UNIVERSITY OF HOHENHEIM

Wild plants as an ecosystem service:

Contextualizing sustainability and socioeconomic Impact In rural Armenia

Master thesis

Miriam Rueger
620176
M.Sc. EnviroFood

First examiner:
Professor Dr. Claudia Bieling
Institute for Societal Transition and Agriculture
University of Hohenheim

Second examiner:
Alen Amirkhanian
Acopian Center for the Environment
American University of Armenia

10th June 2020

Abstract

The relevance of ecosystem services has increased significantly over the past few years in scientific research. Armenia, as a biodiversity hotspot, provides great potential in this regard. This is especially true because ecosystem services are often not quantified and neglected in policy and decision-making processes there. Wild harvest is an activity that is widely acknowledged as an important benefit people obtain from natural ecosystems. However, it remains poorly researched and data availability is fairly limited. The aim of this study was to document wild harvest in rural Armenia and put it in the context of the ecosystem service framework.

For that, a total of 23 structured interviews were conducted in four rural Armenian communities. Questions aimed to identify the most important wild plant species and their uses. Further, they tried to capture the sustainability of wild harvest and document a possible decline of biodiversity. Finally, the study intended to record the socioeconomic and cultural dimensions of wild harvest.

The respondents listed a total of 68 species that they use for multiple purposes like medicine, cooking, spice, tea, preservation, and as ornamentals and it was consequently possible to capture the importance of wild harvest as a provisioning ecosystem service. However, the study was limited in documenting the overall sustainability of wild harvest and conclusions could only be drawn for specific species in certain communities. The sustainability of wild harvest is very context-specific and more detailed data is needed to fully capture whether wild harvest is sustainable or not in different locations. Lastly, the study was able to show a clear socioeconomic and cultural relevance of wild harvest. In the investigated communities, wild harvest is an important tool for people to uphold their traditions and strengthen their community bonds. Moreover, while the study only touched upon the economic dimension of wild harvest, it was still able to show that for some households wild plants are an important additional source of income.

Overall, the research proofed the importance of wild harvest as an ecosystem service in rural Armenia. While the study captured wild harvest broadly based on many factors, some of these characteristics could be investigated more thoroughly with more specific objectives. More research is needed in Armenia to allow comprehensive decision-making for wild harvest regulations. For the research on ecosystem services, this study is a good example on how one activity can incorporate not just one ecosystem service but be embedded holistically in the overall concept.

Acknowledgements

First of all, I want to thank my two supervisors, Professor Dr. Claudia Bieling, director of the institute of Societal Transition and Agriculture at the University of Hohenheim and Alen Amirkhanian, director of the Acopian Center for the Environment (ACE) at the American University of Armenia (AUA). Thanks a lot to both of you for supervision and always taking the time to help me with any questions before, during and after my stay in Armenia. Next, I want to thank Anahit Amirkhanian for facilitating the field interviews and helping me to get a better understanding of Armenian culture than I would have on my own. Further, I thank Aghavni Harutyunyan for helping out with anything related to ArcGIS, creating maps for the field work and of the results, for translation of the questionnaire and helping out with field logistics. For project coordination and organization of field logistics I also want to thank Siranush Harutyunyan and Lilia Khzmalyan of the ACE and Julia Rietze from the University of Hohenheim. From the GIZ office in Yerevan, I want to thank Caroline Wegner and Artur Hayrapetyan for project coordination. Also, I want to thank Alla Aleksanyan from the Agrarian State University in Yerevan for helping with the correct botanical identification of the local plants. Lastly, I want to thank the DAAD for funding and enabling this project in the first place.

Table of Contents

List of figures

List of tables

Introduction

1.1. Thematic background

In recent years there has been an increasing interest in the research of biodiversity and ecosystem services (ESS) (McDonough et al. 2017). The latter is a concept which tries to capture the services and benefits humanity can obtain from natural environments (Brown et al. 2016). While there are publications from many different countries on the topic of ESS, most scientific literature in that field stems from the European Union (EU) and the United States (McDonough et al. 2017). While it is useful and important to know about ESS in developed countries, it is especially vulnerable communities in low-income countries that rely on ESS for their survival (Egoh et al. 2012). The present study focuses on wild harvest which is an activity where people extract plants or fungi from their natural environment to use them for different purposes (Poe et al. 2013).

As an ESS, wild harvest is important since wild plants can provide an additional nutrient source in terms of food security (Mollee et al. 2017, Sõukand 2016) and an additional income source for poor people in times of economic distress (Mollee et al. 2017, Kaoma and Shackleton 2015, Davenport et al., 2011). Wild plants are harvested for various reasons, including consumption, fire wood, medicinal usage, ornamental uses and leisure time activity (Mollee et al. 2017, Kaoma and Shackleton 2015, McLain et al. 2013, Schulp et al. 2014, Poe et al. 2013). Besides, the cultural value of wild food should not be underestimated (Garcia-Martin et al. 2017) since many foragers possess valuable knowledge about ecosystems and processes within those that are connected to the practice of wild harvest (McLain et al. 2013). Based on that, wild plant usage can play an important role in upholding traditions, shaping the cultural identity within a community and thus influence people's lives on a daily basis (McLain et al. 2013).

The present study focuses on wild harvest in rural communities of Armenia. The country is a biodiversity hotspot (FAO 2008) which makes it a valuable location for ESS research. For the Southern Caucasus in general, the importance of ESS has been recognized for rural communities that rely on the support of biodiversity and ecosystems to maintain their livelihoods (Batello et al. 2010). When further looking at wild harvest, this activity has been important for these people for centuries. It is estimated that around 2,000 herbs and other plants that make up 60 % of the total flora have been used traditionally (Armenia Gender Project 2018, AM Partners Consulting Company 2010). On the one hand, wild harvest in Armenia is recognized as an opportunity to supplement people's incomes substantially (Armenia Gender Project 2018), on the other hand there are still

many issues regarding the commercialization of the harvested products. Among other things, local producers face difficulties to enter foreign markets and commercialization can be hard due to unreliable supply from local collectors (AM Partners Consulting Company 2010, GTZ Armenia 2010). As it is the case in many other countries (Mollee et al. 2017, Sõukand 2016, Stryamets et al. 2015, Cruz-Garcia and Price 2014, Poe et al. 2013, Menendez-Baceta et al. 2012, Termote et al. 2011), Armenia is losing ethnobotanical knowledge because of the availability of modern alternatives, urbanization and migration (Hovsepyan et al. 2019). At the same time, people might harm a species by harvesting excessive amounts or harvesting plants in a way that harms the species' reproduction (GTZ Armenia 2010). This can result in a decrease of the current ESS which will force people that rely on these resources to further exploit them (CBD 2015).

1.2. Knowledge gaps and research aims

There are only a few studies available that are related to wild harvest in Armenia: Hovsepyan et al. (2016) linked wild harvest to the cultural identity of certain ethnic minorities, the Yezidis and Kurds. In a later study, they investigated the sources of phytomedicinal knowledge in the Tatev region in the Southern parts of the country (Hovsepyan et al. 2019). Gabrielyan et al. (2004) highlighted the regulation of herbal medicine in Armenia which is also related to wild harvest to a certain extent. Further, the GIZ[1] provided several reports on projects they carried out in the past on wild harvest in Armenia. They all focus on the value chain and business opportunities associated with wild harvest (GTZ Armenia 2011, AM Partners Consulting Company 2011, AM Partners Consulting Company 2010, GTZ Armenia 2010) which is also the angle on wild harvest of the Armenia Gender Project in a study they carried out in 2018. Apart from that, wild harvest and ESS are rarely the main topics in scientific literature in Armenia.

Hence, the major angle was to get a broad understanding of wild harvest in Armenia and gather information that could be the starting point for further research in this context. Since it is the local people that are the keepers of the knowledge related to wild harvest (Hovsepyan et al. 2019), the study focused on capturing their perspective to appropriately asses and address the issues and questions at stake. This included getting an idea on the wild plants people harvest and their uses, to quantify and assess the

[1] Deutsche Gesellschaft für internationale Zusammenarbeit – German Corporation for International Cooperation. https://www.giz.de/en/html/index.html (accessed on 9th June 2020).

sustainability of this process, and connect it to a socioeconomic dimension to capture the full extent of wild harvest as an ESS.

The survey conducted to achieve this was part of a bigger project, the German-Armenian Network on the Advancement of Public Participation GIS for Ecosystem Services as a Means for Biodiversity Conservation and Sustainable Development (GAtES[2]). The GAtES project is a cooperation between the institute of Societal Transition and Agriculture of the University of Hohenheim and the Acopian Center for the Environment (ACE) of the American University of Armenia, taking place from 2018 to 2021. In this period, several subprojects are carried out to capture a range of ESS present in Armenia. For that purpose, student and staff exchanges are enabled to Germany and to Armenia which allows the participants to collaborate on site and gain experience in international cooperation. Wild harvest was proposed as a topic by the Armenian partners due to its relevance as an ESS, especially for rural communities of Armenia. Further, the GIZ office in Yerevan collaborated in this research since they already investigated wild harvest in Armenia during past projects.

1.3. Research objectives

Under this framework, the present study was designed to adequately capture wild harvest as an ESS in rural Armenia and address the abovementioned issues. Based on that, the following research objectives were formulated:

- To identify which plant species are harvested and determine their usage as an ecosystem service within four rural communities of Armenia
- To ascertain harvesting techniques people use and investigate if these and other customs related to wild harvest are sustainable, or if they are detrimental to plant abundance
- To connect wild harvest to the socioeconomic background of local stakeholders, identify how important wild harvest is for them and what resources they invest in this activity

[2] Source: https://ace.aua.am/gates/ (accessed 27th April 2020)

State of knowledge

2.1. Ecosystem services

In their report, the TEEB (Müller and Sukhdev 2018) arranges natural capital and all corresponding flows and services from it as the foundation of the agriculture food and value chain. These flows include pest control, nutrient cycling, biomass growth, pollination, and fresh water (Hussain and Vause 2018). The Millennium Ecosystem Assessment (MA 2005) describes ecosystems as 'the planet's life-support system'. Basically, there is a link between ecosystem functioning, human well-being and economic development (Garcia-Martin et al. 2017, CBD 2015).

The term ecosystem services (ESS) captures a broad range of benefits that people obtain from the environment (Brown et al. 2016). These benefits can be distinguished in the four categories supporting, regulating cultural and provisioning (MA 2005). The Millennium Ecosystem Assessment (MA 2005) distinguishes them in the following way: The center of the ESS framework is supporting ESS which captures processes like primary production, soil formation, nutrient cycling and others. They form the backbone for other services like regulating ESS that include climate, flood and disease regulation. Cultural ESS describe the aesthetic, recreational and educational benefits of a landscape, but also encompass how a local group of people connects to a place and how a landscape is embedded in their culture. Provisioning ESS capture every material resource that can be extracted from an ecosystem, for example firewood, fresh water, fuel, food et cetera. In the present study, mainly provisioning and cultural ESS are important.

Cultural ESS are measured in terms of their non-material benefits and/or values whereas the other ESS can be scaled according to their material value. Generally, non-material benefits are perceived through a combination of different experiences associated with a landscape (Chan et al. 2012). This also varies depending on the individual person and it is generally difficult to capture cultural ESS and thus they are often neglected in scientific research and decision making processes (Brown 2013, Chan et al. 2012). Partially this is due to the fact that ESS assessment often focuses on monetary valuation and since cultural ESS are by definition non-material, it is difficult to put a price tag on them (Chan et al. 2012).

The importance of provisioning ESS on the other hand has been more widely acknowledged, especially in developing countries of the global South, although ESS are important in supporting livelihoods both in developed and developing countries (Pritchard

et al. 2019, Egoh et al. 2012). Particularly, in countries like those in Africa many people live below the poverty line and rely on natural resources for survival (Egoh et al. 2012). Provisioning ESS can be monetized as environmental income which on average is about 28 % of the household income of rural areas in low-income countries globally (Angelsen et al. 2014). Often food is perceived as one of the most important provisioning ESS (Cruz-Garcia et al. 2016, Fagerholm et al. 2012). Further, an estimated 2.7 billion people (around 35 % of the global population) rely on firewood as their primary energy source (Bonjour et al. 2013). Pritchard et al. (2019) found in their study in central Zimbabwe that besides firewood, fibers, construction materials, leaf litter fertilizers, wild food, and medicinal plants were considered to be particularly important provisioning ESS. They found out that woodland cover to an extent defines the availability of these services, but other factors play a role as well. Further, they highlight the importance of understanding the connection of the rural population to landscape structure and ESS, especially in the face of ongoing deforestation and ecosystem degradation, not only in Zimbabwe, but everywhere (Pritchard et al. 2019).

When generally looking at the ESS concept, it is sometimes difficult to draw the line between the four basic categories since one service can provide multiple benefits and thus applies to more than one sector (MA 2005). The present thesis investigates wild harvest specifically and tries to arrange it in the broad ESS framework.

2.2. Wild harvest

The process of extracting resources from nature can have several synonymous names like collecting, foraging, harvesting and gathering (Mollee et al. 2017). Poe et al. (2013) define it as an activity where (parts of) plants or fungi are being removed from their habitat to use them as medicine, food, fuel, decoration et cetera. For the present study, the term wild harvest is employed to describe this process. ‘Wild’ in this case refers to plants that grow by themselves without cultivation (Menendez-Baceta et al. 2012). Several authors argue about the distinction between wild, cultivated and semi-cultivated and adopt their own definitions (Stryamets et al. 2015, Menendez-Baceta et al. 2012, Bharucha and Pretty 2010, Tabuti 2007, Censkowsky et al. 2006). For simplicity reasons, a product harvested from the wild here will be referred to as a ‘wild plant’ since this term does not specify the purpose for which the plant is harvested and also indicates that fungi are not included in this study.

Wild harvest can play an important role in high-income societies, but as mentioned before, it is especially low-income countries that depend on provisioning ESS for their

livelihoods (Poe et al. 2013, Egoh et al. 2012, MA 2005). Wild plants are harvested for different purposes which includes food, fire wood, medicinal substances, and others which has direct implications for the health of a community (MA 2005). According to a FiBL survey, more than 30 million ha globally are utilized for wild harvest, though details on the specific purposes of that harvest are only available for seven million ha (FiBL and IFOAM 2019). Other estimates say that the wild harvest area globally lies between 77 and 103 million ha (Censkowsky et al. 2006). Generally, there are many studies on wild harvest from many countries like Thailand (Cruz-Garcia and Price 2014), New Zealand (Wehi and Wehi 2010), the Congo (Termote et al. 2011), Uganda (Mollee et al. 2017, Tabuti 2007), South Africa (Kaoma and Shackleton 2015), Estonia (Sõukand 2016), Spain (Reyes-García et al. 2015, Menendez-Baceta et al. 2012), Austria (Schunko and Vogl 2010), Armenia (Hovsepyan et al. 2019, Hovsepyan et al. 2016) and others. In Armenia, wild harvest was important for people's livelihoods for centuries, especially in rural communities and it is estimated that around 2,000 herbs and other plants that make up 60 % of the total flora have been used traditional in this country (Armenia Gender Project 2018, AM Partners Consulting Company 2010). Also, nowadays wild harvest is a tradition that is still upheld by different communities, for example in the Tatev region where people still collect around 80 different species from nature (Hovsepyan et al. 2019). Of the wild plants, a wide array of different parts is utilized including leaves, stems, shoots, roots, bulbs, fruits, berries, nuts, pollen, seeds, flowers, tubers, branches, bark, cones, and sap (Hovsepyan et al. 2016, McLain et al. 2013, Poe et al. 2013).

The purposes of wild harvest are fairly diverse as well: A major reason to collect wild plants is for consumption (Cruz-Garcia and Price 2014,Schulp et al. 2014, McLain et al. 2013, Poe et al. 2013, Batello et al. 2010). Another important motive is the usage of plants for their medicinal properties: According to a WHO survey, 80 % of the global population depended on traditional medicine in the 1980's (WHO 1993). It is thus not surprising that in some cases the medicinal properties of plants are valued higher than their edibility like it was the case in one study in New Zealand (Wehi and Wehi 2010). Also, in many African communities medicinal plants play an important role since the accessibility and availability of medicinal facilities might be limited (Egoh et al. 2012). Some important pharmaceuticals like aspirin, quinine and digitalis are derived from wild plants and thus natural environments are a valuable source of medicinal compounds (MA 2005).

Especially when talking about food security, wild harvest can be crucial since many people use wild plants to bridge gaps in food shortages and supplement their diets with what they can collect from the wild (Cruz-Garcia et al. 2016, Stryamets et al. 2015, Cruz-

Garcia and Price 2014, Bharucha and Pretty 2010, McMichael et al. 2007). Globally, 95 % of the food intake could be attributed to 30 species at the end of the 20th century (FAO 1997). However, more than 30,000 species of plants are known as food and globally wild food is used by about one billion people according to FAO estimates (Aberoumand 2009). Also in terms of nutrition, wild plants (and fungi) are valuable sources that can supplement diets with essential nutrients and diversify them (Tabuti 2007). Hunger and malnutrition are fundamental global problems that are often emerging in low-income countries and wild harvest provides an opportunity to counterbalance this to a certain extent (Bharucha and Pretty 2010). Furthermore, the diversity of wild plants provides important genetic resources that can be important regarding breeding, economic growth and food security (FAO 2008).

2.2.1. Socioeconomic and cultural aspects of wild harvest

As partly highlighted before, selling wild plants can significantly contribute to the income of vulnerable households (Kaoma and Shackleton 2015, Egoh et al. 2012). This is especially true for times of economic shortages (Stryamets et al. 2015, Bharucha and Pretty 2010). Selling wild plants provides a buffer for households and enables them to pay for healthcare, household needs, education and other goods (Kaoma and Shackleton 2015). In their study, Stryamets et al. (2015) even found that for some households in the Ukraine and Russia selling wild plants as food and medicine was the only source of income. Here, people in rural areas could easily earn more money than the average daily labor payment (approximately 10 Euro) when selling fruits. Another study from South Africa (Kaoma and Shackleton 2015) ascertained that selling wild plants provides around 20 % of additional income in rural households on average which can be crucial for these people. To contrast this, Gubbi and MacMillan (2008) concluded from their study in India that wild harvest in this case has negative consequences for poverty mitigation and biodiversity conservation. They highlight that economic benefit is to a large extent connected to the socio-economic status of the individual person and they list obstacles like the legal situation that prevent economically successful and sustainable wild harvest.

Although they are material resources, the valuation of provisioning ESS is difficult. One of the reasons for this is that they are often not sold but exchanged or traded otherwise (Egoh et al. 2012, Bharucha and Pretty 2010). Altogether, to properly assess ESS economically, their occurrence and distribution must be determined first (Brown et al. 2012). Once an ESS is evaluated in economic terms, trade-offs that arise from keeping

that service can be estimated (Brown 2013). Putting a monetary value per area on an ESS can thus be the starting point to identify priorities in their conservation (Brown 2013). However, ESS are often interconnected and might not be expressed solely through material benefits and thus monetary valuation might inadequately capture the value of that service (Chan et al. 2012).

For wild harvest in particular, the economic benefit might be obvious at first while the underlying cultural and social values of this activity are not as clear and thus potentially neglected. Several studies from high-income regions like the European Union (Schulp et al. 2014) and the United States (McLain et al. 2013, Poe et al. 2013) emphasize the cultural value of wild harvest. There, facets like mental wellbeing, spirituality, communal connectedness, knowledge sharing, and ideological aspects like participating in a sustainable activity are significant for wild harvest. The reason for this is that people in these areas usually do not rely on wild harvest for survival (Schulp et al. 2014). Moreover, wild harvest is often regarded as a leisure time activity (Batello et al. 2010). However, the cultures and traditions of wild harvest are not only important in high-income countries but everywhere. In many instances, wild harvest is regarded as an activity that enables people to uphold and maintain traditions (Poe et al. 2013, Wehi and Wehi 2010). For instance, the Yezidis and Kurds in Armenia build parts of their cultural identity through traditional dishes they prepare with wild plants (Hovsepyan et al. 2016). Besides that, folk medicine is important in Armenia as well (Hovsepyan et al. 2019) and customs like wild harvest of herbs and flowers to make tea have been an important aspect of the everyday life of people in the Southern Caucasus for millennia (Batello et al. 2010). This cultural and traditional side of wild harvest is influenced by a number of factors like history. For example, in the Soviet Union, wild harvest was coordinated by the government to collect food and medicinal plants for state purposes (Sõukand 2016, AM Partners Consulting Company 2010). Also, gender is an important aspect since wild harvest in some cultures is traditionally more practiced by women (Sõukand 2016) and preserving cultural legacy is often a female task (Manoogian et al. 2007).

2.2.2. Sustainable wild harvest

Since wild harvest can be essential for the livelihoods of people and the services that wild plants fulfil are so diverse, it is crucial to have guidelines in place that ensure that this ESS stays intact. There are several suggestions on what sustainable harvest could look like, regarding how, when and what to harvest (Khumalo et al. 2013). For that, plants should only be harvested when they are abundant, when they are neither rare nor

endangered, when they are in optimal condition for usage, when the weather is suitable, when the plants have been identified correctly, and when there is no risk from contamination from for example pesticides (Khumalo et al. 2013, Schindler et al. 2010, WHO 1993). Furthermore, during the harvest it is important to take special care with sensible plant parts, avoid mechanical damage to the tap root and surrounding plants, have adequate storage containers, and change the area of harvest often enough to give a population time to recover (Khumalo et al. 2013, Schindler et al. 2010, WHO 1993). Moreover, there are specific instructions on how to handle different plant parts like leaves and flowers (Khumalo et al. 2013, Schindler et al. 2010). Additionally, it is important to pay attention to signs of overharvest such as plant diseases or bad conditions of the plants or the disappearance of plants from collection sites and local areas (Khumalo et al. 2013).

The first step in ensuring that wild harvest is not affecting plant populations in a negative way is to get an inventory about the plants present in an area in order to identify the habitats that are of highest priority for conservation. Equally, it is important to determine which plants people use, for what purpose(s), which parts, the quantity harvested, and also the plant species' regenerative capacity (WHO 1993). In all of this, the interests of the local collectors should not be neglected since most often vulnerable communities are those that are the most affected by regulations (MA 2005, WHO 1993). A possible solution to avoiding exploitative use of wild plant resources is to have people grow the plants they need themselves instead of collecting them from the wild or to issue a permit system that provides a legal control mechanism on the wild harvest activities (Khumalo et al. 2013, WHO 1993).

However, trying to ensure sustainable harvest does not come without significant challenges: Often, there is neither comprehensive data on the plant species present nor on the environmental conditions the plant species need (Schippmann et al. 2006, WHO 1993). This is especially a problem in low-income countries since they often do not have the capacity to investigate the status quo of their natural resources and sustainable alternatives if these resources are being exploited (MA 2005). Since people there often rely on wild harvest, these are the countries where overharvesting is most likely to become an issue (Khumalo et al. 2013). Furthermore, trying to regulate a resource that is not specifically known and that people depend upon overall creates mistrust and makes it highly unlikely that recommendations will be accepted (MA 2005). Another issue that further impedes the introduction of sustainable harvesting guidelines is the frequent misidentification of wild plants. Besides that, harvesting guidelines need to be adjusted to different plant parts since harvesting a certain part (e.g. bark) can be more harmful

than harvesting another (e.g. leaves) (WHO 1993). Also harvesting a common plant species is less harmful than harvesting an endangered one and thus guidelines also need to be species specific (Khumalo et al. 2013, Batello et al. 2010). Sustainable harvest aims at certain outcomes like the survival of a species, maintaining a steady population size, and not damaging the surroundings or other plants and animals. This can be difficult to achieve in practice since often general solutions are difficult to apply (Schindler et al. 2010).

2.3. Problems and degradation of ecosystem services

Human interventions like urbanization, agricultural intensification, and deforestation are significantly altering ecosystems globally (Abrahamyan 2011b, Wehi and Wehi 2010, MA 2005). It is estimated that about 60 % of ecosystems are used unsustainably and thus many of them are already degraded which leads to a significant loss in biodiversity (Barbier 2008, MA 2005). These anthropogenic changes have increased the need for research but at the same time hindered it (Abrahamyan 2011b). This becomes more urgent when considering the necessity to feed a growing world population which further increases pressure on ecosystems and which calls for change that has to come about through sustainable intensification (Royal Society 2009). So far, anthropogenic intervention has been essential to decrease world hunger and improve human health which has come at large environmental costs and a significant decrease in ESS (MA 2005). Paradoxically, it is the people in areas that are the most vulnerable to deterioration of ESS where most of the change is happening since this often corresponds with biodiversity hotspots (Treweek et al. 2006). This exacerbates the pressure on already vulnerable ecosystems and leads to non-linear change and growing inequities (MA 2005). As a consequence, ESS are declining further and contribute to hunger, malnutrition and food insecurity among the world's most vulnerable populations (Cruz-Garcia et al. 2016). Further, the degradation results in complete changes of landscapes where ecosystems that were present in the past now are vanishing or are at least underrepresented (Wehi and Wehi 2010). These changes can sometimes result in irreversible erosion of biodiversity and the loss of species (MA 2005).

Naturally, the drop in ESS availability includes wild harvest as well (MA 2005). Part of this is due to the fact that agriculture and economic development continue to destroy areas where wild food is largely available (FAO 1995). There are several consequences arising from this trend: Firstly, although wild harvest by itself is not sufficient to ensure food security, it largely contributes to it and a decline in provisioning ESS capacity opens

economic gaps between supply and demand in the food market (Bharucha and Pretty 2010). Further, many wild plants are relatives of cultivated crops and destroying their habitats leads to genetic erosion (FAO 1995, WHO 1993). Hence, these plants are not available for breeding in the future which might be crucial to adapt crop varieties to changing environmental conditions like drought (FAO 1995). Additionally, wild plants provide buffers against food shortages induced by climate change (Bharucha and Pretty 2010). Lastly, wild plants are important for nutritional security by diversifying diets and providing micronutrients and thus their decline can have serious health implications (Sõukand 2016, Bharucha and Pretty 2010, Buchmann 2009, Tabuti 2007). The general decline of ESS is further perpetuated by the fact that harvest is often done unsustainably since many areas are not protected sufficiently and traditional knowledge on how wild harvest is done properly is being lost (Khumalo et al. 2013, Fagerholm et al. 2012, Censkowsky et al. 2006).

Paradoxically, while overharvest is an issue, this is true for the opposite case as well. Globally, many ESS go unused despite their availability and also the opportunity to practice wild harvest is often missed and many wild plants are not utilized and neglected (Tabuti 2007). This is largely induced by the fact that lifestyles in many regions are changing and a general erosion of indigenous knowledge is taking place (Garcia-Martin et al. 2017, Sõukand 2016, Stryamets et al. 2015, Menendez-Baceta et al. 2012). Often, traditional customs like wild harvest are abandoned by younger generations when they are regarded as old-fashioned (Hovsepyan et al. 2019, Stryamets et al. 2015, Menendez-Baceta et al. 2012). Further, as is the case in Uganda (Tabuti 2007), young people nowadays have better access to education and less time available to get acquainted with traditional knowledge. Besides that, wild harvest might be considered as too time-consuming (Menendez-Baceta et al. 2012). Additionally, migration and urbanization geographically limit people's access to areas where they can practice wild harvest (Hovsepyan et al. 2019, Mollee et al. 2017). Finally, the increasing availability of modern pharmaceuticals and easy access to food in retail stores has reduced people's reliability on wild resources (Hovsepyan et al. 2019, Sõukand 2016). With traditional knowledge decreasing for wild harvest, this also includes the understanding of biodiversity management which can pose significant challenges on its own (Batello et al. 2010).

Study area and communities

3.1. Republic of Armenia

3.1.1. Geography and natural diversity

The Republic of Armenia was the first soviet state to claim its independence in 1991 after the collapse of the Soviet Union in 1989 (Cohan 2005). It comprises a total area of 29,800 km^2 (Batello et al. 2010) (or 29,965 km^2 according to Gabrielian and Zohary 2004). Armenia is landlocked and situated about 750 km northeast of the Mediterranean Sea and 960 km north of the Persian Gulf; closer are the Black Sea which is 145 km northwest of Armenia and the Caspian Sea that is 175 km east of the country. Armenia extends from 41°18' to 38°5' latitude north and 43°29' to 46°37' longitude east. Bordering countries are Turkey in the West, the Islamic Republic of Iran in the South, Azerbaijan in the Northeast, and Georgia in the North (Batello et al. 2010). Armenia is divided in marzes and communities. A marz is an administrative unit that contains urban and rural communities. There are 11 marzes in Armenia that consist of a total of 48 urban and 866 rural communities (FAO 2008). The four communities investigated in this project are situated in the Aragatsotn and Gegharkunik marzes (Figure 1) (see 3.2. Communities).

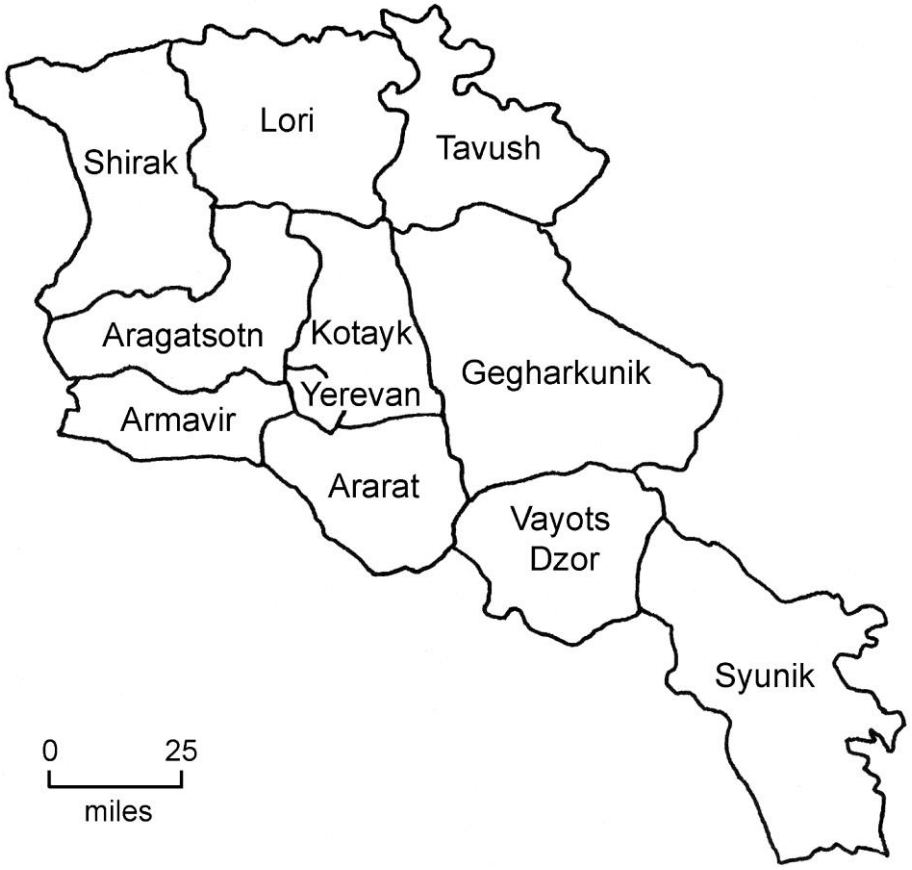

Figure 1: Marzes of Armenia in 2001 (according to Rowland 2007).

Armenia's topography is fairly mountainous, with altitude ranging from 380 m above sea level in the Debed river valley according to Batello et al. (2010) or 450 m in the Arax river according to Gabrielian and Zohary (2004) to 4096 m at the highest peak of Aragats mountain (Gabrielian and Zohary 2004). Less than 10 % of the country lies below 1000 m while more than 70 % are located higher than 1500 m and 51 % lies above 2000 m (Batello et al. 2010, FAO 2008, Gabrielian and Zohary 2004). The climate is characterized by its dryness and overall classified as mountainous continental with short springs and long autumn periods (FAO 2008, Gabrielian and Zohary 2004). Annual precipitation is 800 mm in rainier parts of the country and 200 mm in dry semi-desert areas. Mean temperature ranges from 14.0°C in the warmest regions to -2.7°C in the coldest regions (FAO 2008) with temperature extremes spanning from -37°C to 42°C (Gabrielian and Zohary 2004).

The complex relief structure of the country creates different climatic conditions that in turn are the prerequisite for a great number of ecological niches (FAO 2008, Gabrielian and Zohary 2004). Therefore, despite its small size, Armenia's flora is exceptionally diverse. Further, the country lies in between several phytogeographic regions including the Caucasian and the Armeno-Iranian region (Gabrielian and Zohary 2004) as well as the Ancient Mediterranean floristic province (FAO 1995). Characteristic plant formations as identified by the CBD (2015) are (semi-)deserts, (meadow) steppes, arid open woodlands, forests, (sub-)alpine meadows, wetland vegetation, and petrophilous vegetation. These landscapes support a huge number of species. Depending on the source, Armenia harbors a total of 3500 (Gabrielian and Zohary 2004), 3600 (Abrahamyan 2011b, FAO 2008), or 3800 species of vascular plants (CBD 2015). This makes up around half of the entire Caucasian flora (FAO 2008). The level of endemism is around 25 %. Out of the total flora, 452 species are registered in the Red Book of Plants of Armenia (Tarmanyan et al. 2010, FAO 2008).

From this total stock of plants, approximately 2000 species have been harvested from the wild at some point in time for different purposes (Armenia Gender Project 2018, FAO 2008). Wild harvest has been a tradition the people of Armenia have followed for millennia (FAO 1995). Estimates are that the total number of medicinal plants in the Armenian flora is around 10 %. Further, there are 200 species of edible plants, 350 species of melliferous plants, 60 resin plants, 120 species of plants bearing volatile oils et cetera (FAO 2008).

3.1.2. Agriculture and ecosystem degradation

In the Caucasus, the concentration of economically important crops like single-grain wild wheat and Ararat wheat (*Triticum boeoticum* Boiss.[3] and *T. timopheevii* (Zhuk.) Zhuk.) and other crop wild relatives like barley and rye is very high which makes significant also in terms of genetic diversity (Batello et al. 2010). Further, according to FAO estimates, there are around 280 vegetable species that originate at least secondarily from Armenia. Parallel to the rest of the flora, vegetable production differs along an altitudinal gradient. Moreover, fruit production is an economically important branch of agricultural production. However, it is the cultivation of cereal crops that supports the countries food security the most (FAO 2008). Before 1950, around 20 local varieties of wheat were present in Armenia that were adopted to a variety of stresses like drought, cold, and fungal diseases. Unfortunately, nowadays only two or three of those varieties remain (Batello et al. 2010).

Still, 18.2 % of the country are under intense development and these areas concentrate 87.7 % of the population in them (CBD 2015). The population of Armenia is around 3.2 million out of which two million people live in urban communities with around 1.1 million people registered in the capital city Yerevan alone (FAO 2008). Thus, Yerevan made up 53.4 % of Armenia's urban population in 2001 (Rowland 2007). With respect to ethnic groups, there were 93.3 % of ethnic Armenians present in the country in 1989 which increased to 97.9 % in 2001. Within the country, between 1989 and 2001 an increase of the rural population with a simultaneous decrease of the urban population could be observed. Reasons for that are versatile and include reclassification of certain areas from urban to rural, a higher fertility rate in rural regions, and a certain degree of net emigration from urban to rural settlements (Rowland 2007).

3.1.3. Demographics, history and culture

Overall, it is estimated that there are seven to eight million Armenians globally, thus the majority of ethnic Armenians lives in diaspora (Baser and Swain 2009). After the Armenian genocide in the beginning of the 20th century, Armenians settled in all parts of the world, including Eastern Europe, North America and the Middle East (Adalian 1991). The biggest group of around one million Armenians lives in Russia to which close ties still exist due to Armenia's Soviet past (FAO 1995, Baser and Swain 2009). During the Soviet period, with many government regulations like media censorship, Armenia got assimilated into the Soviet culture to an extent which can still be observed today (Baser

[3] All scientific plant names in this study are according to http://www.theplantlist.org/. Accessed on 28th April 2020.

and Swain 2009). Besides cultural influences, the Soviet period had and still has significant political and economic implications for Armenia. After the collapse of the Soviet Union and the earthquake in 1988, Armenia's economy was struggling and only slowly got established. Further, the fact that the borders to Azerbaijan and Turkey are closed nowadays, costed Armenia around 10 to 30 % of its GDP in the 1990's and it still is the most isolated country in the Southern Caucasus. On top of that, corruption is another recognized problem (Sarian 1996) that largely contributes to the existence of a shadow economy (Tunyan 2005)

Diaspora Armenians and the homeland still have close relationships. Diaspora Armenians for example donate money to support different courses in the homeland (Baser and Swain 2009). Although these strong ties persist, there are significant cultural differences that manifest themselves the longer diaspora Armenians are separated from their home country (Abakumova et al. 2019, Manoogian et al. 2007). Abakumova et al. (2019) conducted a study on the cultural differences between homeland and diaspora Armenians. They found that the biggest difference here is that security is of higher importance in Armenia than in its diaspora. This is a result of the complex political and economic situation of the country. On the contrary, diaspora Armenians have a stronger sense of necessity to appropriately represent their ethnic group. For homeland Armenians, this was the third most significant factor in the same study. The second most important factor for them was the value system which includes etiquette and national values. Of highest significance in homeland Armenia were ethnocultural traditions like customs, language and family life (Abakumova et al. 2019). Family rituals are a means to express culture and identity for any ethnic group (Fiese and Pratt 2004). This is manifested very strongly in Armenian culture since here the family is cherished more than the individual person (AM Partners Consulting Company 2010). Moreover, there are differences in gender in which men and women might have different ideas about the qualities that represent an ideal Armenian (Abakumova et al. 2019). In Armenia's patriarchal society, women often hold the role as kinship keepers and it is their task to preserve and pass on cultural legacy to an extent (Manoogian et al. 2007). This is also true when it comes to ethnobotanical knowledge and wild harvest practices at least in some areas like the Tatev region (Hovsepyan et al. 2019). Overall, people in the Southern Caucasus base their traditional food practices on their respect and understanding of their local environment (Batello et al. 2010) and one task of this present study is to highlight that connection for the Armenian case.

3.2. Communities

3.2.1. Aragatsotn marz – Kuchak and Geghadzor

The following data was obtained from the National Statistical Service of the Republic of Armenia (2008b). Aragatsotn marz comprises a total area of 9.3 % of the country and is home to 4.3 % of its population. There is a total of three urban and 111 rural communities in the marz with the urban population size amounting to a share of 23.6 % of the marzes total population. The biggest city in the Marz is Ashtarak. Agricultural land is 217,921 ha out of which 54,157 ha are arable land. Agriculture is the most important economic branch and contributes to 7.6 % of Armenia's agriculture. Main practices here include plant growing and cattle breeding. The second most important economic sector is industry which contributes 1.3 % of the country's total industrial output. Aragatsotn's industry is located in the food production sector with manufacturing of beverages and food products being the most significant outputs. The two communities under investigation in the Aragatsotn marz are Kuchak and Geghadzor which were both classified as grassland areas in the survey.

Kuchak lies at 1880 m above sea level at 40°30'57.8'NN and 44°23.4''E[4]. The administrative area is 2693 ha. Mean temperature is at 4.3°C, ranging from -41°C to 32°C with precipitation accumulating to 651 mm. The climate data was extracted from Aparan[5] which is 9.5 km north of the community. Kuchak had 2492 inhabitants in 2008 (National Statistical Service of the Republic of Armenia 2008b). Geghadzor lies at 2190 m above sea level at 40°37'43.2''N and 44°10'18.4''E[4] and comprises an administrative area of 1350 ha. The temperature ranges from -30°C to 34°C with an annual mean of 5.8°C. Annual precipitation is 516 mm. The next available climate data was obtained from Artik which is 20 km west of Geghadzor[5]. The community had 1325 inhabitants in 2008 (National Statistical Service of the Republic of Armenia 2008b).

[4] Coordinates and altitude above sea level according to https://maps.google.de/.
[5] All climate data obtained from https://web.archive.org/web/20041025104249/http://www.unccd.int:80/actionprogrammes/centraleu/national/2002/armenia-eng.pdf. (accessed 19th December 2019)

3.2.2. Gegharkunik marz – Kalavan and Dprabak

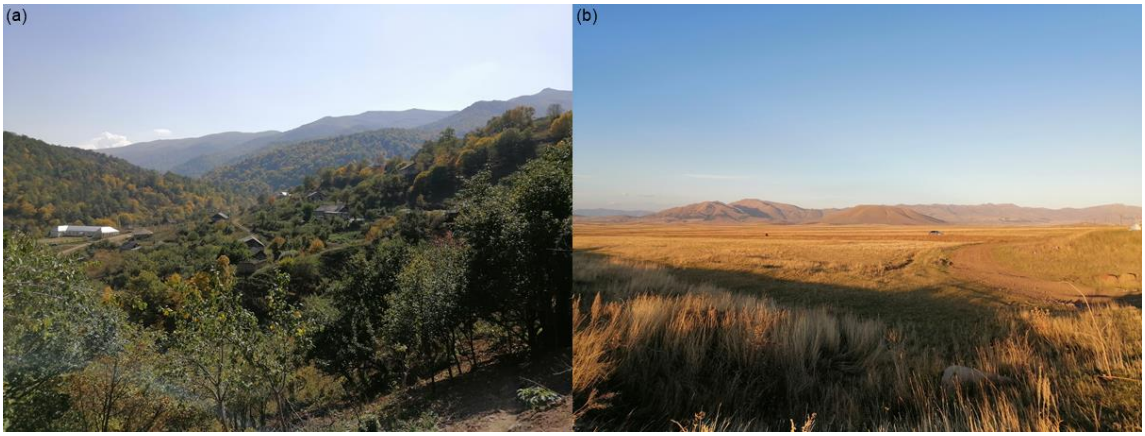

Figure 2: Different landscape types under investigation. (a) Forest area (Kalavan and Dprabak). The picture shows Kalavan community. (b) Grassland area (Kuchak and Geghadzor). The picture shows the landscape around Geghadzor community. Pictures taken by Miriam Rüger.

The following information is obtained from the National Statistical Service of the Republic of Armenia (2008a). Gegharkunik covers 18 % of Armenia and thus it is the largest marz of the republic. A total of 7.3 % of Armenia's population live in Gegharkunik marz in five urban and 87 rural communities. The centre of Gegharkunik is Gavar. Agriculture land covers a total of 352,800 ha which includes 80,900 ha of arable land. As is the case in Aragatsotn marz, agriculture is also the main economic branch of Gegharkunik. It comprises 14.4 % of Armenia's total agriculture with main aspects being plant production, animal husbandry and fishing. Other important economic sectors are trade and services for which Gegharkunik holds a share of 2.1 % of Armenia's total economic output. This is connected to the mining industry that is present in Gegharkunik marz. Other economic sectors are construction and industry that each contribute 1.8 % to Armenia's total output. Further, lake Sevan which is the largest source of freshwater in the whole republic is situated in Gegharkunik marz (National Statistical Service of the Republic of Armenia 2008a). Lake Sevan national park is important in terms of biodiversity since there are more than 100 edible plants and about 60 medicinal plants registered there (Dingarac 15. November). The communities investigated here are Kalavan and Dprabak which were both classified as forest areas.

Kalavan lies in a forested area at 1600 m above sea level at 40°38'58.0''N and 45°06'35.7''E[4], encompassing 2400 ha of administrative area. Mean temperature is 4.8°C, ranging from -34°C to 31°C with an annual precipitation of 557 mm[5]. The total number of people is 245, with 105 people being male and 140 being female[6]. A special thing to note about Kalavan community is that in recent years it has undergone a transformation from a village that was in the process of being abandoned to a center of

[6] http://gegharkunik.mtad.am/files/docs/34640.pdf. (accessed on 19th December 2019)

ecotourism: This development includes the establishment of guesthouses to support activities like for example archeological and botanical tours. A prerequisite to establish a business in Kalavan is to keep in mind the interests of the local people. In Kalavan, no businesses from outside the village that want to establish themselves for economic profit are permitted (Aghbalyan 2017, Androushan 2018, Mirzoyan 2017).

Dprabak ranges from 1200 mm above sea level on the Getik river side up to 1300 m on the mountain slope and was classified as forested area as well. The coordinates are 40°41'18.2''N and 45°07'39.3''E[4]. A total of 555 people lives in Dprabak, 260 male, 195 female[6]. Annual temperature and precipitation data are the same as for Kalavan since the closest available station for both communities is in Chambarak[5] which is about 24 km northeast of both villages. Important to note for Dprabak is that wild harvest there to an extent is related to the 'Mothers of Dprabak' Herbs Production Cooperative which was founded in 2015. The cooperative is part of the ENPARD[7] Project in Armenia. Within the project, two women of the Dprabak community were trained in sustainable harvest techniques. Consecutively they were implemented as the heads of the cooperative and shared their knowledge with the women that are part of it (personal communication with head of Mothers of Dprabak cooperative on 15th October 2019).

[7] Producer Group and Value Chain Development https://www.am.undp.org/content/armenia/en/home/operations/projects/poverty_reduction/enpard-technical-assistance--producer-group-and-value-chain-deve.html. Accessed on 14th May 2020.

Methodology

4.1. Literature review

Functioning as a baseline of the research, a literature review was conducted. This was done before the project began and throughout the whole research period until completion of the thesis. Literature databases used for the review were Scopus and Google scholar, general key search terms included ‘ecosystem services’, ‘Armenia’, ‘wild plants’, ‘medicinal plants’, ‘PPGIS’, and ‘ethnobotany’ among others. More material was researched with more specific searches to for example investigate Armenian history, culture et cetera for contextualization. Other material was identified through the reference sections of the encountered literature and additional sources were provided by various people involved in the project. References included reports from different organizations (e.g. CBD 2015, FAO 2008, MA 2005, FAO 1995) that were used to lay out the status quo of ESS globally as well as in Armenia. Other literature covered sustainable harvesting practices (e.g. Khumalo et al. 2013, Schindler et al. 2010, WHO 1993, Asva-Raf, GIZ). Besides literature that was capturing the theoretical side of the research, other references were used as methodological guidelines like Atteslander and Cromm (2010) that describe the steps in working out a questionnaire.

Further, information about the study area, especially about the communities included in the survey, was investigated during the research period in Yerevan through different online sources and by interviewing community members directly. However, getting specific information about the communities was difficult and the information was scarce, old, and probably unreliable. Issues that came along with this will be discussed later (see 6.1. Survey design). Further, in some instances it was difficult to find suitable literature on certain topics. For example, information on the legal status of wild harvest in Armenia was scarce and contradictory. Although it would have been interesting and important to include this aspect in the survey, the theoretical baseline for the methodological approach and later the analysis was not given. This is why the legal aspect of wild harvest was not part of the research. In general, the literature review was the theoretical framework for identifying the research objectives and it was the prerequisite for designing and preparing the questionnaire that was used in the field.

4.2. Questionnaire

The first weeks of the research period in Yerevan were dedicated into designing and finalizing a questionnaire (see: Annex 1: Questionnaire about wild harvest in rural Armenia). It was formulated to answer the research objectives (see 1.3. Research objectives) and was first completed in English and then translated into Armenian. The Armenian version was further checked and corrected before it was used in the field. The questionnaire included mostly single-choice and multiple-choice questions, but some open-ended questions were part of the survey as well.

The questionnaire included ten sections on different aspects of wild harvesting practices. Two of these sections were only included in the survey if a participant specified that she[8] sold collected plants for economic profit. The first section tried to capture general aspects of wild harvest to get participants comfortable with the interview situation. In the next part a botanical inventory was conducted, capturing all the plants that people collect and organizing them in different use categories (medicinal, cooking, spice or seasoning, tea and other beverages, making preserves, ornamental, and other) as well as specifying which parts (whole plant, leaves, fruits, flowers, stem, root, and other) people use for each plant. In the next sections, specifications about the harvesting season and the quantity harvested of the three most important plants for consumption and if applicable of the three most important plants for selling were obtained to allow a more detailed analysis later on. The next set of questions aimed to investigate if people harvest sustainably or not and then questions about perceived changes in plant availability were asked to later analyze the effects of harvesting practices on species availability. After that, people were asked to point out areas where they have perceived changes on a map if applicable and then also to specify the area where they collect wild plants generally. More questions included general socioeconomic criteria of wild harvest to capture how important wild harvest is for the collectors and how much time and how many resources they invest in this activity. Women that sell their collected plants were further asked specifically about how they sell it, how important wild harvest is for them in terms of income, and if they face any problems in this regard. The last section included demographic variables like household size, education, occupation and age. Since asking these questions can be sensitive, they were put in the end of the survey to increase the chances of people answering them.

[8] All the participants in the study were women and thus will be addressed as female throughout the thesis. This employed terminology is only applicable for the case at hand: There were mentions of men doing wild harvest in some of the communities, but wild harvest was frequently referred to as an occupation for women.

Besides answering the questions, the women often gave additional information which was interesting to complement the data acquired from the interviews qualitatively.

4.3. Timing of research and data collection

The research period lasted from September to October 2019. The weeks in September before the field visits were spent to prepare and finalize the questionnaire and to prepare the field visits in terms of logistics. After that, the actual field visits took place between the 2nd and the 16th of October 2019. The specific days of the field work are listed in Table 1 (also for more details about the study areas see 3.2. Communities). The field work in Kuchak was split into two afternoons, in Geghadzor and Dprabak each a whole day was spent for conducting interviews, and in Kalavan the field work lasted two days. After completing the interviews, the data was structured and analyzed, which partly took place at the ACE in Yerevan but was done to a large extent at the University of Hohenheim in Germany.

For the survey, structured interviews were conducted one-on-one with a local student facilitating the conversation in Armenian. An interview lasted approximately between 30 and 90 minutes. The duration of the interviews depended largely on the number of plants people listed for the botanical inventory since this was the most extensive section of the questionnaire. Interviews often lasted longer than intended since often the women gave additional information. In most cases, the interviews took place in a respondents' home or in the home of a respondents' neighbor and there was time needed to move in between the different houses after a survey was completed.

The answers were recorded on a tablet by the facilitator, using the software Maptionnaire[9] while simultaneously recording the answers on a paper-based questionnaire in English. This was done to ensure back-up of the data since Maptionnaire is an online-based tool and in some cases internet connection was problematic in the communities. Whenever the connection was too weak to use Maptionnaire, paper-based questionnaires in Armenian were used to record the answers. Later on the data was added into Maptionnaire after the surveys were completed. Maptionnaire allowed to design a survey with different types of questions, for example open-ended, multiple choice, single choice etc. It also featured a mapping component that could be utilized to get geographic information on certain aspects of a survey by visualizing maps and allowing respondents to place points or draw polygons in certain areas.

[9] https://maptionnaire.com/. Accessed on 24th February 2020.

It was intended to observe the respondents in the field during wild harvest to complement the data accumulated in the interviews. However, this was not possible due to time constraints and organizational difficulties. The latter was especially a problem in Dprabak. However, since most of the interviews took place in people's homes, participants could be observed in their communities and home environment which gave some insights into local Armenian culture and the lives of the people in the communities.

4.4. Respondents

In Kuchak, Kalavan and Geghadzor, informants were identified through a contact person in each community. These contact people were identified through people from the ACE and GIZ that were involved in the GAtES project. Partly, collectors were selected beforehand by the respective contact person or in other cases they were called by them during the field visits to check availability. In Dprabak, the contact was established through one of the respondents in Kalavan. There, the interviews took place with the Mothers of Dprabak wild collector cooperative. Their director was the last woman that was interviewed on that day. Besides identifying respondents through a preceding contact, snowball sampling was conducted in Kuchak, Kalavan and Dprabak as well. In these cases, women that were interviewed before would point out a neighbor, friend or family member as a potential survey participant. On one occasion, a respondent was identified by approaching her directly on the side of the road in Dprabak and it turned out that she was a member of the Mothers of Dprabak cooperative coincidentally.

In Kuchak and Geghadzor some candidates previously identified by the local contact person could not participate in the survey. They stated that they were busy with work since the field visits were conducted during working days and hours in these two villages. Besides that, nobody else refused to participate in the survey. In general, consent was ensured by verbally reading out a declaration on confidentiality and usage of the data before the interviews started.

4.5. Botanical inventory

An important part of the survey was to get a general idea about the number and types of species that people harvest. This was done by relying on the memory and knowledge of the respondents and have them list the plants that they collect (Suggestions on how to improve this methodology will be discussed later in 6.1.2. Limitations of the interview-based **survey**). For recording the plants, their names were written down in Armenian, often registering the local name if the respondents did not know the official name of the

plant. Later, most of the plants were identified with the help of Alla Aleksanyan from the Armenian National Agrarian University. In total, 76 different plants were listed by the respondents (see 5.2.1. Plants listed). Out of these, nine plants could not be identified by recording their local name only. One of them was later identified with the help of a dry sample. For the other eight species that were listed as unknown this was unfortunately not possible since dried samples were only given for a limited number of species (see Figure 3). They were thus excluded from the analysis. For another nine plants identification to the species level was not possible and only the plant genus was included in the final list.

4.6. Data analysis

All the data was recorded with Maptionnaire. To generate a geographic output, maps were created by Aghavni Harutyunyan from the ACE (see 5.3.3. Spatial component) utilizing ArcGIS. For the descriptive statistics, the software SPSS was employed. Tasks performed in SPSS included the generation of frequency tables to get an idea on the distribution of the data to evaluate certain questions of the survey. Statistical tests that were performed in SPSS included ANOVA and Generalized linear model (GLM).

4.6.1. Data organization and adjustment

The Maptionnaire output was given as a Microsoft Excel sheet with a separate file for each community in which surveys were conducted. It was possible to later on add the data of the surveys performed on a paper-based questionnaire into the respective Maptionnaire file. For further data processing, all these files were merged and organized in a general database using Microsoft Excel.

When listing the most important plants for consumption and selling in the last research objective, preparatory steps had to be taken to estimate the quantity of some of the plants, namely *Rumex crispus* L. (curled sorrel). This was the case since people braid the plants (see Figure 3h) after harvesting it and would give the quantity as a number of braids. Some respondents gave estimates on the length of braids and an average length of 1.75 m was assumed after generating the mean of those answers. Further, the length and weight of the dried samples was measured and then the mean of that was calculated as well and applied to the assumed braid length. In a final step, leaf water content was estimated at 90 % for curled sorrel according to data from Atkinson and Davison (1973) and the harvested quantity was calculated. Additionally, in some cases people gave an

estimate on the number of braids, for instance five to ten braids and in the following 7.5 braids were considered for the analysis.

For the same section of the analysis, further adjustment had to be made in terms of which data was used. Respondents were asked to first list the three most important plants for their own consumption and then do the same for selling. However, in many instances people listed the same plants for both set of questions. Table 7 in Annex 5: Most important plants listed in the survey shows the original dataset with all the plants mentioned as most important for consumption. However, since this includes many plants that are also used for selling, the quantities estimated for these plants are usually a lot greater than quantities estimated for plants that were only listed once as most important for own consumption. Including all plants thus deviates or rather inflates the quantity for the own consumption. One example here is turnip-rooted chervil where the average quantity harvested for all plants listed is 864.32 kg (SD = 360 kg) as compared to an average of 17.78 kg (SD = 6.61) when only the plants listed once are considered. Therefore, the results of the most important plants for consumption do not include the ones that were mentioned also for selling.

Another aspect was to analyze differences in resource investment for people that harvest plants for their own consumption opposed to people that harvest plants also for selling. The resources considered were materials and time for collection and processing. For the analysis, the hours spent on harvesting alone were more representative of this objective than using the sum of the time necessary to harvest and process. This was done because processing in this instance does often not correspond to processing before selling the plants. Rather this meant processing before own consumption and plants used for selling were mostly processed in the same instance since selling was often just an additional activity. Furthermore, estimating the time used for processing was difficult for a few respondents, because the duration of processing depends on the plant. The most frequently mentioned example in this case was rosehip (*Rosa* sp.) since collectors would say that processing the rosehips takes the whole day but that they would only harvest it once or twice a year when it is in season. Processing for other plants, most often drying, on the other hand almost took no time at all. Therefore, only the harvesting time was considered for the ANOVA.

4.6.2. Statistical methods

After finalizing the list of wild plant species collected, analysis was conducted to investigate how the spectrum of these plants differed in between grasslands and forests. A more general approach to do this was to calculate similarity indices. After literature research, the Sørensen and Jaccard index were selected for that purpose since they are commonly known and widely used (Chao et al. 2006, Magurran 2004, Ludwig. J. A. and Reynolds 1988).

The Jaccard similarity index K_J is calculated the following way:

$$K_J = \frac{a}{a + b + c}$$

with a being the total number of species present in both samples, b is the total number of species in sample 1 and c is the total number of species in sample 2 (Magurran 2004). The Sørensen index K_S of similarity is a variation of the Jaccard index of similarity and is calculated according to the following formula (Looman and Campbell J. B. 1960):

$$K_S = \frac{2c}{a + b}$$

The variables in the Sørensen index correspond to the same population sizes as in the Jaccard similarity index. Both indices estimate similarity based on the number of species in each population and the common number of species in both populations.

For further comparison, a GLM were created to statistically analyze differences in collection of single plant species. The GLM had the form of:

$$y_i = g(x_i) + c_i + e$$

The GLM was employed since both the dependent variable (y_i = plant collected yes or no) and the independent variable or predictor (x_i = landscape type) were binomial and thus categorical. Further, g is the link function which followed a logit relationship.c_i refers to the covariates. These were community, harvest experience (years), occupation, education, household size, and age. Covariates were selected via backward elimination. For this process, the least significant variable was consecutively taken out of the model until only significant variables remained. For this analysis, only the plants that were collected at least ten times were used to allow proper comparison. This included nine species and for each of the plants the GLM was set up according to the described procedure.

To analyze the differences in resource investment an ANOVA was performed in SPSS.

Results

5.1. General information

All the respondents that were interviewed were female. On one occasion a man was answering the questions. However, he was joined by his sister-in-law that provided most of the information so her demographic data was included in the survey since she was the wild collector of the family. In total, 25 people were interviewed. However, in two cases there were two respondents answering the questions simultaneously and they both gave the same answers each time. Therefore, 23 interviews were considered for the analysis.

Table 1: Survey dates and number of people interviewed during the research period in each community.

Community	**Date**	**Number of interviews**
Kuchak	2nd October 2019	3
	16th October 2019	3
Kalavan	5th October 2019	3
	6th October 2019	5
Geghadzor	8th October 2019	5
Dprabak	15th October 2019	4

The interviewed women practiced wild harvest in between 4 and 40 years with a mean duration of 19.28 years (standard deviation SD = 9.84 years). The mean age of the respondents was 47.44 years, ranging from 26 to 61 years (SD = 11.57 years). For 16 respondents their highest level of education was high school, in four cases it was vocational school and in three cases a bachelor's degree. Of the 23 women, 11 were homeworkers, nine were occupied in the service sector (e.g. being a teacher) and three in the production sector (in this case agriculture). Household sizes ranged from one to nine people with an average of 5.17 people living in one household (SD = 1.97 people).

5.2. Harvested plants and their usage

The first research objective aimed to investigate which plants people harvest, for what purpose, and later arrange them in the concept of ESS. Here, people first named a plant and then identified its usage according to provided categories. After that they mentioned which parts of this plant they use.

5.2.1. Plants listed

Figure 3: Samples of plants that people harvested: (a) Wormwood *Artemisia fragrans* Willd., (b) Common marigold *Calendula officinalis* L., (c) Tatarian cephalaria *Cephalaria gigantea* (Ledeb.) Bobrov, (d) Sickleweed *Falcaria vulgaris* Bernh., (e) Ross mint *Mentha longifolia* (L.) L., (f) Cherry plum *Prunus cerasifera* Ehrh., (g) Rosehip *Rosa* sp., (h) Curled sorrel *Rumex crispus* L. (i) Thyme *Thymus kotschyanus* Boiss. & Hohen., (j) Linden *Tilia cordata* Mill. Pictures taken by Miriam Rüger.

The respondents named 76 different plants int total. Out of these, as described above (see 4.5. Botanical inventory), eight plants were excluded from the survey since they were recorded as unknown and could not be identified. One dry sample was provided for a plant that was mentioned by three people in Geghadzor and it could later be added as *Cephalaria gigantea* (Ledeb.) Bobrov, the Tatarian cephalaria (see Figure 3c). In total, the plants could be allocated to 68 different species and genera, more exactly 59 species and nine genera. It was expected that not all plants could be identified to the species level since the way of recording the data verbally did not allow for more in depth analysis. The full list is included in Annex 2: List of plants mentioned in the survey. This list has 305 entries of plants.

5.2.2. Similarity indices

One aim of the study was to analyze whether there are differences in the plants that people collect depending on the assigned landscape type grassland and forest. To get a first idea on that, the similarity indices by Sørensen and Jaccard were calculated. The results of this calculation are shown in Table 2. It shows the indices for the comparison of the landscape type as well as the similarity of the communities belonging to each landscape type. The latter was done to investigate whether the list of plants collected in a landscape type was more similar than between the landscape types as would be expected.

The calculation of the Jaccard index for the two landscape types resulted in a similarity of 0.32. The comparison of the grassland communities Kuchak and Geghadzor gave a Jaccard index of 0.26 and for the comparison of Kalavan and Dprabak as the two forest communities the result was a Jaccard index of 0.26 as well. Therefore, in this case the similarity of plants collected in between the communities within a landscape type was lower than between the landscape types themselves.

Table 2: Results of the calculation of the Jaccard and Sørensen similarity indices. Displayed are the comparison of the landscape types and of the communities within each landscape type.

	Jaccard index	**Sørensen index**
Landscape type (Grassland and forest)	0.32	0.24
Grassland communities (Geghadzor and Kuchak)	0.26	0.20
Forest communities (Kalavan and Dprabak)	0.26	0.21

A similar result was produced by calculating the Sørensen similarity index: Here, the similarity in between the landscape types was 0.24. However, between the two grassland communities Kuchak and Geghadzor the similarity was lower with 0.20. Also for the two forest communities Kalavan and Dprabak similarity was lower than in between the landscape types with a Sørensen similarity index of 0.21.

5.2.3. Generalized linear models for plant collection

To take a closer look at the differences between the landscape types, a GLM was created for each plant that was collected at least ten times (see 4.6. Data analysis). These were nine plants including rose hip with n = 20 entries, followed by curled sorrel (*Rumex*

crispus L.), turnip-rooted chervil (*Chaerophyllum bulbosum* L.), and ross mint (*Mentha longifolia* (L.) L.) with n = 19 entries for each plant. Next on the list was thyme (*Thymus kotschyanus* Boiss. & Hohen.) with n = 16, stinging nettle (*Urtica dioica* L.) with n = 15, wild pear (*Pyrus caucasica* Fed.) with n = 14, and then oregano (*Origanum vulgare* L.), and chamomile (*Matricaria* sp.) with each n = 10 number of respondents that mentioned these plants. The results of the statistical analysis are listed in Annex 4: Results of the Generalized linear model for plant collection. When looking at the model results, significant p-values for the main factor landscape type were found when analyzing each thyme and wild pear ($p = 0.00$). Both these plants were collected more often in the forest areas than in the grassland areas. Additionally, for wild pear a significant influence of the covariate community ($p = 0.00$) was also found. No respondent in the grassland community Geghadzor collected wild pear and in Kuchak five out of six respondents did. For the forest communities, all respondents in Kalavan and one out of four respondents in Dprabak harvested wild pear.

When further looking at community as a covariate, this variable also had a significant influence for rosehip, chamomile, oregano, turnip-rooted chervil, and curled sorrel ($p < 0.05$). For the first three plants mentioned here, community was the only significant variable. For rosehip, all respondents in Kuchak and Kalavan collect rosehip, but only two out of four respondents in Dprabak and three out of five respondents in Geghadzor harvest it. Chamomile is collected by all respondents in Dprabak, two out of eight in Kalavan, three out of five in Geghadzor, and one out of six in Kuchak. For oregano, the numbers are one out of six in Kuchak as well, two out of five in Geghadzor, three out of eight in Kalavan, and all respondents in Dprabak. For turnip-rooted chervil and curled sorrel, harvest experience and occupation were significant covariates besides community. They had the same numbers of collection with all respondents in Kuchak, Kalavan, and Geghadzor collecting these two plants while the women in Dprabak collect neither turnip-rooted chervil nor curled sorrel. In all these cases, the main factor landscape type was not significant as well. Ross mint showed a significant influence of the covariate occupation. How occupation of respondents has a significant influence on the harvest of ross mint will be discussed later (see 6.2.3. Influence of landscape types and community-specific variables). Four people in each Kuchak, Geghadzor, and Dprabak as well as seven people in Kalavan collect the plant. Also here, the influence of landscape type was not significant.

5.2.4. Purpose of plants

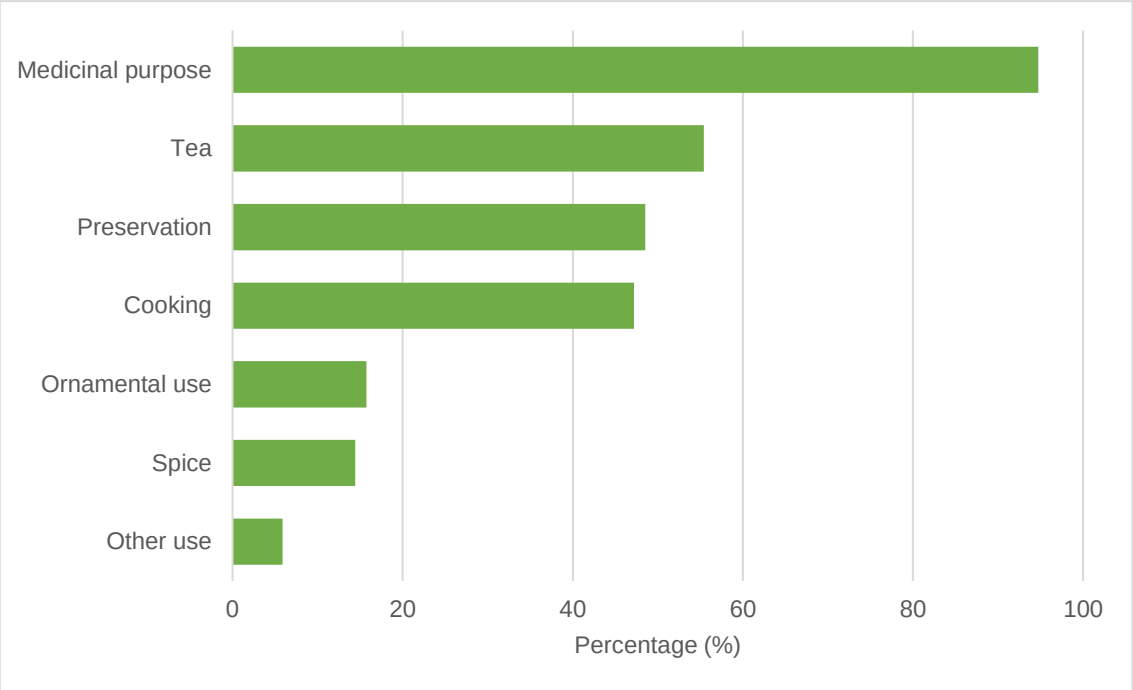

Figure 4: Purpose for which people collect plants. Here, all 305 plants that people mentioned are listed and one plant can have multiple purposes. Categories mentioned were Medicinal purpose, Tea (and other beverages), Preservation (making jams, pickling etc.), Cooking (or eating, i.e. major ingredient in a dish), Ornamental use, Spice, Other uses. The results are displayed as percent of the total number of plants.

Figure 4 shows the purpose for which people harvest plants. One plant could have multiple purposes and thus appear in more than one category. In total, 305 plants were included in this graph. Out of these, people use 26 plants for just one purpose, 85 plants were listed to be used for two purposes, 126 for three purposes, 57 for four purposes and eight plants finally have five different purposes.

The most commonly mentioned category was medicinal purpose with 94.75 % (289 plants). This category does not only include plants that are consumed for the purpose of e.g. healing an illness, but in a lot of cases respondents would mention that a certain health benefit is associated with a plant and thus they consume it. In many cases respondents would give additional information about these health benefits voluntarily (see Annex 3: Additional information about the use of plants).

The second largest category was tea (and other beverages like vodka, wine, juices etc.) with a total of 55.41 % (169 plants). It is not surprising that this category is relatively big since most of the plants that were mentioned a lot of times are usually consumed as tea, for example thyme, ross mint, stinging nettle. and St. John's wort (*Hypericum perforatum* L.). Other plants like rosehip, wild pear et cetera were mentioned in terms of making juice or distilling especially the wild pear to vodka.

The third largest category in terms of use was preservation with 48.52 % (148 plants). This included making jams and pickling. Therefore, mostly fruits from plants like rosehip, wild pear, black currant (*Ribes nigrum* L.), walnut (*Juglans regia* L.), but also herbs like turnip-rooted chervil, stinging nettle. et cetera were mentioned to be pickled. This category excluded drying as a mode of preservation. Most of the listed herbs were dried and it was not reasonable to include it in this category to distinct the other modes of preservation from drying.

The category cooking was used to describe plants that were used as a major ingredient in a dish or that was just eaten by itself. 47.21 % of the plants were listed in this category (144 plants). Typically, turnip-rooted chervil and the curled sorrel got mentioned here. Both are well-known plants in Armenia, the local name for turnip-rooted chervil is Shushan, for curled sorrel it was Aveluk and both were used in a lot of traditional dishes throughout the country.

The next smallest category ornamental plants included 15.74 % of all plants (48 plants); it was followed by spice with 14.43 % (44 plants). The smallest category was other uses with 5.9 % (18 plants). When listing this option, respondents were asked to specify what kind of other use there was for this plant (also see Annex 3: Additional information about the use of plants). In most of the cases it was a type of cosmetic, for example the women in the Mothers of Dprabak cooperative made soaps out of stinging nettles. Other plants that were used for a cosmetic purpose were St. John's wort, sickle weed (*Falcaria vulgaris* Bernh.), ross mint, burdock (*Arctium palladinii* Grossh.), dandelion (*Taraxacum campylodes* G.E.Haglund.), oregano, felty germander (*Teucrium polium* L.), and three-lobe beggartick (*Bidens tripartite* L.). Furthermore, ross mint. was used in one instance in Geghadzor as an aromatic plant inside a respondents' home and *Artemisia absinthium* L. in Kalavan was mentioned to be used for broom making. Further, oregano and yarrow (*Achillea millefolium* L.) were veterinary remedies that people use on their cattle and ross mint and primrose (*Primula veris* subsp. *Macrocalyx* (Bunge) Lüdi) had a symbolic purpose by representing the Greek goddess Aphrodite and the Ascension Day.

5.2.5. Parts used

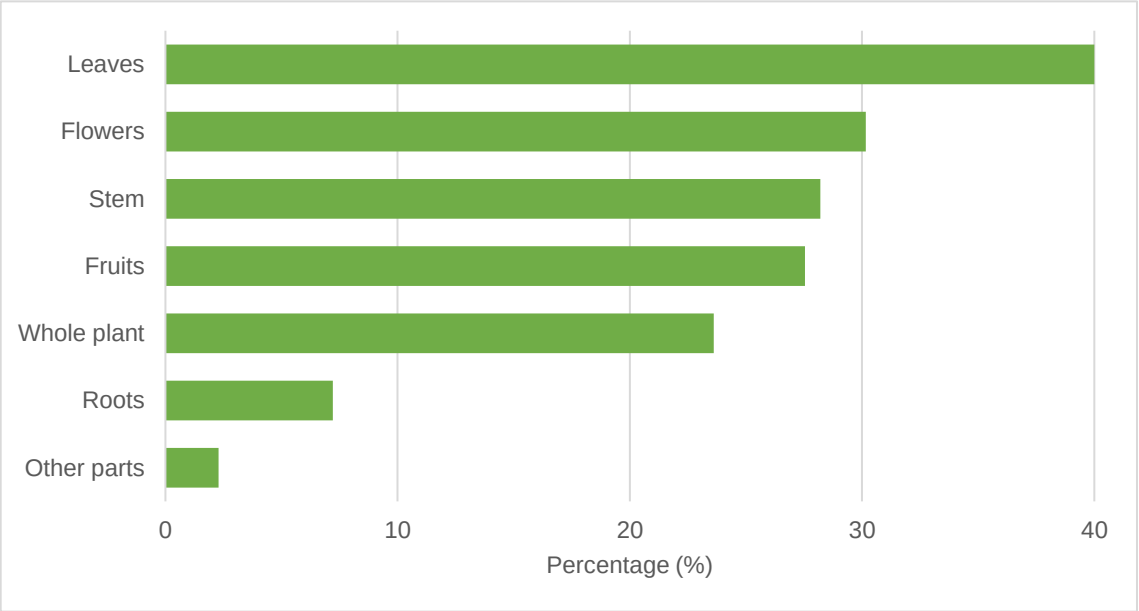

Figure 5: Parts of plants that people use. Included in this graph were all the plants that respondents mentioned, multiple parts of a plant can be used. Categories mentioned were Leaves (122 entries), Flowers (92 entries), Stem (86 entries), Fruits (84 entries), Whole plant (72 entries) (i.e. all aboveground parts except for the roots), Roots (22 entries), Other parts (7 entries). Results are displayed as percentage of the total number of plants

Figure 5 illustrates which parts of plants the people use. Multiple parts of a plant could be listed, and the plant could be included more than once in this graph. A total of 305 plants were listed. Out of this, people specified for 175 plants that they use only one part, for 82 plants it was two plant parts, for 46 it was three plants parts and for two plants four different parts were used.

The plant part that was utilized the most were leaves which were mentioned in 40 % of cases (122 entries). The second largest category of plant parts were flowers with 30.16 % (92 entries) followed by stem with 28.2 % (86 entries) and fruits with 27.54 % (84 entries). The category whole plant was originally intended to capture if people harvest a whole plant to avoid them having to list all the single parts. However, it became obvious already during the first interview session that people usually did not harvest the roots and thus the meaning of this category was shifted to ‘all above-ground parts excluding the roots’. If people still harvested the roots of this plant, they were asked to specify that, and the root was recorded separately. In 23.61 % of the cases (72 times) the category whole plant was selected. Roots were harvested in 7.21 % of instances (22 entries). The smallest category was other parts which was mentioned in 2.3 % of cases (seven times). When listing other parts, the respondents were asked to specify the plant part. In most cases this concerned the seeds of certain plants, for example stinging nettle and in one instance it was the sap of dandelion.

5.3. Harvesting techniques and changes

The second objective was to ascertain harvesting techniques people use and investigate if these and other customs related to wild harvest are sustainable, or if they are detrimental to plant abundance. The corresponding questions (see Annex 1: Questionnaire about wild harvest in rural Armenia) were aiming to ask people how they harvest specific plant parts and whether or not they have perceived certain changes in their local areas over the course of the past five years.

5.3.1. Harvesting techniques

Figure 6 shows the answers respondents gave about the harvesting techniques they used, illustrated as pie charts. The segments show the number of respondents that gave a certain answer. Figure 6a presents how respondents harvested leaves: Here, 11 out of 23 respondents plucked only individual leaves of a branch, seven cut off branches to harvest the leaves later, and one person stripped all the leaves of a branch while four people specified that they did not harvest leaves from trees. For harvesting fruits (Figure 6b), 13 respondents collected only a few high-quality fruits in an area, nine people collected all the fruits they can find, and one person collected all the high-quality fruits in an area. High-quality in this case is an arbitrary term and it was left open for people to define it for themselves. The general aim of this question was to see if people select specific fruits when collecting them or if they do not pay attention to the quality and harvest all they can find. Figure 6c shows the harvesting routine for roots. However, harvesting roots was not a common practice and only nine respondents answered that question. Out of these, four people took only parts of the root and five people dug up the whole root. For harvesting herbs, 13 people harvested as many herbs as they can find in an area, nine harvested only a few, and one person only took parts of plants as can be seen in Figure 6d. For collecting ornamental plants and flowers (Figure 6e), five respondents indicated that they did not harvest plants at all for this purpose, 12 people took only a few ornamental plants from an area at a time, four took all of the plants from an area, and two respondents collected only parts of plants as ornamentals. Figure 6f shows the results of a general question that intended to reveal people's habits in terms of the location where they harvest. Six people did not answer that question and specified that they normally harvest a specific plant only once and thus this question was not applicable to them. Seven people always changed the area in which they harvest a plant even if there might still be a sufficient amount in the area where they harvested the plant previously in the same season. Another five people only changed the location if the

amount left of the plant was not sufficient anymore in the previous area and five people went to the same area each time in one season.

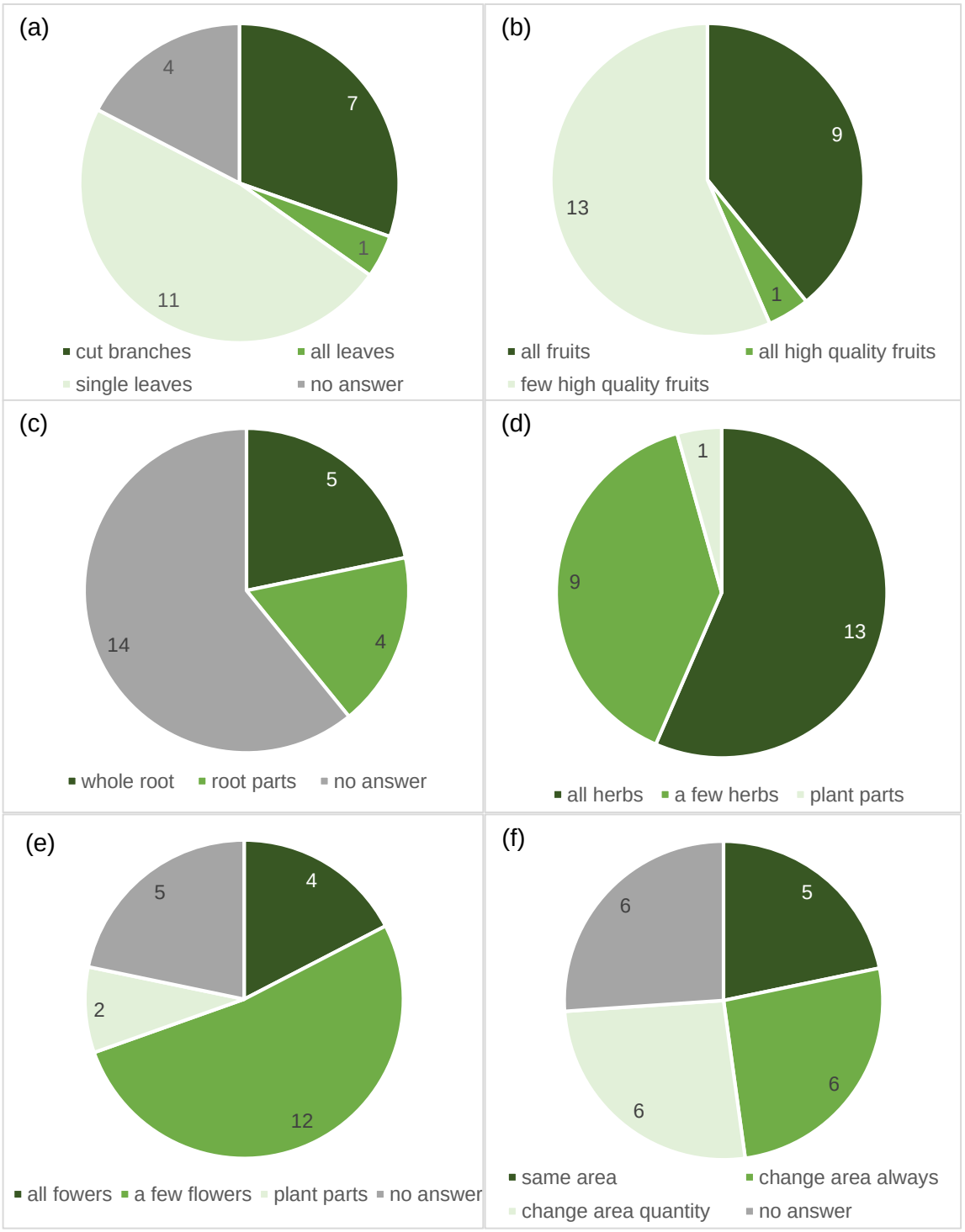

Figure 6: Percentage of harvesting techniques people employ for different plant parts: (a) leaves, (b) fruits, (c) roots, (d) herbs, (e) flowers (ornamental plants), (f) location of harvest.

This section was concluded by asking people if they are familiar with the concept of sustainability. Here, three respondents said no while 20 said yes. For that question a brief definition of sustainability was given as 'harvesting plants in a way that they are still available in the future'. A few respondents mentioned that they had never heard the specific term before, but they were familiar with the concept and would mention that this was how they harvest anyway since their families taught them how to harvest accordingly.

5.3.2. Changes in plant availability

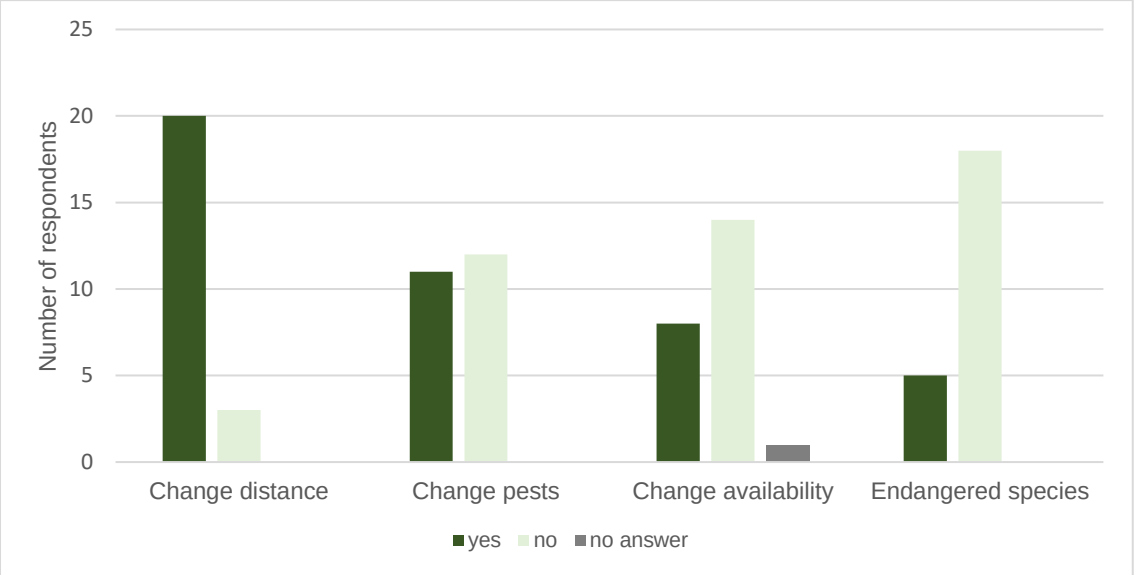

Figure 7: Number of respondents that have perceived certain changes in the past 5 years. The meaning of the categories is explained in more detail in the text below. The total number of respondents is 23.

Figure 7 shows the perception of certain changes over the course of the past five years. Whenever a respondent perceived a change, she was asked to specify what kind of change that was and which species this affected. For the change distance section of the diagram, people answered whether they needed to travel further to collect certain plants in comparison to five years ago. Here, 20 people noticed a change while three people did not. Specifically, two respondents in Kuchak mentioned for each oregano and turnip-rooted chervil that they had to travel further to collect these plants. Another respondent in Kuchak mentioned that the availability of turnip-rooted chervil and curled sorrel depended on seasonality. She clarified that the change she perceives had nothing to do with outside influences. In Kalavan, one respondent listed raspberry (*Rubus idaeus* L). as a plant whose availability had changed. Another two respondents in Kalavan said that they would start to collect wild plants in the near future to sell them and thus they would have to travel further. However, they did not perceive any change. In Geghadzor, three

people perceived changes: Two mentioned that ross mint was affected. Other plants that were mentioned in Geghadzor were chamomile, St. John's wort and the strawflower (*Helichrysum plicatum* DC.). Some of these plants used to be available on the fields in between the village and the main road in the Northern part of the map (see 5.3.3. Spatial component), but nowadays they could only be found on the slopes of Aragats mountain according to these respondents. In Dprabak, two respondents mentioned that they had to travel further to collect ross mint, Tatarian cephalaria, and thyme. However, all of the interviewed women in Dprabak were part of the Mothers of Dprabak cooperative which was only established four years prior to the survey. Most of these women did not collect wild plants before that time and thus the changes they perceive might not be applicable to this set of questions.

The question related to the change pest section of the diagram asked if plants are affected by pests and/or were in worse conditions in comparison to five years ago. Here, 11 people specified that they perceived such changes while 12 did not. Plants mentioned in that case were rosehip in Kuchak, curled sorrel in Kalavan and Geghadzor, raspberry in Kalavan, Tatarian cephalaria in Geghadzor and Dprabak, stinging nettle in Geghadzor, and chamomile in Dprabak. Another respondent in Kuchak could not give a specific plant name but vaguely mentioned that there was some sort of decline.

In the next part (change availability), eight people specified that there were certain plants that could not be found locally anymore that were available five years ago. Another 14 people said this was not the case and one respondent did not answer that question because she did not know. A woman in Kuchak said that strawberry (*Fragaria vesca* L.) was not available locally anymore. In Kalavan change in availability was mentioned for sickle weed by one person. In Geghadzor St. John's wort and felty germander were listed. Here, the respective respondents further specified that there were people coming from outside of the community that did not know how to harvest a certain species and thus damaged the plant population. One respondent explained more detailed that people from other countries (e.g. Georgia) overharvested felty germander for its medicinal properties since it is supposedly good for the health of the female reproductive system and that it helps to prevent hormonal imbalances. Since felty germander is or at least used to be abundant in Geghadzor, non-regulated harvest took place a lot. As a consequence, the population of this plant was declining based on the perception of this respondent.

The last question in that section concerned endangered species. Here, 18 people said that there were no endangered plants growing in their local areas that were prohibited to collect while five people said that was the case. These five people emphasized that they did not harvest these species. However, none of them was able to name a specific plant.

To complement these answers, an open, more general question on bad practices that negatively affect next year's harvest was asked. Here, 13 respondents mentioned bad weather (three specifying hail, two drought) as detrimental to wild harvest though this was not a practice. Another seven people stated that taking out the roots of plants was a problem and some specified that this is why they did not harvest the roots of plants at all. One woman mentioned biennial bearing of trees to have had a negative effect on yield. Another one said that harvesting too many plants was bad for next year's harvest. One more response was that harvesting too much of a plant dries out the roots.

To get further insights on the harvesting situation, people were asked to list problems they faced when harvesting. Here, 14 people gave answers that were related to travelling to the collection sites. All of them mentioned that the roads were bad, another six people further specified that not having a car was an issue and that they had to walk which limited their ability to harvest. Also, one respondent emphasized that her age as a problem and that she could not go as far as she used to. Further, two people mentioned that personal time constraints were an issue regarding wild harvest. Another respondent said that rosehip was difficult to harvest because of the plant's physiological properties. One respondent from Kuchak talked about people from Yerevan that came to the village to harvest were a problem. In her perspective, these people did not know how to harvest which damaged the plants. Also they harvested on some people's properties without permission. She emphasized that people in Kuchak did not do that and that they respect their boundaries.

5.3.3. Spatial component

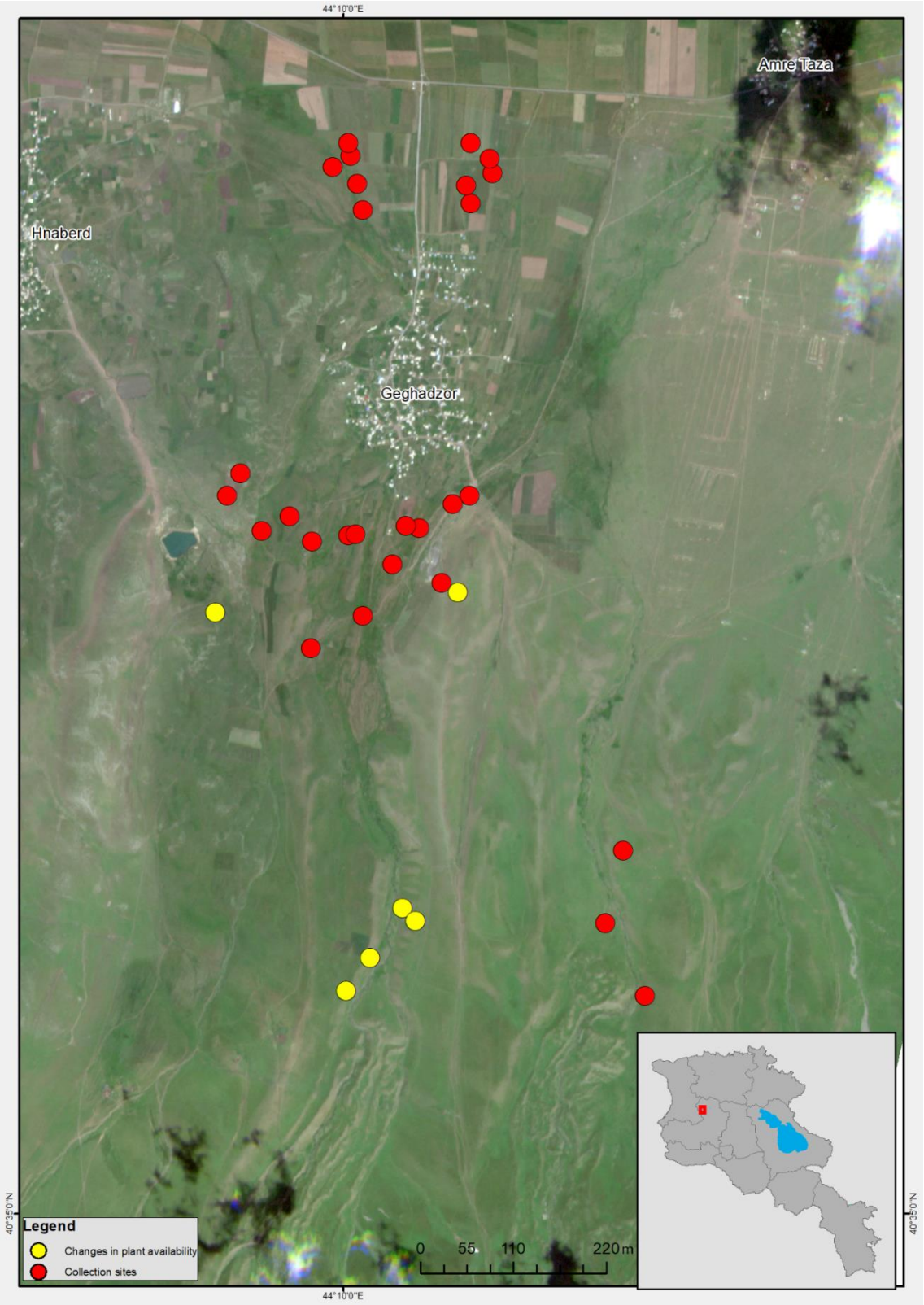

Figure 8: Map of wild harvest in Geghadzor. Yellow dots show areas where respondents perceived changes in plant available, red are the general collection areas. A respondent could place as many points as she wanted. Map created by Aghavni Harutyunyan.

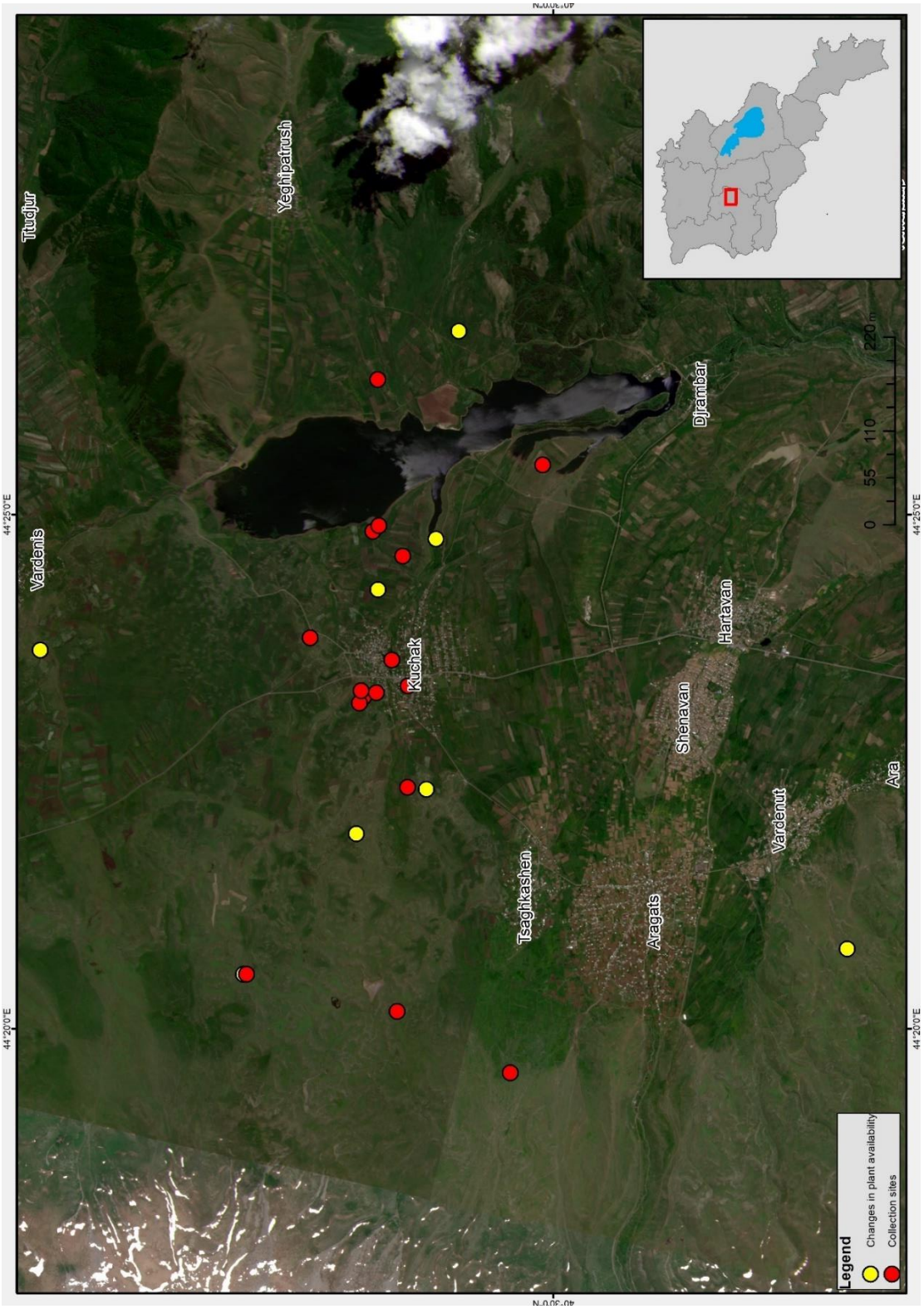

Figure 9: Map of wild harvest in Kuchak. Yellow dots show areas where respondents perceived changes in plant available, red are the general collection areas. A respondent could place as many points as she wanted. Map created by Aghavni Harutyunyan.

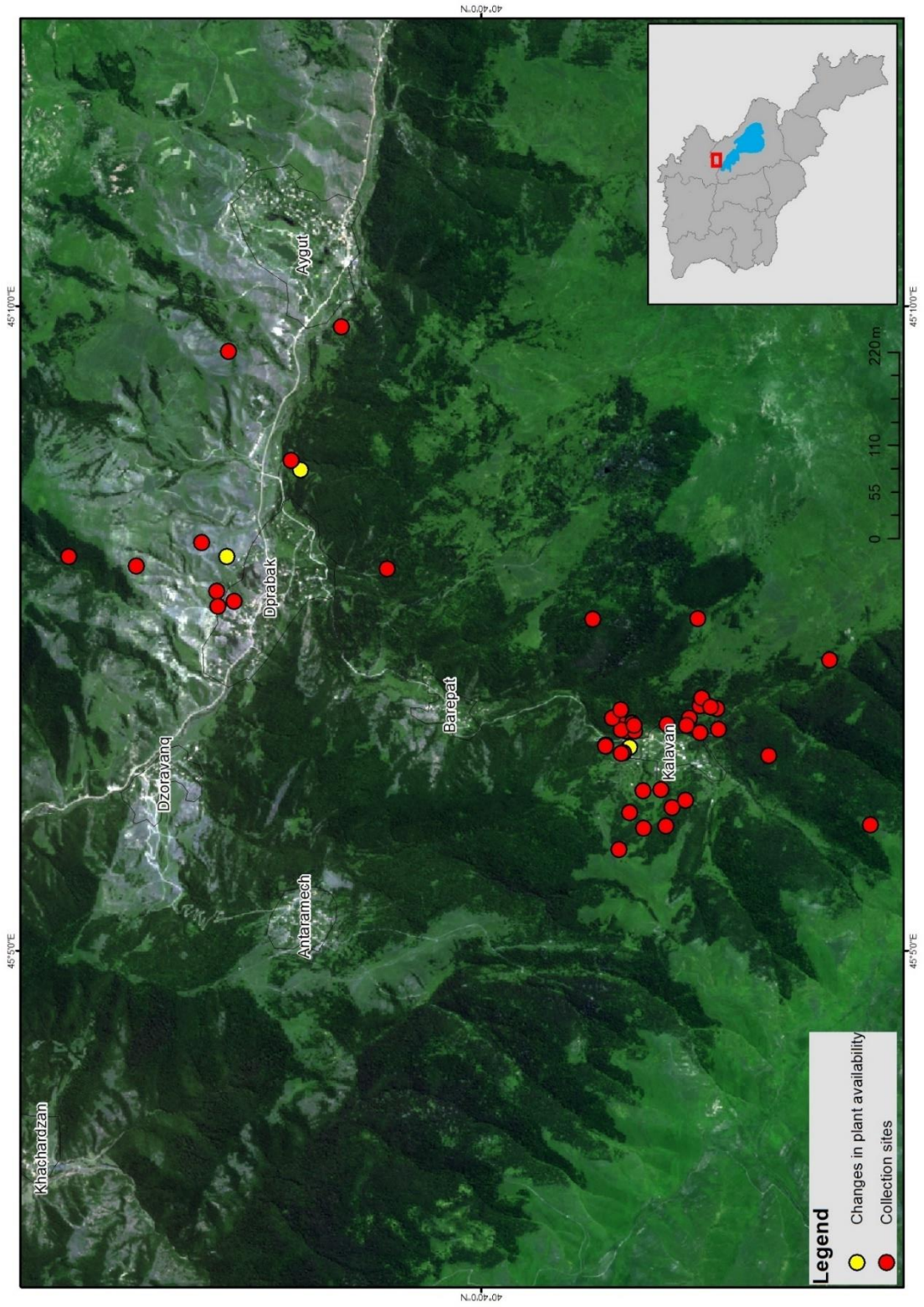

Figure 10: Map of wild harvest in Kalavan and Dprabak. Yellow dots show areas where respondents perceived changes in plant available, red are the general collection areas. A respondent could place as many points as she wanted. Map created by Aghavni Harutyunyan.

5.4. Socioeconomic relevance of wild harvest

The last research objective tried to link a socioeconomic side to the topic of wild harvest. For this, multiple questions were asked throughout the survey in different sections of the questionnaire. This also allowed to get an insight into the socioeconomic side of wild harvest. Further, this allowed to draw conclusions on wild harvest not only as a provisioning, but also a cultural ESS in rural Armenia.

5.4.1. Community aspect

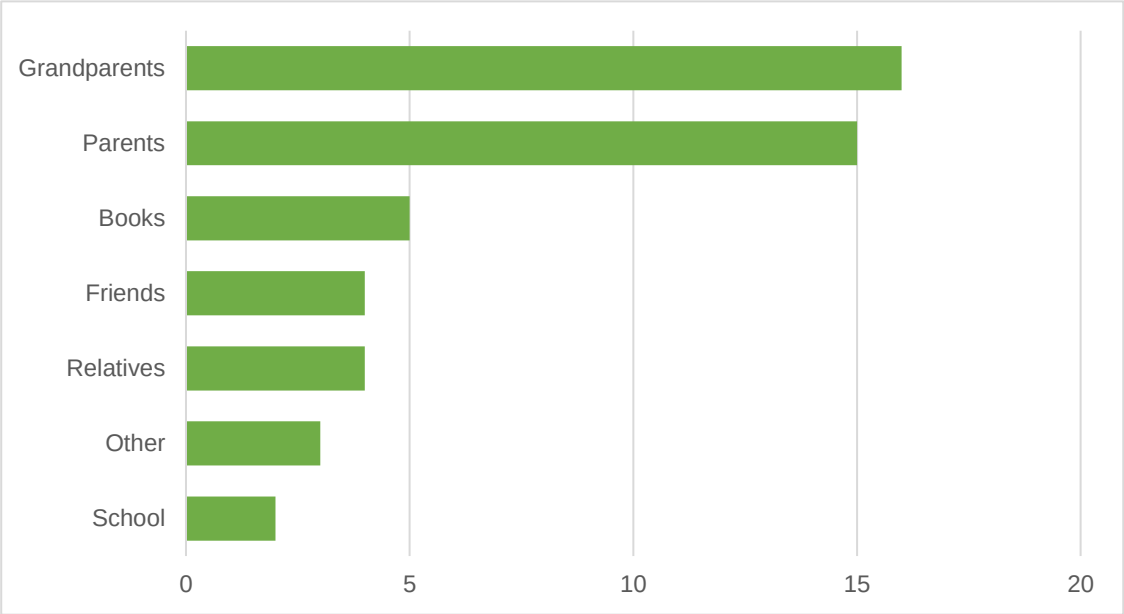

Figure 11: Sources of knowledge for wild harvest. One respondent could specify multiple sources. The results are displayed in absolute numbers.

Figure 11 shows different sources of knowledge of wild harvest for the respondents. When answering the question related to this, they were presented with the displayed categories and could select all that were applicable. For example, two respondents in Kuchak identified everything besides other as sources of knowledge for themselves. The category mentioned most frequently was grandparents: A total of 16 people confirmed this as a source of knowledge, followed by 15 respondents learning from their parents. Another four women learned wild harvesting from each either relatives or friends, a further five respondents specified books as a source of knowledge. The two respondents from Kuchak mentioned in the beginning of this paragraph were the only ones to list that they learned about wild harvest in school. Another three respondents named other as a category and it turned out that all of them meant trainings about wild harvest. Out of these, two respondents were from Dprabak. Both these women were the leaders and founders of the Mothers of Dprabak cooperative. They learned wild harvest from a

workshop conducted under the ENPARD[10] Project which was also the starting point for the cooperative. What is also interesting to note here is that all women except for the two founders of the Mothers of Dprabak learned how to harvest wild plants from family members (20 out of 23 from grandparents and/or parents, one from another relative).

Further, respondents were asked if they were accompanied for wild harvest or if they go alone. Here, all but one respondent in Geghadzor answered that they were accompanied. Most frequently people said that they go for wild harvest with family members. This concerned nine respondents. Further, people often mention that they take children which was true eight times. Seven times people said they go with friends and six times that they go with neighbors or generally community members. These categories were generated after the survey based on what people said since that part of the question was left open. These categories are probably interchangeable since a neighbor can also be a friend and children are also part of the family. The overall idea was to get a sense of the social aspect of wild harvest as an activity and it was often highlighted that the social component here is important for the respondents.

5.4.2. Purpose of harvesting

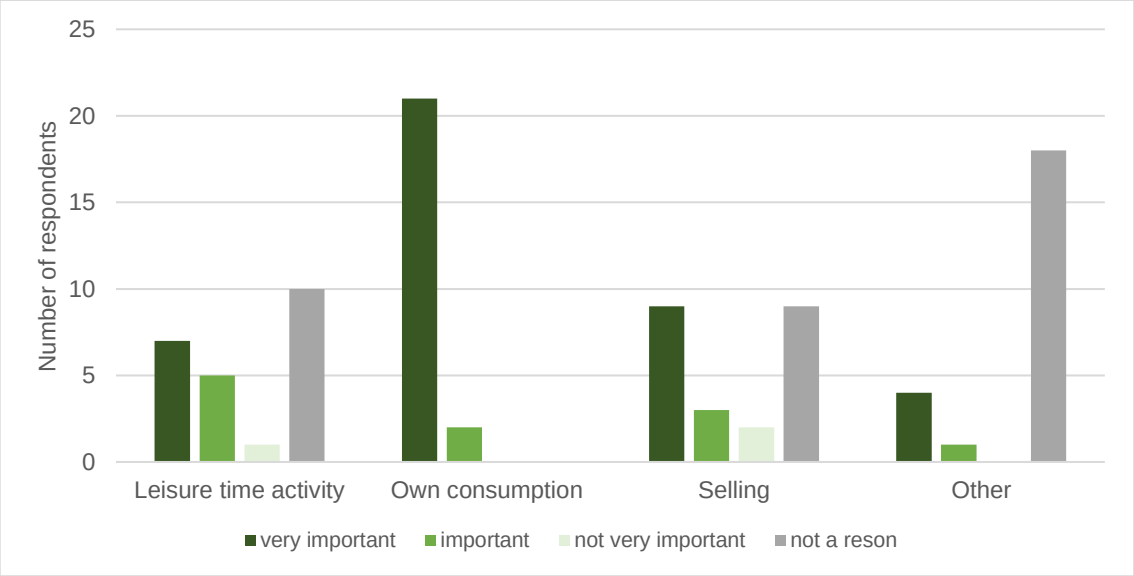

Figure 12: Reasons people harvest plants for. Respondents were asked to rank the importance of each reason according to given categories of importance.

[10] Producer Group and Value Chain Development https://www.am.undp.org/content/armenia/en/home/operations/projects/poverty_reduction/enpard-technical-assistance--producer-group-and-value-chain-deve.html. Accessed on 14th May 2020.

During the survey the respondents were also asked to rate different purposes for harvesting wild plants in the categories very important, important, not very important, I do not harvest for this reason. The purposes asked about were leisure time activity, own consumption, selling, and other as illustrated in Figure 12. When asked about wild harvest as a leisure time activity, ten respondents answered that they did not harvest plants for this reason, one person said it was not important for her, five people said it was important and seven people said it was very important. Often when people rated leisure time activity as an important or a very important reason for wild harvest, they would casually add that this was not the major purpose for them to go harvesting, but that it was a nice side-effect and that they enjoyed wild harvest in general. When asked about own consumption, two of the respondents rated this aspect as important and 21 as very important. Since no other categories were used, all of the respondents utilized the plants that they harvest for themselves and this aspect was at least important for them. In terms of selling, nine respondents did not harvest for this reason and two said it was not an important facet of wild harvest for them. Further, three people listed selling as an important reason and another nine women mentioned that it is a very important reason for them. When asked about other reasons, 18 respondents said that there are no other reasons for them to harvest plants from the wild, while four specified other reasons as very important and one as important. When mentioning this, the collectors were asked to elaborate on these other reasons. Two respondents in Dprabak and one in Geghadzor said that they took tourists out for wild harvest and another collector in Dprabak says that she made gifts for relatives from the harvested plants.

5.4.3. Most important plants

The most frequently mentioned plant in the survey as most important for own consumption was turnip-rooted chervil which was listed by nine respondents for own consumption with average quantities harvested being 17.78 kg (SD = 6.61 kg). The harvesting season for this plant lasted from May to July. The second most important plant for own consumption was curled sorrel which was specified by eight women. Mean harvest was 13.24 kg (SD = 6 kg) for curled sorrel with the harvesting season lasting from April to July. Next on the list was rosehip, which was named seven times, the average quantity for this plant was 33.75 kg (SD = 19.24 kg) for own consumption. Rosehip was harvested from September to November. Further, wild pear was important for people's own consumption and four women mentioned it. The average amount collected here was 350 kg (SD = 165.83 kg) and it was harvested in September and October. Next on the list were thyme and the cherry plum (*Prunus cerasifera* Erh.) that

were listed three times each. Thyme was harvested from May to October with an average of 4.33 kg (SD = 0.94 kg). The harvest season for cherry plum was in September and October and an average of 40 kg was collected (SD = 42.43 kg). Further, sickle weed, ross mint and blackthorn (*Prunus spinosa* L.) were the most important plants for own consumption each for two women. Sickle weed was harvested in May and June with an average of 8 kg (SD = 2 kg), ross mint was harvested from May to October with a mean amount of 1 kg (SD = 0 kg), and blackthorn was collected from September to November with average amounts reaching 26.25 kg (SD = 3.75 kg). Plants listed only once were coriander (*Coriandrum sativum* L., June to October, 1 kg), St. John's wort (July to August, 0.7 kg,) chamomile (September and October, 2.5 kg), peppermint (*Mentha* x *piperita* L., May to November, 10 kg), medlar (*Mespilus germanica* L., October, 30 kg), raspberry (July and August, 15 kg), summer savory (*Satureja hortensis* L., July, 5 kg), houseleek (*Sempervivum transcaucasicum* Muirhead., April and May, 30 kg), stinging nettle (April and May, 4 kg), and valerian (*Valeriana officinalis* L., July and August, 0.15 kg).

There were fewer plants listed as most important for selling than most important for own consumption since only around half of the respondents collected plants for selling. The plant with the most entries here was thyme that was mentioned five times, namely by all the women in Dprabak and one respondent in Kalavan. The harvesting season for thyme was already mentioned above and an average quantity of 195.6 kg (SD = 286.93 kg) was harvested for selling. Next on the list were ross mint and curled sorrel. Ross mint had an average amount of collection for selling of 259 kg (SD = 427.85 kg) and for curled sorrel this number was 118.88 kg (SD = 105.32 kg). Further, turnip-rooted chervil, wild pear and linden (*Tilia cordata* Mill.) were listed three times each. Here, quantities for turnip-rooted chervil reached an average of 1767 kg (SD = 917.73 kg), for wild pear it was 2883.83 kg (SD = 1777.8 kg) and for linden harvest quantity was 670 kg on average (SD = 466.69 kg). The harvesting season for linden was June to July. Linden was the most characteristic product of the Mothers of Dprabak cooperative which one of the women mentioned in the interviews. Two women of the Mothers of Dprabak further listed oregano as most important for selling with an average quantity of 510 kg between the two of them (SD = 490 kg). The harvest season for oregano was June to August. Only once mentioned as most important for selling were rosehip (40 kg) and felty germander (10 kg). Felty germander was harvested in July and August.

5.4.4. Time and resource investment

One more facet within the last objective was to record differences in resource investment of people that collected wild plants also for selling in comparison to people that only used wild plants for their own consumption. Here, the intention was to get a general idea about whether the people had a sense for value-added goods or not. A full socioeconomic analysis would have gone beyond the scope of this project. As described before (see section 4.6. Data analysis), only the time invested in collecting was included in the analysis: The ANOVA resulted in a significant p-value of 0.001 when comparing time invested of people that collected for selling with people that did only collect for their own consumption. People that harvested plants for selling spent an average of 24.45 h per week on that activity (SD = 15.01) while people that do not sell the plants spent on average 6.42 h per week harvesting (SD = 6.22).

For comparing the material resources an open question was asked so the women could provide a list of materials that they use for harvesting. The idea was to have people list all the resources they use freely. If they struggled to do so, a few examples (fuels, harvesting tools, storage containers, drying apparatus) were given to stimulate their answers. However, in the end most people selected materials from that list. Six respondents specified that they use fuel for their cars to reach the collection sites, seven listed drying apparatuses (one of these were ropes to dry curled sorrel), seven people listed harvesting tools and in total 21 listed containers and bags. However, in this case it was sometimes unclear whether that referred to containers for harvesting or storage. Further, two respondents listed additives that they use for preservation (sugar, salt, acetic acid) and another collector said that she uses her gas stove at home to process the plants.

5.4.5. Sale of wild plants

Out of the 23 respondents, 12 specified that they also collect wild plants for selling. If this was the case, the women were asked to give an estimate about the percentage of income they generated from selling the harvested plants (Figure 13). Responses ranged from 2 to 100 %, with an average answer of 42.46 % (SD = 42.63 %). In one case, a respondent refused to give that information.

Further, the women were asked whom they sell the wild plants to and were given the options of an intermediary or middle-man, a processor like a restaurant or directly to consumers. It was also possible for them to select multiple categories. Here, half of the respondents said that they sold directly to consumers which in some cases were

neighbors and community members. Five respondents sold their collected wild plants to an intermediary. One specified that this was a juice company to which she sold wild pear. Further, two women mentioned that they sold to a processor. These were the two women in charge of the Mothers of Dprabak cooperative. However, two other members of the cooperative gave the answer of an intermediary. It became clear at some point that all the collected plants of the Mothers of Dprabak cooperative are sold to the Antaram cooperative[11].

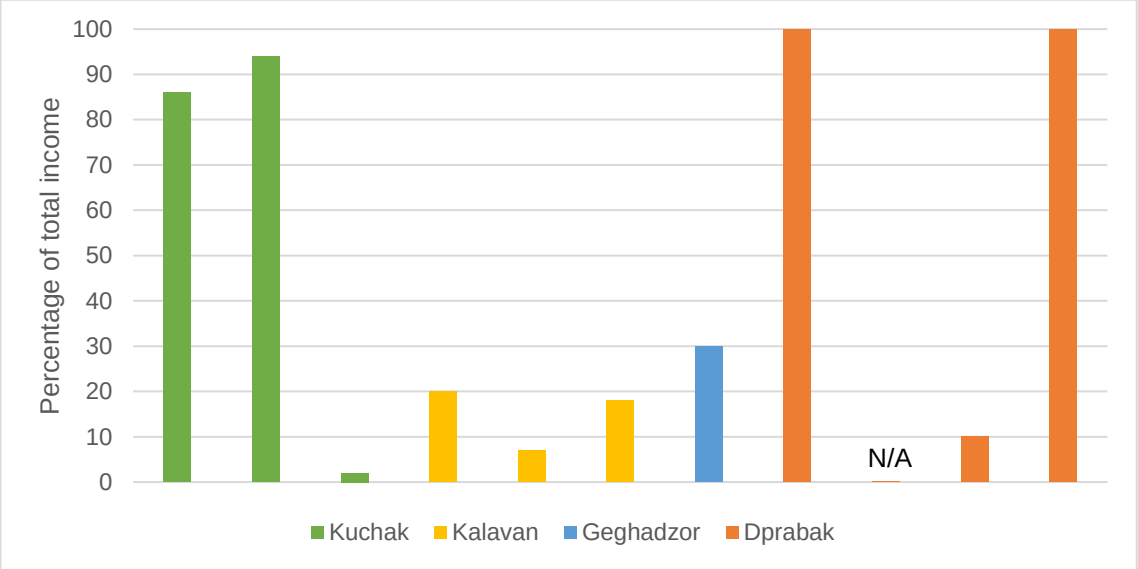

Figure 13: Percentage of total income generated from wild harvest of individual respondents in each community. 11 people specified that they collected wild plants for selling.

Problems in selling products did not occur to most respondent. A woman in Kalavan said that sometimes the intermediary she sold to complained about the low quality of wild pear, but she did not care about that. The Mothers of Dprabak brought up the issue of the low prices they received from their intermediary as opposed to how much they would earn if they knew themselves how to market their wild herbs.

Out of the 12 respondents, eight processed the plants before they sold them. One respondent from Kalavan did not specify the processing mechanism but it came up during the interview that she prepared food with the wild plants for visitors in a guesthouse she operated with her husband. The other seven respondents all mentioned drying as a processing mechanism and two respondents also added cleaning to the list. Problems in processing were mentioned by five respondents which comprised bad weather to be problematic for drying.

[11] Antaram is a production cooperative that was established in 1989. They employ a wide range of Armenian families in rural area for wild harvest to produce herbal teas. Antaram is certified according to EU Organic for processing and export (Organic Armenia).

Discussion

6.1. Survey design

6.1.1. Terminology and categorizations

In terms of the conceptual structure of the survey, there were issues regarding terminology that mostly became apparent when the data collection was completed. As highlighted earlier in this thesis (see 2.2. Wild harvest), several authors argue about the clear definition of 'wild' and the distinction between semi-cultivated and cultivated (Stryamets et al. 2015, Menendez-Baceta et al. 2012, Bharucha and Pretty 2010, Tabuti 2007, Censkowsky et al. 2006). In the present study, 'wild plant' refers to plants harvested from the wild, i.e. uncultivated lands. However, sometimes there were some borderline cases when respondents would point out a plant and mention that they cultivate or collect it on their own property. If this was the case, plants that were cultivated were excluded. For plants collected on people's properties, individual decisions on whether to include them or not were made to follow the conceptual framework in the best way possible. For example, a respondent in Kuchak mentioned that she harvested stinging nettle only on her property. In this case the plant was recorded since stinging nettle is a species that typically also grows in the wild and just happened to be available on that person's property. This obstacle in the survey highlights that the lines between wild harvest and non-wild harvest or cultivation are blurry and that it is difficult to single out this activity with a clear definition.

Other terminological issues referred to some categorizations that were undertaken in the study: For example, it was difficult for some respondents to distinguish between the use categories cooking and spice. Often the women listed a plant in the cooking category and later realized that there was a separate category for spice. In this case it probably would have been better to change the order of options in the questionnaire and put spice before cooking to avoid confusion. Moreover, providing the option whole plant as an alternative category for listing all the plant parts separately proved to be difficult and the category was later on changed to the meaning of 'all above-ground parts besides the roots'. To improve the study design, the category whole plant should be excluded. Further, broad categories as the distinction of grassland and forest communities were a potential source of overlap. For example, Dprabak also borders a grassland area and furthermore, people could travel to another area and collect wild plants in a different landscape type. Also, the geographic proximity of Dprabak and Kalavan as opposed to

Kuchak and Geghadzor could be an issue (Pritchard et al. 2019) since the collection areas of the forest communities potentially overlap.

Additionally, every person that collected wild plants for selling was at the same time a person that collected wild plants for personal use. Separating own consumption and selling in terms of for example quantity harvested proofed to be difficult and the data was adjusted in the best way possible later on. Still, dividing total quantity harvested into quantity sold and quantity used personally would probably not have been possible since people already struggled to estimate concrete values for the total harvest in the first place. Besides, the quantity harvested was more an approximation than a reliable absolute number. This was not only true for plants harvested in huge quantities, but also for instance for medicinal plants of which usually only small amounts are needed (Kaoma and Shackleton 2015). Another aspect the women struggled with was pinpointing the location of wild harvest and changes in plant availability on the map. Sometimes the respondents could only give vague information like ‘that forest over there’ or ‘on the slopes of Aragats mountain’. However, this kind of difficulties were expected since in another survey (Canedoli et al. 2017) the researchers faced a similar problem. In that study, respondents struggled to point out specific locations in which they perceived benefits in a national park in Northern Italy. Brown et al. (2012) found that pointing out nature’s benefits was difficult for about one third of their respondents. Thus, the spatial component of the present survey was seen more as complementary than essential already before starting the field work. One more question the women struggled with was to give examples of bad practices that affect next year’s harvest in a negative way. Here, most respondents listed natural conditions like bad weather for harvest or physiological properties of the plants rather than an actual practice potentially conducted by themselves. In this case, the wording of the question was probably not explicit, or the meaning got lost in translation from English to Armenian. Overall, having translation as an intermediary link between researcher and respondent might have resulted in the loss of some additional information.

Another issue with respect to the questionnaire was its length: Depending on how many plants women listed, the surveys lasted up to/more than 90 minutes. Thus, when asking about the socio-economic side of wild harvest in the end, the women were most likely less focused than in the beginning. However, most of these questions were purposefully designed as single or multiple-choice questions and only few open questions were asked in that section. One of those was to list materials and resources used for harvesting and processing of wild plants. Here, if necessary, some examples were given. Since this usually was the case, it biased the answers of the women towards that list of examples.

6.1.2. Limitations of the interview-based survey

Besides these explicit flaws in the design of certain questions, the overall methodology had its limits as well. Rasmussen et al. (2016) discussed at length why having interviews as a stand-alone method is problematic. They highlighted that in order to capture the real status of wild harvest activities, other methodological tools need to be applied as well. Further, if using interviews and thus respondents' recall as the only way of recording data, surveys should be conducted repeatedly over the whole vegetation period to fully capture all the information (Gray et al. 2015, Cruz-Garcia and Price 2014). The consequences of that could also be observed in the Armenian study since sometimes respondents would come up with a certain plant later in the interview and suggested adding it to the list. This implies that probably not all plants were captured since a respondent might not have thought about all the plants she harvested during the interview. However, in the present study the survey was capturing ESS more universally with respect to wild harvest while Rasmussen et al. (2016) focused more on detailed mapping of this activity. Still, their criticism on interview methodology provides useful suggestions on how to identify mismatches between status and use of ESS. In the present study, having adequate vegetation data available would have been a valuable addition to compare harvest activities to the current status of ESS availability. Potentially this allows to draw conclusions on how wild harvest is determined by species availability or if wild harvest of a certain plant has more cultural implications (Termote et al. 2011). Additionally, data on the abundance of plants can provide the next step to further analyze this also with respect to sustainability rather than basing conclusions on presence and absence data (Schulp et al. 2014).

For the first research question that aimed to identify which plant species are harvested and to determine their use an ESS, there are some more specific points that could be improved methodologically. For example, it is described as helpful to provide people with information in the form of books and pictures to spark their memories (Menendez-Baceta et al. 2012). However, this approach is only useful if sufficient information on wild harvest in a certain region is available which unfortunately was not the case in the present situation. Another way of complementing data is to accompany respondents to the field for direct identification (Stryamets et al. 2015). This was intended for the Armenian survey, but as mentioned before did not happen due to organizational issues and time constraints. Still, some samples were provided (see Figure 3) and botanical identification for one species was possible later on. Besides, when recording the local names from the respondents, it is beneficial if the facilitator has extensive knowledge of the local flora and could ask specific questions in order to identify the plants directly (Stryamets et al.

2015). In this study it was only possible to consult an expert later on. Still most of the plants were identified. Moreover, to get more specific botanic information the survey could be shortened and tailored to this aspect only. Further, the respondents could be instructed beforehand to prepare for the survey with specific prompts. This also necessitates that respondents are identified before the survey.

Another factor that could have biased the outcome of the survey was the perception of the researchers in the communities. The importance of having people feel comfortable when conducting an interview-based survey is widely recognized in methodological literature (Atteslander and Cromm 2010). The Millennium Ecosystem Assessment (MA 2005) highlighted that in vulnerable communities the trustworthiness towards certain groups like government agencies is often doubted. With respect to the Armenian culture, Manoogian et al. (2007) pointed out that her personal background led to some mistrust in her survey conducted with diaspora Armenians in San Francisco, United States. Some women she interviewed expressed skepticism since she was not fully of Armenian descend and spoke little Armenian. Furthermore, Hovsepyan et al. (2019) pointed out that their research participants in the Tatev region of Armenia would sometimes give false information when interacting with an 'official'. This skepticism probably stems from Armenia's Soviet past in which the government largely exercised control over citizen's lives (Bayadyan 2007). How much this was the case in the present study is subject to speculation. However, in one instance a woman in Kalavan pointed out that two respondents who answered that they only harvested wild plants for their own consumption also collected wild pear to sell it although they did not say so. Overall, these two women seemed hesitant to give the interview in the first place. On the contrary, all the other women were welcoming the research and were happy to participate in the survey. Though this was the only instance of tension between researcher and participants, this aspect needs to be kept in mind. The CBD (2015) emphasized the importance of establishing trust in order to get proper feedback about regulatory decisions for ESS conservation. However, these decisions need to include all parties involved and should not overemphasize the view of a certain minority group, in this case the wild harvesters (MA 2005).

6.1.3. Statistical limitations

In terms of statistics, a source of error is that samples might not have been randomly distributed. This is the case since respondents were usually pre-selected by a contact person which biases the samples towards that selection. In turn, that restricts the independence of the samples from one another. Still, the influence of this type of error is probably different for the different communities: Kalavan has a population of 245 people

in around 90 households and chances are high that all the wild collectors know each other and thus the sample is still random since nobody would be excluded from the selection process. Kuchak however has a population of 2492 and randomisation of the samples is probably not given since it is possible that not all collectors in that community were considered potential participants in the survey. Further, in Dprabak, the women were all members of the cooperative and thus the statistical population was the Mothers of Dprabak whereas in other villages the statistical population was the group of wild harvesters in that village. In that respect, the survey is statistically speaking not representative of the whole population of these communities but only of the group of wild harvesters.

Moreover, the high standard deviations in the analysis of the quantities harvested suggest that the sample size was not big enough. On the one hand, the true population size (i.e. the number of wild harvesters) was unknown and so an estimation of the adequate sample size would not have been possible (McLain et al. 2013). Besides, the set-up and time frame of the research did not allow for more intensive field work. On the other hand, the high standard deviations might also result from the categorization used for comparison. This considered selling versus own consumption. As described in the results section earlier (5.4.2. Purpose of harvesting), the women sold wild plants for different purposes and scales ranged from high to low, concerning for example commercialized harvest in Dprabak and selling in a guesthouse in Kalavan. This extended the possible range of values for the category selling immensely while for own consumption the quantities might have been more homogenous. Also, in Dprabak two women answered the questions based on their own contribution to the Mothers of Dprabak cooperative while the other two respondents of that community answered in the name of the whole cooperative. This most likely distorted the data as well. Overall, the statistical analysis was only of secondary importance in the survey. The most important aspect was to include the perspective of local people on wild harvest with qualitative statements. Therefore, having a somewhat biased sample is acceptable since the results still allow to draw a coherent conclusion with respect to the overall research objectives.

6.2. Wild harvest as a provisioning ESS

The first research objective was to identify which plant species were harvested and identify their use as an ESS in four rural communities in Armenia. To achieve that, the following paragraphs highlight and discuss how wild harvest is a provisioning ESS in the investigated communities.

6.2.1. Types of plants harvested

In the context of this objective context, the most substantial aspect was to create a list of the harvested plants, their uses, and plant parts collected. The acquired list of wild plants is too extensive to carry out a full analysis of every single one of them. However, it is worth to take a closer look at some plants to identify how wild harvest is a provisioning ESS. A good starting point for comparison is provided by the study of Hovsepyan et al. (2019) that gives a list of species commonly collected as medicinal plants in villages of the Tatev region in Armenia. From plants that were listed more than ten times in the present survey, Hovsepyan et al. (2019) recorded rosehip, ross mint, wild pear, and oregano as well. However, the remedies that these plants provide differ according to the respondents from this and the present study. The only common medicinal property was identified for wild pear as a preventative measure against diarrhea. Plants that were listed less in the present study, but that had the same curative properties as plants listed in the study by Hovsepyan et al. (2019), are the Tatarian cephalaria to treat respiratory diseases, burdock against joint pain and plantain that has an anti-inflammatory effect on the skin. Plants listed in other sources of literature that were also mentioned in the present wild harvest study, included turnip-rooted chervil, thyme, walnut (*Juglans regia* L.), asparagus (*Asparagus officinalis* L.), sea-buckthorn (*Elaeagnus rhamnoides* (L.) A. Nelson), and curled sorrel (AM Partners Consulting Company 2010, Batello et al. 2010). The latter is commonly known as Aveluk in Armenia. This plant is a good example for a typical Armenian wild herb that is integrated in a lot of traditional dishes and is well-known for its medicinal properties which makes it a culturally important plant (Vann 2016). Besides its importance as food and medicine, harvesting Aveluk and the typical braiding of the plant (see Figure 3h) are considered important traditional activities as well (Vann 2016).

6.2.2. Uses of wild plants

This example gives a first idea how wild plants are important as a provisioning ESS since there are multiple uses of Aveluk. The present survey captured this aspect for each of plants listed. When looking at the results, the most frequently mentioned category in the present survey was medicinal purpose which includes 94.75 % of all the plants listed.

Other surveys drew different conclusions: In New Zealand, Wehi and Wehi (2010) found that 36 % of plants are used for medicinal purposes and in South Africa this was true for 43 % of plants (Schlesinger et al. 2015). Further, Poe et al. (2013) identified in their survey in the United States that 55 % of respondents harvested wild plants for medicinal purposes in an urban setting. When looking at the number of respondents that harvested wild plants for medicinal purposes in the present study, all the respondents collected at least one plant species for that reason. This could be derived from the notion that plants that have (perceived) health benefits were also referred to as medicinal plants and not only plants with specific curative properties. This was confirmed by some respondents during the interview and also highlighted in another Armenian study (Hovsepyan et al. 2019). Another important use is the consumption of wild plants. Here, it is worth to look at the use category cooking: 47.44 % of the plants were listed there. In New Zealand this number was 25 % (Wehi and Wehi 2010) and in South Africa 53 % of plants were used as wild vegetables and another 36 % are wild fruits (Schlesinger et al. 2015). For the study from the United States, 95 % of respondents harvested wild plants as food, in Armenia again all respondents harvested at least one plant for the purpose of cooking or eating. However, attention needs to be paid when comparing the numbers of different studies. Consumption is a broad term that captures for example cooking, spice, beverages et cetera. The different categories of consumption in each case were designed to suit the individual study aims and local settings. In this respect, the categories in the present study were chosen to suit the Armenian context in the best way possible. For instance, it is acknowledged in the literature and also becomes apparent when being in Armenia, that herbal teas are important not only as a beverage, but also in the cultural context of Armenia (Batello et al. 2010). Thus, tea and other beverages were included as a category while other studies might not capture this aspect.

In summary, the respondents harvest a large variety of plants for a number of different uses, often utilizing one plant for more than one purpose. When looking at the numbers, the most frequent count of uses for the plants was three different purposes that was listed for 126 (41.31 %) of the plants. When considering some of the numbers jointly, almost 90 % (268 plants) are used for two, three or four different purposes. This underlines the importance of wild harvest for the local women. Further, it shows that they possess the knowledge to use this ESS adequately. Although comparison to different studies might be limited, a general conclusion on wild harvest in Armenia can be drawn: As shown in the introductory section of this study, the value of wild harvest as a provisioning ESS is widely recognized in different countries globally and the current findings confirm that wild harvest is important in Armenia as well.

6.2.3. Influence of landscape types and community-specific variables

When looking at the analysis of the landscape types, the first step was to calculate the similarity based on each the Sørensen and Jaccard index. It was expected that the two landscape types would be less similar in the spectrum of plant species harvested than the communities within one landscape type. The highest similarity found here was a Jaccard index of 0.32 for the comparison of landscape types. The lowest values were calculated for the comparison of the two forest communities Kalavan and Geghadzor with a Jaccard index of 0.26 Sørensen index of 0.20. This is surprising because these communities are close to each other and the women harvested in the same forest (see Figure 10) although they might have been active in different locations. Still, based on the proximity of those communities, it was expected that the data collected there would have resulted the highest similarity indices.

There are multiple reasons how this can be explained: First, the total sample size was probably too small, and outliers had a significant influence. Outliers in this instance were women that were especially knowledgeable about wild harvest and that listed a comparatively high number of species. Consequently, 29 out of the total 68 species have only been listed once. When including these species in the calculation of the similarity indices, they will decrease similarity for any comparison since they are only recorded in one community each. Besides that, having the genus identified for only nine entries in the total list of plants might deviate the results of the calculation since it is possible that multiple species were harvested within one genus: e.g. *Plantago* sp. could correspond to *Plantago lanceolata* L., *Plantago media* L. or any other species of plantain. Moreover, the communities lie on different altitudes and the local climate might have had a strong influence on plant availability and thus the spectrum of plants harvested. However, adequate climate data was not available. For example, the weather station for Geghadzor was 20 km away in Artik and for Kalavan and Dprabak there was only the same weather data available and the closest station in Chambarak was 24 km away from both of these communities. Besides, the weather data was not updated. Additionally, Dprabak also borders a grassland and the distinction of grassland and forest might not have been accurate enough. In summary, the calculation of the similarity indices under the aspect of landscape type reveals that collection is independent from this factor and rather depended on the individual harvester and circumstances.

In the GLM, landscape type only had a significant influence on the harvest of thyme and wild pear. Thyme was harvested by all the respondents in the forest communities but only by four out of ten respondents from the grassland communities. This indicates that the landscape type is important for the harvest of this plant. This is further confirmed

since some women from Dprabak and Kalavan indicated the forest as locations of harvest for thyme. For wild pear on the other hand, the significance of the variable landscape type was probably coincidental: No respondent in Geghadzor harvested wild pear and when asked about it, a woman mentioned that it does not grow in Geghadzor. However, in the other grassland community Kuchak all but one respondent harvested wild pear. Thus, the availability of that plant is probably not depending on the landscape type. Rather, geographical influences like altitude could be more significant since Geghadzor is also the community that lies the highest above sea level and it is possible that wild pear simply does not grow on that altitude. Further, the covariable community had significant influences on the harvest of six of the plants analyzed. A logical explanation for this is the fact that in Dprabak wild harvest was connected to the Mothers of Dprabak cooperative. In some cases, if a plant was included in their harvest portfolio but not commonly harvested in other villages, community could be a significant covariable. This pattern was observed for chamomile and oregano. The opposite case was also true if the cooperative does not harvest certain plants which are commonly used in other communities. This could be observed for wild pear and rosehip that were only mentioned once and twice by women in Dprabak. These women probably harvested these plants for their own consumption and not within the activities of the cooperative. For curled dock and turnip-rooted chervil this was more obvious since all respondents but the women of Dprabak harvested these plants. Additionally, for these two plants the covariable harvest experience showed statistical significance. Again, this ties back to the Mothers of Dprabak since they all indicated that they started to harvest four or five years ago when the cooperative was funded. In other communities, the women's harvest experience ranged from 10 to 40 years, averaging 22.1 years and thus on average their experience was higher overall. The last covariable that showed statistical significance was occupation for turnip-rooted chervil, curled dock and ross mint. Since there is no visible pattern that could explain that outcome based on the information available, it is safe to assume that this statistical outcome is coincidental or may depend on other factors that were not examined in this research.

6.2.4. Status and change in ecological knowledge

To finalize this section of the discussion chapter, it should be noted again that the answers provided are based on people's recollection. In this sense, it is important to contextualize the status of the ecological knowledge in the best way possible since it is the foundation of wild harvest in rural Armenia. As shown in an FAO survey (Batello et al. 2010), in the Southern Caucasus, ecological knowledge is still present and traditional practices are being upheld contemporarily. However, another study highlighted that out of 100 biodiversity products, only 30 to 40 are used intensively (AM Partners Consulting Company 2010). It is thus important to recognize the risk of ecological knowledge being lost and be aware of the consequences of this process.

Some drivers that lead to the loss of ecological knowledge became apparent in the present study (2.2.1. Socioeconomic and cultural aspects) and included generational changes in lifestyle, time constraints, geographical limitation and an increase in the availability of pharmaceuticals and food in the commercial market (Hovsepyan et al. 2019, Garcia-Martin et al. 2017, Mollee et al. 2017, Sõukand 2016, Stryamets et al. 2015, Schulp et al. 2014, Menendez-Baceta et al. 2012, Tabuti 2007). Most of these drivers were probably present in Armenia as well. As an example from the field study, the contact person in Geghadzor said that there were around 300 people registered in the community that did not live there. Further, he went on to describe that many young people left or at least wanted to do so, but often did not have the opportunity. Consequently, there was a discontinuation of traditional practices like wild harvest. Another source of this decrease in knowledge is the decline in biodiversity: Fragmentation and shrinking of natural habitats take away the environment in which wild harvest happens and thus change the use of natural resources (Sogbohossou et al. 2015, Vandebroek et al. 2011, Tabuti 2007). In Armenia, deforestation has been an ongoing trend for decades (Armenia Tree project 2020). Thus, it can be suspected that this factor contributes to the loss of ecological knowledge as well. Furthermore, the loss of ecological knowledge perpetuates the loss of biodiversity since abandoning wild harvest practices decreases the sense of environmental stewardship and also negatively affects the knowledge on how to preserve a natural environment (Termote et al. 2011). In extreme cases, this trend can jeopardize food and nutritional security (Tabuti 2007). The importance and current status of biodiversity conservation with respect to wild harvest in Armenia will be discussed in the following subchapter.

6.3. Sustainability of wild harvest

For analyzing sustainability, the corresponding research question dealt with harvesting techniques used and tried to investigate whether these are sustainable or detrimental to plant abundance. When looking at the sustainability of wild harvest, there are two aspects that are of importance: The process of harvest itself and the abundance or decline of plant species.

6.3.1. Methodological shortcomings

In the following, it will be explained why the applied methodology fell short of answering the research question fully. When looking at the harvesting techniques, the questions were designed according to several harvesting guidelines (Khumalo et al. 2013, Asva-Raf, GIZ, Schindler et al. 2010). The questions were single-choice with answers representing either a sustainable or an unsustainable way of harvesting a certain plant part. Whether or not a technique was considered sustainable or unsustainable was related to how severely it intervenes with either a single plant or a whole plant population. For example, harvesting leaves was considered sustainable if only individual leaves of a tree were harvested and unsustainable if a branch was stripped of its leaves completely or if branches were cut off to harvest the leaves later. In this case, the question dealt with sustainability on the level of an individual but neglected the plant population or the size of the individual tree. In this case, cutting of branches of a big tree or a tree in a group of the same species is less severe than harvesting individual leaves of a small tree that is more susceptible to damage. However, scaling the survey questions up and down from species to population to ecosystem level was not possible and general conclusions about the sustainability of harvest cannot be drawn.

The second aspect of sustainability of wild harvest was the change in plant availability. Problems here are that the changes recorded were all based on people's recall and personal perception which might not be in line with the decline that is present. This could only be analyzed if corresponding data was available. For instance, changes perceived can also be explained by other factors than an actual physical decline of a plant population like a decrease in local ecological knowledge (Pritchard et al. 2019). For Dprabak specifically, the harvest cooperative had only been established four years prior to the survey while the changes asked about referred to a time frame of five years. However, it is also possible that the women harvested before they joined the cooperative and only answered the questions based on their activity related to the Mothers of Dprabak. Thus, the answers might still be valid which unfortunately is unknown at this point. Despite these methodological shortcomings, having perception-based data on changes is a good starting point to have a look at the sustainability of wild harvest.

6.3.2. Harvest patterns of specific plants and their effects on sustainability

Viewing the two aspects harvesting and plant availability separately leaves little room to draw conclusions on the sustainability of wild harvest. However, when these two aspects are considered jointly, some information for individual species can be obtained.

For example, two respondents in Kuchak listed changes for both turnip-rooted chervil and curled dock. One of these women stated that the distance she needed to travel to collect these plants changed depending on the year while the other woman said that generally the distance to harvest turnip-rooted chervil increased in the past five years while curled dock was affected by a certain disease. The decline in a plant population's health is commonly considered a negative outcome of unsustainable practices (Khumalo et al. 2013). In the current example, both respondents also said that they commonly collected all the herbs they can find in an area which would be considered unsustainable according to the survey set-up. Further, these two plants were harvested by all respondents interviewed in Kuchak. Another example is the change in distance for certain herbs like St John's wort and ross mint which were both mentioned twice in Geghadzor. Here, the respondents explained that they used to harvest these plants on the meadows in between the village and the main road but that they were only available on the slopes of Aragats mountain nowadays. Other plants that were listed in this context were chamomile and strawflower. The harvesters of these plants also harvested all the plants they can find in an area which was considered unsustainable. Again, ross mint and chamomile were harvested by all interviewed respondents.

Concluding from these examples, it can be said that whether or not wild harvest is sustainable or negatively affects plant abundance cannot be pinpointed to a single driver, but depends on a number of factors: First, a change for turnip-rooted chervil and curled dock was only observed in Kuchak although these two plants were commonly harvested in the other communities as well (except for turnip-rooted chervil in Dprabak). Thus, the sustainability of wild harvest is highly dependent on the local context (Censkowsky et al. 2006). This includes the popularity of the plant; i.e. how much of that plant is harvested in total in a local area and the general size of the plant population. Further, ross mint and chamomile were harvested by all respondents in Geghadzor. As a consequence, sustainability also depends on the harvesters themselves. Their collective activity, that is the techniques they employed and the quantity they harvested, potentially affected plant abundance which are factors that were also identified in a study conducted by GIZ (AM Partners Consulting Company 2010). Last, the individual species is a factor on its own in this context since the regenerative capacity and the susceptibility to damage caused by wild harvest of individual species might differ (Batello et al. 2010). Keeping all these

factors in mind gives a general idea on how difficult it is to define adequate guidelines and laws for wild harvest and biodiversity conservation.

6.3.3. Status of and requirements for sustainable harvest in Armenia

In Armenia, there are several laws and regulations on biodiversity conservation in place. The country signed a number of environmental conventions and protocols including the Convention on Biodiversity of 1993, the Kyoto Protocol of 2002, and the European Landscape Convention of 2004 among others (FAO 2008). Specifically for wild harvest, there is a permit system in place which few harvesters are aware of (Armenia Gender Project 2018) and about which little information is available. Also, according to a GIZ survey conducted in 2010, there are three laws related to wild harvest: The RA Law On Nature Protection and Environmental fees which was adopted in 1988, the RA Law on Fauna which was adopted in 1999, and the RA Forest code of 2005. In the context of the present study, these laws were not examined thoroughly. For the purpose of this research it is sufficient to notice that in theory regulations for wild harvest are in place, but they are almost not enforced currently (AM Partners Consulting Company 2010).

To identify adequate harvesting guidelines, there are some prerequisites and issues that need to be kept in mind. When looking at necessities to identify comprehensive sustainable harvesting guidelines, it is essential to have appropriate policies and legislations in place (and enforced), to have regulation bodies that deal with rights, ownership and access to wild harvest, and to have comprehensive data on the species in question and sustainable yields of those (Schippmann et al. 2006). In Armenia, the RA Law on Fauna allows wild harvest in state forests for ‘household consumption’ (GTZ Armenia 2010). An issue here is that it is difficult to distinguish between household and non-household consumption. Accordingly, it is impossible to set a limit on harvest quantity which also prohibits to regulate the commercialization of wild harvest products (GTZ Armenia 2010). This is further impeded by the fact that regulation bodies are not well organized or that they are absent in the first place (AM Partners Consulting Company 2010). Additionally, the general data situation in Armenia is rather poor. Almost no data was available on threats and losses of habitats, invasive species, climate change, environmental pollution, biological resource exploitation, and sustainable harvesting rates (CBD 2015, Batello et al. 2010). However, having adequate information on the stock of resources available is the first step to introduce legislations on sustainability, not just for wild harvest (Pritchard et al. 2019). An inventory of that sort was never conducted in Armenia (GTZ Armenia 2010). This, and other contradictions in between law, use and regulation make it impossible to properly organize the use of wild plants and sustainable harvest at this point in time (Pritchard et al. 2019, GTZ Armenia 2010).

For biodiversity conservation, it is crucial to know how species reduction affects ecosystems in the long-run (CBD 2015). With respect to wild harvest, as a baseline, detailed information like the correct botanical name, the location of growth and what species are harvested needs to be identified (WHO 1993). An important aspect is to make sure that none of the species that are of interest for collection are endangered (Khumalo et al. 2013). For Armenia, this information is available in the Red Book of Plants (Tarmanyan et al. 2010). As highlighted before, sustainable harvest is very specific to local conditions and the plant species in question which is why standards need to be flexible and adaptable (Batello et al. 2010, Censkowsky et al. 2006). Based on that, questions like the ones asked in the present survey can be helpful but need to be deconstructed for the individual species. Still, there are some common good practices that are applicable in any case. Sustainable wild harvest refers to activities that neither threaten the long term survival of the species nor decrease the plant population but ensure that the surroundings of the species stay intact without damaging or disturbing other plants (Schindler et al. 2010). Keeping this broad concept in mind can already achieve that wild harvest is done more thoughtfully and that wild harvesters are more attentive to their surroundings (CBD 2015). Considering that, it is essential to start and maintain a dialogue between the local population and the responsible regulation bodies and also to increase general awareness of sustainability (AM Partners Consulting Company 2010, CBD 2015).

6.3.4. Examples and general ideas for sustainable wild harvest

A good starting point for sustainable harvest is to offer corresponding trainings (AM Partners Consulting Company 2010) as was done for the Mothers of Dprabak cooperative. They are a successful example on how appropriate education is not only helpful for biodiversity conservation, but also, it gave these women an economic opportunity they did not have before. Educational measures could include lectures, educational campaigns, guided visits of research facilities and establishing gardens of for example medicinal plants (WHO 1993). This last notion of cultivation is often referred to as a good alternative to wild collection (Batello et al. 2010, Bharucha and Pretty 2010, WHO 1993). Growing plants in such a home garden system instead of harvesting them from nature reduces the impact on natural ecosystems, allows for better regulation of the use of certain plants, and also is practicable for the locals since they have the resource available right at their doorstep (Cruz-Garcia and Price 2014, Batello et al. 2010, Buchmann 2009, WHO 1993). However, the opportunity to do that depends on the species since not all wild plants might be suitable for cultivation (Khumalo et al. 2013). Regardless, it is important to preserve or reconstruct natural ecosystems in which wild

harvest takes place. As mentioned before, deforestation has been and still is a big issue in Armenia. A good initiative here is the Armenia Tree project (2020) which aims to accomplish a wide set of goals, including education, awareness raising and community empowerment among others through the regeneration of natural habitats. Another concrete example of good environmental stewardship specifically for Armenia is the Kalavan ecovillage. In this community, ecotourism was established more and more over the recent years, integrating concepts of sustainability in a holistic way to preserve natural surrounding while keeping the social and economic interests of the community members a priority (Androushan 2018, Mirzoyan 2017). One of the activities included in the ecovillage are excursions to the forest for wild harvest and cooking of traditional Armenian dishes with these plants (Mirzoyan 2017). This shows how wild harvest is not only important for a household's own consumption and as a provisioning ESS but also that the socioeconomic dimension of it should not be neglected. This will be discussed in the following.

6.4. Cultural and socioeconomic dimension of wild harvest

The final objective was to connect wild harvest to the socioeconomic background of local stakeholders, identify how important wild harvest is for them and what resources they invest in this activity. In terms of methodology, for this section specifically, it is unclear whether the respondents referred to the family or their individual income when estimating the percentage of income generated from wild harvest. Additionally, people often struggled to give numbers for the quantity harvested of the most important plants or to estimate the time investment for wild harvest. Altogether, it appeared that the respondents struggled to estimate concrete values. This needs to be kept in mind when analyzing the socioeconomic relevance of wild harvest since all questions that required to estimate numbers where related to this aspect.

6.4.1. Economic opportunity and status quo of wild harvest

An important facet of this research objective was to determine the purposes of wild harvest: The most important reason that was identified in the present study was own consumption which falls in line with similar studies on wild harvest (e.g. Stryamets et al. 2015, Poe et al. 2013, Egoh et al. 2012, MA 2005). Further, selling was also a reason for 11 of 23 respondents. However, the commercialization of wild plants in Armenia is generally low (AM Partners Consulting Company 2010) and the sale of wild plants is adding onto people's income without necessarily being essential (Armenia Gender Project 2018). As estimated by the respondents, the rate of income generated from wild

harvest ranged from 2 to 100 %. Here, four women stood out, two in Dprabak and two in Kuchak that listed significantly higher numbers than the other respondents. The values given by them lay in between 86 and 100 % while the next highest figure was 30 %. Probably these four women referred to their individual income while other respondents that listed significantly lower numbers here might place this on the level of the family income. If this really was the case can only be speculated about. However, it is important to note here that no explicit statement can be made based on these numbers alone. The lowest values expressed were 2 and 8 %. While 2 % of income might not seem essential at first, the importance of that contribution cannot be judged since there was no information available on the economic situation of that respondent and her family. Nevertheless, for all the numbers higher than 8 %, it can be assumed that for these respondents, wild harvest is at least appreciated if not necessary as an additional source of income.

Irrespective of its significance, the income generated from wild harvest is a stable source of money and wild harvest can further be regarded as a form of women empowerment since this activity mainly involves women in rural areas (Armenia Gender Project 2018). The Mothers of Dprabak are a good example in this context on how women are generating economic benefits for themselves after having been given the opportunity to do so. This is important not only for these women but contributes to the overall economy of the country as well. The rate of female unemployment in Armenia is around 42 % as opposed to around 10 % of men being out of work. Consequently, the wild harvest sector provides an opportunity to mitigate unemployment in Armenia (Armenia Gender Project 2018, AM Partners Consulting Company 2010). However, while collection is often led by experienced women (Hovsepyan et al. 2016), they seldom hold responsibilities in other steps further up the value chain (Armenia Gender Project 2018). This could again be observed in Dprabak where the head of the cooperative expressed that they needed additional training on marketing in order to enter the market themselves without selling to a processor. She estimated that currently the cooperative earns around 10 % of the overall revenue that is created through their wild harvest activity and that they could receive a larger share of that income if they had control over more steps of the value chain.

6.4.2. Gaps and market constraints

What is currently preventing market participation of wild harvesters is that often they do not take the initiative themselves to enter the market and it is the processors that identify which plants should be harvested as stated in a report by the Armenia Gender Project (2018). The same study pointed out that commercialization of wild harvest products is difficult for these women since they believe that they need the support from NGO's to gain market access by themselves. In Dprabak, this exact statement was given by the head of the Mothers of Dprabak cooperative. This struggle to enter markets is further perpetuated by the fact that the quantities required by for example foreign traders frequently exceed the quantities that can be harvested by an individual or a group of local harvesters (Armenia Gender Project 2018, AM Partners Consulting Company 2010). Other obstacles include having an overall instable market with fluctuating demand, low earnings for wild harvest, and a low demand for the products in the domestic Armenian market (AM Partners Consulting Company 2010). Additionally, rural households often struggle economically and do not have the capital available to establish a wild harvest business themselves (Sarian 1996).

Different studies highlighted that there is a significant unequal distribution of income in Armenia causing the following consequences (Baser and Swain 2009, Sarian 1996). In low-income countries like Armenia, corruption (Sarian 1996) and the existence and promotion of a shadow economy as described by Tunyan (2005) are of major concern. Activities included in the shadow economy create economic benefits that are not captured by official statistics. In Armenia, the shadow economy played a vital role in stabilizing the economic situation of the country after it became independent. However, it should be kept in mind that these actions were and still are not legal. Prerequisites of the shadow economy include poor data availability (Tunyan 2005). This was also encountered during the present survey with respect to data on the communities (population, climate) or wild harvest (legal status, common plants, inventory of natural resources et cetera). In this sense, wild harvest can contribute to the shadow economy, for example when people sell their harvested products amongst community members as was seen in the survey. It should be noted that this activity should not be condemned completely. However, it is a factor that might further hinder a transition to officially entering the market for local harvesters.

Another obstacle to assess wild harvest as an economic opportunity is that the valuation of ESS can be problematic. Especially in Armenia, ESS are often underestimated due to a number of factors like the lack of (economic) assessment, low public awareness, and inappropriate legislation (CBD 2015). This under- or inadequate estimation of ESS or

natural resources prevents the implementation of appropriate legislation which in turn might cause an unsustainable use of these resources as was discussed in the last sub-chapter (6.3. Sustainability of wild harvest). That does not only lead to resource degradation, but also has socioeconomic implications. For example, insufficient knowledge on wild harvest often goes hand in hand with insufficient knowledge on marketing and organization of this activity (AM Partners Consulting Company 2010). ESS can only be valuated and sustainable harvest can only be regulated if the availability and distribution of the resource 'wild plant' is known (Pritchard et al. 2019, Brown et al. 2012). Still, evaluating natural resources solely based on economic indicators like the gross domestic product is problematic since being fixated on these values often leads to an unsustainable use of natural resources and a decline in biodiversity (CBD 2015). Generally, monetary valuation of ESS can be insufficient to capture their total value as highlighted by Chan et al. (2012). They emphasize that people do not put a price tag on the cultural benefits of a landscape but that there are other non-material factors at play. Valuation was also a problem in the present study. There, respondents struggled to estimate concrete numbers on quantity harvested, resource investment and the percentage of income generated. If wild harvest was to be evaluated economically in these communities, missing those numbers is a significant knowledge gap to properly assess provisioning ESS economically.

The economic implications of wild harvest for the individual person depended on her background like her work and family situation, the scale on which she intended to sell and the opportunities for her to enter the market. What is interesting to note is that the information on the processors and intermediaries the respondents gave was sometimes unclear in the sense that they did not seem to know who that person exactly was. Whether the respondents were unwilling to give the information, whether they were indifferent to where their products go, or whether there was another reason cannot be deduced from the data available. Connected to that, one aspect of the survey was to see whether or not the people have a sense of value-added goods. Here, the questions related to problems encountered for selling and processing and whether or not and how the respondents process the wild plants. In the end, no information stood out, it was rather the lack of problems listed that was interesting. Overall, the women seemed hesitant to talk about problems of any sort which again could be a remnant of Armenia's Soviet past in the sense that people normally do not speak ill of the system. At the same time this could be an implication of the gender roles in Armenian society which will be elaborated upon in the next paragraph. In summary, there did not seem to be a distinct sense for value added goods amongst most of the respondents. Concluding from this

section, the people often do not see wild harvest as an activity that can support them economically and if they do so after all, there are limits to their actions as can be seen in Dprabak.

6.4.3. Social dimensions connected to wild harvest

At this point it should be emphasized that there is no need to sell wild plants in order to improve the livelihood of the people but that this is merely an opportunity that often goes unused or is executed inadequately. While this economic dimension clearly marks wild harvest as a provisioning ESS, there is a cultural dimension to it as well. Since cultural ESS are difficult to quantify and the present study did not aim to investigate ESS based on concrete numbers, the socioeconomic and cultural side of wild harvest was approximated differently.

In order to do that, a few things should be noted about Armenian culture. There, the family as a unit is valued more than an individual and well-being is perceived more on the family level (AM Partners Consulting Company 2010). Further, Armenians have a strong sense of cultural identity and cherish ethnic traditions and their value system (Abakumova et al. 2019). This was confirmed during the interviews in which several women expressed their pride in their ethnobotanical knowledge. Further, conducting the interviews in respondents' homes gave comprehensive insight into Armenian hospitality and the strong sense of community in the villages. Most women were welcoming the research and the effort made by them to appropriately represent Armenian culture were clearly standing out. This representational aspect was identified as characteristic for Armenians in another survey before (Abakumova et al. 2019). Aside from that, women frequently asked whether and how the research project will contribute to the development of their communities. This shows Armenia's connection to its Soviet past in which the citizens got used to having outside forces determine certain aspects of their lives (Bayadyan 2007).

Besides the overall value system and recent historical influences, there are specific gender roles in Armenian culture. Women are often the keepers of traditions in Armenian society, also when it comes to ethnobotanical knowledge (Hovsepyan et al. 2019, Manoogian et al. 2007). This is a common characteristic of wild harvest not only in Armenia, but other countries like Estonia as well (Sõukand 2016). Men on the other hand are or at least were more regarded as the leaders of the family in Armenian society (Manoogian et al. 2007). What was interesting during the survey with respect to this gender dynamic was that in two instances in Kuchak a male member of the family entered during the interview and joined the survey. In one instance this was the husband of the

respondent, in the other case it was the son. Both times the woman stopped answering the questions when the man interjected although it was apparent that his knowledge on wild harvest was more limited. It is of course not feasible to generalize on other Armenian families in the rural areas based on those examples, but these instances clearly showed a pronounced gender dynamic and defined hierarchy in the family context. Also, there is a dependence on men when collecting wild plants that require more physical workload (AM Partners Consulting Company 2010) or in the case of Dprabak when transportation to remote areas was needed. Having this mismatch in gender roles does not imply that women are exploited in Armenia (AM Partners Consulting Company 2010). Rather this shows that the social and gender dynamics observed in the respondents' homes and the communities also transfer to wild harvest as an activity. Relating this social aspect back to the low involvement of women in the value chain shows that there is a missed economic opportunity. After all, it is these women that possess the knowledge on wild plants and their collection that could proof valuable to connect the social and economic dimension of wild harvest.

6.4.4. Cultural dimensions of wild harvest

This knowledge on wild harvest is a manifestation of the traditions that people connect to it. For example, when asking the women about the most important plants the harvesting seasons were identified as well. There was no instance when a respondent hesitated or was unsure about the harvesting dates of the plants she listed here. Moreover, the fact that often additional information on the plants collected was given casually accentuates that these women have sophisticated knowledge on wild harvest. Although there might be a risk of ecological knowledge being lost, if it is maintained, it is passed down from generation to generation and thus it is an instrument for these people to maintain and express their cultural identity (Batello et al. 2010). It is further acknowledged that people in Armenia are often aware about wild harvest and the uses of wild plants although not all of them might use these plants themselves (Hovsepyan et al. 2019). In the beginning of the present study, the respondents were asked about their sources of knowledge on wild harvest and all but the two women responsible for the Mothers of Dprabak cooperative learned from either parents or grandparents (and one respondent from another relative). Furthermore, in eight cases respondents specified that they take children which shows that it was important to them to pass on and keep up with this tradition. Besides, all respondents but one woman are joined by others for wild harvest, including mostly family and friends which. This shows the importance of wild harvest as a cultural ESS on the community, as well as on the family level (Hovsepyan et al. 2019, Stryamets et al. 2015, Poe et al. 2013).

Another aspect derived from literature connects wild harvest with environmental stewardship (McLain et al. 2013, Poe et al. 2013, Bharucha and Pretty 2010). In the Armenian case this notion could be underlined by the fact that all but three respondents were familiar with the concept of sustainability and acted accordingly. A few respondents in all communities emphasized that they know their boundaries and respect their natural environments. Besides, one woman in Kuchak explained that people from outside the community are not aware of land ownership. Hence, they practice wild harvest on someone else's land which community members do not do. This shows that wild harvest in this case not only is an environmental, but also a social responsibility for these people. Overall, maintaining traditions is a common theme when talking about wild harvest (Poe et al. 2013) which could also be observed in the present study. Further, A GIZ survey concluded that in some cases wild harvest even seemed to be more important in terms of tradition and entertainment than generating income in Armenia (AM Partners Consulting Company 2010).

In summary, there are several factors like knowledge transfer, community bonds, environmental and social stewardship, gender and family roles that are connected to wild harvest that define it as an important cultural ESS in the investigated communities in rural Armenia.

Conclusion and Outlook

In summary, the present survey tried to highlight the importance of wild harvest as an ESS in rural Armenia. In this sense, the significance of wild plants as a provisioning ESS clearly stood out since the people used a wide range of plants for different purposes. Further, some respondents sold the harvested wild plants on different scales and thus wild harvest was not only a provisioning ESS by directly supplying goods for consumption, but also by providing a source of income for vulnerable households. Moreover, there was a strong cultural aspect to wild harvest in these communities: The respondents mostly highlighted how their wild harvest practice maintained their community bonds and traditions which manifested itself in different ways. One example is that there was a knowledge transfer from generation to generation. In this sense, the women often highlighted that their families taught them to harvest sustainably even if they were not familiar with the specific concept. This underlines the environmental and social responsibility these people connect with wild harvest. However, to appropriately quantify whether wild harvest is sustainable or not, more information is needed as was discussed previously (see 6.3.3. Status of and requirements for sustainable harvest in Armenia). Further, the present study had limits in accurately capturing the economic relevance of wild harvest. However, the project was not designed as an economic value chain analysis in the first place.

The ESS concept is a holistic principle that encompasses several types of services that are often analyzed separately (e.g. Canedoli et al. 2017, Rasmussen et al. 2016). However, a certain benefit derived from a natural landscape might be applicable to more than one ESS category as was shown with wild harvest in the present study. Wild harvest is a good example for a multifaceted ESS especially with respect to provisioning and cultural ESS. While more subtle, wild harvest can also contribute to the promotion of regulating and supporting ESS, at least secondarily. The threat of wild harvest to biodiversity has been discussed at length in this survey. However, at the same time, wild harvest might do the opposite and positively enhance biodiversity since it is in the interest of local stakeholders to preserve this resource, especially if they rely on it (Buchmann 2009). This interest in conservation was also present in the rural communities of Armenia. Enhanced biodiversity supports more complex food webs and enhances primary production among other things (Müller and Sukhdev 2018, Batello et al. 2010). These supporting ESS in turn increase an ecosystems resilience towards for instance climate change, flooding and diseases which are regulating ESS (MA 2005). This shows that wild harvest is well embedded in the whole ESS concept.

One can apply the triple bottom line approach of sustainable development that describes environmental, social and economic dimensions as equally important for human well-being (Sachs 2012). These dimensions were captured separately in the present study and there were limits on how to connect them. With respect to that, following up the value chain to processors and sellers of wild plants could provide useful insights into complementing the work done specifically for Armenia. The opportunity here is to connect the current business practices with what is happening in the field and identify sustainable alternatives and opportunities if necessary. A good example for a holistic business idea that considers all dimensions of sustainability is the previously mentioned Kalavan ecovillage. Additionally, more work in identifying the plants the locals regard as most important or collect most commonly could be done with similar surveys. This could help to get an idea for which plants regulative standards on sustainable harvest are needed.

The present survey conducted in Armenia can serve as a case study for similar questions in other settings: When looking at ESS as a research field, there has been an increasing interest in the topic over the past decade (McDonough et al. 2017). However, comparatively little research on this is done in low-income countries that rely most on these services and often they coincide with biodiversity hotspots which unproportionally increases pressure on natural resources (McDonough et al. 2017, Bharucha and Pretty 2010, Treweek et al. 2006). This notion shows that there is a necessity to include the opinions and voices of local stakeholders as is often done with research regarding wild harvest (e.g. Reyes-García et al. 2015, Cruz-Garcia and Price 2014, Poe et al. 2013). It was also shown in the present study that it is the local people that hold valuable knowledge about wild harvest. This could be the foundation of scientific assessment of that ESS and decision-making processes arising from that. With respect to that, it is crucial to not only include local harvesters, but also other stakeholder parties like regulation bodies, decision-makers and academia in the research of ESS (GTZ Armenia 2010, MA 2005).

A big challenge for ESS research is the quantification of the resource use: Generally, the valuation of wild harvest as an ESS is difficult as was highlighted throughout this study. This complicates decision making on conservation and research in general. That concerns especially cultural ESS that are the most difficult to quantify and thus often neglected in ESS research (Brown 2013, Chan et al. 2012). Thus, a recommendation that can be deducted at this point is that more research needs to be done to develop a system which allows appropriate quantification of a benefit derived from a natural ecosystem. This concerns not only single ESS but the whole concept. However, deriving

such a broad system from case studies alone is not possible since they mostly have low external validity (Brown et al. 2015). In the context of the present study it was shown that the conditions for wild harvest are fairly heterogeneous already in between the different communities. Still, it is important to have more studies on wild harvest available since there are always parallels that can be drawn. Cumulatively, this might allow for a broad conceptualization of certain issues like valuation or sustainable regulation.

In summary, it is beneficial to look into multiple aspects of wild harvest in order to capture the full scope of this activity, its relevance for biodiversity conservation, its socioeconomic dimension and its importance to preserve a local cultural identity.

References

Abakumova, Irina; Berberyan, Asya; Berberyan, Hermine (2019): Psychological Characteristics of the Value Orientation System of Armenians in Title Ethnos and Russian Diaspora. In: *IJCRSEE* 7 (2), S. 11–17. DOI: 10.5937/IJCRSEE1902011A.

Aberoumand, Ali (2009): Nutritional Evaluation of Edible Portulaca oleracia as Plant Food. In: *Food Anal. Methods* 2 (3), S. 204–207. DOI: 10.1007/s12161-008-9049-9.

Abrahamyan, Armine (2011a): Changes in Distribution and Structure of Wild Melissa officinalis L. Populations During the Last Decade in Armenia and Implicatins for Conservation. In: *Environment. Technology. Resources.* 2, S. 321–324.

Abrahamyan, Armine (2011b): Estimations in Distribution and Growing Characteristics of Wild Hypericum perforatum L. (Hypericaceae) Populations During the Last Decade in Armenia. In: *Environment. Technology. Resources.* 2, S. 317–320.

Adalian, Rouben (1991): The Armenian Genocide. Context and Legacy. In: *Social Education* 55, S. 99–104.

Aghbalyan, Gagik (2017): Armenia's Kalavan village. A Community Development Model for Others. hetq. Online available at https://hetq.am/en/article/78358, last checked on 14.05.20.

AM Partners Consulting Company (2010): Analysis of Processors and Traders Involved in Value Chain of Selected Biodiversity Products in Armenia. With the cooperation of GTZ (Sustainable Management of the Biodiversity in Protected Areas and Forests, Southern Caucasus).

AM Partners Consulting Company (2011): Analysis and Identification of Business Opportunities in Kirants and Shikahogh Sub-regions. Completion report. GTZ; AM Partners Consulting Company.

Androushan, Andy (2018): Kalavan: Once an Obscure Village in Armenia, Now Gaining International Fame. The Armenian Weekly. Online available at https://armenianweekly.com/2018/12/12/kalavan-once-an-obscure-village-in-armenia-now-gaining-international-fame/, last checked on 14.05.20.

Angelsen, Arild; Jagger, Pamela; Babigumira, Ronnie; Belcher, Brian; Hogarth, Nicholas J.; Bauch, Simone et al. (2014): Environmental Income and Rural Livelihoods. A Global-Comparative Analysis. In: *World Development* 64, S12-S28. DOI: 10.1016/j.worlddev.2014.03.006.

Armenia Gender Project (2018): Wild Harvst Value Chain Assessment Report. Armenia. With the cooperation of Internaional Finance Corporation. Armenia.

Armenia Tree project (2020). Available online at https://www.armeniatree.org/?lang=en, checked on 6/9/2020.

Asva-Raf, GIZ: Rosehip collection Manual. Creation of value chains for rosehip and other products in selected pilot areas of Syunik region and sustainable development of wild plants collection in the region.

Atkinson, D.; Davison, A. W. (1973): The Effects of Phosphorous Deficiency on Water Content and Response to Drought. In: *New Phytol.* (72), S. 307–313.

Atteslander, Peter; Cromm, Jürgen (2010): Methoden der empirischen Sozialforschung. 13. Aufl.: Erich Schmidt.

Barbier, Edward B. (2008): Poverty, Development, and Ecological Services. In: *International Review of Environmental and Resource Economics* 2 (1), S. 1–27. DOI: 10.1561/101.00000010.

Baser, Bahar; Swain, Ashok (2009): Diaspora Design versus Homeland Realities: Case Study of Armenian Diaspora. In: *Caucasian Review of International Affairs* 3 (1), S. 45–62.

Batello, Catherina; Avanzato, Damiano; Akparov, Zeynal; Kartvelishvili, Tamar; Melikyan, Andreas (2010): Gardens of biodiversity. Conservation of genetic resources and their use in traditional food production systems by small farmers of the Southern Caucasus. Rome: FAO.

Bayadyan, Hrach (2007): Soviet Armenian Identity and Cultural Representation. In: T. Darieva and W. Kachuba (Hg.): Representations on the Margins of Europe. Politics and Identities in the Baltic and South Caucasian States. Frankfurt: Campus Verlag, S. 205–219.

Bharucha, Zareen; Pretty, Jules (2010): The roles and values of wild foods in agricultural systems. In: *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* 365 (1554), S. 2913–2926. DOI: 10.1098/rstb.2010.0123.

Bonjour, Sophie; Adair-Rohani, Heather; Wolf, Jennyfer; Bruce, Nigel G.; Mehta, Sumi; Prüss-Ustün, Annette et al. (2013): Solid fuel use for household cooking: country and regional estimates for 1980-2010. In: *Environmental health perspectives* 121 (7), S. 784–790. DOI: 10.1289/ehp.1205987.

Brown, Greg (2013): The relationship between social values for ecosystem services and global land cover. An empirical analysis. In: *Ecosystem Services* 5, S. 58–68. DOI: 10.1016/j.ecoser.2013.06.004.

Brown, Greg; Helene Hausner, Vera; Lægreid, Eiliv (2015): Physical landscape associations with mapped ecosystem values with implications for spatial value transfer. An empirical study from Norway. In: *Ecosystem Services* 15, S. 19–34. DOI: 10.1016/j.ecoser.2015.07.005.

Brown, Greg; Montag, Jessica M.; Lyon, Katie (2012): Public Participation GIS. A Method for Identifying Ecosystem Services. In: *Society & Natural Resources* 25 (7), S. 633–651. DOI: 10.1080/08941920.2011.621511.

Brown, Greg; Pullar, David; Hausner, Vera Helene (2016): An empirical evaluation of spatial value transfer methods for identifying cultural ecosystem services. In: *Ecological Indicators* 69, S. 1–11. DOI: 10.1016/j.ecolind.2016.03.053.

Buchmann, Christine (2009): Cuban Home Gardens and Their Role in Social–Ecological Resilience. In: *Human Ecology* 37 (6), S. 705–721. DOI: 10.1007/s10745-009-9283-9.

Canedoli, Claudia; Bullock, Craig; Collier, Marcus J.; Joyce, Deirdre; Padoa-Schioppa, Emilio (2017): Public Participatory Mapping of Cultural Ecosystem Services. Citizen Perception and Park Management in the Parco Nord of Milan (Italy). In: *Sustainability* 9, S. 1–27. DOI: 10.3390/su9060891.

CBD (2015): On approval of the Strategy and National Action Plan of the Republic of Armenia on Conservation, Protection, Reproduction and Use of Biological Diversity. Excerpt from the protocol of the session of the Governmentof the Republic of Armenia. CBD. Online available at https://www.cbd.int/doc/world/am/am-nbsap-v2-en.pdf, last modified 09.09.2019.

Censkowsky, Udo; Helberg, Ulrich; Nowack, Anja; Steidle, Mildred (2006): Overview of World Production and Marketing of Organic Wild Collected Products. Internaional Trade Centre; IFOAM. Bosnia-Herzegovina.

Chan, Kai M.A.; Satterfield, Terre; Goldstein, Joshua (2012): Rethinking ecosystem services to better address and navigate cultural values. In: *Ecological Economics* 74, S. 8–18. DOI: 10.1016/j.ecolecon.2011.11.011.

Chao, Anne; Chazdon, Robin L.; Colwell, Robert K.; Shen, Tsung-Jen (2006): Abundance-based similarity indices and their estimation when there are unseen species in samples. In: *Biometrics* 62 (2), S. 361–371. DOI: 10.1111/j.1541-0420.2005.00489.x.

Cohan, Sara (2005): A Brief History of the Armenian Genocide. In: *Social Education* 69 (6), S. 333–337.

Cruz-Garcia, Gisela. S.; Sachet, Erwan.; Vanegas, Martha.; Piispanen, Kyle. (2016): Are the major imperatives of food security missing in ecosystem services research? In: *Ecosystem Services* 19, S. 19–31. DOI: 10.1016/j.ecoser.2016.04.001.

Cruz-Garcia, Gisella S.; Price, Lisa L. (2014): Gathering of wild food plants in anthropogenic environments across the seasons. Implications for poor and vulnerable farm households. In: *Ecology of food and nutrition* 53 (4), S. 363–389. DOI: 10.1080/03670244.2013.808631.

Dingarac, S. (15. November): Armenia. Gegharunik guide book. With the cooperation of A. Arakelyan, H. Maghakyan and A. Ghazanchyan, 15. November. Online available at https://issuu.com/svetlanadingarac/docs/gegharkunik_guide_book-3/3.

Egoh, Benis. N.; O'Farrel, Patrick. J.; Charef, Aymen.; Gurney, Leigh. J.; Koellner, Thomas.; Abi, Henry. N. et al. (2012): An African account of ecosystem service provision. Use, threats and policy options for sustainable livelihoods. In: *Ecosystem Services* 2, S. 71–81. DOI: 10.1016/j.ecoser.2012.09.004.

Fagerholm, Nora; Käyhkö, Niina; Ndumbaro, Festo; Khamis, Miza (2012): Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services. In: *Ecological Indicators* 18, S. 421–433. DOI: 10.1016/j.ecolind.2011.12.004.

FAO (1995): Armenia: Country Report to the FAO International Technical Conference on Plant Genetic Resources. With the cooperation of Armenian Ministry of Agriculture. FAO. Yerevan.

FAO (1997): The State of the World's Plant Genetic Resources for Food and Agriculture. FAO. Rome.

FAO (2008): Country report on the State of Plant Genetic Resources for Food and Agriculture. National report on the State of Plant Genetic Resources in Armenia. With the cooperation of Ministry of Agriculture of the Republic of Armenia. Yerevan. Online available at http://www.fao.org/3/i1500e/Armenia.pdf, last checked on 23.09.2019.

FiBL; IFOAM (2019): The world of organic agriculture. Statistics & emerging trends 2019. Bonn: Frick. Online available at http://www.organic-world.net/yearbook/yearbook-2019.html.

Fiese, Barbara H.; Pratt, Michael W. (2004): Metaphors and Meanings of Family Stories: Integrating Life Course and Systems Perspectives on Narrative. In: Family stories and the life course: Across time and generations. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, S. 401–418.

Gabrielian, Eleonora; Zohary, Danial (2004): Wild relatives of food crops native Armenia and Nakhichevan. In: *Flora Mediterranea* 14, S. 1–76.

Gabrielyan, Emil; Amroyan, Elmira; Zakayan, Annet; Grigoryan, Gagik (2004): The Regulation of Herbal Medicinal Products in Armenia. In: *Drug Information Journal* 38, S. 273–281.

Garcia-Martin, Maria; Fagerholm, Nora; Bieling, Claudia; Gounaridis, Dimitris; Kizos, Thanasis; Printsmann, Anu et al. (2017): Participatory mapping of landscape values in a Pan-European perspective. In: *Landscape Ecol* 32 (11), S. 2133–2150. DOI: 10.1007/s10980-017-0531-x.

Gray, Clark L.; Bozigar, Matthew; Bilsborrow, Richard E. (2015): Declining Use of Wild Resources by Indigenous Peoples of the Ecuadorian Amazon. In: *Biological conservation* 182, S. 270–277. DOI: 10.1016/j.biocon.2014.12.022.

GTZ Armenia (2010): Analysis of Legal Institutional Frameworks for Value Chains Based on Biodiversity and Respective Business Practices. GTZ. Yerevan.

GTZ Armenia (2011): Sampling and organizing testing of biodiversity products. Sustainable Management of Biodiversity, South Caucasus. With the cooperation of Eco-Globe NGO.

Gubbi, Sanjay; MacMillan, Douglas C. (2008): Can non-timber forest products solve livelihood problems? A case study from Periyar Tiger Reserve, India. In: *ORX* 42 (2), S. 222–228. DOI: 10.1017/S0030605308071111.

Hovsepyan, Roman; Stepanyan-Gandilyan, Nina; Melkumyan, Hamlet; Harutyunyan, Lili (2016): Food as a marker for economy and part of identity. Traditional vegetal food of Yezidis and Kurds in Armenia. In: *Journal of Ethnic Foods* 3 (1), S. 32–41. DOI: 10.1016/j.jef.2016.01.003.

Hovsepyan, Roman; Stepanyan-Gandilyan, Nina; Stollberg, Christian (2019): Phytomedicinal Knowledge and “Official” Sources in Tatev (Armenia). In: *Ethnobiology Letters* 10 (1), S. 23–34. DOI: 10.14237/ebl.10.1.2019.1266.

Hussain, S.; Vause, J. (2018): TEEB for Agriculture & Food: background and objectives. In TEEB for Agriculture & Food: Scientific and Economic Foundations. UN Environment. Geneva.

Kaoma, Humphrey; Shackleton, Charlie M. (2015): The direct-use value of urban tree non-timber forest products to household income in poorer suburbs in South African towns. In: *Forest Policy and Economics* 61, S. 104–112. DOI: 10.1016/j.forpol.2015.08.005.

Khumalo, Sibonginkosi Gugulethu; Fröde, Alexander Fröde; Sola, Phosiso (2013): Guidelines for Sustainable Harvesting of Traiditional Medicinal Plants in Zimbabwe. With the cooperation of Ministry of Environment and Tourism. Research and Development Section Southern Alliance for Indigenous Resources (SAFIRE). Harare, Zimbabwe. Online available at http://projects.nri.org/adappt/docs/HarvestingGuidelines.pdf, last modified 13.11.2013, last checked on 18.10.2019.

Looman, J.; Campbell J. B. (1960): Adaptation of Sorensen's K (1948) for Estimating Unit Affinities in Prairie Vegetation. In: *Ecology* 41 (3), S. 409–416. Online available at https://www.jstor.org/stable/1933315, last checked on 07.02.2020.

Ludwig. J. A.; Reynolds, J. F. (1988): Statistical Ecology: A Primer on Methods and Computing. New York: Wiley.

MA (2005): Ecosystems and Human Well-being. Health Synthesis. With the cooperation of Millennium Ecosystem Assessment and World Health Organization. WHO Press. France.

Magurran, A. E. (2004): Measuring Biological Diversity. Oxford: Blackwell Publishing.

Manoogian, Margaret M.; Walker, Alexis J.; Richards, Leslie N. (2007): Gender, Genocide, and Ethnicity. The Legacies of Older Armenian American Mothers. In: *Journal of Family Issues* 28 (4), S. 567–589. DOI: 10.1177/0192513X06297605.

McDonough, Kelsey; Hutchinson, Stacy; Moore, Trisha; Hutchinson, Shawn J.M. (2017): Analysis of publication trends in ecosystem services research. In: *Ecosystem Services* 25, S. 82–88. DOI: 10.1016/j.ecoser.2017.03.022.

McLain, Rebecca J.; Hurley, Patrick T.; Emery, Marla R.; Poe, Melissa R. (2013): Gathering “wild” food in the city. Rethinking the role of foraging in urban ecosystem planning and management. In: *Local Environment* 19 (2), S. 220–240. DOI: 10.1080/13549839.2013.841659.

McMichael, Anthony J.; Powles, John W.; Butler, Colin D.; Uauy, Ricardo (2007): Food, livestock production, energy, climate change, and health. In: *The Lancet* 370 (9594), S. 1253–1263. DOI: 10.1016/S0140-6736(07)61256-2.

Menendez-Baceta, Gorka; Aceituno-Mata, Laura; Tardío, Javier; Reyes-García, Victoria; Pardo-de-Santayana, Manuel (2012): Wild edible plants traditionally gathered in Gorbeialdea (Biscay, Basque Country). In: *Genetic Resources and Crop Evolution* 59 (7), S. 1329–1347. DOI: 10.1007/s10722-011-9760-z.

Mirzoyan, Gayane (2017): Kalavan and the Art of Living. JAM news. Online available at https://jam-news.net/kalavan-and-the-art-of-living/, last checked on 14.05.20.

Mollee, Eefke; Pouliot, Marième; McDonald, Morag A. (2017): Into the urban wild. Collection of wild urban plants for food and medicine in Kampala, Uganda. In: *Land Use Policy* 63, S. 67–77. DOI: 10.1016/j.landusepol.2017.01.020.

Müller, Alexander; Sukhdev, Pavan (2018): Measuring What Matters in Agriculture and Food Systems. A Synthesis of the Results and Recommendations of TEEB for Agriculture and Food's Scientific and Economic Foundations Report. TEEB: UN Environment. Geneva, last modified 2018.

National Statistical Service of the Republic of Armenia (2008a). RA Gegharkunik Marz. In: National Statistical Service of the Republic of Armenia (Hg.): Marzes of Republic of Armenia in Figures. Yerevan, S. 224–230.

National Statistical Service of the Republic of Armenia (2008b): RA Aragatsotn Marz. In: National Statistical Service of the Republic of Armenia (Hg.): Marzes of Republic of Armenia in Figures. Yerevan, S. 203–210.

Organic Armenia: Armenian Organic and Natural Products. Catalogue.

Poe, Melissa R.; McLain, Rebecca J.; Emery, Marla; Hurley, Patrick T. (2013): Urban Forest Justice and the Rights to Wild Foods, Medicines, and Materials in the City. In: *Human Ecology* 41 (3), S. 409–422. DOI: 10.1007/s10745-013-9572-1.

Pritchard, Rose; Grundy, Isla M.; van der Horst, Dan; Ryan, Casey M. (2019): Environmental Incomes Sustained as Provisioning Ecosystem Service Availability Declines Along a Woodland Resource Gradient in Zimbabwe. In: *World Development* 122, S. 325–338. DOI: 10.1016/j.worlddev.2019.05.008.

Rasmussen, Laura Vang; Mertz, Ole; Christensen, Andreas E.; Danielsen, Finn; Dawson, Neil; Xaydongvanh, Pheang (2016): A Combination of Methods Needed to Assess the Actual Use of Provisioning Ecosystem Services. In: *Ecosystem Services* 17, S. 75–86. DOI: 10.1016/j.ecoser.2015.11.005.

Reyes-García, Victoria; Menendez-Baceta, Gorka; Aceituno-Mata, Laura; Acosta-Naranjo, Rufino; Calvet-Mir, Laura; Domínguez, Pablo et al. (2015): From Famine Foods to Delicatessen. Interpreting Trends in the Use of Wild Edible Plants Through Cultural Ecosystem Services. In: *Ecological Economics* 120, S. 303–311. DOI: 10.1016/j.ecolecon.2015.11.003.

Rowland, Richard H. (2007): Recent Demographic Trends in Armenia. Results of the 2001 Census and Update to 2006. In: *Eurasian Geography and Economics* 48 (1), S. 73–94. DOI: 10.2747/1538-7216.48.1.73.

Royal Society (2009): Reaping the benefits. Royal Society. London, UK.

Sachs, Jeffrey D. (2012): From Millennium Development Goals to Sustainable Development Goals. In: *The Lancet* 379 (9832), S. 2206–2211. DOI: 10.1016/S0140-6736(12)60685-0.

Sarian, Armand (1996): Economic Challenges Faced by the New Armenian State. In: *Demokratizatsiya*, S. 193–222.

Schindler, Heiko; Ponsens, Jenni; Schneider, Antonia (2010): Manual for Sustainable Wild Collection Practices. With the cooperation of Federal Ministry for Economic Cooperation and Development, GTZ, FairWild and Bio Foundation Switzerland. Institute for Marketecology BIO Foundation Switzerland. Switzerland. Online available at https://static1.squarespace.com/static/5bec424b297114f64cb908d8/t/5cc9755b4785d307eac2e04d/1556706659380/IMO-Sustainable-Wild-Collection-Practices.pdf, last checked on 21.10.2019.

Schippmann, Uwe; Leaman, Danna; Cunningham, A. B. (2006): A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainablility aspects. In: R. J. Bogers, L. E. Craker and D. Lange (Hg.): Medicinal and aromatic plants. Netherlands: Springer, S. 75–95.

Schlesinger, J.; Drescher, A.; Shackleton, C. M. (2015): Socio-spatial Dynamics in the Use of Wild Natural Resources. Evidence from Six Rapidly Growing Medium-sized Cities in Africa. In: *Applied Geography* 56, S. 107–115. DOI: 10.1016/j.apgeog.2014.11.013.

Schulp, Catharina J.E.; Thuiller, Wilfried; Verburg, Peter H. (2014): Wild Food in Europe. A Synthesis of Knowledge and Data of Terrestrial Wild Food as an Ecosystem Service. In: *Ecological Economics* 105, S. 292–305. DOI: 10.1016/j.ecolecon.2014.06.018.

Schunko, Christoph; Vogl, Christian R. (2010): Organic Farmers Use of Wild Food Plants and Fungi in a Hilly Area in Austria (Styria). In: *Journal of ethnobiology and ethnomedicine* 6 (17), S. 1–14. Online available at http://www.ethnobiomed.com/content/6/1/17.

Sogbohossou, O. E.D.; Achigan-Dako, E. G.; Komlan, F. A.; Ahanchede, A. (2015): Diversity and Differential Utilization of Amaranthus spp. along the Urban-Rural Continuum of Southern Benin. In: *Economic Botany* 69 (1), S. 9–25.

Sõukand, Renata (2016): Perceived Reasons for Changes in the Use of Wild Food Plants in Saaremaa, Estonia. In: *Appetite* 107, S. 231–241. DOI: 10.1016/j.appet.2016.08.011.

Stryamets, Nataliya; Elbakidze, Marine; Ceuterick, Melissa; Angelstam, Per; Axelsson, Robert (2015): From economic survival to recreation. Contemporary uses of wild food and medicine in rural Sweden, Ukraine and NW Russia. In: *Journal of ethnobiology and ethnomedicine* 11 (53), S. 1–18. DOI: 10.1186/s13002-015-0036-0.

Tabuti, J.R.S. (2007): Status of non-cultivated food plants in Bulamogi County, Uganda. In: *African Journal of Ecology* 45 (1), S. 96–101.

Tarmanyan, K.; Fayvush, G.; Nanagulyan, S.; Danielyan, T. (2010): Red Book of Plants of the Republic of Armenia.

Termote, Céline; van Damme, Patrick; Dhed'a Djailo, Benoît (2011): Eating from the wild. Turumbu, Mbole and Bali traditional knowledge on non-cultivated edible plants, District Tshopo, DRCongo. In: *Genetic Resources and Crop Evolution* 58 (4), S. 585–618. DOI: 10.1007/s10722-010-9602-4.

Treweek, J. R.; Brown, Claire; Bubb, Philip (2006): Assessing biodiversity impacts of trade: a review of challenges in the agriculture sector. In: *Impact Assessment and Project Appraisal* 24 (4), S. 299–309. DOI: 10.3152/147154606781765057.

Tunyan, Bagrat (2005): The Shadow Economy of Armenia. Size, Causes and Consequences. The World Bank Armenia Country Office, Armenian National Policy Research Group.

Vandebroek, Ina; Reyes-García, Victoria; Albuquerque, Ulysses P. de; Bussmann, Rainer; Pieroni, Andrea (2011): Local knowledge. Who cares? In: *Journal of ethnobiology and ethnomedicine* 7 (35), S. 1–7. Online available at http://www.ethnobiomed.com/content/7/1/35, last checked on 21.05.2020.

Vann, Karine (2016): A Taste of the Wild Side. Finding Local Flavor in Armenia's Edible Highlands. Smithsonian Center for Folklife and Cultural Heritage. Online available at https://www.smithsonianmag.com/travel/taste-wild-side-out-yerevan-and-armenias-local-dishes-180960889/, last checked on 13.05.2020.

Wehi, Priscilla M.; Wehi, William L. (2010): Traditional Plant Harvesting in Contemporary Fragmented and Urban Landscapes. In: *Conservation biology : the journal of the Society for Conservation Biology* 24 (2), S. 594–604. DOI: 10.1111/j.1523-1739.2009.01376.x.

WHO (1993): Guidelines on the Conservation of Medicinal Plants. Gland Switzerland: World Health Organization; World Conservation Union; World Wide Fund for Nature.

Annex

Annex 1: Questionnaire about wild harvest in rural Armenia

Declaration of confidentiality

Good Day. We are students from the American University of Armenia. We are conducting a research project to understand how communities in rural Armenia use and harvest plants from the wild. The aim of this project is to help improve and prolong the use of wild plants in your area.
We would need 20-30 minutes of your time to ask you some questions. Your answers to our questions will greatly help us with our project. Your answers will be confidential. Nobody within the community or beyond, neither authorities nor enterprises, will be able to connect your answers with your person. Also, researchers involved will keep all data strictly anonymous

1/10 General questions about wild harvest

1.1. How many years have you been collecting wild plants in this area?

_____ years

1.2. How did you learn which plants you can harvest?

- ☐ Parents
- ☐ Grandparents
- ☐ Other relatives
- ☐ Friends/neighbors
- ☐ Books
- ☐ School program
- ☐ Other. Please specify:

  _____

1.3. Do you normally collect alone or are you accompanied by others for wild harvest? For example, do you take your children with you to teach them about wild harvest? Are you joined by other members of the community?

- ☐ I normally go alone
- ☐ I am accompanied by:

  _____

2/10 Question about the plants collected

Please list the plants that you harvest from the wild throughout the year. Name one plant and answer the two questions below, then proceed to the next plant until you have listed all the plants that you harvest from the wild.

Plant name					
Please select all the reasons that you harvest this plant for					
Medicinal purpose Cooking meals Spice or seasoning Tea or drinks Making preserves Ornamental plants Other					
Please select all the plant parts that you use of this plant					
Whole plant or Leaves Fruits, berries, nuts Flowers Stem Root Other (bark, sap etc.)					

Plant name					
Please select all the reasons that you harvest this plant for					
Medicinal purpose Cooking meals Spice or seasoning Tea or drinks Making preserves Ornamental plants Other					
Please select all the plant parts that you use of this plant					
Whole plant or Leaves Fruits, berries, nuts Flowers Stem Root Other (bark, sap etc.)					

3/10 Questions about the plants most important for consumption

We would now like to know which are the 3 most important plants for you own consumption that you harvest from the wild. Please name one plant and answer the questions, then proceed to the next plant.

3.1. Name of the plant: _____

3.1.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

3.1.2. How many times to you harvest this plant per year?
_____

3.1.3. How many kilograms do you harvest of this plant per year?

3.2. Name of the plant: _____

3.2.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

3.2.2. How many times to you harvest this plant per year?
_____

3.2.3. How many kilograms do you harvest of this plant per year?

3.3. Name of the plant: _____

3.3.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

3.3.2. How many times to you harvest this plant per year?
_____

3.3.3. How many kilograms do you harvest of this plant per year?

Do you collect wild plants to sell them? (otherwise skip to 5/10)
- □ Yes
- □ No

4/10 Questions about the plants most important for selling

We would now like to know which are the 3 most important plants for you for selling that you harvest from the wild, i.e. the plants that you generate the most income from. Please name one plant and answer the questions, then proceed to the next plant.

4.1. Name of the plant: _____

4.1.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

4.1.2. How many times to you harvest this plant per year?
_____

4.1.3. How many kilograms do you harvest of this plant per year?

4.2. Name of the plant: _____

4.2.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

4.2.2. How many times to you harvest this plant per year?
_____

4.2.3. How many kilograms do you harvest of this plant per year?

4.3. Name of the plant: _____

4.3.1. When do you harvest this plant?
- □ Start of the harvest season: _____
- □ End of the harvest season: _____

4.3.2. How many times to you harvest this plant per year?
_____

4.3.3. How many kilograms do you harvest of this plant per year?

5/10 Questions about harvesting techniques

5.1. How do you harvest leaves?
- □ I pluck individual leaves of a branch
- □ I strip all the leaves of a branch
- □ I cut of branches to harvest the leaves later

5.2. How do you harvest fruits, berries or nuts?
- □ I collect only a few high-quality fruits in an area
- □ I collect all the high-quality fruits in an area
- □ I collect all the fruits in an area regardless of their quality

5.3. How do you harvest roots?
- □ I take only parts of the root without taking out the whole plant
- □ I dig up the whole plant and take the whole root

5.4. How do you harvest grasses and herbs?
- □ I only take parts of a single plant
- □ I only take a few plants from an area
- □ I collect as many plants as I can find in an area

5.5. How do you harvest ornamental plants and flowers?
- □ I only take parts of a single plant
- □ I only take a few plants from an area
- □ I collect as many plants as I can find in an area

5.6. If you collect a plant more than once in a year: Which of the following statements describes your usual harvesting routine most accurately?
- □ I go to a different area for each harvest even if there are still plants in the previous area
- □ I go to a different area if I cannot find enough of the plant in the previous area anymore
- □ I collect the plant in the same area each time

5.7. Are there any general practices you noticed that might affect next year's harvest in a negative way?

_____

5.8. Did you ever learn about sustainable harvest (i.e. harvesting plants in a way that they are still available in the future)? Either through a training, books or from other sources?
- □ Yes
- □ No
- □ If there was a training offered, who conducted it?
  _____

5.9. What makes wild harvest difficult? Are there any problems that you face? (e.g. bad roads, difficulty identifying a plants etc?)

_____

6/10 Questions about changes in plant availability

6.1. Do you have to walk a further distance to collect certain plants than you did 5 years ago?
- □ Yes
- □ No
- □ If yes, which plants do you walk further for to collect them?
  _____

6.2. Are the plants you collect in worse condition and/or infected by pests in comparison to 5 years ago?
- □ Yes
- □ No
- □ If yes, which plants are worse off?
  _____

6.3. Are there any plants that you cannot find locally anymore that you could find 5 years ago?

- □ Yes
- □ No
- □ If yes, which plants are these?

  _____

6.4. Are you aware of any endangered species that are prohibited to collect in your area?

- □ Yes
- □ No
- □ If yes, which plants are these?

  _____

7/10 Geographical components of wild harvest

7.1. Changes in plant availability:
Have you perceived any changes in plant availability in the past 5 years? Can you point out these areas on the map? You can place as many points as you want:

What kind of changes are these?

_____

7.2. Are there areas that are especially important to you for wild harvest? Can you point out these areas on a map? You can place as many points as you want.

8/10 Questions regarding the socioeconomic side of wild harvest

8.1. Please rank the following reasons why wild harvest is important for you:

	very important harvest	important	not very important	I do not for this reason
Leisure time activity	□	□	□	□
Own /consumption	□	□	□	□
Selling/generating income	□	□	□	□
Other	□	□	□	□

If other, please specify: _____

8.2. How many hours do you spend on average collecting wild plants in a week during harvesting season?

_____ hours

8.3. How many hours do you spend on average processing the harvested plants that you collect in such a week?

_____ hours

8.4. Please provide a list of resources and materials that you use for harvest and processing until consumption or selling a plant. Examples are fuel, harvesting tools, storage containers, drying apparatus etc.

_____

8.5. Do you harvest wild plants for selling? (otherwise skip to 10/10)

- ☐ Yes
- ☐ No

9/10 Questions about selling wild plants

9.1. How much of your income do you generate from selling wild plants? Please give an estimate in percent:

_____ %

9.2. Who do you sell wild plants to? (multiple answers possible)

- ☐ Intermediary (e.g. a broker).
- ☐ Processor (e.g. a restaurant, a herbal shop etc.)
- ☐ Consumers
- ☐ Other.

9.2.1. If you are selling to an intermediary or a processor, can you give the name of the person or the company?

_____

9.3. What kind of problems do you face when selling plants? (e.g. quality requirements of buyers, lack of market access etc.)

_____

Do you normally process wild plants before selling them? For example, do you dry the plants instead of just selling the raw material collected? (e.g. drying, making preserves, making beverages, et cetera)

- ☐ Yes
- ☐ No

If yes, how do you process wild plants before selling them?

_____

_

9.4. Are there any problems when processing plants? (e.g. bad weather for drying, lack of equipment etc.)

_____

10/10 Background information

10.1. How old are you?

_____ years

10.2. Are you female or male?

- Female
- Male

10.3. How many people live in your household including yourself?

_____ people

10.4. If you are not living alone, who else is living in your household besides yourself?

_____

10.5. What is your highest level of education?

- finished elementary school
- finished high school
- finished vocational school
- finished university bachelor
- finished university master
- higher

10.6. What is your current occupation?

- I'm occupied in the production sector (e.g. agriculture, forestry)
- I'm occupied in the processing sector (e.g. food industry, electrical industry)
- I'm occupied in the service sector (e.g. tourism, public health and medical services, media and communication)
- Homeworker
- Student
- Unemployed
- Retired
- Unfit for work or disabled

Thank you very much for participating!

Comments of the facilitator

The survey was

- A test
- Finished
- Unfinished. If not finished, why?

  _____

Further comments

_____

Annex 2: List of plants mentioned in the survey

Table 3: List of plant species mentioned by people in alphabetical order. Shown is how often a plant was mentioned in total as well as how many times it was mentioned in the communities under investigation.

Scientific plant name	English name	Armenian name	Collection total	Collection by community			
				Kuchak	Kalavan	Geghadzor	Dprabak
Achillea millefolium L.	yarrow	Հազարատերևուկ	3	1	-	2	-
Arctium palladinii Grossh.	burdock	Կռատուկ	2	-	-	2	-
Amaranthus blitoides S.Watson	amaranth	Հավակատար	1	-	1	-	-
Artemisia absinthium L.	absinthe wormwood	Դառը օշինդր	1	-	1	-	-
Artemisia fragrans Willd.	wormwood	Յավշան (օշինդր)	1	1	-	-	-
Asparagus officinalis L.	asparagus	Ծնեբեկ	2	-	2	-	-
Astrodaucus orientalis (L.) Drude		Մանդակ	1	-	-	1	-
Berberis vulgaris L.	common barberry	Բարբարիս	1	-	1	-	-
Bilacunaria microcarpa (M.Bieb) Pimenov & V.N. Tikhom	hornbeam	Բոխի	3	-	3	-	-
Bidens tripartita L.	three-lobe beggartick	Կատվալեզու	1	-	-	-	1
Brassica rapa L.	Turnip rape	Շաղգամ	1	-	1	-	-
Calendula officinalis L.	common marigold	Վաղենակ	1	-	-	-	1
Capsella bursa-pastoris (L.) Medik.	shepherd's purse	Ծտապաշար	1	-	1	-	-
Cephalaria gigantea (Ledeb.) Bobrov	Tatarian cephalaria	Ղանթապա	6	-	2	3	1
Cephalaria sp.		Արտնջիվան	3	-	-	3	-
Chaenomeles sinensis (Dum.Cours.) Kohene.		Սերկևիլ	1	-	-	-	1
Chaerophyllum bulbosum L.	turnip-rooted chervil	Շուշան	19	6	8	5	-
Chenopodium album L.	white goosefoot	Թելուկ	1	-	1	-	-
Cichorium intybus L.	common chicory	Եղերդակ	1	-	-	1	-
Coriandrum sativum L.	coriander	Համեմ	1	1	-	-	-
Crataegus sp.	hawthorn	Ալոճ	7	1	3	3	-

Scientific plant name	English name	Armenian name	Collection total	Collection by community			
				Kuchak	Kalavan	Geghadzor	Dprabak
Elaeagnus rhamnoides (L.) A. Nelson	sea-buckthorn	Չիչխան	1	1	-	-	-
Epilobium angustifolium L.	fireweed	Իվանթեյ	1	-	-	1	-
Falcaria vulgaris Bernh.	sickle weed	Սիբեխ	6	4	-	2	-
Fragaria vesca L.	wild strawberry	Վայրի ելակ	5	1	4	-	-
Helichrysum plicatum DC.	strawflower	Անթառամ	1	-	-	1	-
Heracleum sp.	hogweed	Քեղ (Կոծուկ)	1	-	-	1	-
Hypericum perforatum L.	St. John's wort	Սրոհունդ	7	1	2	2	2
Juglans regia L.	walnut	Ընկույզ	1	-	-	-	1
Leonurus cardiaca L.	motherwort	Առյուծագի	1	-	-	1	-
Malva neglecta Wallr.	common mallow	Փիփերթ	8	1	7	-	-
Matricaria sp.	chamomile	Երիցուկ	10	1	2	3	4
Mentha longifolia (L.) L.	ross mint	Դաղձ	19	4	7	4	4
Mentha x *piperita* L.	peppermint	Անանուխ	4	2	1	1	-
Mespilus germanica L.	medlar	Ձկեռ	3	-	3	-	-
Narcissus sp.	daffodil	Նարգիզ	2	-	2	-	-
Nuphar lutea (L.) Sm.	yellow water-lily	Նունուֆար	1	-	-	1	-
Onopordum acanthium L.	cotton thistle	Կաղշնակ	1	-	-	1	-
Origanum vulgare L.	oregano	Խնկածաղիկ	10	1	3	2	4
Plantago sp.	plantain	Եզան լեզու	5	1	-	2	2
Polygonatum sp.	Solomon's seal	Սինդրիկ	5	-	5	-	-
Polygonum aviculare L.	common knotgrass	Մանդիկ ծտային	1	-	-	1	-
Portulaca oleracea L.	common purslane	Դանդուռ	1	1	-	-	-
Primula veris subsp. *macrocalyx* (Bunge) Lüdi	primrose	Գնարբուկ	3	-	-	1	2
Prunus cerasifera Ehrh.	cherry plum	Վայրի սալոր	7	2	4	-	1
Prunus spinosa L.	blackthorn	Մամուխ	8	-	7	-	1
Pulsatilila albana (Stev.) Bercht. & J. Presl.	pasque flower	Քնախոտ	1	-	-	1	-
Pyrus caucasica Fed.	wild pear	Վայրի տանձ	14	5	8	-	1
Quercus macranthera Fisch & C.A.Mey. ex Hohen.	Caucasian oak	Վայրի կաղին	2	-	2	-	-

Scientific plant name	English name	Armenian name	Collection total	Collection by community			
				Kuchak	Kalavan	Geghadzor	Dprabak
Rhamnus pallasii Fisch & C.A.Mey.	buckthorn	Դժնիկ	1	-	-	-	1
Ribes nigrum L.	black currant	Հաղարջ	2	-	2	-	-
Rosa sp.	rosehip	Մասուր	19	6	8	3	2
Rubus idaeus L.	raspberry	Ազնվամորի	9	1	8	-	-
Rubus sp.		Մոշ	1	-	1	-	-
Rumex crispus L.	curled sorrel	Ավելուկ	19	6	8	5	-
Salvia nemorosa L.	woodland sage	Եղեսպակ	1	-	-	1	-
Satureja hortensis L.	summer savory	Ծիթրոն	3	-	1	2	-
Sempervivum transcaucasicum Muirhead.	houseleek	Գառան դմակ	4	-	4	-	-
Taraxacum campylodes G.E.Haglund.	dandelion	Խատուտիկ	4	-	-	2	2
Teucrium polium L.	felty germander	Մայրամախոտ	4	-	-	1	3
Thymus kotschyanus Boiss. & Hohen.	thyme	Ուրց	16	1	8	3	4
Tilia cordata Mill.	small-leaved linden	Լորենի	4	-	1	-	3
Tragopogon pratensis L.	meadow salsify	Սինձ	1	-	-	1	-
Triticum diococcoides (Körn. ex. Asch. & Graebn.) Schweinf.	emmer	Հաճար	4	-	4	-	-
Tussilago farfara L.	coltsfoot	Տատրակ	2	-	1	1	-
Urtica dioica L.	stinging nettle	Եղինջ	15	3	7	2	3
Valeriana officinalis L.	valerian	Կատվախոտ	3	-	1	2	-
Viola odorata L.	wood violet	Մանուշակ	1	-	1	-	-

Annex 3: Additional information about the use of plants

Table 4: Additional information given on the use of plants. This information was provided spontaneously by the respondents.

Community	Respondent	Plant	Category	Additional information
Kuchak	KU1	*Pyrus caucasica* Fed	Medicinal purpose	Diarrhea
	KU3	*Coriandrum sativum* L.	Medicinal purpose	Regulates blood pressure
	KU4	*Chaerophyllum bulbosum* L	Medicinal purpose	Heart problems
	KU4	*Rumex crispus* L.	Medicinal purpose	Diarrhea, digestive problems
	KU4	*Mentha* x *piperita* L.	Medicinal purpose/ Spice	Nausea Added to meat in tolma (traditional Armenian dish)
	KU4	*Origanum vulgare* L.	Medicinal purpose	Good for female reproduction
	KU4	*Achillea millefolium* L.	Medicinal purpose/ Other use	Dental hygiene, Anti-inflammatory (animal wounds)
	KU4	*Elaeagnus rhamnoides* (L.) A. Nelson	Medicinal purpose	Sunburn
	KU4	*Urtica dioica* L.	Medicinal purpose	Diabetes
	KU5	*Thymus kotschyanus* Boiss. & Hohen.	Medicinal purpose	Lowers blood pressure (dangerous in high dosis)
	KU5	*Achillea millefolium* L.	Medicinal purpose	Dental hygiene, anti-inflammatory on wounds, gastrointestinal tract (give it to calves as well)
	KU5	*Plantago* sp.	Medicinal purpose	Stomach problems, on wounds
	KU5	*Malva neglecta* Wallr.	Medicinal purpose	Stomach problems
	KU5	*Rubus idaeus* L.	Medicinal purpose/ Spice	Painkiller (“aspirin”) Leaves used for tolma
Kalavan	KA1	*Amaranthus blitoides* S.Watson	Medicinal purpose	Cancer
	KA3	*Hypericum perforatum* L.	Other use	Cosmetics
	KA3	*Malva neglecta* Wallr.	Medicinal purpose	Bronchitis
	KA3	*Matricaria* sp.	Other use	Cosmetics
	KA3	*Mentha longifolia* L.	Other use	Cosmetics
	KA3	*Artemisia absinthium* L.	Other use	Broom making
	KA6	*Rumex crispus* L.	Medicinal purpose	Constipation
	KA7	*Urtica dioica* L.	Medicinal purpose	Dandruff
	KA9	*Matricaria* sp.	Medicinal purpose	Detox

Community	Respondent	Plant	Category	Additional information
Geghadzor	GE1	*Rosa* sp.	Medicinal purpose	Good for kidneys
	GE2	*Cephalaria gigantea* (Ledeb.) Bobrov	Medicinal purpose	Common cold, stomach problems, fever
	GE4	*Mentha longifolia* (L.) L.	Other use	Aroma
	GE4	*Valeriana officinalis* L.	Medicinal purpose	Heart problems
	GE4	*Urtica dioica* L.	Other use	Cosmetics
	GE4	*Teucrium polium* L.	Medicinal purpose	Female reproduction, menstruation, hormonal balance
	GE4	*Origanum vulgare* L.	Medicinal purpose/ Other use	Anti-inflammatory on wounds Heat infections of cattle
	GE4	*Plantago* sp.	Medicinal purpose	Good for female reproduction, detox tea after menstruation, hormonal imbalances
	GE4	*Arctium palladinii* Grossh.	Medicinal purpose/ Other use	Dandruff, joint pain Cosmetics
	GE4	*Taraxacum campylodes* G.E.Haglund.	Other use	Cosmetics
	GE5	*Primula veris* subsp. *macrocalyx* (Bunge) Lüdi	Other use	Symbolic flower on Ascension Day
	GE5	*Mentha longifolia* (L.) L.	Other use	Symbolic flower of Aphrodite
	GE5	*Falcaria vulgaris* Bernh.	Medicinal purpose	Curing ulcers
	GE5	*Tragopogon pratensis* L.	Medicinal purpose/ Cooking (food)	Stomach illnesses Mountain chewing gum
	GE5	*Heracleum* sp.	Medicinal purpose	Good for thyroid and blood pressure
	GE5	*Achillea millefolium* L.	Medicinal purpose	Antibiotic, anti-inflammatory (deep wounds), good for constipation
	GE5	*Plantago* sp.	Medicinal purpose/ Cooking	Wound healing (leaves), dental health (roots), cough (seeds) Leaves used for tolma
	GE5	*Salvia nemorosa* L.	Medicinal purpose	Good for the gums
	GE5	*Taraxacum campylodes* G.E.Haglund	Medicinal purpose/ Tea (beverages)	Good for the bowels, bronchitis Coffee (roots)
	GE5	*Arctium palladinii* Grossh.	Medicinal purpose	Thyroid, muscle/joint pain, hair loss (roots), menstrual pain

Community	Respondent	Plant	Category	Additional information
Geghadzor	GE5	*Urtica dioica* L.	Medicinal purpose	Hair loss (tea/brew), constipation, allergies (seeds)
	GE5	*Pulsatilila albana* (Stev.) Bercht. & J. Presl	Medicinal purpose	Menstrual cramps
	GE5	*Cichorium intybus* L.	Medicinal purpose	Diabetes (helps the body to produce insulin)
	GE5	*Origanum vulgare* L.	Medicinal purpose/ Other use	Good for fertility, wound healing (cattle) Cosmetics (perfume)
	GE5	*Epilobium angustifolium* L.	Medicinal purpose	Headache
	GE5	*Onopordum acanthium* L.	Medicinal purpose	Diabetes
Dprabak	DP1	*Cephalaria gigantea* (Ledeb.) Bobrov	Medicinal purpose	Heachache (“aspirin”)
	DP1	*Urtica dioica* L.	Other use	Cosmetics (shampoo, soap)
	DP4	*Bidens tripartite* L.	Medicinal purpose/ Other use	Skin conditions Cosmetics (shampoo, soap)
	DP4	*Urtica dioica* L.	Other use	Cosmetics (shampoo, soap)
	DP4	*Plantago* sp.	Medicinal purpose	Stomach ulcers
	DP4	*Teucrium polium* L.	Other use	Cosmetics (face wash)
	DP4	*Calendula officinalis* L.	Medicinal purpose	Anti-inflammatory (wounds), sore throat

Annex 4: Results of the Generalized linear model for plant collection

Table 5: Results of the generalized linear models for plant collection. Displayed are the plants that were mentioned at least 10 times in the interviews. Dependent variable was landscape type, covariates included community, harvest experience (years), and occupation. They were left in the model if their influence was significant.

Plant	Landscape type	Community	Number of people	Landscape type p-value	Covariates		
					Community	Harvest experience	Occupation
Turnip-rooted chervil (*Chaerophyllum bulbosum* L.)	Grassland	Kuchak	6 (100 %)	0.276	0.001	0.002	0.022
		Geghadzor	5 (100 %)				
	Forest	Kalavan	8 (100 %)				
		Dprabak	0 (0 %				
Ross mint (*Mentha longifolia* (L.) L.)	Grassland	Kuchak	4 (66.66 %)	0.417	-	-	0.014
		Geghadzor	4 (80 %				
	Forest	Kalavan	7 (87.5 %				
		Dprabak	4 (100 %)				
Rosehip (*Rosa* sp.)	Grassland	Kuchak	6 (100 %)	0.228	0.005	-	-
		Geghadzor	3 (60 %)				
	Forest	Kalavan	8 (100 %)				
		Dprabak	2 (50 %)				
Curled sorrel (*Rumex crispus* L.)	Grassland	Kuchak	6 (100 %)	0.276	0.001	0.002	0.022
		Geghadzor	5 (100 %)				
	Forest	Kalavan	8 (100 %)				
		Dprabak	0 (0 &)				

Plant	Landscape type	Community	Number of people	Landscape type p-value	Covariates		
					Community	Harvest experience	Occupation
Thyme (*Thymus kotschyanus* Boiss. & Hohen.)	Grassland	Kuchak	1 (16.66 %)	0.000	-	-	-
		Geghadzor	3 (60 %)				
	Forest	Kalavan	8 (100 %)				
		Dprabak	4 (100 %)				
Stinging nettle (*Urtica dioica* L.)	Grassland	Kuchak	3 (50 %)	0.061	-	-	-
		Geghadzor	2 (40 %)				
	Forest	Kalavan	7 (87.5 %)				
		Dprabak	3 (75 %)				
Wild pear (*Pyrus caucasica* Fed.)	Grassland	Kuchak	5 (83.33 %)	0.000	0.000	-	-
		Geghadzor	0 (0 %)				
	Forest	Kalavan	8 (100 %)				
		Dprabak	1 (25 %)				
Chamomile (*Matricaria* sp.)	Grassland	Kuchak	1 (16.66 %)	0.655	0.005	-	-
		Geghadzor	3 (60 %)				
	Forest	Kalavan	2 (25 %)				
		Dprabak	4 (100 %)				
Oregano (*Origanum vulgare* L.)	Grassland	Kuchak	1 (16.66 %)	0.472	0.041	-	-
		Geghadzor	2 (40 %)				
	Forest	Kalavan	3 (37.5 %)				
		Dprabak	4 (100 %)				

Annex 5: Most important plants listed in the survey

Table 6: Most important plants for own consumption. The table includes the plants that were listed only listed as important for own consumption and not for selling as well.

Plant name	Number listed	Respondent ID	Harvesting season	Quantity (kg)	
				Mean	SD
Chaerophyllum bulbosum L.	9	KU3, KU5, KA1, KA2, KA6, KA8, GE1, GE3, GE5	May - July	17.78	6.61
Coriandrum sativum L.	1	KU3	June – October	1	-
Falcaria vulgaris Bernh.	2	KU2, GE3	May – June	8	2
Hypericum perforatum L.	1	GE4	July – August	0.7	-
Matricaria sp.	1	GE2	September – October	2.5	-
Mentha longifolia (L.) L.	2	KU3, KU5	May – October	1	0
Mentha x *piperita* L.	1	KU4	May – November	10	-
Mespilus germanica L.	1	KA8	October	30	-
Prunus cerasifera Erh.	3	KU1, KA4, KA5	September – October	40	42.43
Prunus spinosa L.	2	KA3, KA7	September – November	26.25	3.75
Pyrus caucasica Fed.	4	KU1, KA2, KA4, KA5	September – October	350	165.83
Rosa sp.	7	KU1, KU4, KU6, KA2, KA3, KA4, KA5	September – November	33.75	19.24
Rubus idaeus L.	1	KA7	July – August	15	-
Rumex crispus L.	8	KU4, KU5, KA2, KA6, GE1, GE3, GE4, GE5	April – July	13.24	6
Satureja hortensis L.	1	GE1	July	5	-
Sempervivum transcaucasicum Muirhead.	1	KA2	April – May	30	-
Thymus kotschyanus Boiss. & Hohen.	3	KA2, KA3, KA8	May – October	4.33	0.94
Urtica dioica L.	1	GE5	April – May	4	-
Valeriana officinalis L.	1	GE4	July – August	0.15	-

Table 7: Most important plants for consumption. This table includes all the plants that were listed as most important for consumption. The plants and respondents that listed the same plant also as most important for selling are displayed in parenthesis

Plant name	Number listed	Respondent ID	Harvesting season	Quantity (kg)	
				Mean	SD
Chaerophyllum bulbosum L.	11	(KU2), KU3, KU5, KA1, KA2, KA6, KA8, GE1, (GE2), GE3, GE5	May - July	864.32	360
Coriandrum sativum L.	1	KU3	June – October	1	-
Falcaria vulgaris Bernh.	2	KU2, GE3	May – June	8	2
Hypericum perforatum L.	1	GE4	July – August	1	-
Matricaria sp.	1	GE2	September – October	2.5	-

Plant name	Number listed	Respondent ID	Harvesting season	Quantity (kg)	
				Mean	SD
Mentha longifolia (L.) L.	5	KU3, KU5, (KU6), (DP2), (DP4)	May – October	206.4	396.86
Mentha x *piperita* L.	1	KU4	May – November	10	-
Mespilus germanica L.	1	KA8	October	30	-
(Origanum vulgare L.)	2	(DP1), (DP2)	June – August	510	490
Prunus cerasifera Erh.	3	KU1, KA4, KA5	September – October	40	42.43
Prunus spinosa L.	2	KA3, KA7	September – November	26.25	3.75
Pyrus caucasica Fed.	7	KU1, (KA1), KA2, KA4, KA5, (KA6), (KA7)	September – October	735.18	1715.21
Rosa sp.	7	KU1, KU4, KU6, KA2, KA3, KA4, KA5	September – November	36.64	17.95
Rubus idaeus L.	1	KA7	July – August	15	-
Rumex crispus L.	11	(KU2), KU4, KU5, (KU6), KA2, KA6, GE1, (GE2), GE3, GE4, GE5	April – July	47.4	81.17
Satureja hortensis L.	1	GE1	July	5	-
Sempervivum transcaucasicum Muirhead.	1	KA2	April – May	30	-
(Teucrium polium L.)	1	(DP3)	July – August	10	-
Thymus kotschyanus Boiss. & Hohen.	8	(KA1), KA2, KA3, KA8, (DP1), (DP2), (DP3), (DP4)	May – October	123.88	245.01
(Tilia cordata Mill.)	3	(DP1), (DP2), (DP4)	June – July	670	466.69
Urtica dioica L.	1	GE5	April – May	4	-
Valeriana officinalis L.	1	GE4	July – August	0.15	-

Table 8: Most important plants for selling. The table includes all the plants that were listed as most important for selling.

Plant name	Number listed	Respondent ID	Harvesting season	Quantity (kg)	
				Mean	SD
Chaerophyllum bulbosum L.	3	KU1, KU2, GE2	May – June	1767	917.73
Mentha longifolia (L.) L.	4	KU6, KA1, DP2, DP4	May – October	259	427.85
Origanum vulgare L.	2	DP1, DP2	June – August	510	490
Pyrus caucasica Fed.	3	KA1, KA6, KA7	September – October	2883.33	1777.8
Rosa sp.	1	KU6	September – November	40	0
Rumex crispus L.	4	KU1, KU2, KU6, GE2	April – July	118.88	105.32
Teucrium polium L.	1	DP3	July – August	10	0
Thymus kotschyanus Boiss. & Hohen.	5	KA1, DP1, DP2, DP3, DP4	May – August	195.6	286.93
Tilia cordata Mill.	3	DP1, DP2, DP4	June – July	670	466.69

Declaration of originality

„Hiermit erkläre ich, Rüger, Miriam, geboren am 09. Oktober 1994, Matrikelnummer: 620176, an Eides statt, dass die vorliegende, an diese Erklärung angefügte Master-Arbeit selbstständig und ausschließlich unter Zuhilfenahme der im Literaturverzeichnis genannten Quellen angefertigt wurde und noch an keiner anderen Stelle vorgelegt wurde. Alle Stellen der Arbeit, die wörtlich oder sinngemäß aus Veröffentlichungen oder aus anderen fremden Mitteilungen entnommen wurden, sind als solche kenntlich gemacht.

Betreuer:

Prof. Dr. Claudia Bieling	Leitung Lehrstuhl für gesellschaftliche Transformation und Landwirtschaft, Universität Hohenheim
Alen Amirkhanian	Leitung Acopian Center for the Environment, American University of Armenia

Thema der Arbeit:

Wild Plants as an Ecosystem Service: Contextualizing Sustainability and Socioeconomic Impact in Rural Armenia.

Semester:

Sommersemester 2020

Ich erkläre weiterhin, dass den betreuenden Dozenten ein unverschlüsseltes digitales Textdokument der Arbeit übermittelt wurde, das in Inhalt und Wortlaut ausnahmslos der gedruckten Ausfertigung entspricht. Mir ist bekannt, dass diese digitale Version anhand einer Analyse-Software auf Plagiate überprüft werden kann. Ich bin außerdem damit einverstanden, dass die Arbeit in der in der Fachgebietsbibliothek aufgestellt und ausgeliehen werden kann, sowie dass eine Kurzbeschreibung dieser Arbeit auf der Webseite des Fachgebiets vorgestellt wird.“

Ostfildern, den 10. Juni 2020