded zone in the west (Hasankeyf, Gercüş and Bismil) and east (Çınar, Mazıdağı) the Mardin plateau is formed by a gradually decreasing crest (Metala H., 1194 m, Şıhlik H, 1038 m and Şıhra H 677 m) and has a slightly jagged bend. This is valid for the geomorphological units (Agir H., 923, Kavli H., 723 m and Killi H., 640 m) extending from Mardin to the Bismil depression. Therefore, a gradual decrease from the Mardin plateau towards the depression area at the bottom of the Tigris River is remarkable. Pleats are common in the south as well as in the north of Bismil. Visit Hill (1255m) is the highest point in the study area located in the Hazro-Silvan folded zone (high fold zone). Oow plateau zone, the morphological unit called Silvan plateau from this high fold extending between Bismil-Diyarbakır-Silvan.

Bismil meteorological station data reflects the climatic character of the study area. According to the 15-year data of the station, the annual average temperature value is 15.7 ˚C. When these station data are compared with the other station data of the basin, it is noteworthy that the features are relatively arid. Average monthly temperatures in Bismil district vary between 2.5˚C and 30.4˚C throughout the year. The difference between the average temperatures in July and January is around 28˚C. In winter, against the cold air masses with the northern sector (polar air mass), the temperature values at the bottom of the basin protected by the Southeast Taurus Mountains do not affect the living conditions negatively. Despite this determination, when the average temperature values in July are examined, around Bismil; It is seen that the rather problematic summer temperatures are effective.

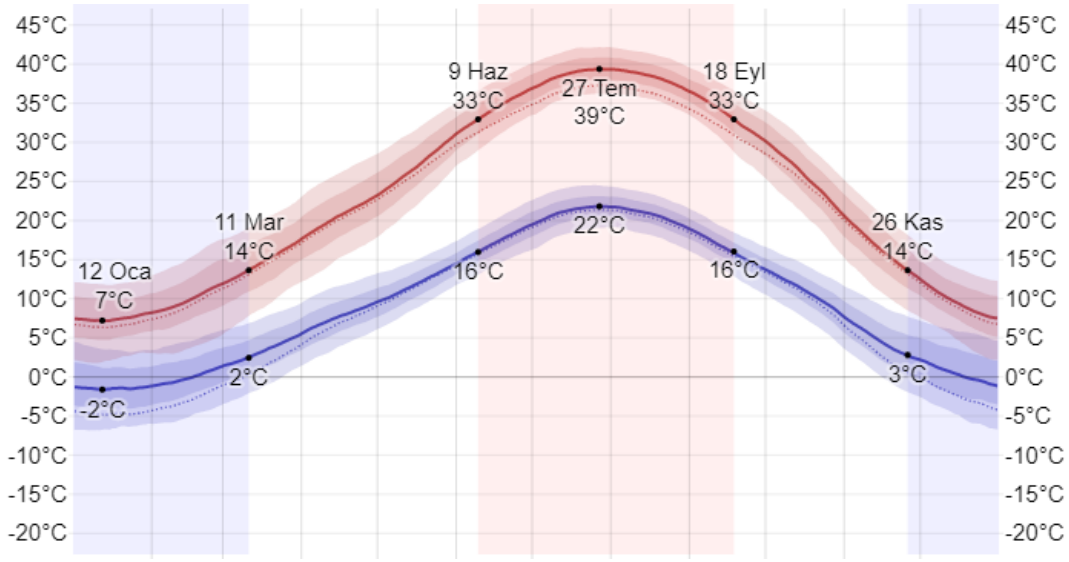

Figure 5 Climate zone in focused study site

Source: *weatherspark.com*

The average annual precipitation in Bismil is (53 mm). The months with the highest precipitation are respectively; February (68.6 mm), December (68.4 mm), March (62.1mm) and January (57.9 mm)

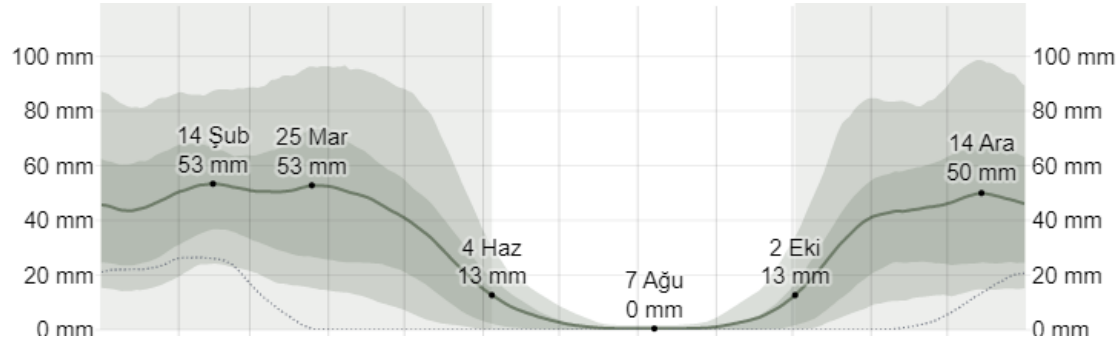

Figure 6 Precipitation graph of focused study site

Source: weatherspark.com

Homegardens in the rural area is very common in Turkey. Mainly cultivate fruit trees and seasonal vegetables for nutrition to household members and other needs are cultivate, like fuel and building materials and over products sold in local markets. Homegardens can be seen as a place for learning and testing for new crops and can be used for wider fields (Hoogerbrugge & Fresco 1993; Tolunay et al. 2007).

4.2 Data collection techniques and research design

Data collection began in September 2020. This time was chosen because farmers were easier to approach because it was after harvesting their major crops in the fields. The study area was four neighbourhoods – Altinok, Akpinar, First and Sentepe of Bismil district – and seven different villages - Direkli, Meydanlik, Kazanci, Kilavuztepe, Kose, Turkmenhaci and Tepe in Diyarbakir province. A structured questionnaire with 52 questions collecting about socioeconomic background information such as number of household members, household income, size of homegarden, age of homegarden and as well as questions related to ethnobotanical knowledge of the plants was developed. Questionnaires were considered the most effective research tool due to the high number of active respondents and the short time available to contact these interviews. Questionnaires were prepared in Turkish language and conducted in Turkish and Kurdish languages for Kurdish speaker's questionnaires translated to Kurdish language. Data collection total number of 40 households with homegardens were selected through snowball and transect walk sampling methods (Bernard 2002). Through direct observation, interviews, and transect walks at each of the selected home gardens, the required information from both measurements and descriptions of parcels of land, crop types, estimated harvested amounts, the percentages of these crops for household consumption, and estimated percentages for the sale and use of different plants and crops found in their plots was gathered. As data gathered mainly through the interviews among households, all responses were supported by observations and transect walks in the studied area.

In order to identify classification of homegardens into commercial and non-commercial was done based on the number of products sold to in the market (Abdoellah et al. 2006). If more than half of homegardens products were produced for selling in local markets or to other places, then we identified as commercial homegardens but if more than half of homegardens products used for food purpose of the household's members then we identified as non-commercial homegardens.

Table 1 Various characteristics used in the study

Socioeconomic variables	Demographic variables	Biophysical variables	Homegarden Variables
Ownership of homegarden (rented, inherited, purchased, common)	Homegarden size	Market availability	Plant species
Off farm job	HH gender and age structure	Location (urban, rural area)	Number of individual species
	Years of Schooling	Fence (1=yes)	Estimated production (kg)
	Origin of household		Used part of a plant
	Ethnicity		Purpose of Use
	Gardening experience		Selling (yes/no), if yes (%)
			Place of selling
			Would you like to grow more (+), same (0), less (2)
			Type of seed (own, external)
			Irrigation system [1-rain, 2-river, 3-irriagion]
			Homegarden size (sq.m)
			Perception of homegardens for household
			Homegarden limitations

4.3 Data analysis

After data collection was done, all the data were checked and entered into Microsoft Office 365 Excel Software for Windows, cleaned, summarised, and coded. The statistical analyses were done in the SPSS (IBM SPSS Statistics for Windows Version 25.0) and MS 365 Excel software. Data were analyzed via various methods. We used three different indexes to calculate and analyze agrobiodiversity, simple descriptive statistics such as mean, medium maximum and percentages. The student's t-test was applied to find the difference between commercial and non-commercial, market availability and location of homegarden (urban, rural area). Furthermore, we applied

Pearson correlation to define the relationship between homegardens, homegarden age and homegarden owner farming experience with diversity indexes.

Shannon-wiener index (H) was calculated for every homegardens.

$$H = -\Sigma_{i=1}^{S} piln(pi),$$

where pi proportion of the species relative to the total number of plants

Shannon-Wiener index is one of the most well-known and widely used diversity index. It measures the diversity, so it relates to the number of species in the community and to the relative abundance of each species and accounts for both abundance and evenness of the species present. The index expresses the uncertainty of predicting the species from a random sample. The uncertainty decreases along with a decrease of evenness and with the number of species, i.e., the value of the Shannon index increases as diversity increases. Shannon-wiener index expresses the uncertainty of predicting the species of a random sample. (Magurran 1988; Prihatini et al. 2018).

Species richness was estimated by using the Margelef species index (DMg).

$$\text{DMg} = \frac{S-1}{In(N)},$$

where S the number of species, NB total number of individuals in the sample.

Margelef index measures species richness, which means the number of species an area contains and does not count the relation between the abundance of species. It is highly sensitive to sample size. The range of the Margelef index is 0-∞ (Magurran 1988).

Simpson's diversity index

$$D = \sum pi^2$$

Simpson's index is used to estimate dominance of the species. Simpson's index gives more weight to the more abundant species in a sample. The addition of rare species to a sample causes only small changes in the value of D. With increasing diversity, dominance decreases. Simpson's index is a similarity index, saying that the higher is the value the lower is diversity. However, for the purpose of our study we have used Simpson's reciprocal index 1/D. The value of this reciprocal index starts with 1 as the lowest possible figure. This figure would represent a community containing only one species. The higher the value, the greater is the diversity. The maximum value is the number of species (Simpson 1949; Mohan et al. 2007).

Classification of 40 homegardens a hierarchical cluster analysis was applied using Shannon-Wiener index, number of species, homegarden age and homegarden size as a main variable. Hierarchical cluster analysis was executed via IBM SPSS (IBM SPSS Statistics for Windows Version 25.0). Ward minimum variance method was used to identify homegarden types with Euclidean distances as a measure of dissimilarity (Peyre et al. 2006; Vlkova et al. 2011; Whitney et al. 2017). The results were separated into five different groups and the data on homegardens characteristics were analyzed using MS Office Excel on following variables: 1) Shannon- Wienner index, 2) Margalef index, 3) Simpson's Index 4) number of plant species 5) homegarden age, 6) homegarden size.

5. Results

5.1 Diversity and use of species

Homegardens researched in this study cultivated both annual and perennial plant species. The main focus of the study was edible plant species. There were 36 different edible plant species (Table 2) found within 40 homegardens. Of those, 50 % were commonly (culinary distinction) classified as vegetables, 31% as fruits, 11% as herbs and the last 8% out of the number of species were nuts. Lettuce (*Lactuca sativa*) and sunflower (*Helianthus annuus*) were only found in non-commercial homegardens. On the other hand, peach (*Prunus persica*), quince (*Cydonia oblonga*) and radish (*Raphanus sativus*) were found cultivated only in commercial homegardens. Parts of the plants used for eating – by humans or animals – were also classified from the biological perspective. Use of various plant parts, such as leaves, seeds, roots, fruits, flowers, was reported. Plants of some species are commonly used with dual purpose. For example, it was documented that maize (*Zea mays*) leaves were used as fodder, while kernels were used primarily for humans. Moreover, both fruits and leaves of grapes (*Vitis* sp.) were used for household purposes, same as pumpkin (*Cucurbitaceae*), watermelon (*Citrullus lanatus*) and melon (*Cucumis melo*) fruits and seeds are being consumed by household members.

5.2 Household characteristics

Household refers to a group of people, often a family, who live together. The average size of the household in this study equals 6.23 members. The minimum being 3 household members, the maximum 10. Average family size in Turkey is 3.30 in 2020 (TUIK). A larger size of the household may be connected with rural location of the study area or number of hands being needed to maintain the homegarden. The second hypothesis could be indicated by on average bigger households in average 7 commercial homegardens than the subsistence one's average household size were 6.

Table 2 The names, use and part of use of the local species found in the study.

Local name	Scientific name	English name	Purpose of use	Part of use
Acur	*Cucumis melo var. Flexuosus*	White cucumber	Food	Fruit
Armut	*Pyrus*	Pear	Food	Fruit
Aycicegi	*Helianthus*	Sunflower	Food	Seed
Ayva	*Cydonia oblonga*	Quince	Food	Fruit
Badem	*Prunus dulcis*	Almond	Food	Fruit
Balkabagi	*Cucurbita*	Pumpkin	Food	Fruit, seeds
Bamya	*Abelmoschus esculentus*	Okra	Food	Fruit
Ceviz	*Juglans*	Walnut	Food	Fruit
Dereotu	*Anethum graveolen*	Dill	Food	Leaf
Domates	*Solanum lycopersicum*	Tomato	Food	Fruit
Dut	*Morus alba*	Mulberry	Food	Fruit
Elma	*Malus domestica*	Apple	Food	Fruit
Havuc	*Daucus carota subsp. Sativus*	Carrot	Food	Root
Incir	*Ficus carica*	Fig	Food	Fruit
Kabak	*Cucurbita pepo*	Zucchini	Food	Fruit
Karpuz	*Citrullus lanatus*	Watermelon	Food	Fruit, seeds
Kavun	*Cucumis melo l.*	Melon	Food	Fruit, seeds
Kayisi	*Prunus armeniaca*	Apricot	Food	Fruit
Kirmizi tupr	*Raphanus sativus*	Radish	Food	Root
Kuru sogan	*Allium cepa*	Onion	Food	Leaf
Lahana	*Brassica oleracea var. Capitata*	Cabbage	Food	Leaf
Marul	*Lactuca sativa*	Lettuce	Food	Leaf
Maydanoz	*Petroselinum crispum*	Parsley	Food	Leaf
Misir	*Zea mays*	Maize	Food, fodder	Fruit, leaf
Nar	*Punica granatum*	Pomegranate	Food	Fruit
Patlican	*Solanum melongena*	Eggplant	Food	Fruit
Pirasa	*Allium porrum*	Leek	Food	Leaf
Roka	*Eruca vesicaria ssp. Sativa*	Arugula	Food	Leaf
Salatalik	*Cucumis sativus*	Cucumber	Food	Fruit
Sarimsak	*Allium sativum*	Garlic	Food	Fruit
Seftali	*Prunus persica*	Peach	Food	Fruit
Taze fasulye	*Phaseolus vulgaris*	Green beans	Food	Fruit
Taze sogan	*Allium fistulosum*	Spring onion	Food	Leaf
Uzum	*Vitis*	Grape	Food	Fruit, leaf
Yesil biber	*Capsicum*	Paprika	Food, spice	Fruit

Figure 7 Apple harvesting in one of the homegarden in the study are Bismil

The standard head of the household is a Kurdish (80%) male (90%). The average age of the head of the household is 57,8 years old. However, the youngest was 32 and the oldest 84 years old. When analyzing data for commercial and subsistence gardens separately, it turns out that on average, heads of the commercial gardens (61,6 years old) are older than non-commercial ones (56.67 years old). It may be the case that the younger generation's main purpose is to produce enough food for their own household and as a source of income perform a different job. Heads of the household

spent usually about 8.7 years on education. Only 2 of them had a university degree and 2 had no education whatsoever. That indicates that the majority of the household heads had finished high school which takes 9 years. On the other hand, the average time spent on farming experience is 37,7 years. With the minimum being 6 and maximum being 66 years of farming experience. As a labour force we understand a household member after 14 years old but below 60 years old. On the other hand, a dependent member is a family member who is below 14 or above 60 years old. Average labour force is around 4 people and 2 are dependent members.

Table 3 Household (HH) characteristic.

Variable	Unit of Measure	Mean	SD	Min	Max	CV
HH size	number	6.23	1.54	3.00	10.0	0.25
HH head age	years	57.8	12.5	32.0	84.0	0.2
HH head gender	male =1 female=0	0.90	0.30	0.00	1.00	0.34
Ethnicity	Kurdish= 1 Turkish=0	0.8	0.4	0.0	1.0	0.5
HH head education	years	8.7	3.6	0.0	16.0	0.4
HH head farming experience	years	37.7	15.1	6.0	66.0	0.4
HH labour force	number	4.1	1.5	2.0	8.0	0.4
HH dependent members	number	2.1	1.1	0.0	4.0	0.5

5.3 Homegarden characteristics

Fourty home gardens were evaluated in this study. Majority (77%) of them were subsistence - the garden was used for the family's needs. The rest - 23% - were commercial. Homegardens researched in this study have the average size of 711.75 m^2, where 150 m^2 was the smallest and 2,600 m^2 was the biggest (table 1). Average commercial homegarden was 1560 m^2, while the subsistence homegardens were on average 460 m^2. The average age of the homegarden is 30 years old. The oldest

homegarden was 70 and the newest was 10 years old. Commercial gardens were on average only one year older than subsistence ones. Mean age of a commercial garden is 31 years of subsistence is 30 years. What is interesting, 73% of homegardens were inherited. That would explain why many of them were cultivated for many years already.

Table 4 The homegarden (HMG) characteristic.

Variable	Unit of Measure	Mean	SD	Min	Max	CV
HMG size	Square meters	711	675	150	2600	0.95
HMG age	Years	30.3	15.7	10.0	70.0	0.5
HMG species	Number	12.2	3.5	7	21	0.3
HMG close to market	1=Yes, 0= No	0.73	0.45	-	-	0.62
HMG commercial	1=Yes, 0= No	0.23	0.42	-	-	1.88
HMG terrain	1=Yes, 0= No	0.98	0.16	-	-	0.2
HMG ownership	1= inherited, 0= purchased	0.73	0.45	-	-	0.62
HMG irrigation system	1= Advanced irrigation, 0= river	0.8	0.4	-	-	0.5
Fence around HMG	1=Yes, 0= No	0.83	0.38	-	-	0.47

Figure 8 Harvesting crops from homegarden in the study are Bismil

Closeness to the marketplace is another important characteristic of homegardens. Majority (over 70%) of the owners declared that their homegarden is situated close to some form of market. All the homegardens were situated on flat terrain, rather than on the hills. Most probably farmers avoid hills because of difficult access as well as lower quality of the soil. The Diyarbakir area is arid. Most of the homegardens (80%) had to develop an advanced irrigation system. Only 20% of them depend on the river as the main source of water. Around the study area sheep and goat herding is very common. This is one of the reasons why 83% of gardens have fences around. All commercial homegardens is secured with fences. The subsistence gardens are protected in 27 of 31 cases. It may be connected with the location or the cost of putting a fence.

5.4 Diversity quantified of reported plant species within homegardens

Other than plant species summary, we also calculated agrobiodiversity on 36 edible plant species within selected 40 homegardens. Species diversity index value was found different between type of homegardens such as commercial and non-commercial, in some cases it was based on garden location or market availability. Based on Table 5 with the same amount of plant species and for each diversity indexes were calculated. On the average all three diversity indexes had different values. Simpson's diversity index values were the highest between Shannon-Wiener and Margalef index. However, Shannon-Wiener diversity index values were the lowest within other indexes.

Table 5 Diversity quantified within reported plant species

Diversity Indexes	N	Total no. of plant species	Mean	Std. Deviation	Min.	Max.	Coefficient of variation
Shannon-Wienner	40	36	1.83	0.35	0.85	2.34	0.19
Margalef	40	36	1.64	0.40	0.90	2.66	0.25
Simpson	40	36	2.63	1.00	1.35	5.76	0.38

5.5 Classification of homegardens types

Based on cluster analysis using a dissimilarity index of 9.0 as a cut-off point, the 40 chosen homegardens were classified into five small clusters (Figure 9 and Table 6). Firstly, they were distinguished by age into 2 groups. Older group was divided in 3 subgroups (nr 1,2,3) and youngest by 2 (nr 4,5). Which in total gave five clusters. Group 5 had the highest number of homegardens from all. It contained 11 gardens which were characterized by lowest Shannon-Wiener index (on average 1.7), lowest Margalef index (on average 1.5) and had lowest number of species with on average 11.4. Following in size of the clusters were group 1 and 2. Both groups had 9 gardens. Group 1 had on average the highest number of species (12.9) with the second highest average of garden size (817.8 m^2), age (42.7), and Shannon wiener index (1.9). Group 2 had on average the highest size of homegarden (863.3 m^2). Moreover, it had the second highest average in number of species which was 12.4

species. Next in line was cluster 4. It had 7 gardens with on average the highest Margalef (1.8) and Simpson's index (2.8). Homegardens in group 4 were the youngest and had on average 11.7 years. Moreover, the homegardens from this cluster had the lowest size – on average 394.3 $m^{2.}$ The remaining group 3 was the smallest group of all. It only contained 4 gardens. It had the highest Shannon-Wiener index, which was on average 2.0. It was also a group with the highest on average homegarden age - 62.5 years old.

Table 6 Structural characteristics of homegarden types in Bismil

	Homegarden types				
	1 (n= 9)	2 (n=9)	3(n=4)	4 (n=7)	5 (n= 11)
Shannon- Wienner	1.9	1.8	1.9	1.9	1.7
Margalef index	1.7	1.7	1.7	1.8	1.5
Simpson's	2.7	2.6	2.1	2.8	2.7
HMG age [years]	42.7	31	62.5	11.7	19.6
HMG size [sq.m]	817.8	863.3	787.5	394.3	675.5
Number of Species	12.9	12.4	12	12.4	11.4

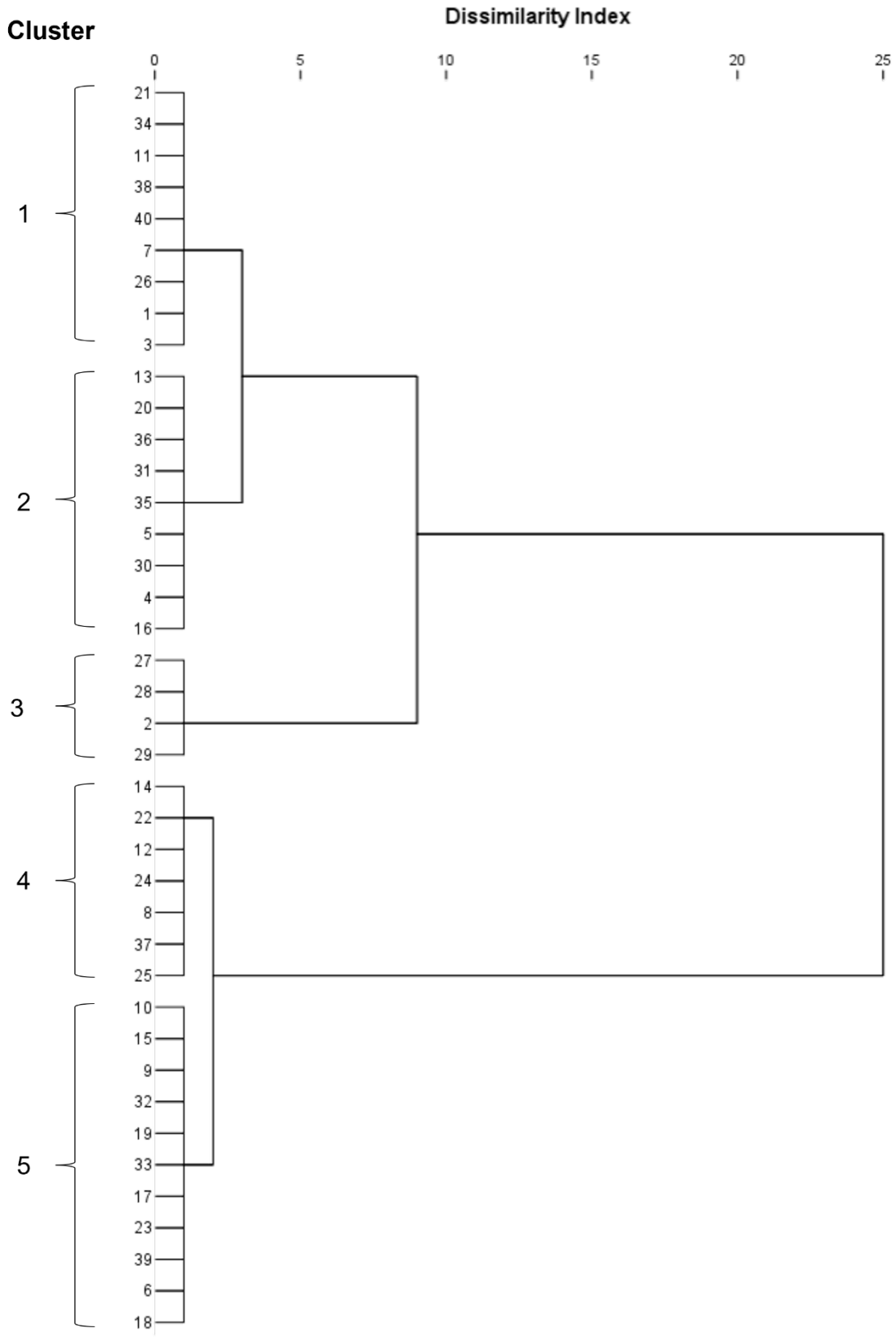

Figure 9 Cluster dendrogram of homegardens based on Ward's method

5.6 Biophysical and economic benefits of diversity

To compare certain characteristic variables, such as distance to market, commercialization, and location, with Shannon-Wiener, Margalef, Simpson's indexes T-test was run. This analysis may indicate which factors have a significant effect on homegardens' species diversity, abundance and evenness of species present, species richness which means the number of species are surrounding and lastly, the dominance of the species, which means Simpson's index gives more weight to more abundant species. First variable that has been checked is the location of the homegarden (Table 7). We have checked if there is a significant difference between diversity indexes in rural and urban homegardens.

Via one-tailed t-test with equal variance assumed that all the indexes were higher in rural areas on average. After the statistical analysis, a significance of 2 of those differences was confirmed. Shannon-Wiener (P<.034) and Margalef (P<.026) indexes were found to be significantly higher in rural areas. Simpson's index (P<.484) was not significant. After detection of significant difference in diversity and richness indexes, next step was to see which factors may affect this result. T-test was run to compare urban and rural homegardens (Table 7). Rural areas, together with higher species diversity are significantly bigger in size (P<.005), older (P<.029), farther away from the market (P<.001) and cultivate more plant species (p-value =0,019). The difference which was not significant were labour force, years of education and farming experience of household head.

What is interesting, t-test analysis (one-sided with equal variances not assumed), did not confirm significance of any dissimilarities in mean diversity index between commercial and subsistence homegardens. Shannon-Wiener index for commercial gardens was 1,93. It was 0,14 more than subsistence ones. The p-value for this index equals 0,17. Margalef index was also higher for commercial homegardens (1,70 compared to 1,62 of subsistence HG) this indexes' p-value is 0,35. Lastly Simpson's index (P<.028) was also insignificantly higher for commercial homegardens.
Does it mean that there is no significant difference between commercial and subsistence homegardens? Not really. Subsistent gardens are highly significantly smaller (P<.003). Commercial garden is on average almost a 1000 m2 bigger than a

garden for family use. Another statistically significant difference found is that commercial gardens grow more edible plant species than subsistent ones (P<.04).

Table 7 Species diversity base on HMG location

	Variables				
	Rural area (N=20)		Urban area (N=20)		
Variables	Mean	Std. Dev.	Mean	Std. Dev.	P-Value
Shannon-Wiener	1.93	0.24	1.73	0.41	*0.034
Margalef Index	1.76	0.39	1.51	0.38	*0.026
Simpson's Index	2.63	0.97	2.62	1.04	0.484
HMG Size	914	703.1	509.5	597.0	**0.005
HMG Age	36.5	18.3	24.1	9.3	*0.029
No. of Species	13.4	3.5	11.1	3.3	*0.019
Distance to market (1= close)	0.45	0.5	1.0	0.0	0.001
Labor force	4.1	1.5	4.2	1.5	0.458
HH education	8.05	2.65	9.3	4.3	0.146
HH farming experience	37.9	15.19	37.5	15.4	0.463
Ownership (1= inherited)	0.95	0.22	0.5	0.5	0.001

Note: * represents 0.05 % significant level, ** represents 0.01 % high significant level

Interestingly, small gardens owners have significantly longer education (P<.021). On average, they finished nine years of school, whereas commercial gardens owners completed only six years on average. On the other hand, the opposite happened with years of farming experience (P<.036). Both commercial and subsistence heads of the households had a long experience – on average 45 and 30 years respectively. It is clear that owners of commercial gardens had were significantly more experienced. There have been no significant differences, between commercial and subsistence homegardens, found in following variables: age of the garden, distance to market, labour force and ownership.

Figure 10 Typical homegardens in the rural area of Bismil

The difference in species diversity indexes between homegardens close and far from market was examined. According to one-tailed t-test with equal variances not assumed there was a highly significant difference in Shannon-Wiener species diversity index. Gardens far from the market had significantly higher (P<.004) diversity index than the ones close to the market. The same was true for Margalef (P<.019) although the result was not highly significant.

There was no significant difference between groups found for Simpson's index (P<.392).

Table 8 Species diversity base on commercialization

	Variables				
	Commercial (N=9)		Subsistence (N=31)		
Variables	Mean	Std. Dev.	Mean	Std. Dev.	P-value
Shannon-Wiener	1.93	0.37	1.79	0.34	0.17
Margalef Index	1.70	0.56	1.62	0.35	0.35
Simpson's Index	2.81	1.14	2.57	0.96	0.28
HMG Size	1561.1	864.5	465.1	338.7	**0.003
HMG Age	30.66	12.9	30.16	16.5	0.462
No. of Species	14.7	4.8	11.4	2.7	*0.04
Distance to market (1= close)	0.8	0.4	0.7	0.4	0.001
Labor force	4.9	1.5	3.9	1.3	0.055
HH education	6.1	3.9	9.3	3.1	*0.021
HH farming experience	45.2	12.9	30.1	16.5	*0.036
Ownership (1= inherited)	0.8	0.4	0.7	0.4	0.001

Note: * represents 0.05 % significant level, ** represents 0.01 % high significant level

After detection of significant difference in diversity and richness indexes, next step was to see which factors may affect this result. T-test was run to compare homegardens close and far to the market. Homegardens far from the market had significantly bigger size (P<.02), age (P<.001), number of cultivated edible plant species (P<.017), and farming experience (P<.046) than the homegardens close to market. Moreover, all the gardens far from the market were inherited. The ones close to market were purchased in 60% of cases. Long tradition of cultivating homegardens which were further from market may explain higher diversity in those as well as the higher age of the garden and farming experience of its owner. Knowing, that space is also a limiting resource relatively young gardens may be simply smaller cause the arable land is less affordable. Labour force, years of education turned out to be not significantly different.

Table 9 Species diversity base on market availability

	Variables				
	Market availability - close (N=29)		Market availability - far (N=11)		
Index	Mean	Std. Dev.	Mean	Std. Dev.	P-Value
Shannon-Wiener	1.75	0.36	2.03	0.23	**0.004
Margalef	1.55	0.36	1.88	0.43	*0.019
Simpson's	2.65	1.01	2.56	0.98	0.392
HMG Size	567.9	628.6	1090.9	674.8	*0.02
HMG Age	23.8	10.1	47.27	15.21	**0.001
No. of Species	11.3	2.8	14.54	4.22	*0.017
Labor force	3.9	1.4	4.6	1.4	0.092
HH education	9.1	3.7	7.3	2.7	0.055
HH farming experience	35.3	15.3	43.9	13.1	*0.046
Ownership (1= inherited)	0.6	0.5	1.0	0	0.001

Note: * represents 0.05 % significant level, ** represents 0.01 % high significant level

5.7 Associations between homegarden characteristics and species diversity

5.7.1 Homegarden age and species diversity

Homegarden age and species diversity as per evenness, richness, and richness diversity (Shannon-Wiener index, Margalef index and Simpson's index) indexes were different within all selected 40 homegardens. The average size of homegardens was found 30.28 and minimum 10 to 70 years old. Pearson correlation matrix used to determine associations between homegarden age and diversity indices. R values within all three diversity indexes are very similar. Shannon-wiener 0.12 and Margalef 0.09 are positive while Simpson's index has -0.09 but since all the three r-score is close 0 we can say that there is a weak correlation between homegarden age and species indices.

Table 10 The associations between HMG age and species indexes

Index	N	R Score	T-stat	Std. Error	P value
Shannon-Wiener	40	0.13	0.79	0.13	0.43
Margalef	40	0.09	0.55	0.13	0.58
Simpson's	40	-0.10	-0.61	0.16	0.54

5.7.2 Homegarden size and species diversity

Correlation between homegarden size and species richness, evenness and diversity were checked and for all three indexes we can see that with increasing size of homegarden there were increase of diversity. Homegarden average size was 711.75 square meter in the study are with average 12.2 species. Commercial oriented gardens average size was 1561 square meter with 13 species while subsistence oriented average size was 465.16 square meter with average 12 species. Pearson correlation values for all three indexes were similar such as 0.24 in Shannon-wiener, 0.23 Margalef and 0.14 Simpson's index. However, all r score for diversity indexes is close to zero therefore we can say that correlation between diversity and size of homegardens is weak or there is no correlation.

Table 11 The associations between homegarden size and species diversity indexes

Homegarden size					
Index	N	R Score	Std. Error	T-stat	P value
Shannon-Wiener	40	0.24	0.14	1.52	0.14
Margalef	40	0.23	0.20	0.55	0.15
Simpson's	40	0.14	0.18	0.89	0.38

5.7.3 Household head farming experience and species diversity

The household farming experience was found between 6 years to 66 years old with average 37.68. The associations between household head experience and plant species diversity for all three diversity indexes checked with Pearson correlation and value were similar for Shannon-Wiener index 0.16 and Margalef index 0.12 while Simpson's index value was 0.01. All plant diversity indexes r score values found with farming experience of owner there was slightly increase of species however correlation between them found weak since all three-diversity r score is close to 0 value.

Table 12 The associations between household head farming experience and useful species diversity indexes.

Index	N	R Score	T-stat	Std. Error	P value
Shannon-Wiener	40	0.16	0.99	0.16	0.33
Margalef	40	0.12	0.72	0.15	0.48
Simpson's	40	0.01	0.08	0.13	0.94

5.8 Perception of owner to homegarden

The head of the household was asked about the obstacles that come with having a homegarden. The list of possible obstacles and limitations was presented, and the farmers chose that this problem strongly corresponds with their experience (Yes, a lot), is influencing their situation (Could be better), plays a minor role (Okay) or is not a problem in their household (No problem). The most common problem, strongly affecting farmers was poor soil (chosen by 45% respondents) and shortage of quality seeds (42,5%). Around half of the respondents chose those problems as somehow

affecting them (Could be better). Another commonly chosen limitation was lack of finances. Fourteen farmers (35%) said that it strongly affects them and 15 chose the answer that it is somehow influencing their situation. Diseases and pests (insects, small mammals) strongly or somehow affected 70% of farmers. Only 8 farmers see lack of knowledge as a big obstacle in their work in homegardens but over 50% sees that it is somehow influencing their work.

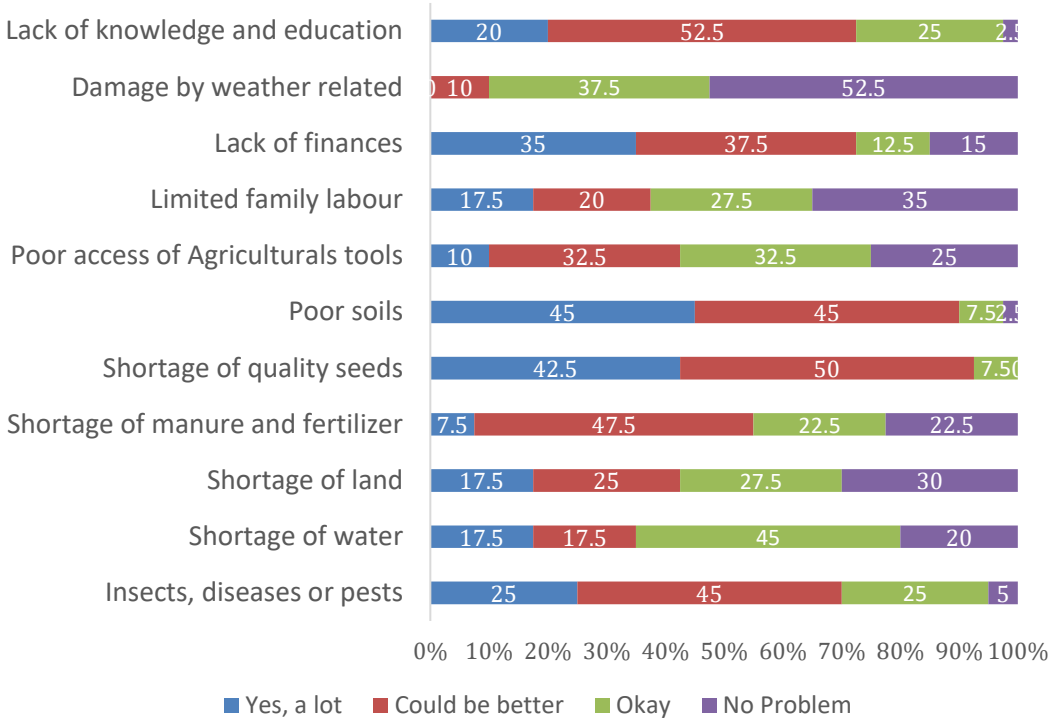

Figure 11 Farmer's perception of HMG limitation

According to the majority of the farmers' shortage of water and land, limited family labour isn't a big obstacle in having and caring for homegardens. None of the farmers chose weather related damage as a significant obstacle in their work. Over half of respondents said it is not a problem at all. What are the health and economic benefits from cultivating homegardens? According to all of the respondents, food grown on their own is healthier and tastier. Out of which 72,5% strongly agreed and 27,5 agreed. For 65% of respondents, it is a big contributor to the family diet, for the remaining 35 it is a welcomed addition. Due to that it is reducing household expenses for 85%, for 27,5% of households it is even a source of income.

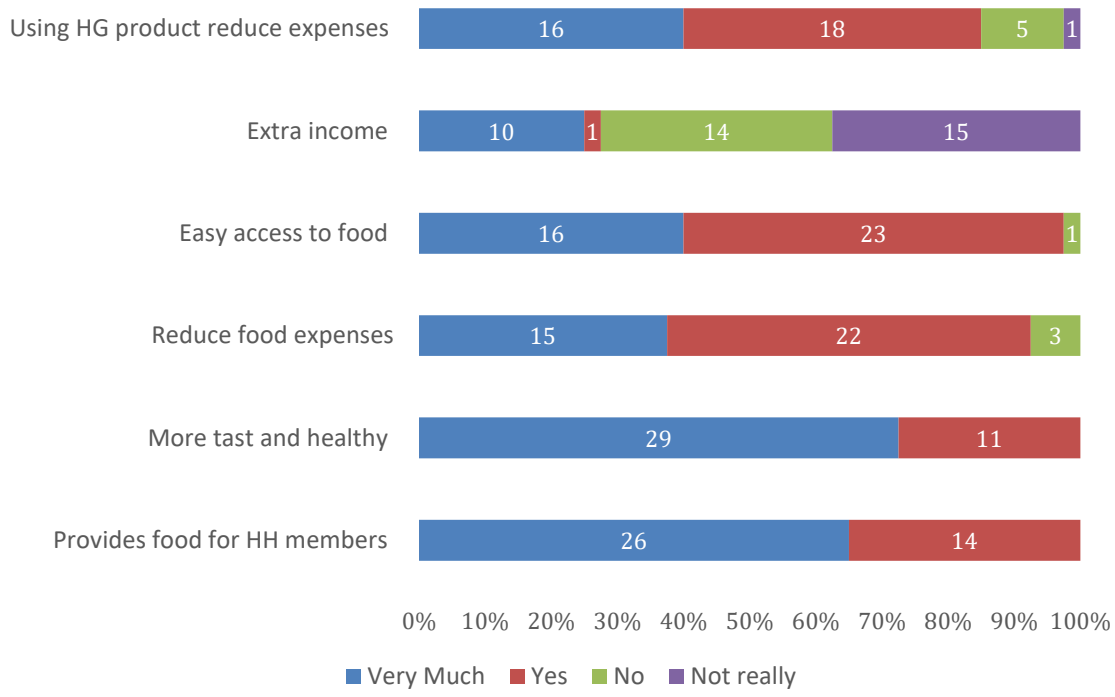

Figure 12 Food and economic perception of homegarden for household

When it comes to farmers' social and environmental perception of the homegardens (Figure 7) everybody agrees that HG provides a nice environment. Over 90% of respondents love their garden because it is beautiful. Moreover, 82,5% of farmers find their garden as a place of relaxation. More than half (65%) of respondents work in the garden as a hobby. Some (32,5%) keep it as a family tradition. For 35% of farmers the diversity of cultivated species is important.

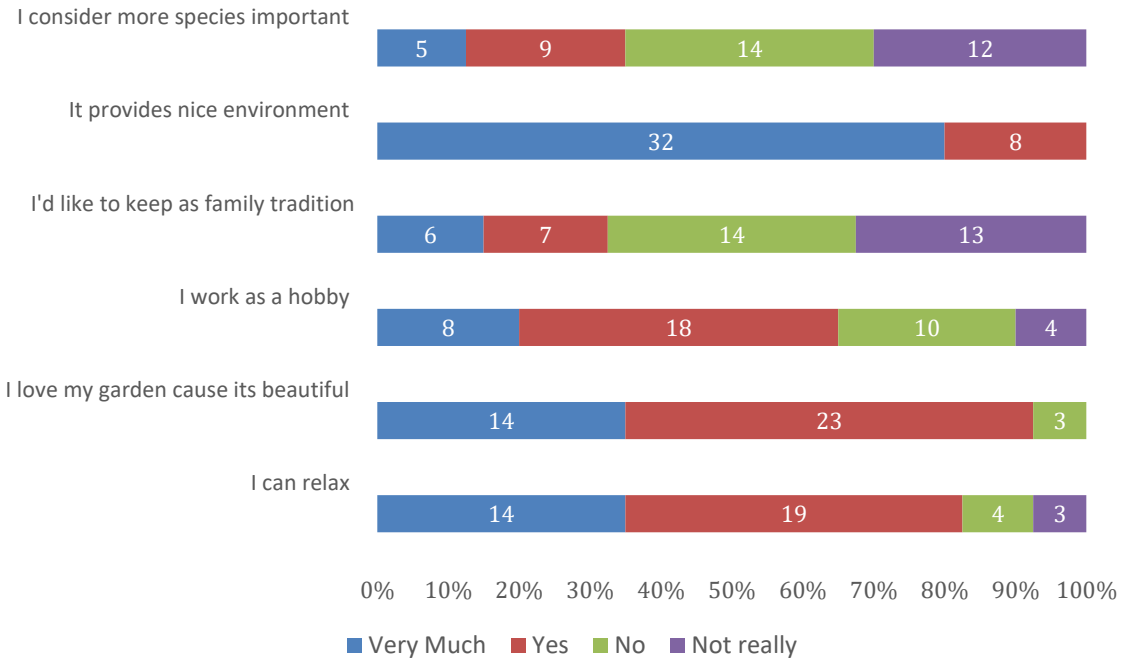

Figure 13 Social and environmental perception of homegarden for household

6. Discussion

The study revealed that main purpose of homegarden in the study area is providing food for household consumption. This is supported by other studies Mendez et al., (2001) Tolunay et al. (2007) Bassulu & Tolunay (2010) Bucheli & Bokelmann (2017) Abdoellah et al. (2020) which found that in Nicaraguan, Turkish, Columbian, and Indonesian homegardens plant species were mostly consumed by household members. On the other hand, studies mentioned above found that household members use their garden as a source of additional income. This was not a case in our study area – Bismil. Farmers in Bismil perceived homegardens rather as a way to reduce expenses. That is supported by the study conducted in Northern Nicaragua which found that majority of owners perceive homegardens as a source of healthy food and opportunity to reduce their expenses by not purchasing goods from market (Boone & Taylor 2016).

In total 36 edible species were identified in our study area. Gardens had on average 12.2 plant species. In comparison to other party of country, the number of plant species found is low. In Isparta, a Mediterranean city in Turkey, 51 edible food species found (Tolunay et al. 2007). Species richness might be connected with management of homegardens but most importantly with heterogenous topography and more humid climate of the region. Compering with other countries Turkish edible species richness is lower. In locations such as Masaya, Nicaragua 324 species were identified and gardens on average had 70 plants (Mendez et al. 2001), similarly in southern Mexico 233 plant species were documented, in Ethiopia Hawassa city 55 edible species were documented (Reta 2016) Sudan gardens 84 plant species and in Nigeria 160 plant species were documented. (Aguilar-Stoen et al. 2009).

The hierarchical cluster analysis divided homegardens into 5 clusters. They were based on many features such as Shannon-Wiener index, number of species, homegarden size and homegarden age. Group 5 had the highest number of homegardens (n=11), and it had lowest Shannon-Wiener and Margalef indexes with the lowest number of species. The remaining all the groups had similar species diversity index but classified with different factors such as homegarden age and size.

Our finding was similar with studies from Vietnam and India (Peyre et al. 2006; Vlkova et al. 2011). According to the hierarchical cluster analysis species diversity was not a big factor in group division. All the clusters have different size, age number of species and diversity indexes. Therefore, to learn more about factors influencing species diversity we had to change the approach and use different statistical methods. Nevertheless, the hierarchical cluster analysis is a commonly used tool to classify, and we would like to recommend more of similar analysis for the future studies in this or other area.

Based on our findings there was no significant correlation between size of the garden and species diversity or richness indexes. Nevertheless, when comparing different gardens' locations (rural/urban) and market availability (close/far) both diversity indexes and size were significantly different. Diversity was directly proportional to size. This is definitely something to look closer into because according to Bernholt et al. (2009) and Vlkova et al. (2011) species richness of gardens can be influenced by farm size. They found out that bigger garden size has a positive effect on species richness and diversity. Abdoellah et al. (2006) found plant species were positively correlated with homegarden size. Our finding was comparable with different study (Wiersum & Ramlan 1982; Coomes & Ban 2004; Abebe 2005; Carvalho et al. 2013) found that homegarden size is not a limiting factor this could be related to low-quality seeds and soils can influence diversity.

Homegarden age was also not significantly correlated with species diversity according to our results from the study area in Bismil. Both Shannon-Wiener and Margalef indexes were slightly increasing with homegarden age while Simpson's index was slightly decreasing. None of those results were statistically significant though. This result is supported by Vlkova et al. (2011) who also found the trend but no significant result to support it. However, Coomes & Ban (2004) found that within increase of homegarden age species diversity significantly increases. The correlation they found was strong significant. On the other hand, when we are looking closely to our results, we can see that homegarden age in the rural area was significantly higher and diversity was higher as well, we found that 95 % of homegarden in rural area were inherited while 55 % urban gardens were purchased. Base on this finding we relate with Coomes & Ban (2004), gardens were passing from one generation to another generation has higher species richness and diversity.

Farming experience of homegarden owner and plant species diversity was not correlated in the study area. Our results documented that there is a trend between experience and age for both Shannon-Wienner index, but Simpson's index was found neither positive nor negative impact on diversity. Sabastian et al. (2014) which found that gardener farming experience has a positive impact on species diversity.

Since we found no significant correlations to detect what may influence species richness, evenness and diversity we tried a different approach. We have grouped homegardens, based on results of previous studies, according to their purpose, location and market availability to check if there will be significant differences between them.

The results show that together with increasing market availability Shannon-Wiener and Margalef species diversity indexes were significantly lower. The difference in the Simpson's index was not statistically significant among gardens far or close to the market. Homegardens far from market had higher plant species diversity on average 14.5 while the close to market had on average 11.3 plant species.

Similarly, distance to the market was found having a significant effect on plant diversity for other countries. According to (Hoogerbrugge & Fresco 1993; Kaya et al. 2002; Abebe 2005) plant species diversity declined within easy reach to the market. Kehlenbeck et al. (2007) concludes even further, authors state that market availability affects biodiversity and decrease plant species as well as drives gardens to focus on a few species and pushes gardens to commercial oriented. On the contrary Abdoellah et al. (2006) found that markets availability has a positive influence on homegardens characteristic and thus impact on plant species richness and evenness.

When collected data were analyzed according to the location (rural/urban) of homegardens a statistically significant difference among study sites was detected (Table 7). Gardens in our study located in the rural areas are older, have bigger size, higher diversity, and richness index as well as number of species. Additionally, they were more often (95% of the time) passed from generation to generation (inherited) than bought. Long tradition of cultivating homegardens with edible species may explain its higher diversity. This trend was also suggested by (Commos & Ban 2004) who wrote that diversity increases with garden's age. Generally, in literature rural homegardens are characterized with higher diversity of edible plant species than in urban areas (Mosina et al. 2014) just as we proved in our research. Berhnholt et al. (2009) also confirmed that the lowest edible plants agrobiodiversity was seen in the

urban homegardens. It is important to highlight that we are talking about edible species now. Things look different when adding ornamental species into the equation. The more fashion forward urban gardens, as Nair, (1993) Eichemberg et al. (2009) Mosina et al. (2014) proved, cultivate more ornamental plant species to show off their aesthetic values.

Inheritance may also explain bigger size of the gardens –knowing, that space is becoming more and more a limiting resource relatively young urban gardens may be simply smaller cause the arable land is becoming less affordable. Moreover, land tends to also be more expensive closer to the city.

Another factor that may influence homegarden characteristic is market availability. It may seem closely connected with rural vs. urban areas but it is not the same. For example, all (100%) the commercial homegardens were located close to the market but only 66% were in urban areas.

Market availability may impact garden commercialization (Wezel & Ohl 2005; Kehlenbeck et al. 2007), farmers would tend to focus more on cash crops and usually cultivating only a few species for example coffee, banana, nuts (Shrestha et al. 2002; Abdoellah et al. 2006; Abdoellah et al. 2020). Logically, that may have a negative effect on the diversity. Nevertheless, we did not find evidence in this study to support that.

Our results show no statistically significant difference in the diversity between commercial and subsistence homegardens. Bernholt et al. (2009) results suggest a similar conclusion in south-wester Niger – commercialization does not significantly influence species diversity. It has no positive nor negative effect on it. With this thought on our mind, we should consider that the sample of commercial homegardens in our study area was low compared to the subsistence-oriented (9 to 31). That could alter the results.

Does it mean though that we found no statistically significant difference between commercial and subsistence homegarden? No. Commercial gardens were bigger in size – just like in studies of Shrestha et al. (2002) Abdoellah et al. (2006) Abdoellah

et al. (2020) – and higher in the number of species. Their owners were on average lower with years of education and higher in years of farming experience and. Possibly, commercial homegardens owners rather than spent time in school had to work and through that gained practical experience. The fact, that heads of households cultivating subsistence-oriented gardens received a longer education may be related to their privileged position in society.

We speculate that this comes with having the safety net to study while someone else is providing for you. Owners of subsistence homegardens have to earn independently from the garden as they do not generate any income with their gardening. The second part of our results-focused on how the homegardens owners perceive their gardens. The species diversity or richness is not an important factor for the majority of homegardens owners. Our results indicate that farmers are mostly focused on provision of heathy and fresh products and reducing expenses. So instead on agrobiodiversity farmers focused on cash crops or the most useful species for them. Similar results were obtained by studies in other countries (Abebe 2005; Abdoellah et al. 2020) found that homegardens owners mostly focus on food species and cash crops.

Only 35 % of respondents answered that species diversity is important for them, visible in the quantified results and indexes. Those same respondents answered that homegardens for them are a way to keep up the family tradition. Due to that, preserving family tradition can presumably be an important factor in preserving native edible species.

What is interesting the years of education are not contributing factor here. That indicates that knowledge can be passed from one generation to another. As the farmers are getting older, it is important to use their wisdom and experience. That could be done, for example, by writing down their wisdom on the pages. Many elderly Kurdish people in this area are analphabets because there was no education in Kurdish provided by the government. Moreover, back in time, access to school was limited due to distance and lack of transportation Putting their experience in digital pages could preserve the knowledge and save indigenous species.

It is important to take that into account. Homegardens were also found to be very important for food security during the economic crises in case of loss of job/income (Wezel & Bender 2003; Bassulu & Tolunay 2010). The perception of homegardens in our study area might have rapidly changed (that remains so far undocumented). People working remotely had more time to cultivate and enjoy their gardens. Due to the general panic having food safety was also a huge factor. It is becoming more and more important to be monitoring the perception and characteristic of homegardens in this challenging time. In the world of pandemics and wars, which affect the food security of people all around the world.

7. Conclusion

In conclusion, homegardens in eastern Turkey in Bismil area according to the results of this study are cultivated mostly to provide fresh and healthy food products for household members. Thirty-one out of forty homegardens were classified as subsistence oriented. There were 36 different edible plant species found in total. The maximum number of species in one garden was 21, on average it was around 12. The species were documented with their local, English, and Latin name as well as their biological organs that are commonly consumed by animals or humans.

Homegardens, according to our respondents (homegardens owners) allow easier access to food which, especially nowadays – due to pandemic and war is extremely important. Having food security as well as reducing food expenses are benefits recognized more widely among homegarden owners than for example having extra income or even reducing household expenses. In other words, due to this study results economical gain is less valued that independent source of (fresh and healthy) food. Let us not forget about a leisure aspect of homegardens. All the farmers cared about the aesthetic environment the homegardens provided. For majority it is also a place to relax.

There was no effect of household and homegarden characteristic found on agrobiodiversity. Neither size, age nor household head education or farming experience influenced the species diversity or richness indexes. The only significant variables on species diversity and richness were location and closeness to the market. Rural areas and homegarden farther away from the marketplaces had higher diversity. Future studies could use plant diversity difference between urban and rural areas. Biodiversity is decreasing within closeness to market and in the urban areas.

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Annex

Questionnaire for homegarden species and household and homegarden characteristics Gujarat state

1. Where is your homegarden located?
    a. Urban area
    b. Rural area
2. Name of area (fill the blank)

    ……..
3. What is garden income? (Fill the blank)

    ……..
4. When was your garden established? (Fill the blank)

    ……..
5. How long is your homegardening experience? (Fill the blank)

    ……..
6. Do you have any other off-farm job? Other than garden?
    a) Yes
    b) No
7. Main source of income?

    ……..

Household characteristics:

No.	Member	Gender [M/F]	Born [age]	School attendance [years]	Do you live here all your life?				Ethnicity (except children)	Involved in homegarden Yes/no
					Yes, born here	Born another place	Year of migration	Reason for migration?		
1										
2										

Homegarden characteristics:

Size /Area [meters]	Altitude [meters]	Age [years]	Distance from house [meters]	Terrain 1-very steep 2-steep 3-flat	Water source 1-rain fed only 2-rainfalls collection 3-river/irrigation	Ownership 1-inherited 2-purchased 3-rented 4-commons	Fence 1-yes 2-no 3-partly	Use of fertiliser 1-no 2-own (manure) 3-purchased (manure) 4-purchased (chemical)

Perception of main roles of home gardens by household members:

Food benefits	Very much	Rather yes	Not really	No
Provides food for household member				
Provides specific plants making food tastier and healthier				
Use plants from garden reduce food expenses				
Social benefits	Very much	Rather yes	Not really	No
I can relax in my garden				
I love my garden because it is beautiful place				
I love to work in home garden, it is my hobby				
I love to keep the tradition of my parents and grandparents				
Economic benefits	Very much	Rather yes	Not really	No
I can get easily food for household than from the market				
I can sell products from the garden to increase my income				
I can exchange the production with my neighbours				
Use products from garden for reducing food expenses				
Environmental benefits	Very much	Rather yes	Not really	No
It provides nice environment (shade, windbreak …)				
I consider more species as important				

Home garden challenges/expectation:

From whom you particularly learn gardening and provide you information about the homegardening?	☐ Parents, family ☐ Business companies ☐ Universities	☐ Neighbours/Friends ☐ Government ☐ Other	☐ Media (TV, radio, Internet) ☐ Non-government institutions
Can you remember any changes in crop species from the past?			
What was the reason for that change?			
Which species you would like to grow in the future, or do you miss some species? If yes, why?			
Would you like to change something in your home garden? What? Why?			
Would you like to extend or make a smaller your homegarden?			

Perception of homegardens' limitations:

Issue	Yes, a lot	Could be better	OK	No
Insects, diseases, or other animal pests	☐	☐	☐	☐
Weeds	☐	☐	☐	☐
Shortage of water	☐	☐	☐	☐
Shortage of land	☐	☐	☐	☐
Shortage of manure and fertilizer	☐	☐	☐	☐
Shortage of quality seeds	☐	☐	☐	☐
Poor soils	☐	☐	☐	☐
Poor access of agricultural tools	☐	☐	☐	☐
Limited family labour	☐	☐	☐	☐
Lack of finances	☐	☐	☐	☐
Damage by weather related	☐	☐	☐	☐
Lack of knowledge and education	☐	☐	☐	☐
Other (specify)				

Overview of the species grown in home garden:

Local name	Number of individuals	Part used	Purpose of use 1 –Food 2 – Breverage 3 – Medicine 4 – Construction 5 – Culture/Religion	Estimated annual production [e.g., kg]	Seeds own/ external	How much you sell? [e.g., kg]	Selling practice: 1-Farm gate 2-Middleman 3-Local market 4- other specify	Would you like produce more in future? 1 – no 2 – not really 3 – yes 4 – very much	Who sells from HH members?

Overview of the product prices:

Where you sell the product and for what price?								Household labour inputs hours/week/day
Farm gate		Middleman		Local market		Distant market		
[%]	Price	[%]	Price	[%]	Price	[%]	Price	