The Importance of Wild Plants for People during the Conflict in Syria

Doctoral Thesis by Naji Sulaiman

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Doctoral thesis

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“Discovery is the ability to be puzzled by simple things.”

Noam Chomsky (1928); linguist, philosopher, and cognitive scientist.

“Ethnobotany is the science of survival.”

Ghillean Tolmie Prance (1937); botanist and ecologist.

“The history of mankind is the history of the search for food.”

Karl Marx (1818 - 1883); philosopher, economist, historian, and sociologist.

“Food is a lens for culture.”

Dana Goodyear (1976); journalist and poet.

“In this plate of food I clearly see the suffering of the world.”

Thich Nhat Hanh (1926 - 2022); Buddhist monk and peace activist.

“There never was a good war or a bad peace.”

Benjamin Franklin (1706 - 1790); writer, scientist, and political philosopher.

Declaration

I, Naji Sulaiman, declare that this doctoral thesis entitled: "**The Importance of Wild Plants for People during the Conflict in Syria**" has not been submitted for any other degree to this or any other university; I also fully declare that this thesis is solely my own work unless otherwise referenced, declared, or acknowledged.

In Prague, 20th March 2023

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Naji Sulaiman

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Preface

This dissertation is prepared in the form of a series of academic articles based on the standard rules of the Faculty of Tropical AgriSciences of the Czech University of Life Science Prague. With four articles (three published and one under-review), I, with other co-authors, covered several aspects of the relationship between humans and wild plants during conflict times. I focused on the Syrian case as the conflict in the country is still ongoing, besides being one of the hottest conflict spots on the planet with a catastrophic impact on all life aspects. In three articles, I have been the principal researcher and have held the responsibility for conducting all stages of the research from designing to publishing (Chapters 2, 3, and 5). In the fourth paper (Chapter 4), where several case studies have been covered, I took, as a co-author, the main role of covering the case study of Syria by conducting the research and preparing the relevant draft. Besides the four included articles in this dissertation, I contributed, as a co-author, to three other papers on the wild plants in the Middle East, Cyprus, and Greece (Zocchi et al. 2022; Pieroni et al. 2022[a]; Pieroni et al. 2022[b]). However, due to my secondary role, I did not include those three papers in the dissertation. Another paper recently published, where I am the first author, focuses on the potentiality of wild plants to become novel crops in several war-affected countries. I aim with the above-mentioned outputs to provide a better understanding of the complex relationship between humans and their surrounding environment during conflict conditions.

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COVID-19:	Coronavirus disease 2019
FAO:	Food and Agriculture Organization of the United Nations
IDS:	individual diet specialization
IFAD:	International Fund for Agricultural Development
IUCN:	International Union for Conservation of Nature
m.a.s.l:	meters above sea level
NRC:	Norwegian Refugee Council
SP:	Syrian pound
TEK:	traditional ecological knowledge
UNESCO:	The United Nations Educational, Scientific and Cultural Organization
UNICEF:	United Nations International Children's Emergency Fund
USD:	United States dollar
WEPs:	wild edible plants
WFP:	World Food Programme
WFPs:	wild food plants
WHO:	World Health Organization
WoS:	Web of Science
WPs:	wild plants
WWI:	The First World War
WWII:	The Second World War

Abstract

Wild food plants have been an important source of human nutrition since ancient times, and their use particularly revives when conventional food is not available due to emergency situations, such as conflicts. Twelve years of the war in Syria have left a devastating impact on all life aspects, and it has caused the largest war-related crisis since World War II. Over 90% of the Syrian population is living below the poverty line, and nearly 60% (12.4 million people) are food insecure. The general focus of this dissertation is to deeply scrutinize the wild plants-people relationship during the conflict in Syria. I particularly aim to conduct an inventory of the wild plant species used for food and beverage preparation in the study area, to determine the most culturally important species; to document the ethnobotanical knowledge, including modes of preparation and consumption; to uncover the potential effect of the conflict on wild plant use; to investigate the impact of socioeconomic factors on wild plant use; and to assess the environmental sustainability status of the highly used species during the current conflict. The study was conducted in the coastal region of Syria through several field visits between March 2020 and May 2022. Ethnobotanical methods were implemented during the fieldwork including in-depth semi-structured interviews and participant observation. Several sets of informants were interviewed based on the need of each specific topic. The main informants set, on which several articles were built, was 50 participants (26 women and 24 men) distributed in 26 villages along the study area. Qualitative and quantitative analyses were implemented on the collected data. The study documented 75 wild food plant species used for food and drink, in addition to their associated ethnobotanical knowledge. Perceptions of local people towards wild food plants and their change during the conflict, were recorded. Sixty-four per cent of informants reported an increase in their reliance on wild plants as a food source during the conflict. The culturally important species, such as *Origanum syriacum*, were highlighted. Socioeconomically, results showed that the number of used species increases with informants' age, and declines with the increase of the annual household income. Informant gender was a predictor for both reliance level on wild plants and frequency of use. On the other hand, war-involved households tend to have a strong relationship with the reliance level on wild food plants; however, the relationship is not statistically significant. On the environmental aspect, the results highlighted the species under environmental pressure, such as *Gundelia tournefortii* and *Thymus vulgaris*. The study also highlights the contribution of wild plants to the beverage culture in the study area. The thesis, through the conducted research studies, provides a better understanding of the complex relationship between humans and wild plants during conflict

times. Future studies should consider the nutritional aspect of the reported wild plants and their potential contribution to a nutritious diet in the study area.

Keywords: Eastern Mediterranean; ethnobotany; food security; plants; socioeconomic factors; sustainability; traditional food

Abstract in Arabic

تشكّل النباتات البرية مصدرًا مهمًا لتغذية الإنسان منذ العصور القديمة، وينتعش استخدام هذه النباتات بشكلٍ خاص عندما لا يتوفّر الغذاء بشكلٍ كافٍ بسبب الحالات الطارئة مثل النزاعات البشرية. تركت اثنتا عشرة سنة من الحرب في سوريا آثارًا كارثيّة على جميع جوانب الحياة، وتسبّبت في أكبر أزمةٍ ناتجةٍ عن حرب منذ الحرب العالمية الثانية. في وقت كتابة هذه الأطروحة، يقبع أكثر من 90٪ من السكان السوريين تحت خط الفقر، ويعاني ما يقرب من 60٪ (12.4 مليون شخص) من انعدام الأمن الغذائي. ينصبّ التركيز العام لهذه الأطروحة على التدقيق والتمحيص العميق في العلاقة بين النباتات البرية والبشر خلال الصراع في سوريا. أهدف من خلال الأبحاث التي أجريتها تحت مظلة هذه الرسالة إلى عدة أهدافٍ، منها: إجراء جردٍ لأنواع النباتات البرية المستخدمة في تحضير الأطعمة والمشروبات في منطقة الدراسة، وتحديد الأنواع الأكثر أهمية في الثقافة المحلية، وأهدف أيضاً إلى توثيق المعرفة الإثنية النباتية، بما في ذلك طرق التحضير والاستهلاك، وتهدف الرسالة أيضاً إلى الكشف عن التأثير المحتمل للصراع على استخدام النباتات البرية، هدف آخر هو البحث عميقاً وراء العوامل الاجتماعية والاقتصادية التي قد تتنبأ باستخدام النباتات الغذائية البرية، كما أهدف إلى تقييم حالة الاستدامة البيئية لاستخدام بعض النباتات البرية خلال سنوات الصراع. أُجريت الدراسة في المنطقة الساحلية لسوريا من خلال عدة زيارات ميدانية بين آذار 2020 وأيار 2022. تمّ تطبيق المنهجية العلمية العرقية أثناء العمل الميداني بما في ذلك المقابلات شبه المنظمة المتعمّقة والملاحظة الذاتية. تمّت مقابلة عدة مجموعات من المخبرين بناءً على الحاجة لكلّ موضوع محدد من الأبحاث المجراة. كانت مجموعة المخبرين الرئيسية، التي بُنيت عليها عدّة مقالاتٍ علمية، 50 مشاركًا (26 امرأة و 24 رجلاً) موزّعين على 26 قرية على طول منطقة الدراسة. تمّ تنفيذ التحليل النوعي والكمي على البيانات التي تمّ جمعها. وثّقت الدراسة 75 نوعًا من أنواع النباتات البرية المستخدمة في الطعام والشراب، بالإضافة إلى المعرفة الإثنية المتعلّقة بهذه النباتات. تمّ تسليط الضوء على تصوّرات السكان المحليين تجاه النباتات البرية وتغيّر هذه التصوّرات أثناء النزاع. أفاد أربعة وستون بالمائة من المخبرين عن زيادة في اعتمادهم على النباتات البرية كمصدر للغذاء خلال سنوات الصراع الدائر. تم الإضاءة على الأنواع ذات الدلالة والأهمية في ثقافة الغذاء لمحلية، مثل *Origanum syriacum*. من الناحية الاجتماعية والاقتصادية، أظهرت النتائج أن عدد الأنواع النباتية المستخدمة يزداد مع ازدياد عمر المخبرين، وينخفض مع زيادة الدخل السنوي للأسرة. كان جنس المخبر مؤشراً لكل من مستوى الاعتماد على النباتات البرية وتكرار الاستخدام. من ناحية أخرى، أظهرت النتائج أن الأسر المنخرطة في النزاع بأحد أفرادها تميل لأن يكون اعتمادها أعلى على النباتات البرية كمصدرٍ للغذاء، ومع ذلك، لم نجد أن هذه العلاقة كانت ذات دلالة إحصائية. من الناحية البيئية، أبرزت النتائج الأنواع الواقعة تحت ضغطٍ بيئي وبالتالي المهددة بيئياً، مثل *Gundelia tournefortii* و *Thymus vulgaris*. تسلّط الدراسة الضوء أيضًا على مساهمة النباتات البرية في ثقافة المشروبات في منطقة الدراسة. توفّر هذه الأطروحة، من خلال العديد من الدراسات البحثية التي تم إنجازها (لكاتب هذه الأطروحة أربعة أبحاث مُدرجة ضمن الرسالة، وخمسة أبحاث أُخرى غير مدرجة)، فهمًا أفضل وأعمق للعلاقة المركّبة بين البشر والنباتات البرية وخلفياتها الأنثروبولوجية والاقتصادية والاجتماعية والسلوكية والبيئية خلال أوقات الصراع. ومع ذلك، هناك حاجة لدراساتٍ مستقبلية مشابهة في مناطق أُخرى من سوريا لتغطية الفجوة الكبيرة في الدراسات الإثنية النباتية. الدراسات المستقبلية يجب أن تنظر أيضاً بالجانب الغذائي للنباتات البرية المشار إليها في هذه الدراسة ومساهمتها المُحتملة في تحسين النظام الغذائي اليومي للسكان المحليين، وأيضاً هنالك حاجة ملحّة لحماية الأنواع النباتية الواقعة تحت ضغطٍ بيئي.

الكلمات المفتاحية: الأمن الغذائي، الاستدامة البيئية، السلوك البشري في حالات الطوارئ، الطعام في زمن الحرب، العوامل الاجتماعية والاقتصادية، شرق البحر الأبيض المتوسط، علم النبات العرقي، نباتات برية

Abstract in Czech

Planně rostoucí jedlé rostliny jsou důležitým zdrojem lidské stravy již od starověku a jejich využívání získává na významu zejména v životně obtížných obdobích (např. válečných konfliktů), kdy složky běžné stravy nejsou částečně či vůbec dostupné a je tak ohrožena potravinová bezpečnost obyvatel. Dvanáct let války v Sýrii zasáhlo všechny aspekty života a způsobilo největší válečnou krizi od druhé světové války. V důsledku toho, více než 90 % syrské populace žije pod hranicí chudoby a téměř 60 % (12,4 milionů lidí) trpí nedostatkem potravin. Záměrem této disertační práce v širším kontextu bylo pochopit způsoby jakými jsou rostliny získávané z volné přírody vnímány a využívány místními obyvateli jako potravinové zdroje. Cíle práce zahrnují etnobotanickou inventarizaci planých jedlých rostlin; identifikaci kulturně významných druhů a podužívaných druhů se slibným ekonomickým potenciálem; dokumentaci tradičních botanických znalostí včetně způsobů přípravy a konzumace jednotlivých druhů; analýzu vlivu konfliktu a konkrétních socioekonomických faktorů na intezitu využívání planých jedlých rostlin; a analýzu udržitelnosti využívání zkoumaných druhů v kontextu válečného konfliktu. Studie byla provedena v přímořské oblasti Sýrie prostřednictvím několika terénních expedic za účelem sběru dat v období od března 2020 do května 2022. Terénní výzkum byl proveden s využitím etnobotanických metod zahrnujících polostrukturované rozhovory a zúčastněná pozorování. S ohledem na jednotlivé dílčí studie bylo v rámci celé disertační práce dotazováno několik skupin respondentů. Hlavní soubor respondentů, na kterém bylo postaveno několik dílčích článků, tvořilo 50 účastníků (26 žen a 24 mužů) z celkového vzorku 26 vesnic na území studované oblasti. Na shromážděných datech byla provedena kvalitativní a kvantitativní analýza. Disertační práce etnobotanicky zdokumentovala 75 druhů planých jedlých rostlin používaných k přípravě tradičních pokrmů a nápojů. Bylo zanalyzováno vnímání a využívání planých jedlých rostlin jako potravinových zdrojů ze strany místních obyvatel a jejich dynamika v průběhu válečného konfliktu. Na základě dat 64% respondentů záviselo na využívání planých jedlých rostlin jako významného potravinového zdroje. Byly identifikovány kulturně významné druhy, s nejvýraznějším druhem *Origanum syriacum*. Socioekonomická data ukázala, že počet využívaných druhů vzrůstá se stoupajícím věkem respondentů a naopak klesá s rostoucím ročním příjmem domácnosti. Příslušnost respondentů k ženské či mužské části populace ovlivňuje jak míru závislosti na planých jedlých rostlinách jako zdrojích potravy, tak i frekvenci jejich využívání. Data také naznačují tendenci k vyšší závislosti na planých jedlých druzích rostlin u domácností přímo ovlivněných konfliktem, nicméně tato závislost se ukázala jako statisticky nevýznamná. Z hlediska udržitelnosti využívání zkoumaných druhů s ohledem na jejich výskyt, výsledky

upozornily na druhy jako jsou *Gundelia tournefortii* a *Thymus vulgaris*, vystavené významným změnám jejich přirozených biotopů. Studie také odhaluje význam planých rostlin jako součásti tradičních místních nápojů, které se dají považovat za kulturní dědictví studovaného regionu. Práce prostřednictvím provedených výzkumných studií navazuje na předchozí relevantní studie a rozvíjí poznání významu původní flóry z etnobotanického hlediska v kontextu období nedostatku potravin. Ovšem v souvisloti s konzumací těchto druhů mohou vyvstat další otázky ohledně detailního nutričního složení jednotlivých druhů, potenciálních antinutričních vlastností, domestikace druhů, či ochrany jejich přirozených biotopů a genetických zdrojů, které by neměly uniknout pozornosti dalšího výzkumu.

Klíčová slova: etnobotanika; potravinová bezpečnost; rostliny; socioekonomické faktory; tradiční potraviny; udržitelnost; Východní Středomoří

1. Introduction

1.1. Background

Wild plants have formed an important part of traditional Mediterranean cuisine since ancient times (Łuczaj & Pieroni 2016; Nebel et al. 2006). Several archaeobotanical studies confirmed the early historical use of wild plants in the land of current Syria. Colledge and Conolly (2010) reported that cultivation of wild cereals in northern Syria occurred during the Younger Dryas around 12,000 years ago. Arranz-Otaegui et al. (2016) highlighted that wild plant gathering was practised in southern Syria in the Early Pre-Pottery Neolithic around 10,000 – 6,500 BC. Species such as *Avena* spp., *Hordeum* spp., and *Malva* spp. are among the archaeological remaining in the site in southern Syria. Jotischky (2011) stated that wild edible leaves were used as fasting foods by monks in the semi-desert of Syria and Palestine in the middle ages. However, despite such proven historical use of wild plants in Syria which suggests a strong people-wild plant relationship, there is a huge gap in studies on this issue. A literature review of both English and Arabic language text revealed only a few ethnobotanical studies were performed in the country. Abdallah (2004) highlighted the contribution of wild plants to the Assyrian (an ethnoreligious group) cuisine on the Syrian-Turkish borderland in north-eastern Syria. Kawas et al. (2014) studied the various use of wild plants in the Badiya (Syrian desert). On the other hand, there are four ethnobotanical studies concerning traditional medicine (Khatib et al. 2021; Obón et al. 2014; Alachkar et al. 2011; Carmona et al. 2005). Some of these studies highlight the preparation of herbs in the form of tea, or added to other popular teas, for medicinal purposes. This small number of ethnobotanical studies reflects the knowledge gap especially on wild food plants in a country rich in ethno/cultural/religious groups and diverse ecosystems. Some regions of the country remain ethnobotanically unexplored, such as the Mediterranean region in the northwest of the country. Studies from the surrounding countries in the Middle East and Eastern Mediterranean region confirm the strong presence of wild plants in regional food cultures. The richness of ethnobotanical knowledge associated with wild food plants is represented through many studies conducted in the region, such as Lebanon (Marouf et al. 2015; Batal & Hunter 2007; Marouf et al. 2005), Turkey (Yeşil et al. 2019; Güneş et al. 2018), Cyprus (Della et al. 2006), Palestine (Ali-Shtayeh et al. 2008), Jordan (Tukan et al. 1998), and Iraq (Pieroni et al. 2018). Recent ethnobotanical studies from the Eastern Mediterranean, where in the author of this dissertation took part, but were not included in this thesis, highlight the role of wild plants in the traditional local cuisines of Syria, Lebanon, Cyprus and Greece (Pieroni et al. 2022[a]; Pieroni et al. 2022[b]). Based on a historical

interpretation, these studies suggest that wild plants could be a hidden core element of the Mediterranean diet.

Besides the traditional role of wild plants in food supplies during peace times, they may be crucial in times of uncertainty (Łuczaj & Pieroni 2016). Sõukand (2016) demonstrates that the use of wild plants as an emergency food has been present throughout the entire history of humankind. Plants gathered from the wild have been used to cope with food shortages in many regions around the globe (Ocho et al. 2012; Cruz-Garcia & Price 2014). Based on a comprehensive report from several international organizations, the major drivers of global food insecurity and malnutrition are represented by conflicts, climate extremes, and economic shocks (FAO et al. 2022). Two billion people (almost a quarter of the global population) experienced hunger or did not have regular access to nutritious and sufficient food in 2019. Much of the recent increase in food insecurity can be attributed to an increasing number of conflicts (FAO 2020). In addition to international organizations' reports, several studies confirmed that violent conflicts drive the majority of global humanitarian crises and are causally linked with food insecurity (Brück & d'Errico 2019). Conflict directly reduces food availability by impacting agricultural production and increases the security risks associated with its use to access the food markets, thus driving up local food prices (Holleman et al. 2017). More than a decade of war in Syria has brought a devastating impact on agricultural production and the livelihoods of millions of people. In March 2011, Syria entered an armed conflict that caused the largest war-related crisis since WWII (WFP 2019). Over 90% of the Syrian population is currently affected by poverty, and more than 12 million people (more than half of the total population) are food-insecure (WFP 2021[a]).

Despite the increasing number of conflicts and their devastating impact on human food security, the use of wild food plants during conflicts has only been limitedly studied around the globe, especially when considering the ethnobotanical perspective. Redžić and Ferrier (2014) highlighted wild plant use for human survival during the Balkan War between 1992 and 1996. Two other studies from the Western Balkan demonstrate the use of wild mushrooms, wild and semi-wild plants for food during siege conditions (Redžić 2010; Redžić et al. 2010). Several military and governmental projects on wild plant use for human survival were carried out during the last century, especially during WWI and WWII. Between 1962-1986 the Yugoslav Army carried out a project on the possibility of soldiers' survival on the Adriatic islands based on wild plants and marine animals (Jug-Dujakovic & Luczaj 2016). Vorstenbosch et al. (2017) studied what is so-called "famine food" in the Netherlands during WWII when the Dutch government provided information on wild plants and other famine food sources in "wartime cookbooks". A

recent study shows that a similar measure to the Dutch one was taken by the Soviet Union during WWII when several books promoting wild plant use were published by the authorities (Bexultanova et al. 2022). An exhaustive survey of the history of food plants, their collection, harvest, and conversion from pre-historic times to WWI was done by Maurizio (1927).

People-wild plant relationship during conflicts is highly complex and not limited to the important role that wild plants may play as a food source. Environmentally, conflicts pose a number of risks to the biodiversity and abundance of species; over 90% of the major armed conflicts between 1950 and 2000 occurred within countries in biodiversity hotspots, whereas more than 80% took place directly within biodiversity hotspot areas, with the Mediterranean being one of these areas (Hanson et al. 2009). Increased demand for natural resources during sociopolitical unrest and armed conflicts could create imbalances in the sustainable use of these resources (Aziz et al. 2022). Conflict generates complex social and environmental dynamics over space and time, and the effects of conflict on wildlife differ across regions and taxa. According to Gaynor et al. (2016), who summarized 144 conflict case studies, the most common pathways linking conflict to wildlife arise from institutional and socioeconomic changes associated with conflict, rather than directly from military interventions. Several studies highlighted the relevance of socioeconomic factors with the behaviour toward natural resources including wild plant harvest (Kideghesho et al. 2006; Campos et al. 2015; Cruz et al. 2013). However, this topic is largely unexplored in conflict conditions.

1.2. Statement of the problem and research rationale

First of all, and apart from the current conflict in Syria, this thesis aims to cover a part of the huge knowledge gap in ethnobotanical knowledge in Syria, especially in the Mediterranean region of the country. These ethnobotanical practices form an essential element of the cultural identity and heritage in the region and preserve endangered knowledge related to plant use.

However, the conflict that started more than a decade ago, created new social, economic, cultural, institutional and demographic realities that can not be ignored when studying people-plant relationships. Hence, this thesis seeks to provide original data and interpretations on this issue. In addition, conflict areas usually lack credible data that could be crucial for planning successful projects, especially those related to food security and wild biodiversity conservation. Thus, this thesis attempts to provide a better understanding of human behaviour towards food and the surrounding environment in emergency times.

The socioeconomic factors' impact on wild plant use during conflicts is largely unexplored. Therefore, it is vital to understand how such conditions could serve as drivers for

wild plant foraging. Sustainability is another crucial aspect that the thesis also aims to cover, as it is necessary to address the potential impact of the conflict on wild plant abundance in times of crisis.

1.3. Research questions and aims of the thesis

The general aim of this thesis is to deeply scrutinize the wild plants-people relationships during the conflict in Syria and to assess the overall importance of wild plants for the local people. The thesis set out to answer the following major research questions: What wild plants are used for food and beverage in the study area? Did the conflict impact the use of wild food plants? And what socioeconomic factors can predict the use of wild food plants during the conflict?

To achieve the main aim of this dissertation, we will focus on the following particular objectives:

1) Conduct an ethnobotanical inventory of the wild plant species used for food and beverage preparation, and determine the most culturally important species.
2) Analyse the effects of the conflict on wild plant use.
3) Investigate the impact of socioeconomic factors on wild plant use; and
4) Assess the environmental sustainability status of the highly used species.

1.4. Significance and conceptual framework of the thesis

With the aim to help fill the ethnobotanical knowledge gap in the study area, and in order to get to know the wild species used for food and beverage preparation during the conflict, we conducted an inventory where species and vernacular names, parts used, and modes of preparation and consumption were documented (Chapter 2). In addition, we assessed the potential effect of the conflict on the use of wild plants by comparing pre-conflict and during-conflict use of wild food plants, including the perception of local people towards such food. The culturally important species were documented by highlighting the most common wild plant-based dishes in the region. Besides, we reviewed the nutritional value of some reported species. The ethnobotanical knowledge documented in the study (Chapter 2) may be crucially useful in the identification and use of wild relatives of some crops, and in the domestication programs as many reported wild plants might have the possibility to become novel crops in the future.

With the goal of knowing and understanding the socioeconomic factors that may predict the use of wild food plants during a conflict, we studied the relationship between several socioeconomic factors such as gender, age, education, household income, household size, war-involved households, and land-holding from one side and other variables related to wild plant use (reliance level on WPs as a food source, use frequency of WFPs, and number of species used) on the other side (Chapter 3). In addition, we documented the contribution of wild plants to generating income for the collectors. The study provides a better understanding of the impact of socioeconomic conditions on human behaviour towards food in crisis conditions. The findings can be significant in planning future projects that would focus on improving diets or nutritional status in the study area, as our findings refer to which categories of local people use and rely more on wild plants.

Further, we study sustainability as a crucial aspect related to wild plant use during a conflict, as the latter is usually characterized by an over-demand for natural resources. We assessed the sustainability status of the most-cited wild species by highlighting the environmental and social characteristics of the traditional foraging practices in the study area (Chapter 4). In this chapter, we conducted an in-depth comparison with original data from other Eurasian case studies in Pakistan, Ukraine and Estonia. The findings of the study may be useful in future biodiversity conservation programs in the study area as we highlighted some abundancy-declined species in the region.

In addition to the role of wild plants in providing food in such emergency times, they also serve as an additive to yerba maté (*Ilex paraguariensis* A.St.-Hil.) which is one of the most culturally important beverages in the country. We studied the sociocultural significance of yerba maté and how the native plant to South America became a popular beverage in Syria (Chapter 5). The chapter also discusses how this beverage may contribute to lining the social wounds of the ongoing conflict. We highlighted the impact of the war on yerba maté consumption, as well as the role of wild plants as additives to this beverage.

2. Ethnobotany of Wild Food Plants and Assessing the Conflict Impact on Wild Plant Use

In the present chapter, the first two aims of the dissertation are covered. We conducted an inventory of the wild plant species used for food and beverage in the study area. We also documented the relevant ethnobotanical knowledge, including modes of preparation and consumption. The most culturally important species were highlighted. We assessed the conflict impact on wild plant use. In addition, we reviewed the literature on the nutritional value of the most frequently reported species.

This chapter is adapted from the published article:

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Abstract

Wild food plants (WFPs) have been an important source of human nutrition since ancient times, and they particularly revive when conventional food is not available due to emergency situations, such as natural disasters and conflicts. The war in Syria marks more than ten years since it started in 2011, and has caused the largest war-related crises since World War II. As a consequence, nearly 60% of the Syrian population (12.4 million people) are food-insecure. WFPs have been culturally important in the region, and may be supplementing local diets during this conflict. Our study aimed to uncover the conflict's effect on the use of WFPs and to know what species are consumed by local people. Fieldwork was carried out between March 2020 and March 2021 in the Tartus governorate, located in the coastal region of Syria. Semi-structured interviews were conducted with 50 participants (26 women and 24 men) distributed over 26 villages in the study area. We recorded the vernacular names, uses, plant parts used, modes of preparation and consumption, change in WFP use since the conflict started, and informants' perceptions towards WFPs. We documented 75 wild food plant species used for food and/or drink. Almost two-thirds (64%) of informants reported an increase in their reliance on wild plants as a source of food during the conflict. *Origanum syriacum*, *Rhus coriaria*, *Eryngium creticum* and *Cichorium intybus* were among the most quoted species by informants. *Sleeq* (steamed leafy vegetables), *Zaatar* (breakfast/dinner food), and *Louf* (soup) were the most popular wild plant-based dishes.

Keywords: Eastern Mediterranean; emergency human behaviour; ethnobotany; *Sleeq*; traditional food; *Zaatar*

2.1. Introduction

Food is located at the bottom of Maslow's hierarchy of human needs, where any threat to these basic needs could impact human behaviour and bring emergency reactions [1]. Despite the importance of food, hunger remains a main part of human history, as well as the present. According to FAO [2] estimations, the number of hungry people will exceed 840 million by 2030. On the other hand, two billion people (25.9% of the global population) experienced hunger or did not have regular access to nutritious and sufficient food in 2019. Much of the recent increase in food insecurity can be attributed to the greater number of conflicts and climate change impacts [2]. In general, wartime is characterized by a deterioration of life quality, as wars often lead to mass human migrations, armed-conflict zones, and economic crises. Conflict areas lack basic living necessities, such as appropriate shelter, drinking water, and medicine. Furthermore, sufficient and diverse food sources are scarce, while hunger and nutritional deficiency-related diseases are widespread [3].

Since ethnobotany has been described as the science of survival [4], its importance increases during armed conflicts. In crises where conventional food is not available, people turn to their traditional ecological knowledge to secure their needs from the surrounding environment, where wild plants serve as the main food source. Generally, the use of wild plants as an emergency food supply has been present throughout the entire history of humankind [5]; gathered plants from the wild have been used to cope with food shortages in many regions around the globe [6,7], as well as to alleviate poverty levels [8]. Several studies have highlighted wild plant use and its importance for human survival in times of conflict, particularly in Bosnia and Herzegovina during the Balkan War [3,9,10] and in the Netherlands with the food famine during World War II [11].

In the last two decades, the world experienced an increase in the number of conflicts. Only between 2000 and 2014, there was an average of 35 active conflicts every year around the globe [12]. Since the so-called "Arabic Spring" started in the Middle East a decade ago, many countries have fallen into civil wars, local conflicts, and economic crises. In March 2011, Syria entered an armed conflict that caused the largest displacement crisis since World War II. So far, 6.2 million Syrians are internally displaced, and 5.7 million are registered as refugees outside of the country. Soaring food and fuel prices, stagnant salaries, decreased purchase power, the unstable exchange rate of SP to USD, loss of livelihoods, and reduced food production have led to widespread food insecurity across Syria [13]. Nearly 60% of the Syrian population (12.4 million people) are food-insecure [14]. FAO [15] reported that wheat production is at less than 25% of pre-conflict levels, which has significantly affected food security in the country. Recent

statistics from Syria show low dietary intake of several key foods and nutrients compared to the minimum recommended level, such as vegetables, which is at 25% less than the global level and almost 50% less than the theoretical minimum-risk exposure level [16]. The economic conditions resulting from the ongoing conflict are not only affecting the war battle areas, but being reflected across the country.

In Syria, as a part of the Mediterranean basin, cooked vegetables and salads made from wild greens have been particularly important as local traditional foods since ancient times [17]. However, wild food plants (WFPs) have not been widely studied in the Syrian context [18,19], and while teas prepared from wild plants have been marginally covered [20,21,22], there are no studies on the use of wild plants with a focus on the effects of the conflict. On the other hand, studies from surrounding countries, such as Lebanon [23,24], Cyprus [25], Iraqi-Kurdistan [26], Palestine [27], and Turkey [28,29,30], clearly show the importance of wild plants in the food culture of the East Mediterranean region. Similarly, the gathered plants from the wild have been a part of the local Syrian cuisine before the conflict and its associated economic crisis [19]. However, we hypothesize that the use of WFPs has changed during the ongoing conflict. Hence, the overall interest of our study was to uncover the conflict's effect on WFP use and to know what species are consumed by local people during the current crisis. We particularly aimed to conduct an inventory of the wild plant species used for food in the region, and to document the ethnobotanical knowledge, including modes of preparation and consumption, as well as to highlight the perceptions of local people toward the use of WFPs both before and during the conflict. We also aimed to summarize the nutritional benefits of the most-reported WFPs.

2.2. Materials and Methods

2.2.1. Study Area

The study was conducted in the Tartus governorate (Figure 2.1.), one of the 14 governorates of Syria. Initially, we aimed to include more than one governorate as a study area, but due to COVID-19 restrictions, the first author could not move beyond the Tartus Governorate. Tartus (34.9° N and 35.9° E) is bordered by Lebanon in the south, the Syrian governorates of Latakia in the north, and Homs and Hama in the east. Tartus forms roughly half of the Syrian Mediterranean coastline, extending to 183 km [31]. The governorate occupies a territory of 1,896 km2 and has a population of 1,114,000 inhabitants [32]. The climate is Mediterranean and characterized by hot and dry summers, moderate in the mountains, whereas winters are mild and wet. Average annual rainfall varies from 800 to 1,000 mm [33]. The region has a long history that dates back to the era of the Phoenicians who built several cities in the

area, such as Arwad and Amrit. Arwad, the only inhabited island on the Eastern Mediterranean coastline, has been continuously occupied since at least the third millennium BC [34]. Tartus is a multi-ethnic and religious region consisting of Alawites, Sunnis, Ismailis, and Christians, with percentages of 69%, 18%, 7%, and 6%, respectively. Arabs are the majority in the governorate, with Greek and Turkmen minorities [35].

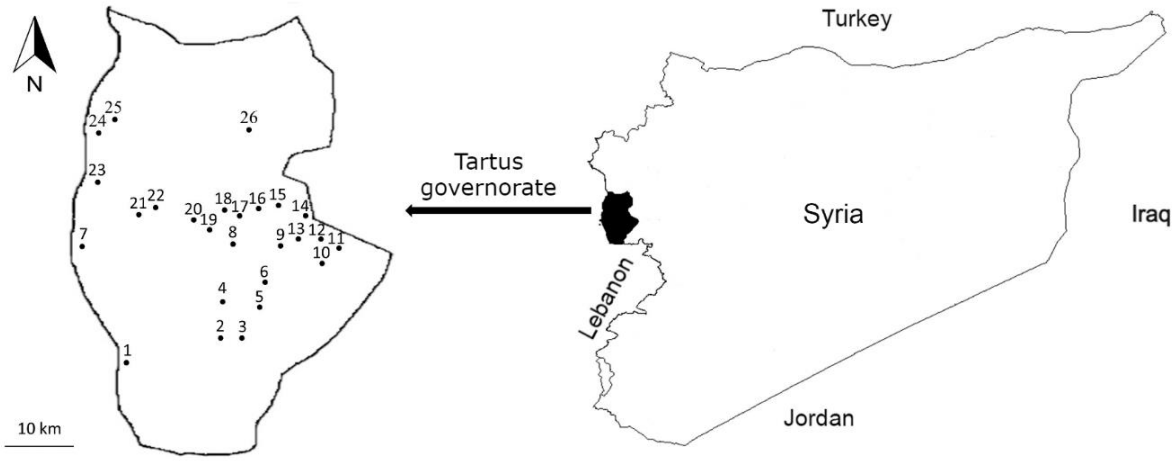

Figure 2.1. Study area map, the Tartus governorate and studied villages: 1. *Al-Hamidiyah*, 2. *Ain Dabesh*, 3. *Al-Mitras*, 4. *Al-Sawma'a*, 5. *Bishrael*, 6. *Sibbeh*, 7. *Tartus*, 8. *Draykish*, 9. *Bait Yousef*, 10. *Husn Suleiman*, 11. *Annabi Saleh*, 12. *Annabi Matta*, 13. *Bestan Assouj*, 14. *Ain Dlaimah*, 15. *Fajlit*, 16. *Al-Tuffaha*, 17. *Kafr Tallesh*, 18. *Krafes*, 19. *Al-A'ujah*, 20. *Kawkab*, 21. *Bazughah*, 22. *Brmmanet Raad*, 23. *Maten Al-Sahel*, 24. *Al-Rawda*, 25. *Dahr Safra*, 26. *Sourani*.

So far, the region has been relatively quiet and safe during the Syrian conflict. Tartus is entirely under government control; however, it witnessed several security incidents [36]. It is facile to observe the lack of young men, since most of them were requested to join or taken to the Syrian army as a result of the ongoing war in other parts of the country. The unfinished conflict did not yet reveal the exact numbers of casualties and wounded young men of the governorate, which could exceed tens of thousands, according to the local people. Tartus houses more than 169,000 displaced people from other Syrian governorates [37]. Although the study area is not significantly affected by war battles as other regions in Syria, the community is suffering from the side-effects of war, such as food shortage, economic sanctions, limited affordability of the market products, labour shortage, fuel insufficiency, frequent power outages, and general lack of agricultural production input [38,39]. Similarly to other governorates in Syria, around 50% of households in the Tartus governorate had inadequate food consumption in the second half of 2020 [40].

2.2.2. Fieldwork, Data Collection and Data Analysis

The study was conducted between March 2020 and March 2021. The participants were chosen using a combination of purposive and convenient sampling methods [41,42]. We asked people in the village's streets if they would agree to be interviewed; the basic criteria for an informant to be selected was that he/she was a breadwinner and usually used wild plants for food or beverage. Semi-structured interviews were conducted with 50 participants (26 women and 24 men), aged between 25 and 97 years with a mean of 55. Participants were chosen from 26 villages in the study area with an attempt to include members from all religious and ethnic groups in the area.

Informants were asked to list all the wild plants they used for food and beverage preparation, their vernacular names, the parts used, and the mode of preparation and consumption. Respondents were asked to report any changes in their use of WFPs prior to and during the conflict. Perceptions of informants towards WFPs were documented using open-ended questions, such as: Why do you use WFPs? Why were you using WFPs before the conflict started?

Verbal consent was always obtained before each interview, and the Code of Ethics of the International Society of Ethnobiology was followed [43]. A research permit was obtained from the General Commission for Scientific Agricultural Research and Tartus municipality (number: 9893; date: 5 April 2020). All interviews were conducted in the Arabic language. Plants were identified with the help of local taxonomists and the herbarium staff of the American University of Beirut, while nomenclature followed World Flora Online [44]. The collected voucher specimens were deposited in the Herbarium of the American University of Beirut (BEI). When the plant sample was not available, identification was done based on a detailed description of the plant and its habitat, as well as the local name(s) provided by the informants. Taxa that were not capable of being classified up to the species level were identified at the genus level. All local plant names were transcribed from the recorded local languages using the Latin alphabet.

Collected data were compared with previously published ethnobotanical studies from the Eastern Mediterranean region and adjacent countries [18,19,23,24,25,28,45], in order to determine differences and similarities in WFPs' uses. Data on the nutritional benefits of most reported species were obtained by reviewing the literature available online [46,47,48,49,50,51,52,53,54,55,56]. The relative importance of the reported plants was obtained by calculating the relative frequency of citation (RFC) for each species by dividing the number of informants mentioning the plant by the total number of informants. The RFC

value ranged from 0 to 1, with 0 as a theoretical value indicating that no informant mentioned the species, and 1 as the highest value indicating that all informants mentioned it [57].

2.3. Results

2.3.1. Pre-Conflict vs. During-Conflict Use of Wild Food Plants

The majority of our study respondents (94%) used WFPs before the conflict, whereas 6% of them started to use those plants only after the conflict started a decade ago. Informants showed that WFPs have always been a part of their traditional diet. However, such meals served as complementary food before the conflict, while they became among one the main dishes in recent years. Almost two-thirds (64%) of informants reported an increase in their reliance on wild plants as a source of food during the conflict compared to the pre-conflict time. On the other hand, 34% of the informants reported a no-change status in their reliance, whereas 2% stated a decrease. The main reported reason behind the apparent increase in reliance on WFPs was the economic crisis that hit the whole country after the war, which affected food prices and purchase power, while the reason for the minor percentage of decrease in reliance was the move from a rural to urban area. The conflict affected accessibility and WFP species selection; informants reported that during the conflict, they started to consume wild plant species that grew in anthropic sites and their surrounding orchards, such as *Eryngium creticum* and *Malva sylvestris*. On the other hand, species that grew in high mountains and remote areas, such as *Gundelia tournefortii*, witnessed a decrease in use during conflict years due to obstacles regarding movement and security concerns. According to our informants' statements, traditional knowledge of WFPs was noticeably decreased during the stable economic situation in pre-conflict years. However, it was revived after becoming necessary to secure food during the conflict.

2.3.2. Perceptions of Local People towards Wild Food Plants Pre and during the Conflict

Informants' statements show a clear difference in perceptions and reasons for using WFPs during and before the conflict. The main motives behind the use of WFPs in the pre-conflict era were represented by the tendency to eat healthy and organic food, efforts to diversify the food and taste, and enjoyment of the activity of gathering plants from the wild. On the other hand, the difficulty in affording the market food products was the main reason for WFP use during the conflict. The majority of informants (58%) reported that the natural ecosystems helped to substitute market products through the gathered plants, and, consequently, to save money. The

mutual perception among the local people was that some of the young generation's views on WFPs did not change during the conflict compared to the pre-conflict time. These young people, especially those who did not bear the responsibility of securing food for the household, perceived WFPs as non-prestigious food and felt ashamed to share information related to this food with their peers.

2.3.3. Diversity of the Wild Food Plants

Our study documented 75 wild plant species used for food and beverage preparation by the local people. One taxon was identified only down to the genus level. A total of 75 taxa belonged to 70 genera and 28 botanical families. The most-represented families were Compositae (15 species), Fabaceae (8 species), Lamiaceae (7 species), Apiaceae, and Rosaceae (5 species each). Compositae included plants that are mostly prepared as cooked vegetables. On the other hand, Lamiaceae mainly included the spices and herbs that are consumed, dried, and ground, whereas Rosaceae included the species that are consumed mostly as fresh fruits. Species mentioned only once or twice in the survey were excluded from further analysis.

Sixty-four plant species were reported by at least 6% of informants (Table 2.1.). The following species showed a level of a quotation above 80% of respondents (in descending order of quotation): *Origanum syriacum, Rhus coriaria, Eryngium creticum, Cichorium intybus, Micromeria myrtifolia, Allium ampeloprasum, Cirsium vulgare, Gundelia tournefortii, Scandix pecten-veneris, Malva sylvestris,* and *Anchusa strigosa*. On the other hand, the species *Nasturtium officinale, Rumex acetosa, Thymus vulgaris,* and *Arum maculatum* were used by 60–80% of informants.

We observed some differences in traditional knowledge and food culture among the different ethnic, religious, and cultural groups in the study area. For instance, *Arum maculatum* was mainly used by Alawites and Ismailis, while *Foeniculum vulgare* was highly used by the Greeks more than other groups in the area. On the other hand, Maronites (an ethnoreligious Christian group) used to cook a mixture of WFPs during the fasting period.

Table 2.1. Wild plant species used in food and beverage preparation in Tartus governorate in coastal Syria

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N[1]= 50)
Amaranthaceae	*Amaranthus retroflexus* L. (NC[2])	*Qttaifeh*	Young aerial part	Steamed with other WFPs (*Sleeq*); fried with eggs.	0.16
	Beta vulgaris L. (NC)	*Selq barri*	Young aerial part	Boiled	0.1
	Chenopodium bonus-henricus L. (NC)	*Sabanekh barri*	Leaves	Boiled	0.08
Amaryllidaceae	*Allium ampeloprasum* L. (Sulaiman 27)	*Kerrat, Twaimeh*	Young aerial part and bulb	Fresh; steamed with *Sleeq*; fried with eggs, or with minced meat.	0.96
Anacardiaceae	*Pistacia atlantica* Desf. (NC)	*Betem*	Leaves and fruits	Spice: leaves are added specifically to the traditional soup *Qishq* (it also serves as a preserver); fruits are added to *Zaatar*.	0.36
	Pistacia terebinthus L. (Sulaiman 3)	*Betem*	Leaves and fruits	Spice: leaves are added specifically to the traditional soup *Qishq* (it also serves as a preserver); fruits are added to *Zaatar*.	0.36
	Rhus coriaria L. (Sulaiman 14)	*Summaq*	Fruits	Spice added to: salads, *Zaatar*, boiled potato, and to the traditional soup *Louf* (*A. maculatum)*	0.98
Apiaceae	*Ammi majus* L.	*Khelleh*	Inflorescence	Added to yerba mate (to substitute an amount of yerba mate) (Sulaiman et al., 2021).	0.06

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Apium nodiflorum (L.) Lag. (NC)	*Qarrah*	Young aerial part	Appetizer	0.44
	Eryngium creticum Lam. (Sulaiman 11)	*Qers anneh*	Young aerial part	Salad; steamed with *Sleeq*.	0.98
	Foeniculum vulgare Mill. (Sulaiman 37)	*Shamra*	Aerial part	Spice added to *Zaatar* and soups; fried with: eggs/ meat/ potato or *A. ampeloprasum*.	0.4
	Scandix pecten-veneris L. (Sulaiman 20)	*Hert manneh*	Young aerial part	Steamed with *Sleeq*.	0.84
Araceae	*Arum maculatum* L. (Sulaiman 31)	*Louf*	Young aerial part	Soup: boiled with *R. acetosa*, *R. coriaria*, bulgur (cracked parboiled groats of *Triticum durum* Desf.), and olive oil.	0.66
Asparagaceae	*Asparagus acutifolius* L. (Sulaiman 30)	*Halyoun*	Shoots	Fried with eggs; salads; steam frying.	0.58
Boraginaceae	*Anchusa strigosa* Banks & Sol. (Sulaiman 46)	*Balasoun*	Young aerial part and underground stem	Fried; steamed with olive oil, and garlic or onion.	0.82
Brassicaceae	*Lepidium ruderale* L. (NC)	*Reshad barri*	Young aerial part	Appetizer	0.48

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Nasturtium officinale R.Br. (NC)	*Jarjeer*	Young aerial part	Appetizer	0.78
	Sinapis arvensis L. (Sulaiman 18)	*Fejjaileh*	Young aerial part	Steamed with *Sleeq*; boiled and then olive oil and lemon are added; fried with eggs.	0.22
Campanulaceae	*Michauxia campanuloides* L'Hér. (NC)	*Qarf awn*	Young aerial part, root	Steamed with *Sleeq*; steamed with onion and carrot.	0.16
Caryophyllaceae	*Silene dioica* (L.) Clairv. (Sulaiman 32)	*Lbas alqetah*	Young aerial part	Steamed with *Sleeq.*	0.2
Compositae	*Centaurea calcitrapa* L. (Sulaiman 4)	*Qellaibeh, Dardar*	Young aerial part	Steamed with *Sleeq*.	0.18
	Cichorium intybus L. (Sulaiman 43)	*Hendbeh*	Young aerial part	*Shabshuleh*: boiled, then olive oil and lemon juice and garlic are added; steamed with *Sleeq*.	0.98
	Cirsium vulgare (Savi) Ten. (Sulaiman 8)	*Qessitah*	Leaves midrib and underground stem	Steamed with *Sleeq*; steamed with chickpea.	0.88
	Crepis sancta (L.) Bornm. (NC)	*Del 'a alhelou, Qers alhelou*	Young aerial part	Steamed with *Sleeq*.	0.08

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Crepis vesicaria L. (Sulaiman 45)	*Harbsees*	Young aerial part	Steamed with *Sleeq*.	0.36
	Cynara syriaca Boiss. (NC)	*Ardi shouki barri, Kharshouf*	Inflorescence	Steamed with minced meat.	0.1
	Gundelia tournefortii L. (Sulaiman 19)	*Salbeen*	Leaves midrib and underground stem	Steamed with chickpea and olive oil; steamed with onion and olive oil; steamed with minced meat; cooked with rice.	0.86
	Helminthotheca echioides (L.) Holub (Sulaiman 44)	*Khishan*	Young aerial part	Steamed with *Sleeq*.	0.28
	Leontodon hispidus L. (Sulaiman 16)	*Sliq aloud*	Young aerial part	Steamed with *Sleeq*.	0.28
	Matricaria chamomilla L. (NC)	*Babounej*	Flowers	Tea; added to yerba maté.	0.08
	Notobasis syriaca (L.) Cass. (NC)	*Shok aljamal, Kherfesh, Qailouh, Shouk alqed*	Leaves midrib	Steamed with onion and olive oil; boiled, then steamed with minced meat.	0.12

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Silybum marianum (L.) Gaertn. (Sulaiman 48)	*Labboun*	Leaves midrib and underground stem	Steamed with onion and olive oil; steamed with *Sleeq*; steamed with chickpea and olive oil, steamed with minced meat and then mixed with yoghurt.	0.34
	Sonchus oleraceus (L.) L. (NC)	*Khesaiseh, Asat alraa'i, Elk alghazal*	Young aerial part	Steamed with *Sleeq.*	0.18
	Tragopogon pratensis L. (Sulaiman 9)	*Daqen alshaikh, Daqen alkhouri*	Young aerial part	Steamed with *Sleeq*.	0.1
Cucurbitaceae	*Bryonia cretica* L. (Sulaiman 36)	*Atairisheh*	Leaves	Fried with eggs.	0.36
Geraniaceae	*Erodium acaule* (L.) Bech. & Thell. (Sulaiman 10)	*Mssaikeh*	Young aerial part	Steamed with *Sleeq*.	0.48
Lamiaceae	*Mentha piperita* L. (NC)	*Nana 'a barri*	Leaves and shoots	Appetizer; salads; tea.	0.08
	Micromeria myrtifolia Boiss. & Hohen. (Sulaiman 29)	*Zoufa*	Aerial part	Tea; added to yerba maté.	0.98

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Origanum syriacum L. (Sulaiman 24)	*Zauba'*	Leaves	Main ingredient of *Zaatar* (dried and ground and then *R. coriaria* and sesame are added); condiment with salad and strained yoghurt; added to yerba maté.	1
	Salvia officinalis L. (NC)	*Quaisineh, Qasa'een, Mariamiah*	Leaves	Added to yerba maté.	0.06
	Teucrium procerum Boiss. & Blanche. (NC)	*Qentariah*	Aerial part	Added to yerba maté.	0.12
	Thymus vulgaris L. (Sulaiman 25)	*Za'atar barri*	Leaves	Fresh as a condiment for salads; dried and ground as spices for the traditional cheese *Shanklish*; added to *Zaatar*.	0.72
	Ziziphora sp. (NC)	*Qernaieh*	Young aerial part	Steamed with *Sleeq*; added to yerba maté.	0.1
Lauraceae	*Laurus nobilis* L. (Sulaiman 33)	*Ghar*	Leaves	Flavouring of meat.	0.2
Fabaceae	*Cercis siliquastrum* L. (Sulaiman 40)	*Shajreeq*	Flowers	Snack	0.12
	Melilotus officinalis (L.) Pall. (Sulaiman 47)	*Handkouq*	Young aerial part	Steamed with *Sleeq*.	0.12
	Lathyrus sativus L. (NC)	*Jelbaneh*	Fruits	Snack	0.06

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N^1= 50)
	Trifolium pratense L. (Sulaiman 35)	*Neffleh*	Flowers	Added to yerba maté.	0.06
	Trigonella foenum-graecum L. (Sulaiman 41)	*Helbeh*	Fruits	Added to yerba maté.	0.28
Malvaceae	*Corchorus olitorius* L. (NC)	*Mlokhiah*	Leaves	Soup: with meat, oil, and lemon added on taste.	0.08
	Malva sylvestris L. (Sulaiman 23)	*Khebbaizeh*	Young aerial part	*Marshusheh*: steamed with onion, olive oil and a bit of bulgur).	0.84
Myrtaceae	*Myrtus communis* L. (Sulaiman 7)	*Hinblas*	Fruits	Snack	0.14
Plantaginaceae	*Plantago lanceolata* L. (NC)	*Lsan alhamal*	Young aerial part	Steamed with *Sleeq.*	0.1
Polygonaceae	*Rumex acetosa* L. (Sulaiman 38)	*Hmmaidah*	Young aerial part	Steamed with *Sleeq;* boiled as a soup with A. *maculatum;* rice stuffing; salad.	0.74
Portulacaceae	*Portulaca oleracea* L. (NC)	*Beqaileh barriah*	Young aerial part	Salad	0.28
Primulaceae	*Cyclamen libanoticum* Hildebr. (NC)	*Doghnain*	Leaves	Rice stuffing	0.4
	Cyclamen persicum Mill. (Sulaiman 15)	*Doghnain*	Leaves	Rice stuffing	0.4

Table 2.1. Continued

Botanical family	Latin name (voucher specimen code)	Local name(s)	Part used	Mode of preparation and consumption	Relative Frequency of Citation (N[1]= 50)
Ranunculaceae	*Anemone coronaria* L. (Sulaiman 1)	*Shaqaeq alnoa'man*	Young aerial part	Steamed with *Sleeq.*	0.4
	Ficaria verna Huds. (Sulaiman 34)	*Mghayriqah*	Young aerial part	Steamed with *Sleeq.*	0.06
Rosaceae	*Crataegus azarolus* L. (NC)	*Za'arour asfar*	Fruits, Flowers	Snack	0.38
	Crataegus monogyna Jacq. (Sulaiman 5)	*Za'arour ahmar*	Fruits, Flowers	Snack	0.38
	Pyrus syriaca Boiss. (Sulaiman 13)	*Mrab barri*	Fruits	Fruit	0.08
	Rubus sanctus Schreb. (Sulaiman 6)	*Dees*	Fruits	Snack	0.08
Urticaceae	*Urtica dioica* L. (NC)	*Qerras*	Young aerial part	Steamed with *Sleeq.*	0.12

[1]: N= number of informants; [2]: NC= not collected.

2.3.4. Most Common Wild Plant-Based Foods

2.3.4.1. *Sleeq*

Sleeq is the most popular wild plant-based dish in the study area. It is prepared from gathered wild leafy vegetables. The name *Sleeq* is probably derived from the word *Saleeq*, which in the Arabic language means boiled food; however, the dish is mainly prepared by steaming rather than boiling. The same dish was also called *Mhabbleh* by some informants, which locally refers to steamed food. There is no limitation to what kind of or how many wild vegetables can be included in the preparation. The most common species used in the preparation of *Sleeq* are *Scandix pecten-veneris*, *Cirsium vulgare*, *Allium ampeloprasum*, *Erodium acaule*, *Cichorium intybus*, *Anchusa strigosa*, *Gundelia tournefortii*, *Silybum marianum*, *Rumex acetosa*, *Anemone coronaria*, *Malva sylvestris*, and *Urtica dioica*. Practically every wild leafy vegetable that is able to be gathered by the collectors can be included in the dish, since it is sometimes difficult to gather a sufficient amount from one species only. The young shoots are the main part used in the *Sleeq*. The dish is mostly prepared in a local traditional clay pan called *Meqli* (see the video abstract in the online version of the article), where chopped onion is fried in olive oil, then cut wild leafy vegetables are added. Some informants add a small amount of chickpea and/or softly ground bulgur if available. Several informants reported that it is possible to use *Sleeq* as a topping on the dough to be prepared as pizza, with the same mentioned receipt excluding chickpea and bulgur. *Sleeq* is a seasonal food connected with the availability of wild leafy vegetables, usually collected from January to April.

2.3.4.2. *Zaatar*

Traditional food in many regions in Syria. It is a sour spicy dish consumed by mixing with olive oil, usually in breakfast and dinner meals, as well as in *Zaatar* bread/pizza. The dried and ground leaves of *Origanum syriacum*, the main ingredient of *Zaatar*, are mixed with dried ground fruits of *Rhus coriaria*, and roasted seeds of *Sesamum* spp. in the following proportion: 1.0 of *Origanum syriacum*, 0.75 of *Rhus coriaria*, 1.0 of *Sesamum* spp. Dried fruits *of Pistacia terebinthus/Pistacia atlantica* and seeds of *Foeniculum vulgare* may be sprinkled as spices. *Zaatar* is usually dried and stored in jars or plastic bags and consumed over the whole year.

2.3.4.3. *Louf* Soup

Louf is a traditional soup consumed only in some parts of the Syrian coastal mountains, especially by the Alawite and Ismaili cultural-religious groups. The soup has a sour-astringent taste with a thick texture. *Arum maculatum* is the main ingredient in *Louf* soup; its dark-green leaves are loosely cut and steamed for around half an hour. Afterwards, olive oil and bulgur are

added, and then the water of boiled *Rhus coriaria* is added after disposing of *Rhus coriaria*. The dish is characterized as a winter soup, as *Arum maculatum* is usually available from December to April. Some informants reported that they store it in glass jars in the refrigerator and consume it throughout the year.

2.3.4.4. *Shabshuleh*

The young aerial part of *Cichorium intybus* is boiled for around half an hour, then olive oil, crushed garlic, and a little bit of lemon juice are added (Figure 2.2.). It is typically consumed between January and April before *Cichorium intybus* starts flowering.

Figure 2.2. The most popular wild plant-based dishes. (1): *Sleeq* dish; (2): *Zaatar* dish with olive oil; (3): *Louf* soup; (4): *Shabshuleh* dish

2.4. Discussion

2.4.1. Emergency Behavioural Reaction: Reliance Increase on Wild Food Plants during the Conflict

The reported increase of wild plant use during the conflict compared to the pre-conflict time clearly shows the effect of the conflict-associated economic crisis on the informants' behaviour toward food securing. This finding is strongly supported by the respondents' statements that highlighted economic reasons as the main motive behind such an increase. Wild plant foraging shifted from a complementary and entertainment activity for many informants a decade ago, to an important and necessary action in recent years. Such an emergency reaction went beyond being individual in other countries; in the winter of 1944–1945, the Dutch government provided information on wild plants and other famine food sources in the so-called "wartime cookbooks" [11]. Similarly, Redžić [3] broadcasted information over the radio to assist local people in finding edible plants as a quick reaction to food scarcity during the siege of Sarajevo in the Balkan war. Several other studies around the globe concluded that wild plant use and their related traditional knowledge served as a coping mechanism in response to food shortages [58,59,60]. Hence, traditional ecological knowledge (TEK) has to be conserved by societies, apart from its cultural importance, due to its ability to save the lives of millions of people in times of future crisis. Many obstacles stand in the way of TEK preservation, such as the invasion of fast food and prestige-related perception of local food. However, several strategies could be followed to preserve TEK, such as marketing the local food based on traditional knowledge, documenting TEK, raising awareness of its importance, and teaching the skill of recognizing and collecting wild plants to school students.

Changes in diet in the study area have mainly been represented by the decrease in buying market food products and an increase in the use of WFPs, particularly leafy vegetables. Most commodities' prices in Syria have increased tens of times since the beginning of the conflict. However, a few products are still affordable by the majority due to the government supporting these products. Bread, which is the main part of every meal, is one of these affordable commodities at 0.06 US Dollars per 1 kg (1 USD = 3,500 Syrian Pounds according to the market exchange rate of late October 2021). Olive oil is produced by the majority of people in the study area where olive orchards dominate the landscape. Vegetable prices in the market vary between 0.3 to 1.4 USD for 1 kg, and prices for 1 kg of meat range between 2.9 and 5.7 USD. Those prices are considered relatively high and commonly unaffordable compared to the average monthly salary of 149,000 SP ≈ 43 USD [61]. Hence, we find that bread, olive oil, and gathered WFPs form the key ingredients for the most affordable food (e.g., *Sleeq*). Wild vegetables are

also sold in the local markets at a lower price than other cultivated vegetables; for instance, the price of 1 kg of wild leafy vegetables (*Sleeq*) varies between 0,28 and 0,42 USD. We observed that several informants attempted to cultivate some wild species (e.g., *Origanum syriacum*, *Thymus vulgaris*) in their home gardens. Some people living in the cities and town centres (where access to wild plants is limited) depended on their relatives and friends in rural areas to gather WFPs for them.

2.4.2. Comparison of the Reported Wild Plant Diversity with Other Regions and Cultural Importance of Some Reported Species

The total number of 75 documented WFPs in the study area represents relatively high diversity compared to the Eastern Mediterranean region. It demonstrates a richness in the wild-related food culture. Kawas et al. [18] documented eight wild edible species out of 145 wild plants found in Hama Steppe in central Syria. On the other hand, 42 wild plant species are used in the Assyrian cuisine in the Eastern Syrian-Turkish borderland [19]. The majority of the reported plants in our study were not mentioned in either study of Kawas et al. [18] or Abdalla [19]; this is possibly due to the difference in ecosystems and vegetation types, or due to the differences in traditional knowledge between the regions. We believe that this survey may help to transfer the knowledge and use of WFPs to other neighbouring regions in Syria. Lower diversity of WFPs was found in Lebanon with 32 recorded species [23,24]. On the other hand, high diversity was noted in Adana in Turkey (76 documented species) and Cyprus with 78 recorded species [25,28]. On the other side of the Syrian borders, Pieroni et al. [45] documented 34 taxa used as WFPs in the Kurdistan region in Northern Iraq. The high diversity in species used in our study area could be attributed to the emergency situation, which pushed local people to use every edible plant available in the surrounding environment. Figure 2.3. shows the overlap in the used WFPs between our study (64 species in Table 2.1.), and studies selected from the closest countries to our study area represented by Lebanon [23], Cyprus [25], and Turkey [28]. The overlap demonstrates the Mediterranean influence on the wild plant-based diet in our study area, where 41% of our species (26 out of 64) was used in food preparation in the other compared studies. More than one-fourth (17) of our reported species were used in Cyprus, and some species were similarly prepared; this is possibly due to the geographical closeness to our study area. In addition to the overlap in used species between the selected study areas, more similarities were found in genera; this is due to the presence of different species that belong to the same genus. The use of *Gundelia tournefortii* is documented in all compared studies; this is possibly due to its pleasant taste, as our study informants reported that it is one

of the most preferred WFPs. It is usually steamed in olive oil with minced meat or chickpeas. Several plant species were found to be unique to the study area, such as *Arum maculatum*, which is a very popular and traditional soup (*Louf*) in some parts of the study area. All the species that comprise the most common wild plant-based dishes are culturally important and often frequently used. Despite that some of these species are less available nowadays in the wild, they still remain highly preferred, and this is possibly due to their pleasant taste or their importance in the local culture as a main part of the traditional diet. Based on the results and our observation, the sour-astringent taste was found to be preferred by many informants, especially from Alawites and Ismailis, which was demonstrated by the high use of some wild species, such as *Arum maculatum* and *Rhus coriaria*, which were described by some informants as "the sour of Phoenicians".

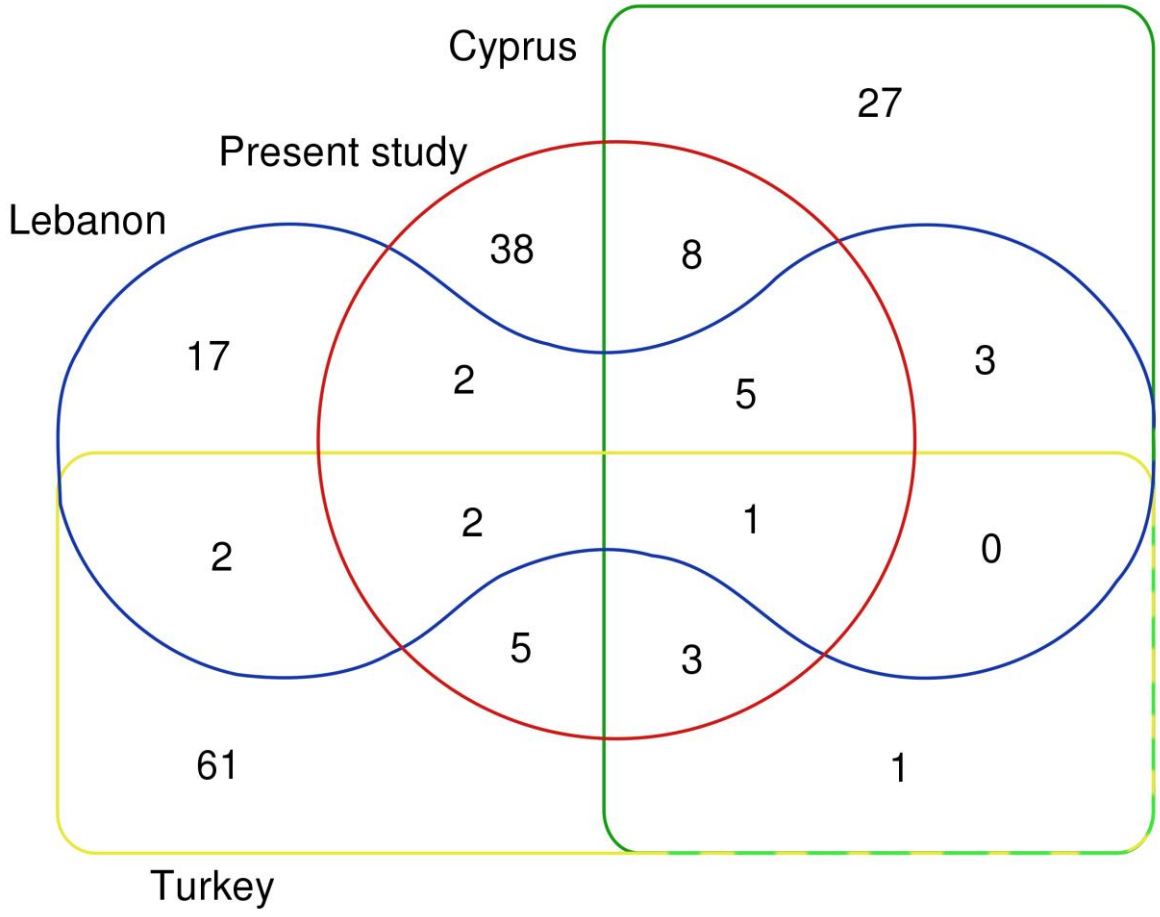

Figure 2.3. Overlap of used wild food plants between our study and selected studies from some East Mediterranean countries (numbers refer to the overlapping species)

2.4.3. Nutritive Value of the Most Quested Species

There is a deficiency of data on nutritional status in Syria, especially considering that the situation is getting worse every year with the continued conflict, economic sanctions, and conflict-related chaos and corruption. However, a report from WFP [62] showed a high level (12.7%) of chronic malnutrition among children under the age of five. Anaemia is widespread amongst both children under the age of five and women, with a prevalence of 25.9% and 24.5%, respectively. Here, iron-rich WFPs, such as *Scandix pecten-veneris, Gundelia tournefortii,* and *Nasturtium officinale,* as well as other dark-green leafy wild vegetables, such as *Arum maculatum* could play a significant role in preventing anaemia (Table 2.2.). In times of COVID-19 and immunity-related diseases, species-rich in zinc content, such as *Scandix pecten-veneris* and *Allium ampeloprasum,* could significantly help local people due to the direct effect of Zn on the overall activity of the immunity system [63]. Some of the reported species, especially those which are quoted by the majority, have shown a general richness in nutritional value and health benefits (Table 2.2.). Species such as *Origanum syriacum* and *Thymus vulgaris* demonstrated a richness in antioxidants. The protein content was particularly high in some species, such as *Rumex acetosa*. Hence, for instance, the wild plant-based meal of *Sleeq,* which contains wild leafy vegetables (rich in minerals and vitamins), olive oil (a significant source of unsaturated fatty acids), bulgur (protein-rich cereal), and bread (a main source of carbohydrates) serves as a good source of essential nutrients for the human body.

We checked the edibility rating of our reported species through the international database of Plants For A Future [64]. The rating gives points on the basis of edibility from 0 (the least edibility) to 5 (the most). We found that the majority of reported wild plants have less than medium edibility rating where 18 species have only 2 points of edibility, while 20 species have a rating of 3 and 4 points (10 species for each). On the other hand, there are 14 plant species consumed by the local people, which are not registered in the database of PFAF.

The toxicological aspects of wild food plants have to be seriously considered, as many species could hold topical compounds. The antinutritional properties of WFPs have been highlighted in several studies [65,66,67]. Some of our reported species may hold toxicity properties, such as *Arum maculatum,* which contains a high amount of calcium oxalate [68]; however, as local people are aware of this toxicity, it is thus prepared by boiling for more than an hour to detoxify it.

Table 2.2. Main nutritional benefits of WFPs, which are among the most reported in the current study

Species name	Part used	Main nutritional benefits
Origanum syriacum	Leaves	Antioxidant [54].
Rhus coriaria	Fruits	Good source of phenolics, anthocyanins, organic acids (e.g. malic acid, citric acid and ascorbic acid) and carbohydrates [46].
Eryngium creticum	Young aerial part	Rich in antioxidants [51].
Cichorium intybus	Young aerial part	Rich in K, P, and vitamin C. It has anti-inflammatory and anti-diabetic activity. [47].
Allium ampeloprasum	Young aerial part and bulb	Good source of fibre and zinc [50].
Gundelia tournefortii	Leaves midrib and underground stem	Good source of minerals K, Ca, P, Na, Fe, Mg, and Zn; as well as vitamin E [52].
Scandix pecten-veneris	Young aerial part	Highly rich in Fe; a significant source of Zn [55].
Malva sylvestris	Young aerial part	Rich in Ca, Mg, and K [53].
Nasturtium officinale	Young aerial part	A good source of K and Fe [55].
Rumex acetosa	Young aerial part	Rich in proteins [49,56].
Thymus vulgaris	Leaves	Has antioxidative, anti-inflammatory, antibacterial and antifungal activity [48].

2.5. Conclusions

The field study that we conducted among the local people in the coastal region of Syria showed a remarkable level of reliance on WFPs as a source of human nutrition. The study demonstrated the increased use of WFPs during the conflict compared to the pre-conflict time. Our results strengthened the findings of previous studies that ethnobotanical knowledge functions as a coping method for food shortage. We documented 75 wild plant species used in food and beverage preparation with a relatively high diversity compared to other studies from the Eastern Mediterranean. The most common wild food-based dishes and their preparation mode were documented. Some species, such as *O. syriacum, G. tournefortii*, and *R. acetosa* demonstrated a richness in nutrient content. More research will help determine the exact nutritional role that these WFPs play in supplementing local diets during the conflict. Understanding the perceptions of local people towards WFPs could help plan a successful promotion of some nutritive species. Furthermore, future studies should consider the sustainability of WFP use and how these plants could be protected during crises.

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3. Socioeconomic Dimensions of Wild Food Plant Use in Times of Emergency

As we documented the ethnobotanical knowledge in the previous chapter, we move in this chapter to the socioeconomic aspect of wild plant use in order to know which categories of the society rely more on natural resources during the conflict. This chapter strengthens the findings related to the second aim of the dissertation as it provides an explanation of how economic conditions associated with conflict can lead to higher use of wild plants. In addition, the present chapter covers the third aim of the dissertation, which focuses on investigating the impact of socioeconomic factors on wild plant use. The chapter also provides information on how wild plants contribute to the livelihood of and income generation for local people.

This chapter is adapted from the submitted article:

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Author contribution: Naji Sulaiman designed the study with supervision from Zbynek Polesny. N.S. carried out the data collection, analysed the data, and drafted the manuscript. Other co-authors reviewed and edited the manuscript. N.S. prepared the final version and submitted the manuscript.

Abstract

Wild plants have served as a food source for humans since ancient times. The use of such food particularly increases when the availability or accessibility of conventional food is limited due to emergency situations, such as conflicts. Twelve years of the war in Syria have caused substantial socioeconomic and cultural changes and led to widespread food insecurity across the country. Our study seeks to scrutinize the impact of socioeconomic factors (e.g. age, gender, education, household size, direct involvement in the conflict, and household income) on the use of wild food plants during the conflict. The study was conducted in the coastal region of Syria between March 2020 and March 2021. Fifty informants (26 women and 24 men) were interviewed in-depth on their use of wild plants during the current economic conditions resulting from the conflict. Statistical analysis revealed that the number of used species increased with the informants' age, while it declined with the increase in annual household income. Informant gender was a predictor for both reliance level on wild plants and frequency of use. The findings may be crucially important to understand the effect of socioeconomic conditions on human behaviour towards food in crisis conditions.

Keywords: Eastern Mediterranean; economic crisis; emergency food; food culture; food security; human-nature interaction; Middle East; socioeconomic factors

3.1. Introduction

Wild plants have been an important part of the food cultures of the Mediterranean region since ancient times (Nebel, Pieroni, and Heinrich 2006). Recent ethnobotanical studies from the Eastern Mediterranean highlight the role of wild plants in the traditional local cuisines (Pieroni, Sulaiman, and Sõukand 2022; Pieroni et al. 2022). These studies suggest, based on a historical interpretation, that wild plants could be the hidden core element of the Mediterranean diet. Besides the traditional role of wild plants in food supplies during peace times, they may be crucial in times of uncertainty (Łuczaj & Pieroni 2016). The use of such food particularly increases when the availability or accessibility of basic food is limited due to emergency situations, such as conflicts (Vorstenbosch et al. 2017; Sõukand 2016; Redžić et al. 2014). Violent conflicts drive the majority of the global humanitarian crises and are causally linked with food insecurity (Brück and d'Errico 2019). Conflict reduces food availability by impacting agricultural production and increases the security risks associated with its use to access the food markets, thus driving up local food prices (Tomasevski 1994). Gaynor et al. (2016), who summarized 144 conflict case studies, highlighted that the most common pathways linking conflict to wildlife arise from institutional and socioeconomic changes associated with conflict, rather than directly from military tactics. Hence, we understand that the complex relationship between people and their surrounding environment gets impacted by new realities resulting from the conflict rather than the conflict itself.

Eleven years of the war in Syria have left catastrophic results on agricultural production and the livelihoods of millions of people. The country that was an exporter of many agricultural products such as wheat, barley, and olive oil before 2011, has become now largely reliant on food and livelihood assistance (FAO 2019). Socially and demographically, the armed conflict has caused the largest refugee crisis since the Second World War, where more than half of the Syrian population (12 million people) have been left displaced either internally or abroad (WFP 2019). Economically, households face severely reduced purchasing power and rising food prices; poverty now affects over 90% of the Syrian population, and more than 12 million people are food-insecure. This situation is reflected in the whole country and not only in the war-battle areas (WFP 2021[a], 2021[b]; FAO 2014).

The use of wild plants during conflict conditions was marginally studied from an ethnobotanical perspective; Redžić et al. (2014; 2010) documented the use of wild plants during the Balkan war, where such food saved the life of many people during the 1430 days of the siege of Sarajevo. Khatri-Chhetri and Maharjan (2006) reported that collecting wild food plants is the most followed coping strategy for food insecurity in rural areas of Nepal. In Syria, wild

plants played a crucial role in human nutrition during the ongoing conflict; a recently published study revealed that 64% of the study respondents reported an increase in their reliance on wild plants as a food source during the conflict compared to the pre-conflict time (Sulaiman et al., 2022).

Social, economic, and cultural aspects have a significant impact on human perception towards the surrounding environment. Several studies have highlighted the relevance of socioeconomic factors such as age, gender, education, income, and household size with the behaviour toward natural resources including wild plant harvest (Campos et al. 2015; Cruz, Peroni, and Albuquerque 2013; Kideghesho, Røskaft, and Kaltenborn 2006). Campos et al. (2015) concluded that the effect of age and gender might be important predictors in studies aimed at assessing the knowledge and use of native species. Some species hold cultural importance for a specific community, which could bring higher use of such species (Khoury et al. 2019). On the other hand, the socioeconomic situation could impact local people's food choices and push them to use wild plants (Campos et al. 2015). In a war context, gender, for instance, could be a crucial factor in wild plant foraging and consumption, as men are usually involved in the conflict and women takes the responsibility of the household. Similarly, household size and income could be important drivers behind wild plant foraging. However, this topic is largely unexplored in conflict conditions and its associated socioeconomic results. Hence, Our study seeks to understand what socioeconomic factors can predict the use of wild food plants during the conflict. We aim to scrutinize the impact of socioeconomic factors such as age, gender, education, household size, direct involvement in the conflict, and household income, on the reliance level on wild food plants, frequency of use, and the number of used species. We hypothesize that the use of wild food plants increases with the decline in household income. We also hypothesize that war-involved households (where a household member is a soldier, injured, missing person, and/or a victim) tend to have a higher reliance on wild food plants.

3.2. Materials and methods

3.2.1. Study area

The fieldwork was carried out in the coastal governorate of Tartus (Figure 3.1.). The study area was selected considering security concerns during the fieldwork as the area is relatively safe, and also considering the COVID-19-related restrictions during the period of the fieldwork. However, the area shares similar socioeconomic realities and a food insecurity situation with other governorates in the country (WFP 2021[b]). The governorate of over a million inhabitants

and 1896 km^2 is located along the Mediterranean sea and bordered by other Syrian governorates from the north and east, and Lebanon from the south. Annual precipitation is around 1000 mm, and the vegetation is characterized as Mediterranean with dominant sclerophyllous shrubs and trees. Several religions and ethnicities coexist in the region, such as Christians (Orthodox, Catholic, and Maronites), Alawites, Ismailis, Sunnis, Greeks, Turkmens and Arabs (Qutrib, 2016).

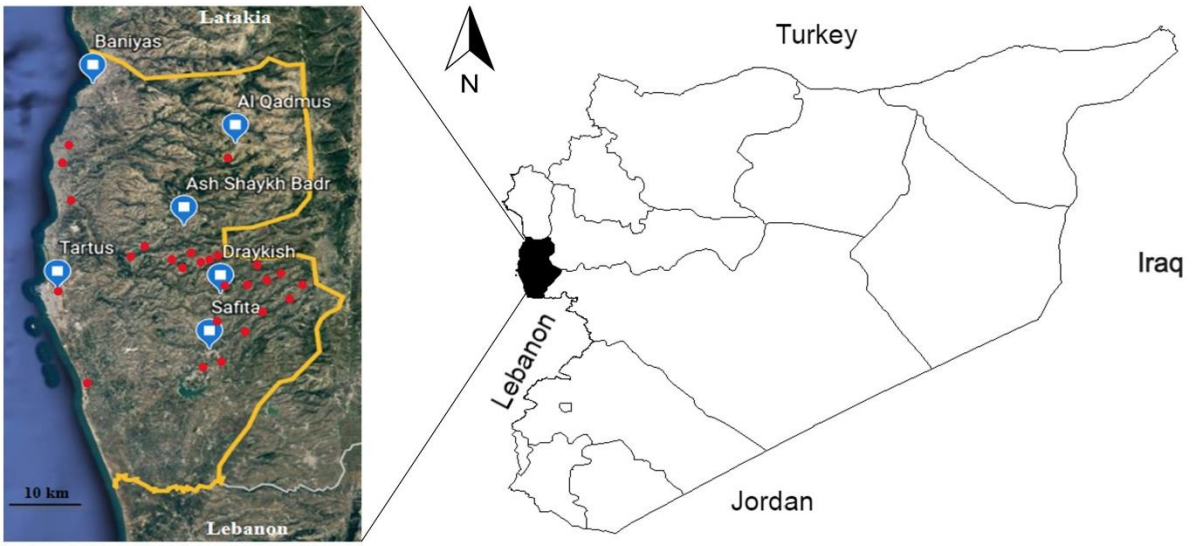

Figure 3.1. Study area, Tartus governorate. White-blue signs refer to the main districts in the governorate; Red points refer to the selected locations where interviews were conducted

Local people in Tartus depend mainly on governmental jobs and the agricultural sector with no significant industrial or commercial activities. The main agricultural products are olive oil, citrus fruits, greenhouses-produced vegetables, and tobacco. The majority of the villages in the governorate are accessible through paved roads, while basic services are provided, such as schools (in some cases, several villages share one school), and small local shops in each village where local products such as cultivated vegetables and bread are sold. Although the governorate experienced a relatively safe situation during the conflict in Syria, the young men in the governorate have been strongly involved in the war battles elsewhere in the Syrian territory. According to the government's rules, which control the entire Tartus governorate, men above 18 years and under 42 years must join the army when requested unless in very limited justified cases. Therefore, it is easy to notice the lack of men in the governorate streets as many of them served in the conflict, died, injured, went missing in action, or left the country. Tartus governorate, like other governorates in Syria, is crucially affected by the economic crisis

resulting from the conflict. During the fieldwork, we observed long queues at fuel stations, food unaffordability due to the high prices and decreasing disposal income, limited access to electricity of four hours per day, and a lack of many commodities as well as agricultural inputs. According to WFP (2021[b]), 51% of households in Tartus did not have adequate food consumption by the beginning of 2021.

3.2.2. Data collection and analysis

The fieldwork was carried out in the period from March 2020 to March 2021. Purposive and convenient sampling methods were applied to select our respondents (Espinosa et al., 2014; Dolores & Tongco, 2007). We approached villagers in the streets and in front of their houses or orchards. The main criteria were that the participant was a household head and commonly used wild plants for food or beverage. In total, 50 participants (24 men and 26 women) took part in the interviews. Participants were sampled from various geographic locations, from the sea level villages to the high mountains (up to 1,000 meters above sea level) in order to represent all regions that may have a variance of the wild vegetation. The age of the study informants ranged from 25 to 97 years. Study participants were sampled from 26 villages in the study area to represent all ethnic and religious groups in the region.

Participants were asked to report their age, education level, household members number, the annual income of the household, total landholding, and if there is a household member directly involved in the conflict (soldier, injured, missing person, and/or victim). Afterwards, informants were asked about the frequency of wild plant use. They were asked to use a scale of daily (every day), often (several times a week), occasionally (once a week), and rarely (less than once a week), which were coded during data analysis as 4,3,2,1, respectively. Informants also reported their reliance level on wild plants using the Likert scale (from 1 to 5), starting from 1 as very low to 5 as very high. The number of used species was calculated when informants listed all wild plants they used for food or beverage.

We did not measure the factor related to the distance between houses and the location of wild plant collection, as wild plant foraging in the study area is based on a horticulturist ecosystem (Aziz et al., 2022) where people mainly collect wild plants from the surrounding abandoned land, nearby orchards, and roadsides. A market survey was conducted in several local markets in the region. The income generated from selling wild plants was calculated by asking informants about the amounts they sell from wild plants per season and the price of its unit.

The Code of Ethics of the International Society of Ethnobiology was strictly followed (ISE, 2008), and prior consent was obtained before each interview. A research permit was obtained from the General Commission for Scientific Agricultural Research and Tartus municipality (number: 9893; date: 5 April 2020). Interviews were conducted in the local dialect of the Arabic language. Plant species were taxonomically identified in a previous study, and voucher specimens were deposited in the Herbarium of the American University of Beirut (Sulaiman et al., 2022). We assume that age, gender, education, household size, household income, war-involving, and land holding are independent variables, while the frequency of use, reliance level, and the number of used species are dependent variables. A multiple linear regression model was applied to understand how socioeconomic factors could predict the dependent variables. In addition, qualitative analysis was used for a better contextualization of the results. The results were discussed with similar studies carried out in other regions (e.g., Mushi et al., 2020; de Oliveira Campos et al., 2015; Assogbadjo et al., 2012; Heinen, 1993). Both descriptive and inference statistics were performed using the Statistical Package for Social Sciences (IBM SPSS program version 28).

3.3. Results and discussion

3.3.1. Socioeconomic profile of informants

There was an almost equal gender distribution among the study informants. The mean age for men and women was 57.2 and 53.3 years, respectively. The household size contained on average 4.2 members (Table 3.1.). Thirty-five households (70%) were not directly involved in the armed conflict compared to 30%, who had at least one household member directly involved. Most of the informants had a school education (elementary, middle, or high school), while a few had either a university degree or no education at all. The mean monthly salary in Syria is 149,000 Syrian Pounds (SP) which equals almost 37 USD ($) according to the exchange rate of July 2022 (Salary Explorer, 2022), while a survey conducted by NRC (2021) shows that an average family of five members need at least 206$ each month to cover the necessities. The annual income was significantly low among most of the study informants; 46% of the households had less than one million Syrian pounds per year (less than 1,000 USD according to the exchange rate at the time of the data collection). On the other hand, 40% had an income between 1,000 and 2,000 USD per annum, while only 14% of the studied households had over 2,000 USD. Almost half of the study respondents (48%) work in the governmental sector, and sometimes they combine it with a second job, such as running a small shop. More than two-thirds (72%) of the households owned land. We observed that most of the lands are planted

with olive trees as they do not require intensive agricultural service. We also observed many lands left abandoned; this may be explained by the lack of manpower due to the conflict, and the costly agricultural inputs. The religious and/or ethnic groups of Christians, Alawites, Sunnis, Ismailis, Arabs, Greeks and Turkmens were not represented equally. However, each mentioned group was represented by at least 10% of the informants' sample.

Table 3.1. Socioeconomic profile of informants (n=50)

Variable	Range	Values definition	Mean	Standard deviation
Gender	From 0 to 1	0 = male; 1= female	-	-
Age	From 25 to 97	Age of the study respondent	55.16	14.12
Education	From 0 to 4	0 = illiterate; 1= elementary school; 2 = primary school; 3 = high school; 4 = university or higher	2.04	1.09
Household size	From 1 to 10	The number of the household members	4.24	2.04
War-involved households	From 0 to 1	0 = not involved; 1 = at least one member is/was involved.	0.30	0.46
Household annual income	From 1 to 3	1 = less than 1,000 $; 2 = between 1,000 and 2,000 $; 3 = more than 2,000 $	1.68	0.71
Landholding	From 0 to 35,000 m^2	The land space owned by the study participants	4,037	6,450

3.3.2. How do socioeconomic factors influence the household reliance level on wild food plants?

The mean reliance level among our participants was 3.6, which falls between moderate and high. We found a significant statistical relationship between reliance level and gender (p-value < 0.05), anticipating that women's reliance on wild food plants is 0.616 lower compared to men (Table 3.2.). This statistically significant variance between both genders could be attributed to the longer time of men's existence in the landscape, including orchards and the communal lands, as we observed that men in the region take over the agricultural fieldwork while women mainly care about the household. Another reason could be the difficulty in market-food affordability due to the high prices since men are generally more responsible for

income generating in the local culture; therefore, they tend to rely, and their managed households, on wild plants. Similarly, households involved in war conflict tended to show higher reliance on wild plants (β = 0.435); however, the relationship is not statistically significant (p-value > 0.05). The result can be explained that households that include a soldier, injured, missing person, and/or victim, already miss one member who could have been a breadwinner. In addition, household income suggests to play an important role in the reliance level where lower income categories rely more on wild food plants; however, the relationship is not statistically significant (p-value = 0.168).

Table 3.2. Results of multiple linear regression predicting reliance level on wild food plants

Variable	**β**	**Standard error**	**Standardized β**	**t**	**p-value**
Gender	-0.616	0.289	-0.314	-2.136	0.039
Age	-0.012	0.011	-0.170	-1.049	0.300
Education	-0.107	0.145	-0.118	-0.738	0.464
Household size	0.008	0.091	0.017	0.089	0.930
War-involved households	0.435	0.356	0.203	1.221	0.229
Household income	-0.330	0.235	-0.238	-1.403	0.168
Landholding	0.000	0.000	0.142	0.944	0.351

Dependent variable: reliance level

Sõukand (2016) reported that searching and collecting wild food plants in Estonia is, traditionally, a female task while men have little knowledge. In contrast, in a study on the influence of socioeconomic factors on the use and knowledge of native food plants in Northeastern Brazil, Campos et al. (2015) found, in one of the studied areas, that men know and use more species than females. This finding is similar to our study. However, native food plants could include several kinds of plants that are beyond wild plants, such as domesticated and semi-domesticated plants. Kang et al. (2013) found that gender was positively correlated with the number of wild food plants used in Shaanxi, central China, where men used more species than women. In the Mediterranean area, a study from Spain found a slight difference between genders where men were able to recognize more wild edible plants than women; however, they found no gendered difference in consumption (Acosta-Naranjo et al., 2021). Similarly, no significant difference was found between genders in collecting and learning to

identify edible fungi in southeastern Poland (Łuczaj and Nieroda 2011); while another study from the same country reported that men showed more diversified knowledge considering wild edible fungi than women (Kotowski et al. 2019). Aziz et al. (2022) stated that wild food plants, in the Mediterranean region, are usually collected by women more than men. This does not necessarily contradict our finding regarding the higher reliance level of men than women, because reliance can be understood as an economic-based strategy, while plant gathering is an action influenced by social habits and duties division amongst genders.

3.3.3. Influence of the socioeconomic factors on the number of used species

The number of used species by the studied households ranged from 7 to 42 species with an average of 24 species. Multiple linear regression showed that older people used more species. In contrast, households with higher cash income used less species (Table 3.3.). This can be explained that an informant aged 80 years old is predicted to use around six species more than an informant in their 30s. On the other hand, by moving one category up in the income categories, the number of used plants decreased by 3.55 species.

Table 3.3. Results of multiple linear regression predicting the number of used species

Variable	β	Standard error	Standardized β	t	p-value
Gender	0.130	1.850	0.010	0.070	0.944
Age	0.163	0.073	0.360	2.231	0.031
Education	0.440	0.933	0.075	0.471	0.640
Household size	0.323	0.581	0.103	0.556	0.581
War-involved households	-1.060	2.281	-0.077	-0.465	0.644
Household income	-3.546	1.509	-0.396	-2.350	0.024
Landholding	0.000	0.000	0.210	1.405	0.167

Dependent variable: number of used species

Ladio and Lozada (2004) found in a study conducted in the Patagonia region in South America that the number of known wild edible plants is significantly correlated with informants' age. However, the same study found that age is not correlated to the number of consumed species. In another study, Campos et al. (2015) showed that age influences the knowledge and use of species. These studies, in accordance with our findings, confirm that old generations hold more knowledge regarding native plants including wild species. Similar to our

finding, Cruz et al. (2013) highlighted a significant inverse relationship between wild plants and monthly family income. On the other hand, Mushi et al. (2020) found that family income influences firewood extraction from the forest, but it does not influence the collection of vegetables and fruits from the forest.

3.3.4. Influence of the socioeconomic factors on the frequency of wild plant use

The mean value of the frequency of wild plant use among our study respondents was 2.98 among our study participants, which refers to an "often" consumption based on the used scale. We found a significant statistical relationship between frequency of use and gender (p-value < 0.05), showing that men use wild plants more often than women (Table 3.4.). Similarly to the reliance level, this result could be attributed to the longer time men spend in the wild and agricultural lands, which led to higher gathering and frequent use of wild plants. Another reason is represented by the difficulty of buying food from the market as they are, mostly, in charge of securing food for the household. Additionally, the prestigious-related reason could be behind such difference where female respondents under-assessed their frequency of wild plant use as it is perceived as food for the poor people. Results of the model revealed a strong relationship between frequency of use and education level and war-involved households. However, it is not statistically significant for both factor. Besides the often-frequent use of wild plants among our study participants, we observed high diversity of used species; 94% of the participants used more than 15 species. On the other hand, we found in a previous study (Sulaiman et al., 2022) the tendency to use specific species where 80% of the study participants reported the same 11 species, which is probably due to their availability or their sociocultural importance.

Table 3.4. Results of multiple linear regression predicting the frequency of wild plant use

Variable	*ß*	Standard error	Standardized *ß*	t	p-value
Gender	-0.543	0.264	-0.307	-2.060	0.046
Age	-0.007	0.010	-0.113	-0.684	0.498
Education	-0.214	0.133	-0.260	-1.606	0.116
Household size	-0.050	0.083	-0.114	-0.605	0.549
War-involved households	0.472	0.325	0.245	1.450	0.154
Household income	-0.156	0.215	-0.124	-0.723	0.474
Landholding	0.000	0.000	0.111	0.724	0.473

Dependent variable: frequency of wild plant use

3.3.5. Contribution of wild plants to the household income

Eighteen per cent of our study participants reported that they sell the collected wild plants in order to generate income for their households. Such income is limited to wild plants' seasonality. Most species are available between January and April, while a limited number of species are available during the summer months. The contribution of wild plants to annual household income was limited to up to 15%, with some exceptional cases where it reached 27% of the total yearly household income (Figure 3.2.). Several informants reported that they collect firewood from the wild to generate additional income; however, in this survey, we only focused on the income generated from selling wild plants that can be consumed as foods or beverages. The generated income from the sales of wild plants has been highlighted in several studies (Cavendish, 2000; You-Kai et al., 2004). Kamanga et al. (2009) highlighted that wild and planted fruit trees on common land contribute up to 15% of total income.

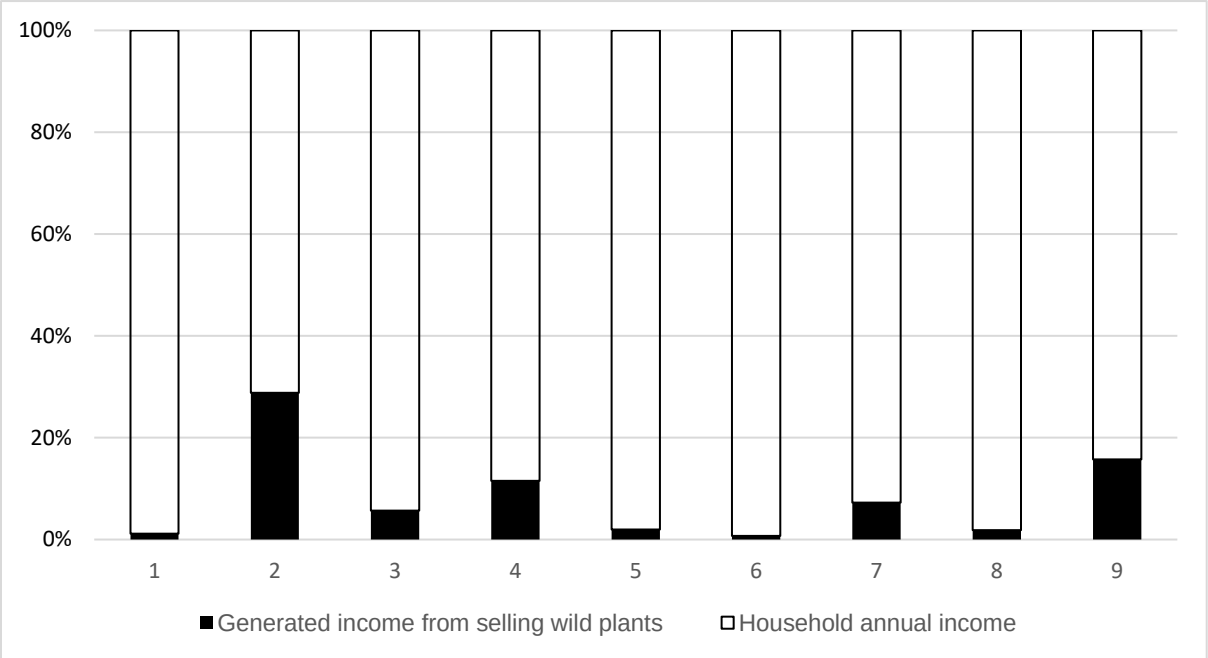

Figure 3.2. Contribution of wild plant collection to household income (*n*=9)

Collected wild species were usually sold to local markets or directly to consumers. Out of 75 wild plant species documented by Sulaiman et al. (2022), 19 species were observed being sold in local markets (Table 3.5.). As many people in the study area depend on collecting wild plants, other people buy wild plants due to their low prices compared to cultivated species, especially those living in town centres or unable to reach the wild and collect plants. The price of agricultural products has been doubled dozens of times since the beginning of the conflict

due to the high cost of agricultural inputs, lack of manpower since the majority of young men are involved in the armed conflict, unpredictable irrigation because of the electricity shortage, inability to cultivate large proportion of the agricultural land due to the security concerns, and other economic sanctions consequences. Hence, many people turned to cheap or free sources of food including wild plants. According to the sellers in the local markets, there has been a noticeable increase in demand for wild plants in recent years. The majority of the wild plants' prices are affordable by those who cannot collect by themselves. However, we observed a relatively high price for some species such as *Thymus vulgaris* L., *Rhus coriaria* L., *Origanum syriacum* L., and *Gundelia tournefortii* L. The high prices of these species could have a reciprocal relationship with their availability in the wild, where high demand led to decreased abundance in the wild and consequently to high prices in the market; the same phenomenon was observed in other areas (Lee et al., 2008).

Table 3.5. Wild plant species sold in local markets in Tartus governorate in coastal Syria

Plant species, Family	**Vernacular name**	**Part used/ main use**	**Part used status**	**Unit**	**Price (SP) per unit**
Allium ampeloprasum L., Amaryllidaceae	Kerrat	Aerial part and bulb/ food	Fresh	Bundle	250
Anchusa strigosa Banks and Sol., Boraginaceae	Balasoun	Young aerial part and underground stem/ food	Fresh	Kg	800
Apium nodiflorum (L.) Lag., Apiaceae	Qarrah	Young aerial part/ appetizer	Fresh	Bundle	75
Arum maculatum L., Araceae	Louf	Young aerial part/ soup	Fresh	Kg	500
Asparagus acutifolius L., Asparagaceae	Halyoun	Shoots/ food	Fresh	Bundle	500
Cichorium intybus L., Compositae	Hendbeh	Young aerial part/ food	Fresh	Kg	600
Crataegus azarolus L., Rosaceae	Za'arour	Fruits/ fruit	Fresh	Kg	1,500
Eryngium creticum Lam., Apiaceae	Qersanneh	Young aerial part/ food	Fresh	Kg	700

Plant species, Family	Vernacular name	Part used/ main use	Part used status	Unit	Price (SP) per unit
Gundelia tournefortii L., Compositae	Salbeen	Leaves midrib and underground stem/ food	Fresh	Kg	2,500
Lepidium ruderale L., Brassicaceae	Reshad barri	Young aerial part/ appetizer	Fresh	Bundle	75
Malva sylvestris L., Malvaceae	Khebbaizeh	Young aerial part/ food	Fresh	Kg	700
Micromeria myrtifolia Boiss. and Hohen., Lamiaceae	Zoufa	Aerial part/ tea	Dried	Bundle	200
Myrtus communis L., Myrtaceae	Hinblas	Fruits/ fruit	Fresh	Kg	500
Mixture of wild leafy vegetables	Sleeq	Young aerial part/ food	Fresh	Kg	600
Nasturtium officinale R.Br., Brassicaceae	Jarjeer	Young aerial part/ appetizer	Fresh	Bundle	75
Origanum syriacum L., Lamiaceae	Zauba’	Aerial part/ food	Dried and grinded	Kg	3,000
Rhus coriaria L., Anacardiaceae	Summaq	Fruits/ spice	Grinded	Kg	5,000
Rumex acetosa L., Polygonaceae	Hmmaidah	Young aerial part/ food	Fresh	Kg	500
Thymus vulgaris L., Lamiaceae	Za’atar barri	Aerial part/ spice and condiment	Dried and grinded	Kg	5,600

3.3.6. Traditional vs. modern: the social dilemma on traditional food culture among the young generation

Despite the fact that traditional food knowledge played a crucial role in human survival in times of food scarcity (Sulaiman et al. 2022; Vorstenbosch et al. 2017; Redžić et al. 2014; Redžić 2010), traditional food is still perceived by many people as outdated (Sõukand 2016). The elderly people (mainly those above 60 years) hold a richer knowledge of how to collect, prepare, and consume traditional food (Ladio and Lozada 2004; Campos et al. 2015). In addition, our results showed that age was a crucial factor in determining the number of used wild plant species. In contrast, this knowledge is facing a drastic abandonment among middle-

aged and young generations (Cucinotta and Pieroni 2018; Nebel, Pieroni, and Heinrich 2006). The alarming decrease in traditional food culture among the new generation can be attributed to several reasons, of which, the success of new mass food cultures including fast food, the increased demand for packaged market food, and the increased dependence on foods with a prolonged shelf life (Cucinotta and Pieroni 2018). Other reasons that could drive such an abandonment of traditional food are the current lifestyle which demands longer working hours and tight connection to life in cities, as well as the media means that are flooded with advertisements of "cool" and "modern" food. Some of our respondents stated that they perceive wild food plants as non-prestigious food as they used to be consumed by poor members of the community. However, this perception has slightly changed during the conflict as wild plants and their associated traditional meal became essential for survival. Some respondents reported that traditional food could bring some nostalgia as it was a preferred food for a missed household member due to the ongoing conflict.

Recent food studies from many regions around the globe show that the current dominant food systems failed to provide a healthy diet and are inequitable and environmentally unsustainable (Béné et al,. 2019; Willett et al. 2019). Therefore, there is a rising global trend of returning to the diverse and organic traditional food systems where wild plants play a key role (Pawera et al. 2020; Sõukand et al. 2020; Schunko and Vogl 2010).

3.4. Conclusion

Conflict areas usually lack data that could be used in planning successful projects, especially those related to food security, rural development, and wild biodiversity conservation. Wild food plants served as one of the main coping strategies for locals in coastal Syria to survive the severe food insecurity situation. Our study provided an analysis of the socioeconomic dimensions of wild plant use in one of the hottest conflict spots on the planet. The results revealed that the informant's gender predicted both reliance level on wild plants and the frequency of use. On the other hand, the number of wild plants used was predicted by the age of informants and the household income. War-involved households tended to have a higher reliance on wild food plants; however, the relationship was not statistically significant. Besides their contribution to the households' food security, wild plants contributed to some participants' income generation and livelihood. In addition, we discussed the perceptions towards traditional food, especially this based on wild food plants, among young generations. The study's findings are crucially important to understand the impact of socioeconomic conditions on human

behaviour towards food in crisis conditions. Future studies should consider how wild food species can support a nutritious diet in the study area.

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4. Environmental Sustainability of Wild Plant Use during the Conflict in Syria and Comparison with a Few Selected Eurasian Case Studies

As highlighted in the previous chapters, economic crises associated with conflict conditions lead to higher reliance on wild food plants. This could threaten the abundance of some highly-harvested species. In this chapter, we focus on assessing the environmental sustainability of some wild plant species. We compared original data between selected Eurasian case studies. This chapter covers the fourth aim of the dissertation concerning the sustainability aspect of wild plant use.

The present chapter is adapted from the published article:

Aziz MA, Mattalia G, **Sulaiman N**, Shah AA, Polesny Z, Kalle R, Sõukand R, Pieroni A. 2022. The nexus between traditional foraging and its sustainability: a qualitative assessment among a few selected Eurasian case studies. *Environment, Development and Sustainability*. DOI: https://doi.org/10.1007/s10668-022-02568-0

Author contribution: Naji Sulaiman conducted the fieldwork of the case study of Syria, analysed its data, and drafted the relevant part of the case study in the manuscript**.** In addition, N.S. contributed to the overall discussion and data interpretation throughout the manuscript.

Abstract

Plant foraging is an important human ecological phenomenon being studied by a number of contemporary ethnobiologists as well as by a few social anthropologists among rural communities and, more recently, in urban environments. The sustainability dimension of foraging is, however, largely unexplored. We analyse a few case studies from recent field research and qualitatively assess both the environmental and social sustainability of diverse patterns of traditional foraging practices in three distinct human ecological environments (horticulturalism-, forestry-, and pastoralism-driven) located in the Eastern Mediterranean, Eastern Europe and North Pakistan, i.e. we address the question of when does traditional foraging become unsustainable and what factors may influence this. The main findings are multidimensional. First, in all case studies, we sometimes observed competitive foraging among the gatherers of certain wild food plants potentially causing ecological degradation; such unsustainable practices seem to be linked to the market pressure on certain species. However, also customs and norms promoted by states can be detrimental (former Soviet Union), as well as climate change (Eastern Europe), and marginalisation of some minority groups (Pakistan). Second, in the Mediterranean Syrian context, wild food plant resources are largely represented by widely available weedy "wild" vegetables, normally (but not exclusively) collected by women, and usually easily accessible; only very few wild food plants seem to be threatened due to specific market demands or to disequilibria created by household economic instabilities due to the recent war. We also argue that unsustainable foraging is enhanced by the abandonment of daily practices and continuous interaction with the natural environment and by the increasingly uneven distribution of active practical knowledge on wild food plants among middle-aged and younger populations. Facilitating the transmission of sustainable foraging knowledge and practices could be therefore crucial, also for coping with food insecurity in times of crisis; but for that to occur, holistic environmental and food educational frameworks, appropriate policies for fostering community-based biodiversity conservation and also social cohesion and communal management of lands should be seriously considered as well. Moreover, future gastronomic and eco-tourism initiatives, if organised in a thoughtful manner, could represent a positive turning point not only for the local small-scale economies of the considered rural communities but also for helping them to dynamically preserve the entire socio-ecological system underpinned in plant foraging and ultimately to better adapt to the current global crisis.

Keywords: Wild food plants; Ethnobotany; Sustainability; Traditional ecological knowledge; Social cohesion

4.1. Introduction

Foraging -the procurement of food from the wild (without using sophisticated technology, as in hunting and fishing, for example)- was crucial throughout human prehistory and has continued to be so among post-Neolithic societies, as it still represents an important strategy for ensuring food to the household economy in some disadvantaged rural areas of the world (e.g. Addis et al., 2005; Erskine et al., 2015; Maroyi, 2011; Turner et al., 2011; Ojelel et al., 2019; Shai et al., 2020; Asia: Punchay et al., 2020; Pieroni et al., 2021), while in most Western societies traditional foraging retains a marginal role and new foraging trends are globally emerging in urban environments (Arrington, 2021; Bunge et al. 2019; Garekae & Shackleton, 2020; Landor-Yamagata et al. 2018; Łuczaj et al., 2012; Menendez-Baceta et al., 2017; Sardeshpande & Shackleton, 2020). The practice of foraging is, in fact, experiencing a remarkable resurgence in new media as well (e.g. Townsend, 2020), and these new practices have often raised some environmental concerns (e.g. Chen et al., 2019; Sarasan et al., 2011). However, in the ongoing context of global climate change, it is extremely important to assess the extent to which traditional foraging is sustainable overall. Despite the increasing number of publications on the topic of sustainability science, we too often still lack reflections linked to tangible improvements of daily human life. We need a more holistic overview of the complex relationships between humans and their environment and also within human communities (which may have very diverse levels of access to natural resources, e.g. Bunge et al., 2019). Thus, in dealing with the issue of sustainability, it is equally important to investigate the subject from an ecological and social perspective. As foraging competition is known among animals (e.g. birds: Liker & Barta, 2002; Smith et al., 2001; primates: Barrett et al., 2002; Di Bitetti & Janson, 2001), there is also deep concern regarding the competition for food resources among humans, not only in the context of famine and crisis but also in terms of the access that most socially disadvantaged groups may have to food resources for survival (Messer & Cohen, 2007). We argue that social unrests could create imbalances in sustainable use of natural resources. This would also likely create a large problem for ensuring environmental justice in certain socio-political contexts, especially towards vulnerable groups (Pellow, 2017). More importantly, in societies where socio-political/armed conflict is occurring, competition for natural resources could be greater than competition in stable societies. Thus this could bring about extreme inequality in the sharing of those resources, especially in times of conflict when the need for foraging is manifold (Sulaiman et al., 2022). In this regard, transdisciplinary research can significantly contribute to informing (environmental) policy forums about systemic sustainability. Yet, policymakers need to embrace its intrinsic complexity and

acknowledge its uncomfortability (sensu Rayner, 2012) to finally promote transformation processes.

In this paper dedicated to the memory of Professor David Pimentel, we analyse the trajectories of traditional plant foraging in a few case studies aiming to assess these phenomena from the point of view of systemic sustainability, which involves both an environmental and a social dimension. Much of Pimentel's research focused on sustainable agriculture and related food systems to "feed the world" in the coming decades that will see increasing population pressure on local resources (Pimentel & Hall, 1989; Pimentel & Pimentel, 2007; Pimentel et al., 1997a, b). Foraging could theoretically be a possible strategy to improve food security, especially in politically and geographically remote contexts (e.g. Paoletti et al., 2011; Pimentel et al., 1997a).

In this paper, we will therefore compare some qualitative data on the sustainability of traditional foraging arising from rural field case studies the authors conducted over the past decade in diverse environments predominantly shaped by different human ecological drivers (horticulturalism, pastoralism, and forestry) in three Eurasian regions: the Mediterranean (coastal Syria), Eastern Europe (Estonia and SW Ukraine), and the Hindukush (North Pakistan). We will try in particular to analyse the possible factors affecting drawbacks and beneficial aspects of traditional foraging in relation to both environmental and social sustainability.

4.2. Study areas and methodology

In the current study, we mainly rely on unpublished qualitative data arising from several previous ethnobotanical case studies devoted to recording plant-related foraging practices that were conducted in coastal Syria (Sulaiman et al., 2022), Eastern Europe (Kalle, 2017; Kalle & Sõukand, 2016; Pieroni & Sõukand, 2017, 2018; Mattalia et al., 2020, 2021; Sõukand, 2016; Sõukand & Kalle, 2016; Sõukand & Pieroni, 2016; Stryamets et al., 2021; Sõukand et al., 2022), and North Pakistan (Aziz et al., 2020a, b, 2021a, b), representing three different human ecological environments as described in Table 4.1.

Table 4.1. The case studies conducted on plant foraging in three distinct human ecological frames

Dominant activity	**Study areas**
Horticulturalism	coastal Syria
Forestry	Estonia and SW Ukraine
Pastoralism	North Pakistan

To a small extent, the data we present here were also drawn from unpublished qualitative observations accumulated in recent years in the considered areas.

The data were mainly collected via participant observation and semi-structured conversations with local (mainly elderly) community members, who are still engaged in foraging. In particular, we analysed the issue of the gathered areas and access to them, the eventual occurrence of trade of certain foraged plants, and the environmental and social aspects of the foraging practices, including their most crucial outcomes (culinary process and consumption arenas). We also thoroughly analysed the case studies via field narratives that were recorded among the selected study participants. During the interviews, the ISE Code of Ethics (ISE, 2008) was followed. Botanical identification followed national floras and was described in the aforementioned papers, from which the botanical data were extracted. We have tabulated the most culturally salient or commonly gathered plant taxa in each study area along with their social and ecological attributes.

4.3. Results and discussion

4.3.1. Foraging patterns in diverse human ecological environments

The data show that the main characteristics of wild food plants (WFPs) foraging differ in each of the selected case study regions.

In coastal Syria, most of the gathered plant species are weeds growing in anthropogenic environments, and foraging occurs mainly on communal lands; moreover, most of the plants are widely available, and their social meaning is complex (Table 4.2.).

Table 4.2. Environmental and social characteristics of the traditional foraging practices of the most common and/or most culturally salient wild food plants gathered in Mediterranean Syria

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Allium ampeloprasum L.; Amaryllidaceae	Communal land and orchards; no access restrictions	Moderate: gathered in large amounts with respect to its wide availability, yet habitat damaged by overharvesting and pulling up the plant with its bulb	Moderate: the plant is cooked and consumed by each family individually; however, the remaining fresh amount is shared with relatives. Prepared by steaming with other wild plants or fried with eggs	Low
Anchusa strigosa Banks & Sol.; Boraginaceae	Communal land and orchards; no access restrictions	Low: gathered in large amounts with no respect to its limited availability; moreover, its natural population has decreased in recent years due to overharvesting	Moderate: a trip for gathering is organised by several community members; however, it is cooked and consumed by each family individually. Consumed fried, steamed with olive oil and garlic or onion	Fair
Arum maculatum L.; Araceae	Communal land and orchards; no access restrictions	Low: its tuber is widely collected from the wild and planted in home gardens and orchards	High: it is gathered and used by each family individually; additionally, the prepared meal is shared with family relatives; it is prepared as a soup known for its sour astringent taste, consumed mainly by specific cultural-religious groups	High

Table 4.2. Continued

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Cichorium intybus L.; Asteraceae	Communal land and orchards; no access restrictions	High: gathered in large amounts with respect to its wide availability	High: it is shared between community members as a typical *Maza* "appetiser" with alcoholic drinks. Prepared by boiling, and then olive oil, lemon juice, and garlic are added	High
Eryngium creticum Lam.; Apiaceae	Communal land and orchards; no access restrictions	High: gathered in large amounts with respect to its wide availability	Low: it is gathered and consumed by each family individually; it is mainly consumed as a salad	High
Gundelia tournefortii L.; Asteraceae	Communal land and orchards; no access restrictions	Low: its availability has significantly decreased in recent decades becoming nearly absent due to overharvesting and landscape changes. Its decrease in abundance is also a result of high community demand for the plant	Moderate: a trip to search for the plant is organised by several community members; however, when found, it is cooked and consumed by each family individually. Steamed mainly with chickpeas or/and olive oil	Nearly absent; expensive
Myrtus communis L.; Myrtaceae	Communal lands; no access restrictions	High: gathered in limited amounts with respect to its wide availability	High: its fruits are gathered as snacks while walking in the wild, individually or in groups. Its branches are gathered for new graves as it symbolises "the promised paradise" by many Muslim/Sufi groups	Fair

Table 4.2. Continued

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Origanum syriacum L.; Lamiaceae	Communal land; no access restrictions	Moderate: gathered in large amounts with respect to its wide availability, and it is also planted in home gardens	High: it is the main ingredient of *Zaatar*, which is a very popular dish in the region; it is shared for breakfast between family members, relatives and neighbours. Additionally, the plant is added to the Yerba Maté drink, which is a social beverage in the area	Fair
Rhus coriaria L.; Anacardiaceae	Communal land; no access restrictions	Low to moderate: habitat was extensively damaged in the last few decades as most wild trees and shrubs, regardless of the species, were cut down for wood fuel due to the lack of fuel supply during the recent conflict	High: it is gathered and used by each family individually; additionally, it is shared as a gift between some families; the plant is mainly used as a spice, and it is the main ingredient of the popular dish *Zaatar*	Fair; expensive
Thymus vulgaris L.; Lamiaceae	Communal land; no access restrictions	Low: gathered in large amounts with no respect to its very limited availability, and now it is nearly absent; moreover, the plant has been widely removed from the wild and planted in home gardens	Moderate: the plant is mainly used for flavouring a local cheese called "*Shanklish*", which is commonly shared between community members and given as a gift	Low; expensive

Conversely, in Estonia and SW Ukraine, the WFPs we recorded in forest environments revealed that there are some species on the list that are particularly sensitive to human pressure. This shows that these species privilege large uncontaminated areas (i.e. forests and marshes) with sparse human settlements; moreover, there are also more wild trees and shrubs in the area that are important to people (Table 4.3.).

In Pakistani Hindukush, we found that the researched pastoralist communities have easy access to various habitats to forage WFPs, although mountain pastures often represent the main gathered spots.

Tables 4.2., 4.3., and 4.4. present the environmental and social characteristics of the most commonly gathered WFPs in the three analysed study areas.

Table 4.3. Environmental and social characteristics of the traditional foraging practices of the most common and/or most culturally salient wild food plants gathered in Estonia and SW Ukrainian forests

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Armoracia rusticana P.Gaertn., B.Mey. & Scherb.; Brassicaceae	Estonia: grows predominantly on private land and it is found naturalised in settlements and cities; Ukraine: also native	Moderate: Estonia: tolerated; Ukraine: disappearing due to perceived consequences of climate change and pests	High: used as an additive to lacto-fermentation, in salads, for seasoning meat dishes, and ritual use	Widespread in the lacto-fermentation season
Betula spp.; Betulaceae	Communal land: found in diverse habitats (forests, meadows, farmsteads); no formal access restrictions	Moderate: currently gathered in limited amounts with respect to its wide availability, yet the collection of sap damages trees if not correctly done	Very high: fresh and fermented sap shared within communities, whisks dried for winter and used in the sauna on a weekly basis – in Estonia only	Some whisks (for the sauna, sold in Estonia—for therapeutic purposes) and rarely sap
Carum carvi L.; Apiaceae	Mostly private land: grows in disturbed human-influenced landscapes only	Low: disappearing due to changed economic activities	Moderate: used as a seasoning, tea, medicine	Only industrial crop sold
Corylus avellana L.; Betulaceae	Communal land: (young) forests; no formal access restrictions	High: currently gathered in limited amounts with respect to its wide availability	Low: in Estonia, it was historically very high (gathered by the whole village together on specific days, used in social Christmas games)	Nearly absent (cultivated one, *C. maxima* Mill., mainly sold)

Table 4.3. Continued

Plant taxon and botanical family	Gathering spots and access	Estimated environmental sustainability (gathered amounts with respect to ecological availability)	Estimated social meaning (including gastronomic uses and arenas)	Occurrence in local markets (and pricing)
Fragaria vesca L.; Rosaceae	Communal land: specific forests and meadows; no access restrictions	Moderate: becoming less common due to changes in forest management	Moderate: widespread snack, the jam is also culturally important. The whole plant is prepared as a tea	Fair (very expensive)
Rubus idaeus L.; Rosaceae	Communal land: forest clearings, ditch banks; no access restrictions	High: currently gathered in limited amounts with respect to its wide availability, yet this is affected by changes in forest management	Moderate: important as food and medicine. Wild berries are preferred to cultivated ones	Nearly absent (cultivated one mainly sold)
Rumex acetosa L.; Polygonaceae	Communal land: meadows; no access restrictions	High: currently gathered in limited amounts with respect to its wide availability	High: in SW Ukraine, its use in soup is widespread; winter preserves are shared within the community; in Estonia mainly used as a snack	Nearly absent (cultivated ones, *R. acetosa* var. *horten sis* or *R. rugosus* Campd., mainly sold)
Urtica dioica L.; Urticaceae	Communal land: human-influenced habitats; no access restrictions	Moderate: in Estonia, suitable soils have partially shrunk due to the absence of animal husbandry in households	Moderate: soup cooked at least once a year as a spring delicacy. The plant is also an important medicinal plant for humans and fodder for animals	(nearly) Absent

Table 4.3. Continued

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Vaccinium myrtillus L.; Ericaceae	Communal land: specific forests; no access restrictions	Moderate: gathered in limited amounts concerning its wide availability, yet communities damaged by berry-picking devices	High: one of the most popular berries, sometimes shared fresh and cooked among community members; provides income for the most vulnerable part of the community. The whole plant is boiled to make a (medicinal) tea	Fair
Vaccinium oxycoccos L.; Ericaceae	Communal land: bogs; no formal access restrictions, yet difficult to access in the majority of cases	High: gathered in limited amounts with respect to its wide availability. Historically very low (gathered for income in large amounts, the collection was regulated, Estonia only)	Moderate: shared fresh among community members for food and medicinal purposes	Fair
Thymus spp.; Lamiaceae	Communal land: specific forests; no formal access restrictions	Moderate: in Estonia is partially shrinking due to changes in forest management	High: used as a seasoning, tea, medicine, and considered a keystone species for some Estonian minority groups	Low (only industrial crop is sold)

Table 4.4. Environmental and social characteristics of the traditional foraging practices of the most common and/or most culturally salient wild food plants gathered in Hindukush, Pakistan

Plant taxon and botanical family	Gathering spots and access	Estimated environmental sustainability (gathered amounts with respect to ecological availability)	Estimated social meaning (including gastronomic uses and arenas)	Occurrence in local markets (and pricing)
Allium carolinianum DC.; Amaryllidaceae	Collected from high mountains and pastures	High: gathered in large amounts; previously, it was collected for food purposes, but nowadays, it is largely collected for medicinal purposes	High: leaves are used as a salad and act as a flavouring agent in many dishes; aerial parts are cooked as a vegetable by different communities	Rarely marketed
Other wild *Allium* spp.; Amaryllidaceae	Mountain pastures	Moderate: the gathering of the species is reported less compared to the past; however, in the traditional cooking system, they were used instead of onion and bought from markets; in the past, the species were mostly used for food purposes, but now they are used for medicinal purposes	Moderate: aerial parts, sometimes whole plants, are gathered and cooked as vegetables, some traditional communities collected their leaves and prepared local spices in their houses, but nowadays, they are no longer used on a daily basis	Fair
Capparis spinosa L.; Capparaceae	Foothills and found near houses in villages; no access restrictions	High: gathered in large amounts with respect to its wide availability to obtain an extract from its flowers to treat various ailments	High: the fruits are cooked as a vegetable; the flower is used in a seasoning amongst elderly community members. The entire plant is highly useful for treating various health problems	High

Table 4.4. Continued

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Carum carvi L.; Apiaceae	High mountains and pastures	High: gathered in large amounts concerning its wide availability to treat various types of gastric problems	High: the consumption of both fruits and seeds as a tea and seasoning is widespread	Fair
Chenopodium album L.; Amaranthaceae	Commonly found in fields and gardens	Moderate: gathered in large amounts as food and medicine. A decrease is reported in its availability currently due to advancing anthropogenic activities like unsustainable agricultural practices and environmental degradation	High: almost all aerial parts, especially leaves, are cooked and consumed as vegetables by all family members of different communities	Nearly absent
Eremurus spp.; Xanthorrhoeaceae	Collected from high mountains and pastures	High: gathered in large amounts concerning its wide availability for food purposes and medicine	High: all aerial parts, mostly leaves, are cooked as a vegetable by different communities across the region	Nearly absent
Ferula spp.; Apiaceae	High mountains and foothills	High: gathered in large amounts for medicinal and food purposes	Moderate: leaves are used as a salad, stems and latex are used as a seasoning and in pickling	Absent

Table 4.4. Continued

Plant taxon and botanical family	**Gathering spots and access**	**Estimated environmental sustainability (gathered amounts with respect to ecological availability)**	**Estimated social meaning (including gastronomic uses and arenas)**	**Occurrence in local markets (and pricing)**
Portulaca quadrifida L.; Portulacaceae	Commonly found in fields and home gardens	Moderate: gathered in large amounts with respect to its limited availability as compared to the past for food and economic purposes	High: both gathering and cooking, sometimes freshly used as a salad by most of the communities	High
Thymus linearis Benth.; Lamiaceae	Foothills	Moderate: gathered in large amounts concerning its wide availability for different herbal sauces or chutneys, teas, seasoning, and for medicinal uses	Moderate: aerial parts are used as salads, in teas and for seasoning. The aerial parts are also used as a spice in meat and rice	Absent

4.3.2. Gathering areas and access to them

In Estonia, as in Ukraine, "everyman's right" is regulated by law. This means that everyone has the right, on both state and private land (unless the land is fenced or marked with prohibition signs), to gather wild berries, mushrooms, flowers, medicinal plants, nuts, and other natural products under nature protection for personal use.

In Syria, communal land, or so-called state land, can be accessed by everyone; however, orchards and private lands can be accessed only by their owners, while others can gain access upon agreement with the landowner.

In the case of Pakistan, people mostly collect WFPs from summer pastures (communally managed) located at higher elevations; to go there and collect plants is, therefore, very labour-intensive and mainly practised by men. Most of the time, local herders go there and collect plants and then sometimes they sell them to local villagers even though they are common goods gathered from a commonly shared property. Land ownership is a complex issue in these areas, but foraging can be done everywhere except in fields where crops are grown and that are owned by someone. Thus far, the state has not imposed restrictions on the foraging of WFPs in the region.

Access to the most commonly used wild plant resources in all our case studies normally occurs on communal lands, and this easy access only represents an obstacle for those who do not have the necessary knowledge and skills to forage or for those who have physical impediments prohibiting foraging. This is especially true in the Mediterranean, where sharing wild vegetables within rural villages is sometimes still customary and culturally important (Pieroni, 2003). However, the assignment of a particular economic value to the foraged items is highly dependent not so much upon access, but much more upon the time needed for the procurement strategy: normally plants, whose gathering requires a lot of investment in terms of time and physical labour, are more prone to be perceived as more economically valuable and therefore suitable for being marketed and meeting consumer demands (see last columns on the marketed WFPs in the tables).

4.3.3. The role of market pressure

Sustainability science holistically considers all the driving forces affecting social, economic, and environmental sustainability and never works in a fragmented way; therefore, it will take time to approach global sustainability (Shrivastava et al., 2020). In regard to plant foraging, we previously discussed (Pieroni et al., 2014) that in North-Eastern mountainous Albania, the external pressure on certain wild plants determined by the herbal market

(remarkably promoted during the Communist period) represented an important driver for shaping a distorted perception of the availability of the local resources, exacerbated by the "Albanian dilemma" of how both ancient customary (*Kanun*) and state laws should be interpreted for regulating access to common goods (communal land). The data presented in the aforementioned tables clearly show that some WFPs collected in forests and high pastures for the market are sensitive to over-foraging. In eastern European forests, foraging is mainly an activity involving families (Sõukand & Kalle, 2016), while in the Pakistani context, it is principally a side activity of male pastoralism (Aziz et al., 2020a). Mediterranean foraging involves widely available weedy plants, normally gathered by women, and the pressure on plant communities seems to be very restricted-possible because the perceived economic value of WFPs is coded in gender relations as well (Pieroni, 2003).

During field observations we conducted in the Hindukush, our research group recorded some striking reflections on foraging patterns which are clearly not sustainable. In one case study, from Yasin Valley of Gilgit Baltistan, we found that people used to collect WFPs, especially *Capparis spinosus* (Aziz et al., 2020a), and sell them at high prices to the local market, which later supplied other cities, thus creating huge competition among foragers in the area. It has been established that when individuals compete for access to resources using aggression (Durham, 1976), resources can be lost, or the net gain can be reduced by the physiological costs of the contest. Experimental results have demonstrated that unregulated use of a common-pool resource, such as common pastures, generates inefficient levels of use; however, there is a fundamental paradox, which we will call the spite paradox, that is in need of replication and explanation (Casari & Plott, 2003). We have observed in some areas in the remote valleys of Northern Pakistan that people, especially children, eagerly looked for the flowers of the plant to harvest, which is a very unsustainable practice and creates negative impacts on the reproduction of the plant in its natural habitat (e.g. also see Aziz et al., 2020a). Such an unsustainable ecological practice not only damages the population density of the species but also has a significant impact on species richness, as in some cases other associated plants can also be affected (Schunko et al., 2021). Therefore, we can also perceive the growing issue of biotic homogenisation (Olden et al., 2004), while intraspecific variation and individual diet specialisation (IDS) have also emerged as key drivers of ecological functions (Lunghi et al., 2020). The niche variation hypothesis predicts that when a population is released from the interspecific competition (i.e. "ecological release"), intraspecific competition will promote resource niche expansion and IDS. It then follows that if biotic homogenisation reduces taxonomic diversity and interspecific competition, intraspecific competition within the

remaining taxa should expand population resource niches and increase the prevalence of IDS (Manlick & Newsome, 2021). Similarly, there were other WFPs that were foraged in the remote mountains of North Pakistan and brought home, without taking into account the negative impacts of the extensive collection; for instance, *Eremurus* spp. and certain species of *Allium* were frequently collected by herders (see Aziz et al., 2021b). Local interviewees from North Pakistan confirmed that in the past, most of the WFPs could also be found in the vicinity of villages, but now they only grow in places far from villages, and people that graze animals in pastures and high mountains are likely to forage them. It is also interesting to note that the pastures are generally communal property which could provoke serious concerns over the exploitation of the rights of local communities in the Hindukush mountains. Field observations have confirmed that in the Kalash Valley of the Hindukush, the minority group of Kalasha has been pushed back by their Chitrali neighbours, and several parts of the valley have been sold to their neighbours. The Kalasha have been facing some problems since they cannot forage freely on communal lands due to security issues, as a few years ago, they were targeted by Islamist militant groups in the remotest part of the surrounding mountain pastures, which are considered the best places to forage plant resources. It is crucial to link the issues of minority groups to the fact that meta-power has often reduced their local ecological practices, as clearly explained by Baumgartner et al. (1975).

Among our case studies in coastal Syria, we investigated the abundance of WFPs over the last decade. Local informants reported a significant decrease in the availability of some wild plant species during the recent conflict compared to pre-conflict times (Sulaiman et al., 2022). This can be attributed to several factors, including the overharvesting of species with no respect to its limited availability, landscape changes due to human displacement from non-secure regions to the very few safe areas, and the absence of governmental control over the widespread use of some non-selective pesticides. Herbaceous species such as *Gundelia tournefortii*, *Anchusa strigosa*, *Arum maculatum*, and *Thymus vulgaris*, in all likelihood, have been affected in their natural habitat by the uncontrolled use of herbicides. This is especially the case for some species such as *Gundelia tournefortii* which at the flowering and fruiting stage are considered by some locals as weeds that need to be pulled out of the ground or treated with chemicals. Wild food plants have shifted from complementary food before the conflict to a main source of food in recent years, resulting in increased demand and subsequent pressure on the species and their habitats. Informants reported that several wild food species (e.g. thyme, *Thymus vulgaris*) have been largely overharvested in an unsustainable way, including the uprooting of whole plants from the wild and planting in home gardens, and, as a consequence, such species have become

nearly absent. On the other hand, several other species were collected in order to be sold in local markets. The natural populations of these species, including *Gundelia tournefortii*, have significantly decreased in recent years due to high demand and market value. *Rhus coriaria*, also known as "the sour of the Phoenicians" referring to its ancient cultural value for the local people of coastal Syria, has been affected by the current conflict in the country. Local inhabitants have been forced to cut down these trees for wood fuel, and this, along with its market value as a main ingredient of the traditional food *Zaatar* (Figure 4.1.) has resulted in high pressure on its habitat. Of the species listed from Syria, *Myrtus communis*, *Thymus vulgaris*, *Cichorium intybus*, and *Rhus coriaria* were classified by the IUCN with the conservation status "least concern" (IUCN Red List, 2022), which is not indicative of some degree of threat. However, the reported assessment by local people could generate greater concern regarding its abundance in the region, especially with the reported availability of *Thymus vulgaris* and *Rhus coriaria*. The social meaning of some species such as *Arum maculatum* is complex: besides its use as a winter soup and as a medicinal plant for digestive disorders, it serves as a hidden part of the cultural identity of the Alawites and Ismaili cultural-religious groups, as they used to eat this soup while they were persecuted and isolated in the mountains during the Ottoman Empire.

Forest plants are often keystone species for forest-dependent communities. Across our case studies in Estonia and the Ukrainian Carpathians, we identified some of the most important species for assessing their social and ecological sustainability. While we acknowledge a shift from wild to cultivated forest plants (especially for raspberries and strawberries, which are now commonly grown in gardens), we also recorded a clear preference for the taste of wild fruits, as well as a recognition of the importance of the practice of foraging (e.g. direct contact with the forest).

Figure 4.1. *Zaatar* (*Origanum syriacum*): one of the culturally salient plants in coastal Syria (Photo: Naji Sulaiman)

In Eastern Europe, the blueberry is probably the most important forest berry across different areas, as it is a major source of livelihood for forest-dependent communities living in

the Ukrainian Carpathians (see also Mattalia et al., 2020). On the one hand, blueberry (*Vaccinium myrtillus*) holds a high social meaning being a keystone species and serving as food, medicine, and a shared recreational activity (Figure 4.2.). On the other hand, this berry represents a crucial economic resource for local communities, which sometimes undermines its ecological sustainability due to overharvesting and forest mismanagement. The fresh berries of *Vaccinium myrtillus* last only a few days after picking. Thus, smaller quantities are gathered for personal use and immediately stored in cans or frozen. In the food industry, blueberries are used to make food colouring. Thus, it does not matter whether the blueberry is spoiled or not, the dye is still obtained. Picking berries with special mechanical aids damages both the berries (those picked in this way spoil quickly) and berry bushes (shrubs do not produce berries for many years), but at the same time, one can quickly collect a large number of berries. In Estonia, these berries are sold to a middleman who usually takes them to the large food industry in Finland. There they are made into natural food colouring. Large-scale berry-picking with mechanical tools for commercial purposes is not sustainable and should be discouraged, while the hand-picking of berries, being sustainable, should be encouraged.

Figure 4.2. Blueberry (*Vaccinium myrtillus*) drink, SW Ukraine (Photo: Nataliya Stryamets)

Wild raspberry is another important forest species in Eastern Europe, yet its value is partially substituted by cultivated ones which are bigger, easier to harvest, and less susceptible to transportation damage. As with blueberries, (wild) raspberries are widely recognised as an important local food and medicinal resource, yet their ecological sustainability is being challenged by the current changes in forest management-raspberry (*Rubus idaeus*) is one of the first species that appears after forest disturbance) and by the perceived consequences of climate change (Ukrainian interviews reported prolonged rains affecting the productivity of raspberries). Similarly, wild strawberries are socially important, yet their ecological sustainability is being challenged by management and climatic changes. From the beginning of the twentieth century until World War II, the harvesting of *Rubus idaeus* and *Fragaria vesca* berries was banned in young forests on Estonian state lands (Kalle & Sõukand, 2012). The reason for the ban was that the foresters feared that berry pickers would trample young trees; violators of the ban were fined. This ban indicates that there were fears that people could pick berries unsustainably. However, there was no known scientific study behind this ban, and thus there is no basis for this preconception.

Stinging nettle is a very common species that grows at the edge of Eastern European forests, especially in areas that are grazed. While it is not used much for most of the year, it is considered a “must eat" in springtime when it is considered to be full of properties able to “clean the blood”. Although the abandonment of animal husbandry has partially reduced the abundance of *Urtica dioica*, it is still foraged in a sustainable way from both ecological and social points of view.

In the 19th and beginning of the twentieth centuries, there were restrictions on picking *Corylus avellana* nuts in Estonia and there were national statute dates for harvesting them (Kalle & Sõukand, 2012). The reason for the ban was that the nuts that were picked too early went bad (mouldy) but were still sold at a high price. In the middle of the twentieth century, the commercial harvesting of nuts in the forest declined so much that restrictions were lifted. There are practically no wild nuts in the market today. Now the market is filled with cultivated, mainly non-native nut species (e.g. *C. maxima*).

In the 1970s, the price of *Vaccinium oxycoccos* berries in Estonia became very high because the USSR began to export them. Thus, the mass harvesting of those berries that damaged the bog surface began in Estonia (people trampled the bogs too intensively). Unripe berries (white) were also picked. In order to prevent this, harvesting periods were imposed, which allowed the berries to be picked in the wild at the correct time. The time-restriction on collecting cranberries (*Vaccinium oxycoccos*) lasted until the 1980s. There is no mass

harvesting of cranberries today. A similar measure was imposed with wild fruits collection in Poland, where the 8th of September was appointed as the harvest day of hazelnuts to prevent the collection of unripe nuts (Łuczaj 2020).

The collection of caraway (*Carum carvi*) fruits (most commonly and erroneously called seeds) has historically been a source of income for rural people in Estonia; caraway fruits were sold in urban markets or country manors. For *Carum carvi* plants to grow, their habitat needs human care. Thus, the natural survival of a plant depends on human activity. However, due to the import of cheap cumin seeds at the end of the twentieth century and changes in land use, the collection of seeds from wild *Carum carvi* has practically disappeared today. Thus, when the commercial need disappeared, the interest in caring for this plant also decreased drastically and today this plant has nearly disappeared from the immediate vicinity of humans.

Finally, we analyse here the socio-ecological sustainability of birch trees (*Betula* spp.), an extremely important tree in the Eastern European milieu (Svanberg et al., 2012). The collection of *Betula* sap and whisks (in Estonia for the sauna and in SW Ukraine for ritual purposes) needs to be done carefully to prevent plant damage which can compromise future collection. Socially, birch can be considered a keystone species, being crucial for essential aspects of forest-dependent communities. During the Soviet era, forest industries in Estonia were obligated to collect *Betula* sap. It was sold to the food industry, where it was bottled. Due to the transition to a market economy in the 1990s, the purchase of industrial birch sap also disappeared. Today, the production of birch sap has become profitable again, and both forest companies and the food industry have started bottling sap. Currently, due to the high cost of pure birch sap, many mixed drinks have entered the market using birch sap as one of the ingredients.

During the time of the Soviet Union (until three decades ago), people in Estonia had a duty to pick medicinal and tea plants and wild berries. The norms of procurement were controlled by specific procurement offices. Schoolchildren were also obligated to pick medicinal plants, wild berries, and, in some areas, wild mushrooms. Although lists of the procured plants were provided, the so-called norms (by weight) were predominantly met by gathering the heavier plant (parts) (e.g. *Rubus idaeus* stems). Such forced picking of certain plants created a situation in which some of the species were not consumed by people at home, but rather were picked only for sale or as a state norm. The whole issue of the role played by the market in shaping cross-spatial, and cross-temporal dynamics of foraging would need however to be addressed more in-depth with ad-hoc surveys. Our field observations of the last two decades suggest, in fact, that small-scale and farmers' markets, for example, not only

represent crucial arenas for the livelihood of local communities and sometimes - especially in the Mediterranean and in Eastern Europe - of women (Sõukand et al., 2020), but can also act as virtuous drivers for training old foraging practices and developing new ones, thus allowing WFPs gathering to evolve and to even become more resilient.

4.3.4. The fading appeal of traditional foraging among rural younger generations

Traditional foraging among the considered groups has revealed interesting insights into how each culture has conceptualized the local environment and how they instrumentalized the value of nature. The study presented an overview of the diverse patterns of WFP-centred foraging, historically shaped by certain human-ecological relationships among the different cultural groups living in the studied regions. Our previous findings have shown that the local communities that have remained in close contact with nature have maintained considerable peculiarities regarding plant foraging (e.g. Mattalia et al., 2021), although in Estonia foraging practices are fading away within the lifetime of one generation due to changes in land management and social changes (Kalle & Sõukand, 2016; Kalle et al., 2020; Sõukand et al., 2022). However, there still exists a remarkable store of traditional/local environmental knowledge (TEK) on foraging, as recorded in each of the case studies.

Despite this important cultural heritage documented in these case studies, it is worth mentioning that the longstanding ecological practices linked to foraging are now being influenced by a wide variety of socio-cultural and political factors (e.g. Aziz et al., 2020b). These either have a direct impact on foraging practices (restricting access, prohibiting the sale, promoting collection through procurement) or indirectly affect the social life of local communities, which in turn has influenced the foraging behaviours of different individuals or groups of individuals and consequently, many cultures have to re-orientate human ecological relationships in the changing socio-political landscape. For instance, in the studies conducted in Southern Italy among ethnic Albanians during the past two decades, we found that the collection of non-domesticated vegetables (locally called *liakra*) gathering during the spring season was a common practice until the recent past, but nowadays, foraging is no longer practised among younger generations and TEK is only retained by elderly women (Pieroni, 2003; Pieroni et al., 2002). During the field survey, we observed that the ethnic minority settled in the area have inevitably been indirectly forced to Italianise, which has seriously threatened both language and human ecology. Similarly, the results of a study conducted by our research group in Vulcano Isle, Sicily (Cucinotta & Pieroni, 2018) found that traditional plant foraging practices are vanishing; local narratives confirmed that in the past, foraging was a crucial part

of food procurement strategies, whereas now it is recognised solely as a recreational activity for some people, who often link wild plant ingredients to a healthier diet. On the island, the increase in touristic activities since many decades has created opportunities for entrepreneurs to open supermarkets, and people have started working for external enterprises, preferring to serve holiday resorts, and thus the link between foraging practices and daily agro-pastoral activities have almost disappeared, and wild vegetables seem to be no longer known and maybe even appreciated by the younger generations. Similar perceptions were recorded in coastal Syria (Sulaiman et al., 2022) in recent decades, where interest in wild plant-based food has decreased; however, the opposite situation has been associated with the conflict in the country that started in 2011. The conflict has left millions of people in poverty, and as a result, wild plants have evolved from being complementary to essential food in many households.

In North Pakistan, traditional foraging has been significantly affected by remarkable social changes (Aziz et al., 2020a). It is important to mention that foraging is a socio-ecological process; therefore, the social attributes linked directly or indirectly to foraging have been crucial in the temporal dynamics affecting foraging. For instance, the folk nomenclatural knowledge of the foraged plants has been lost by a few minority groups, which reveals the impact that acculturation to the mainstream of the majority populations may have on the foraging behaviours (Aziz et al., 2021a; Pieroni et al., 2002). It is also important to note that local communities have shaped across centuries various social beliefs, which are attached to the foraging of certain plants. In Pakistani Hindukush, local people perceived for example, the wild plant *Saussurea lappa* as taboo, or morally unacceptable, and thus they are not allowed to forage for it; this indicates that foraging patterns are not only linked to the local food system, but certain plants are also associated with cultural and religious beliefs (Aziz et al., 2020a). Moreover, during previous research investigations, we could find in diverse Middle Eastern and Caucasian contexts that a strong impact of a dominant language or even religious affiliation affects not only the language/religion of minorities as practised by the youngest generations but also their folk plant nomenclature and taxonomy, thus in turn affecting the ability to recognise and use certain plants, and ultimately both the local ecology and attached cultural practices (see for example Pieroni et al., 2018, 2020, 2021). On the other hand, beyond our considered case studies, which all concern rural traditional foraging practices, new foraging trends are clearly emerging in urban environments, sometimes enhanced during the COVID-19 pandemic, and the literature on these phenomena has exponentially increased in the past two years (Łuczaj et al., 2012, 2021; Hare & Peña del Valle Isla, 2021; Sardeshpande et al., 2021; Shortly & Kepe, 2021; Somesh et al., 2021); it could be therefore worth to carefully compare in the future these

practices with more “traditional” rural foraging practices or their hybridised forms, also for what concerning the holistic sustainability. A few preliminary exploratory studies that our groups conducted in various European locations suggest that the "new foragers" act in a much more utilitarian manner and have much less contextual knowledge of the environment than their "rural grandparents", possibly since continuous daily exposure to nature is often missing.

4.3.5. Challenges for environmental and food education and policies

Several measures have been adopted to counter the impacts of human-made disturbances on ecosystems both on the national and international levels. There are also increasing efforts to ensure integrity among the social, cultural, and biological components of the living planet (Maffi, 2001). Even though a large number of resources have been utilised in different parts of the globe to achieve sustainable goals, there is still a long way to go. Sustainability is often a buzzword that is mentioned because of the anthropogenic pressures that are overwhelming the planet and ultimately affecting each pillar of life every single day. Looking at the preamble of the 2030 Agenda for Sustainable Development (UNESCO, 2015), we can observe highly appreciable phrases, i.e. “This Agenda is a plan of action for people, planet and prosperity. It seeks to strengthen universal peace in larger freedom”, but there are certain crucial gaps that need to be filled in this regard. Looking through the lens of foraging practices, our field research has shown that certain minority groups are striving to extract benefits from local natural resources (e.g. the Pakistani case we discussed in the previous section). Similarly, in the Vulture area in Southern Italy, the Italianisation of former Albanian minorities may have affected the loss of language as well as part of their cultural heritage and some traditional foraging practices too (Pieroni, 2003). In other Mediterranean case studies -i.e. Vulcano Isle, Southern Italy (Cucinotta & Pieroni, 2018)- the increase in inconsiderate tourist activities has displaced local agro-pastoral activities, and many fields have been replaced by concrete, which possibly came at the expense of foraging as locals also believe that the few WFPs that were readily available have now disappeared. Having looked through these examples, policies should be devised and implemented. We have also found that inappropriate policies of local authorities sometimes undermine the rights of local inhabitants to access local natural resources.

It is also worth mentioning that, on the one hand, unsustainable ecological practices are threatening ecosystem stability, while on the other hand, in certain contexts, states are designing unjust policies regarding the protection of nature and putting pressure on local communities without offering them an alternate solution. As an example, in a recent field study in the Wakhan area of Pakistan, we found that the growth of legal restrictions is also creating several challenges

for these agro-pastoralist societies; for instance, Broghil has been given the status of a national park and local inhabitants are facing problems in grazing their animals. Similar problems confront traditional pastoralists in the Carpathian Mountains. Therefore, political changes, such as collectivisation and central planning, are having an impact on long-established patterns of local landscape management (see also Mattalia et al., 2021). Authorities should respect the rights of local people, and there should be an equitable sharing of benefits from natural resources, as the local inhabitants are not content with these legal restrictions. During some field surveys, some local community members refused to share their folk knowledge as they considered us staff members or somehow affiliated with a national park nearby or otherwise related to nature conservation.

We strongly believe in the need to include local communities, especially minority voices, in planning and formulating conservation strategies in any regard. We also recommend exploring the influence of power on environmental justice; for instance, in our case, to identify foraging patterns and access to natural resources by minorities in their respective areas when they are struggling to sustain their economic and social life within multicultural societies. We hope that putting forward these recommendations for policymakers can act as a road map to devise strategies and challenge the consolidated power that denies minorities their rights of inclusion, self-determination, and access to natural resources. It is also not encouraging to know that in some cases, non-locals forage, and in other cases people working for enterprises collect wild food and medicinal plants without respecting private property or local people's property, thus exploiting their common rights to natural resources. In this regard, policymakers should plan certain measures to prevent the destructive practices of both internal and external foragers, and a local community-based committee should be established to provide them with the opportunity to impose decentralised sanctions on destructive foraging; for instance, if we look at the Italian case where foraging is free to locals, this could lead to unsustainable consequences (Sardeshpande & Shackleton, 2020). Moreover, it is worth mentioning that there is a large space to develop gastronomic-based tourism initiatives and local gastronomic practices should be promoted to achieve economic stability among the isolated, marginalised, and minority groups in their respective communities (sensu Derek, 2021), and this could even have a positive impact on the protection of natural ecosystems in a more informed way (see e.g. Corvo & Fontefrancesco, 2019). Lastly, we can observe different kinds of practices, some of which are a threat to ecology while others are very dangerous. On the one hand, biodiversity is under threat, while on the other hand, cultural diversity needs support as well, as Maffi (2001) emphasised two decades ago in her pioneering volume that focuses on the links between

linguistic/cultural diversity and biological diversity. In both cases, policymakers are the main pillars that must be involved, and merely presenting folk use of wild plans is maybe not anymore sufficient for scholars to compel or help society in implementing sustainable practices. We need to divert the attention of policymakers towards the holistic issue of economic, environmental, and social sustainability of various groups in a broader context in order to understand them. Recent efforts to incorporate restorative and recognition justice, alongside procedural equity, have provided important models for progress as well. For instance, granting legal and protective rights to river sheds and other ecosystems provides one promising way forward, as do the efforts to incorporate TEK in our attempts to mitigate and develop more sustainable socio-economic systems (see Fernández-Llamazares et al., 2021). In particular, we would advise putting forward policy measures to build participatory educational platforms aimed at co-creating foraging knowledge and at preventing extensive and destructive foraging, especially among younger generations. It could be crucial also to focus on and discuss the value chain of foraged food ingredients (Epanda et al., 2020), in the case that it is commercialised, in order to obtain a reasonable share for each member of the community.

It is worth mentioning that the current contribution is aimed at supporting policymakers, as the possible environmental threats caused by unsustainable foraging practised for commercial purposes are somewhat intuitive and have a long, tragic history in human society (see the example of the extinction of the possible seasoning plant *Silphion* in ancient Greece, Miski, 2021), unquestionably restricting human rights and going against the 2030 Agenda for Sustainability (UNESCO, 2015). In particular, developing countries need to revise their relative policies and have a greater opportunity to implement measures regarding socio-environmental protection. It has frequently been seen that policy frameworks are generally not very effective in rural areas, which may result in threatening the integrity of socio-ecological systems. It is unfortunate that besides unsustainable local foraging practices, the invasion of non-local foragers is also a phenomenon that should be critically considered in framing sanctions for harmful foraging practices. In this critical situation, solid narratives are needed to define sustainable foraging practices (Pontius, 2020), which might be possible after having undertaken an in-depth analysis of the foraging practices among groups under different socio-political contexts, and discussing the nature of challenges that are constantly threatening and affecting sustainable foraging. However, environmental education alone in the context of foraging would not match the ambitious Agenda 2030 objectives, without (re)considering the link between the environment and foodways and therefore promoting not only local food educational platforms

in the schools (Weitkamp et al., 2013), but integrative approaches linking both the ecological and food dimension.

4.3.6. The importance of revitalizing sustainable foraging practices

Researchers in ethnobiology have often stressed the importance of implementing frameworks for revitalizing plant foraging knowledge and its transmission through possible comprehensive educational tools (Zarger, 2011; Baptista & Araujo, 2019; Carvalho et al. 2021). For establishing socio-ecological sustainability, the revitalization of folk nature and food knowledge and practices is crucial because, on the one hand, the waves of social change that rural communities face are maybe unstoppable, and, on the other hand, the cultural homogenization of food systems (often driven by urbanization and the spread of industrial agriculture and food) is enhancing the disappearance of local food practices. To proceed with concrete tools, TEK recorded in different field studies could provide a better understanding and set a baseline for future planning in this regard. It should be noted that the involvement of ethnobiologists should be highly encouraged because they are the main academic actors that articulate the interactions of people with their nature, and they should often have the needed skills to articulate the issue on different policy platforms and engage the community as well. We also believe that it may be crucial to introduce *place-based* biological teaching (Pontius, 2020), in school curricula and it would be very encouraging to compare the local/folk knowledge with the scientific knowledge in order to get students involved in the process of co-creating/fostering sustainability. We believe that one of the most effective tools that could work in the future is to incorporate traditional foraging knowledge into the modern educational curriculum; this could provide students with the opportunity to cultivate their comprehension of both the natural and cultural spheres and to connect them to their socio-ecological environment in an imaginative way. Comprehensive nature-bound field experiences that enhance relatedness with the natural world through "*contact, meaning, emotion, compassion and beauty*" (Lumber et al., 2017) could, for example, represent an important step along this trajectory. Learning about foraging would therefore need to involve comprehensive, reflective, and multilateral strategies, including the practice and belief dimensions of TEK. Our research groups have proposed some perspectives on how to bring local ecological knowledge into educational platforms (i.e. in local schools, Aziz et al. in press).

4.4. Conclusion

We highlighted some of the important drawbacks and advantages of foraging practices among the different cultural groups subjected to distinct human ecological environments and socio-political factors. Our findings show the need to formulate crucial policy measures to prevent ecological and social damage and ensure environmental and social justice in particular contexts. However, policy forums need to be not only informed but also pushed to transform complex and uncomfortable knowledge on systemic sustainability into practice. Future (possibly also quantitative) investigations are also needed to complement the social, ethnobotanical, and ecological studies to obtain a clearer pattern of the existing foraging practices and their impacts in the studied areas. We also suggest the replication of some of the studies conducted in various regions decades ago in order to have a look at the current situation and to identify changes and interpret them with current knowledge, evaluating different drivers. A strong focus from both national and international organizations is needed to better ensure the integrity of the whole socio-ecological system and prevent unsustainable activities from emerging in societies and being incorporated by them. Looking at the overall situation, both social and ecological implications could be derived from these scientific facts. We hope that this work could have some useful implications for courageous policy makers to help design projects for socio-ecological sustainability in the considered regions in the near future.

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5. Contribution of Wild Plants to the Beverage Culture in Syria and the Possible Role of the Common Beverages in Lining the War-related Social Wounds

Besides the crucial role of wild plants as a food source for people during the conflict, they also serve as a part of the local beverage culture. In this chapter, we discussed yerba mate as one of the most popular beverages in Syria; we demonstrated its importance as a social drink and its position in current conditions. An important aspect of this beverage is the connection with wild plant use for economic and health reasons; hence, we discussed wild plants as additives to this beverage. This chapter contributes to the fulfilment of the first aim of the dissertation concerning ethnobotanical knowledge. The unique point of this chapter is that it goes beyond the study area of the previous chapters, as the informants were selected from all over the country and the Syrian diaspora.

The present chapter is adapted from the following article:

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Author contribution: Naji Sulaiman designed the study with supervision and inspiration from other co-authors. N.S. carried out the data collection, analysed the data, drafted the manuscript, submitted the manuscript, and made the requested revisions.

Abstract

Syria is the world's second–largest importer of the dried leaves of *Ilex paraguariensis* A.St.–Hil., commonly known as yerba maté. The unique story of yerba maté in the Syrian beverage culture started at the beginning of the twentieth century when Syrian migrants returning from South America brought the beverage with them. The overall aim of our study is to understand yerba maté use among Syrians and its role as an essential part of the Syrian beverage culture. We compare yerba maté consumption on spatial, gender, and religious bases through semi–structured interviews with 50 respondents, with equal participation among genders, place of residence, and cultural–religious groups (Sunni, Alawite, Christian, Druze, and Ismaili). We found that the Alawite and Druze groups have the highest yerba maté consumption, and that men drink more than women. Yerba maté was the most preferred stimulant drink among participants, followed by coffee and tea, respectively. Interviews reveal social and cultural factors, perceived addiction, perceived pleasure, and perceived health properties as the drivers behind yerba maté consumption in Syria.

Keywords: *Ilex paraguariensis*; Conflict area; Ethnobotany; Cultural migration; Stimulant plants; Beverages

5.1. Introduction

Plant use-related knowledge is impacted by human migration, mainly as a result of adaptation to the new flora of the host country (Medeiros et al. 2012). During the last century, several stimulant plants have travelled into communities that do not traditionally have an association with its consumption. These plants were transported by migrants and refugees who consumed them in the diaspora (Carrier 2007). Yerba maté (*Ilex paraguariensis* A.St.–Hil., Aquifoliaceae), which was brought into Syria by Syrian migrants returning from South America, is one of those plants. Syria is the world's second–largest importer of the dried leaves of the plant that is commonly known as yerba maté. In 2018, the country imported 34.5 million kilograms, with an approximate value of USD 71.7 million, which clearly reflects the high demand on this product from the Syrian community (INYM 2019; OEC 2018b). Despite the current hard economic sanctions on Syria, which have affected foreign exchange reserves, the Central Bank of Syria decided in 2019 to include yerba maté among the essential commodities supported for import, along with rice, sugar, baby milk, and medicine, which highlights the significance of yerba maté in Syrian life. However, it is still not entirely clear when yerba maté entered the Middle East for the first time; what is certain is that it took place before 1936. The first record–keeping of Argentinian yerba maté exports began in 1936. At that time, Syria was already the second–largest importer after Bolivia (Folch 2010). Understanding the importance of this foreign beverage among Syrian society could stimulate questions on the agro–economic possibilities of yerba maté production in Syria. On the other hand, understanding the patterns of and motivations for yerba maté consumption could be informative for finding alternative local beverages, especially since the local flora contains many candidate plants for beverage use, such as *Micromeria myrtifolia* Boiss. & Hohen. (Obón et al. 2014). This could positively affect the local economy. Additionally, this study fits in the theoretical framework of *Traveling Cultures and Plants* (Pieroni and Vandebroek 2007) and the study of perceptions and uses of plants that travelled with migrating people, highlighting how plant knowledge changes and evolves.

To trace the roots of the unique Syria–yerba maté relationship, we can look back to the second half of the nineteenth century and to significant events linking the Middle East and Latin America. Between 1881 and 1914, at least 600,000 Arabic–speaking individuals from Syria and Mount Lebanon migrated from the Ottoman Empire to the Americas. Of these, around 400,000 Arabs settled in South America before World War I (Karpat 1985). The majority of those migrants (46%) settled in Argentina. Starting from the 1870s, an economic boom took place on the continent due to increased demand for Latin America's agricultural products, which resulted

in demand for a large labour force. Additionally, political riots, intricate and delicate religious affairs, and religious quarrels were among the motives for Syrian and Lebanese migration (Kukovecz 1995).

While some people were drawn to Latin America due to economic conditions, instability was another motive that drove others away from their homeland. A series of armed conflicts embroiled the Levant from the nineteenth century onwards: the Druze–Maronite Christian conflict in the mid–nineteenth century, the Hauran Druze Rebellion against the Ottomans in 1909, the First World War, the collapse of the Ottoman Empire, the French mandate on Syria and Lebanon in 1923, the Great Syrian Revolt in 1925, the Second World War, the Arab–Israeli War in 1948, the Lebanese civil wars in 1958 and 1975, the Arab–Israeli wars in 1967 and 1973, and the Israeli occupation of Lebanon in 1982 (Bouknight 2018; Fersan 2010). Conflicts in the region are still occurring. In 2011, Syria entered an armed conflict that has caused the largest displacement crisis since World War II: 6.2 million Syrians are internally displaced, and 5.7 million more are registered as refugees outside of the country (WFP 2019). As a result of this continuous, unstable situation, many have migrated to safer places, with South America being one of the leading destinations. Over time, migrants have become rooted in their new home and have adapted to the new culture. Some of them have become notable personalities, such as Carlos Menem, the former Argentinian president (1989–1999). Some of the returning Levantines brought yerba maté to Syria, Lebanon, and parts of northern Palestine in the early twentieth century (Fersan 2010; Yerba Maté Argentina 2020).

Religious minorities represent the majority of Levantine migrants due to the previously mentioned reasons and highlighted historical events, as well as the discrimination and persecution they suffered under Ottoman Empire control, represented mainly by religious "Fatwas" that were issued against Ismailis, Nusayris (Alawites), and Druzes (Talhamy 2010). The religious spectrum in Syria mainly consists of Sunnis, Alawites, Christians, Druzes, and Ismailis, which constitute the following percentages of the Syrian population: 74%, 12%, 10%, 3%, <1%, respectively (Lesch 2005). However, those groups do not represent the overall diversity of Syrian society, which also consists of Arabs, Kurds, Assyrians, Armenians, Turkomans, Circassians, Chechens, Jews, Albanians, Greeks, and Yazidis. All those ethno–religious groups have mutually influenced each other over centuries, and they share almost the same socio–economic, political, and cultural realities. However, cultural differences are common, especially in food and beverage habits, which can be drawn along religious lines, according to Grigg (2002), for coffee and tea consumption in different societies where religious background had a significant influence. According to Folch (2010), yerba maté is particularly

associated with the Druze community in the Middle East, which could possibly be due to Druzes being among the first migrants from the Middle East to South America. However, according to the first author's observations, nowadays, yerba maté is widely consumed among different religious groups. Yerba maté has served as a companion to Syrians for more than a century. It contributed to their successful adaptation to South American culture upon their arrival as foreigners in the early twentieth century. The plant also occupied a place in their travel bags when they returned to their homeland. It has been a part of their daily life for a century, and when the war started, conflicted parties held guns in one hand and yerba maté cups in the other. Yerba maté is commonly consumed during discussions of matters concerning the current conflict and the country's political future. Moreover, when Syrians had to escape from war zones to safer countries, they did not forget to bring yerba maté with them.

We set out to understand yerba maté use among Syrians and its role as an essential part of the Syrian beverage culture. We particularly aim to know why informants drink yerba maté, and to compare yerba maté consumption across several Syrian groups as well as spatial, gender, and religious bases. Another aim is to comprehend the current position of yerba maté among the other stimulant drinks in the country. Additionally, we aim to explore the potential change in yerba maté consumption resulting from the social restrictions of COVID–19, recent post–conflict migration, and economic difficulties.

5.2. Methods

5.2.1. Data collection

Study participants were selected using the purposive snowball sampling method (Bernard 2002; Dolores and Tongco 2007) starting from the first author's contact network as a source of informants. When considering potential informants for participation in the study, the basic criterion was that they drank yerba maté at least once per month. We chose informants on a religious basis in order to make a comparative analysis between the cultural differences of those groups regarding yerba maté consumption and to trace the roots of these potential differences. We targeted informants from different social backgrounds, and all levels of education. The 50 total informants were equally represented by men and women. The age of informants ranged between 21 and 70 years. The participants were equally divided into two groups: the first of these included Syrian residents who were chosen from different regions. Out of the 14 total provinces in Syria, 11 were covered by informants sampled in this study. The second group of informants included Syrian diaspora members in 12 countries of Asia, Africa, Europe, and North America. Ten informants (5 Syrian residents + 5 Syrian diaspora members) from each of

the five different cultural–religious groups (Sunni, Alawite, Christian, Druze, Ismaili) were sampled. However, due to limitation in sample size, the sample cannot be considered representative of any part of Syria or the nations with Syrian emigres.

Ethnobotanical surveys were conducted during July and August 2020 through individual in–depth semi–structured interviews (Martin 2014). The majority of informants (47 out of 50) were interviewed remotely, and three were interviewed in person. Informants were asked about their yerba maté consumption patterns, including frequency, ways of and reasons for drinking yerba maté, its perceived health benefits, social and psychological impact, the longest period of time that they could go without drinking yerba maté, and current position of yerba maté among other stimulant beverages. Participants from the diasporas were additionally asked to report changes in their yerba maté consumption since they left Syria, while Syrian residents were asked about the impact of the recent economic difficulties on their yerba maté consumption. We also discussed with all participants changes in yerba maté consumption resulting from social restrictions due to COVID–19 and the history of yerba maté introduction into Syria. All interviews were conducted in the Arabic language. The Code of Ethics of the International Society of Ethnobiology (ISE 2006) was rigorously followed, and informed consent was obtained prior to interviews.

5.2.2. Data analysis

The comparison on spatial, gender and religious bases was conducted, mainly, through calculating the frequency of yerba maté consumption by asking, How often do you drink yerba maté? The answers were calculated on a weekly basis (e.g., the answer of once per day was calculated as seven times per week). One count (one session) of drinking yerba maté is considered the process of infusing dried roasted leaves in a cup, regardless of how many times the glass is refilled with hot water or how much time is spent in drinking. Nevertheless, drinking yerba maté differs from person to person, but commonly takes more than an hour, and includes nearly half a litre of yerba maté infusion.

To determine the position of yerba maté among other stimulant beverages, we asked informants to rank all beverages starting from the most preferred to the least preferred. Since only three beverages were reported, three points were given to the top–ranked drink, two points to the second, and one point to the third–ranked beverage (Martin 2014).

To understand the popularity of this drink in the beverage culture, we asked informants about their reasons for drinking yerba maté, and those reasons were categorized into groups through inductive thematic analysis (Braun and Clarke 2006). Each reason was considered a

report; when an informant reported more than one reason within the same category, all such reasons were considered as one report. Answers concerning the perceived health properties of yerba maté were also counted as reports: each answer was considered a report and some informants stated several reports. We used the tools in RAWGraphs software (Mauri et al. 2017) to illustrate trends and differences between the groups of informants.

We used our previously collected data in Syria to support and interpret the qualitative data regarding herbs commonly used as additives to yerba maté. The previous data were collected in 2018 from 42 informants who were interviewed about medicinal herbal teas, as well as in spring 2020 from 50 informants who were interviewed about the use of wild plants.

5.3. Results

5.3.1. Syrian Method of Yerba Maté Preparation

All respondents reported that they buy yerba maté from local shops in Syria and specialized Levantine/Middle Eastern shops abroad. The majority of respondents reported that they prefer the medium or loose kind of yerba maté because it tastes better and sweeter, whereas only 4% of respondents reported that they prefer the soft kind of yerba maté because it has a heavier taste and it lasts longer until it is washed out (taste becomes too weak). The soft kind of yerba maté is the same as the loose one but ground into smaller pieces, which makes the beverage more concentrated and heavier in taste. The drink is served in different ways in various locations. In most cases, it is consumed as a group activity. It is typically served in small glasses with an approximate volume of 100 ml. Such yerba maté is prepared by filling almost half the glass with dry roasted leaves of yerba maté (around 10 g), placing the straw (*bombilla* or *bomba* in Spanish, *massasa* in Arabic) in the glass; the 12–15 cm long straw consists of a metal or cane tube that terminates with a perforated filter on the end that is inserted into yerba maté, which allows one to drink the infusion free of pieces of yerba maté leaves. Cold water is first added to yerba maté to steep the leaves. Subsequently, this water is discarded and hot water is added to infuse the yerba maté leaves. Drinking starts immediately, and sugar, honey, and/or medicinal herbs are added according to preference. The process of drinking and refilling cups is repeated for one hour or more, using approximately half a litre of hot water, until the yerba maté becomes completely washed out.

5.3.2. The History of Yerba Maté Use in Syria

Despite yerba maté being an everyday drink for most informants, 60% of them did not possess any information about this plant and the history of this beverage in Syria. Some

respondents had the understanding that yerba maté is a traditional Syrian drink. Informants who come from the provinces of Tartus and As–Suwayda, as well as Salamiyah and Qalamoun districts, demonstrated certain knowledge about the history of yerba maté in Syria. The obtained data suggest that yerba maté culture was initially spread by the people of those areas to other regions within the country and possibly to the whole Middle East. Answers with respect to the date of yerba maté introduction to Syria ranged between 1920 and 1960.

The following quoted responses illustrate the perspective of some participants regarding the first entrance of yerba maté into the country.

"*My grandfather went to South America in 1915 in order to escape from the First World War; he returned from Argentina in 1938, bringing with him a big bag (around 50 kilograms) of yerba maté; I think it was the first time that yerba maté entered our village,*" stated a 49–year–old man.

"*Yerba maté entered my region at the beginning of the twentieth century through some of the expatriates in Venezuela, and later it became a popular drink and one of the main types of hospitality in the event of a visitor coming and called it The Duty Cup,*" a 30–year–old informant reported.

5.3.3. Religious, Spatial, and Gender Comparison of Yerba Maté Consumption

The frequency of drinking yerba maté among our participants varied between three to five times per day (six reports) and once per month (five reports). Two–thirds of respondents drank yerba maté between 7 and 14 times per week (one or two times per day). Alawite and Druze communities demonstrated the highest weekly consumption of yerba maté, followed by Ismaili, Christian, and Sunni groups, respectively. Variation in consumption frequency was the highest among the Alawite group members, while the least variable consumption frequency was among the Ismaili group (Table 5.1.).

Table 5.1. Frequency of Drinking Yerba Maté among Different Categories of Participants

Category		**Number of respondents (N = 50)**	**Weekly frequency of drinking yerba maté**	
			Range	**Mean**
Place of residence	Syria	25	1–35	11.8
	Diaspora	25	0.25–21	7.21
Gender	Male	25	0.25–35	10.7
	Female	25	0.25–21	8.31

Category		Number of respondents (N = 50)	Weekly frequency of drinking yerba maté	
			Range	Mean
Cultural-religious group	Sunni	10	0.25–14	4.95
	Alawite	10	0.25–35	12.5
	Christian	10	0.25–14	7.85
	Druze	10	4–21	12.4
	Ismaili	10	7–14	9.8

Yerba maté consumption among the Syrians in the diaspora was lower than that among the Syrian residents. This was especially true for the Alawite group, where average consumption for residents was almost four times higher than in the diaspora (Figure 5.1.). Christian and Sunni groups demonstrated a lower difference in their consumption. In contrast, Druze and Ismaili showed the highest similarity in yerba maté consumption regardless of the place of residence. According to our results, men drank yerba maté more often than women (Table 5.1.). Figure 5.1. shows a clear difference in consumption between genders, mainly among Christians and Alawites.

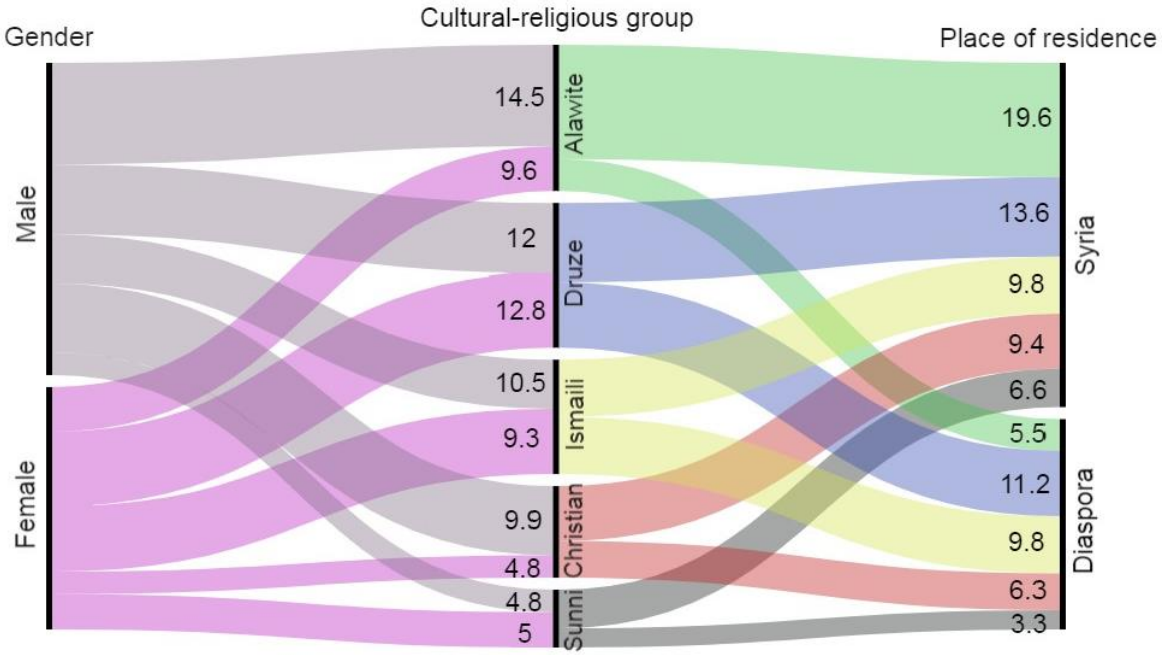

Figure 5.1. Yerba maté consumption among religious groups according to gender and place of residence (numbers within the streams refer to the average frequency of yerba maté drinking per week for each category)

5.3.4. Preference Ranking of Stimulant Drinks

According to the stimulant beverage ranking by informants, yerba maté was the most preferred beverage among study participants, followed by coffee and tea. Coffee was reported as the most preferred by 60% of Sunni participants, while yerba maté was favoured by Alawite, Druze, Christian, and Ismaili participants, with 60%, 70%, 40%, and 70%, respectively.

5.3.5. Reasons for Drinking Yerba Maté

There were 73 reports of reasons given for drinking yerba maté, which we categorized into four groups. The category "Social and cultural reasons" comprised 49% of the reports. This included responses such as, *Because it is a popular drink, Because it is a habit, Because it is a traditional drink,* and *Because it accompanies my meetings with friends and family*. The category "Perceived pleasure" formed 25% of responses; answers in this category were mainly phrased as "recreational" by informants, which, as explained by the participants themselves, means that yerba maté helps them spend time in a joyful manner and with happiness. The category "Perceived addiction" comprised 16% of informant reports, where "addiction" was stated as such by participants. Finally, the "Perceived health properties" category formed 10% of reports.

Some informants explained from their perspective what yerba maté means to them, and why they drink this beverage.

For instance, a 29–year–old man, currently in the Republic of the Congo, stated:

"*I drink yerba maté because of the addiction. If the time passes 15:00 without me drinking it, I cannot concentrate anymore, I get a headache, and my thoughts become blurred. But when I drink yerba maté, after that, I feel that my head goes back to normal. I have an emotional connection to yerba maté; it brings back memories of when I was in Syria, having a picnic under the olive trees with my cousins. I also remember mornings when I used to sit with my father and drink yerba maté with him. Yerba maté drives me to nostalgia, and it makes me feel more at home while I am abroad. I taught my foreign friends to drink yerba maté; here, I drink yerba maté once or twice a day, but when I was in Syria, I drank yerba maté four times a day.*"

While a 60–year–old woman living in Syria stated:

"*Yerba maté, for me, is like something that exists in my blood. Drinking yerba maté serves as an entertainment activity; it gathers people, and talks become longer and more pleasant with this beverage. Usually, I combine yerba maté with salty nuts and cigarettes; it makes me feel comfortable, it gives me the feeling of getting high, relaxing my nerves after hearing the war*

news. I am addicted to yerba maté. In 2014, when yerba maté disappeared from the market after the highways got cut due to the war, I was looking to buy it even by the half ounce."

5.3.6. Perceived Health Properties of Yerba Maté

While only 10% of informants considered health properties as a primary driver of their yerba maté consumption, 86% of informants perceived yerba maté to have beneficial health effects when asked, *Do you find yerba maté to be good for your health?* Participants conveyed 82 health–benefit reports of yerba maté corresponding to 14 different medicinal uses (Table 5.2.). Psychological benefits (concentration, calming, and stimulation) were the most cited with 26 reports in total, while urinary tract–related issues (kidney stones, urinary inflammation, and diuretic) were the second most frequently cited with 22 reports in total. Twelve informants reported that yerba maté serves as a good substitute for water and it hydrates the body. According to some participants' statements, yerba maté has helped them with some specific health issues; for instance, a 30–year–old man stated:

"*I got paralyzed during a battle in the war, and, consequently, I have a urinary catheter. The doctor recommended that I keep drinking liquids from time to time during the day in order to let my kidneys work continuously, which will prevent inflammation from occurring in the urinary catheter. Therefore, I use yerba maté for this purpose.*"

Table 5.2. Ethnomedicinal Uses of Yerba Maté among Study Participants

Medicinal use	**Frequency of citation ($N_{reports}$ = 82)**
Protection from and treatment of kidney stones	18
Help to concentrate	15
Provide hydration	12
Calming	9
Treatment of digestive and intestinal disorders	6
Treatment of pharyngitis	4
Slimming	3
Treatment of cold and flu	3
Treatment of constipation	2
Treatment of headache	2
Treatment of stomach-ache	2
Stimulation	2
Protection against urinary inflammation	2

Medicinal use	Frequency of citation ($N_{reports} = 82$)
Diuretic	2

5.3.7. Yerba Maté, Smoking, and Potential Addiction

Yerba maté consumption is often associated with smoking, and yerba maté consumption itself is considered an "addiction" by some of our informants. While we were piloting the questionnaire, several informants mentioned that they combine smoking tobacco (cigarettes or shisha) with yerba maté; therefore, we asked the question, Does your smoking increase while drinking yerba maté? A high positive relationship between smoking and drinking yerba maté was found among smokers (21 out of the 50 total informants). The majority of smokers (86%) reported that their smoking increases during yerba maté sessions.

On the other hand, assessing addiction is a complicated process, especially given the fact that a person could be addicted without knowing it. However, the ability to abstain from consuming a specific substance serves as an important indicator for measuring addiction (Pohler 2010). In addition to the 16% of informants who perceived themselves to be "addicted," we assessed potential addiction/dependence by analysing all informant answers to questions addressing the maximum period they could go without drinking yerba maté. We received a wide range of answers that varied between 2 h and an unlimited time. The majority of informants (62%) reported that they could withstand not consuming yerba maté for up to 1 week. However, there was no apparent difference between Syrian residents and the diaspora regarding the maximum period of abstaining from drinking yerba maté. The majority of respondents who declared perceived addiction as a primary reason for drinking yerba maté could not go more than two days without having the beverage, and most of their answers fell in the range of only a few hours.

5.3.8. Social Impact of Yerba Maté

Yerba maté is a social drink characterized by the joy of gathering in one place and sharing the same water pot, sugar bowl, salty nuts, sweets, and sometimes even the same cup. Only 14% of all informants reported drinking yerba maté from the same cup. These informants come from the same province (As–Suwayda) and belong to two religious groups (Druze and Christian); some of them live abroad, and others in Syria. Drinking from the same cup is done by sitting in a circle. After one person drinks from the cup, they clean the straw with a piece of lemon, and then the cup is refilled with water and passed to the person on the right. However, 86% of

informants reported that each person has their own cup of yerba maté, but they share the same drinking equipment (water pot, sugar bowl, as well as other snacks and additives).

All informants agreed that they like to drink yerba maté in a group, and some informants mentioned that they do not drink it at all when they are alone. The vast majority of respondents (90%) reported that yerba maté contributes to gathering with friends and relatives. Many informants mentioned that yerba maté creates a unique atmosphere for long talks, and that it provides a sense of familiarity and integration within the group. Here, we quote what some informants stated:

"*Meeting with a group is perfect when yerba maté is present. Without yerba maté, I feel that something is missing. It creates an atmosphere for long meetings.*"

"*It contributes to the closeness of group members as they are around it, sharing the same water pot and sugar bowl. It contributes to long sessions and talks.*"

"*Yerba maté brings about an atmosphere of familiarity, companionship, and reassurance. We feel that the session will be longer just for mentioning (Let us drink yerba maté).*"

"*Yerba maté creates a suitable atmosphere for spending more time with others, as it takes a longer time to drink, compared to coffee or tea. The conversation over yerba maté lasts longer, and the drink yields a kind of intimacy since the group is involved in doing the same thing during the conversation.*"

5.3.9. Impact of War, COVID–19, and Migration on Yerba Maté Consumption

Considering that yerba maté is an imported commodity, it has always been affected by the U.S. dollar (USD) exchange rate to the Syrian Pound (SP), which has frequently changed since the beginning of the conflict in 2011. Nowadays, one package of yerba maté (250 g) costs around SP 2,500 (almost USD 1.00), while its price was SP 25 (USD 0.50) before the war. Due to the lack of available official data, the continuous change in the exchange rate and the value of the currency, and consequently the change in purchasing power, it is difficult to determine the average salary in Syria in USD. It may be estimated to be SP 149,000 per month (Salary Explorer 2020), which equals USD 119 according to the official exchange rate and USD 60 according to the market exchange rate in late October 2020. Yerba maté has frequently become monopolized by traders in order to secure a higher price, while many times during the war it was unavailable in markets because of movement restrictions due to the battles around Yabroud—Rural Damascus, where the factory packaging imported yerba maté is located. Due to all the above–mentioned reasons, 48% of study participants living in Syria have decreased their yerba maté consumption in recent years. In contrast, 52% of participants reported no

change in their consumption, emphasizing that they try to afford yerba maté despite the current conditions, either by storing it or by prioritizing it over other goods. In this regard, some of our informants mentioned that they add other plant species to yerba maté, which function as medicinal herbs and/or partially substitute an amount of yerba maté as a saving method. Most of these herbs are wild-gathered plant species, while the rest are cultivated in home gardens or purchased from local markets (Table 5.3.; listed as an appendix in the published article).

Besides war conditions, which caused a decrease in yerba maté consumption, migration has also had an influence. More than half (52%) of the respondents who live abroad reported no change in their yerba maté consumption levels after moving abroad, in spite of the change in lifestyle associated with integration into a new society. On the other hand, 40% of informants reported a decrease in their yerba maté consumption after immigration, whereas 8% reported an increase. Lack of time, the nature of a fast lifestyle abroad, and the lack of socializing needed for yerba maté sessions were the most frequently mentioned reasons for the decrease in yerba maté consumption.

Moreover, a decrease in yerba maté consumption has been noted due to the lack of socializing following COVID–19–related restrictions. Two–thirds of respondents declared a change in their yerba maté consumption and rituals connected with this drink. The change is represented by a decrease in group consumption, or at least being highly cautious by sterilizing the bombillas, drinking from separated cups, and reducing socializing with relatives and friends to the lowest possible level. Conversely, many have reported that their consumption due to COVID–19 restrictions has increased but in the form of individual consumption, especially during curfew periods when a person has to spend a longer time at home, which they feel the need to fill with some activity. However, most respondents showed a tendency to prefer drinking yerba maté in a group but within the same household, arguing that yerba maté is more enjoyable when it is shared with others.

Table 5.3. List of plant species added to Maté. Data sources include the current study (50 informants), and previous fieldwork in 2018 with 42 informants as well as in spring 2020 with 50 informants

Species and Family	Local name	Part used (F: Fresh, D: Dried)	Medical use	Acquisition source	Data sources		
					Study 1 (the present study)	Study 2 (unpublished study on Syrian wild edible plants, N= 50)	Study 3 (unpublished study on Syrian medicinal herbal teas, N= 42)
Ammi majus L. Apiaceae	Khilleh	Flowers (D)	Kidney stones	Wild		x	
Foeniculum vulgare Mill. Apiaceae	Shamra	Leaves (F, D)	Colic	Wild, Home garden		x	x
Cichorium intybus L. Asteraceae	Hendpeh	Flowers (D)	-	Wild	x		
Matricaria chamomilla L. Asteraceae	Babunej	Flowers (D)	Colon cramps, colic, flu	Wild, Local market	x	x	x
Melilotus officinalis (L.) Pall. Fabaceae	Handqouq	Flowers (D)	-	Wild		x	
Trigonella foenum-graecum L. Fabaceae	Helbeh	Fruits (D)	Galactagogue	Wild		x	

Table 5.3. Continued

Species and Family	Local name	Part used (F: Fresh, D: Dried)	Medical use	Acquisition source	Data sources		
					Study 1 (the present study)	Study 2 (unpublished study on Syrian wild edible plants, N= 50)	Study 3 (unpublished study on Syrian medicinal herbal teas, N= 42)
Trifolium pratense L. Fabaceae	Neffleh	Flowers (D)	-	Wild		x	
Mentha spp. Lamiaceae	Nana'a	Leaves (F)	-	Home garden	x		
Micromeria myrtifolia Boiss. & Hohen. Lamiaceae	Zoufa	Leaves (D)	Cold, flu, cough	Wild	x	x	x
Origanum syriacum L. Lamiaceae	Zauba'	Leaves (F, D)	Throat pain, cold, flu	Wild	x	x	
Rosmarinus officinalis L. Lamiaceae	Ekleel al-jabal	Leaves (F, D)	Cough	Home garden	x		x
Salvia officinalis L. Lamiaceae	Maryamiah	Leaves (F, D)	-	Home garden	x		
Teucrium procerum Boiss. & Blanche Lamiaceae	Qintariah	Aerial part (D)	Stomach pain	Wild		x	x

Table 5.3. Continued

Species and Family	Local name	Part used (F: Fresh, D: Dried)	Medical use	Acquisition source	Data sources		
					Study 1 (the present study)	Study 2 (unpublished study on Syrian wild edible plants, N= 50)	Study 3 (unpublished study on Syrian medicinal herbal teas, N= 42)
Thymus vulgaris L. Lamiaceae	Zaatar barri	Leaves (F, D)	Cough, expectorant	Wild, Home garden			x
Althaea officinalis L. Malvaceae	Khitmiah	Flowers (D)	Cold, colic	Wild			x
Olea europaea L. Oleaceae	Zaitoun	Leaves (F)	Blood sugar regulation	Orchard			x
Anemone coronaria L. Ranunculaceae	Shaqayek al-noa'man	Flowers (D)	-	Wild		x	
Crataegus azarolus L. Rosaceae	Za'arour	Flowers (D)	Heart pressure regulation, diuretic	Wild		x	x
Eriobotrya japonica (Thunb.) Lindl. Rosaceae	Ikednia	Flowers (D)	Cough	Home garden			x
Sarcopoterium spinosum (L.) Spach Rosaceae	Bellan	Fruits (D)	Heart diseases	Wild		x	

Table 5.3. Continued

Species and Family	Local name	Part used (F: Fresh, D: Dried)	Medical use	Acquisition source	Data sources		
					Study 1 (the present study)	Study 2 (unpublished study on Syrian wild edible plants, N= 50)	Study 3 (unpublished study on Syrian medicinal herbal teas, N= 42)
Citrus limon (L.) Osbeck Rutaceae	Laimoun	Flowers (D), Fruits (F)	-	Home garden	x		
Ruta chalepensis L. Rutaceae	Shothab	Leaves, Flowers (D)	-	Home garden, Wild		x	
Aloysia citriodora Palau Verbenaceae	Malliseh	Leaves (F, D)	-	Home garden	x		
Elettaria cardamomum (L.) Maton Zingiberaceae	Haal	Seeds (D)	-	Local market	x		
Zingiber officinale Roscoe Zingiberaceae	Zanjabeel	Roots (F, D)	-	Local market	x		

5.4. Discussion

5.4.1. Socio–Cultural Importance of Yerba Maté within Syrian Society

The socio–cultural importance of stimulant plants has been shown in earlier studies. According to Carrier (2007), consumption of khat (*Catha edulis* (Vahl) Endl.) in Yemen and Ethiopia is associated with contemplation, conversation, and relaxing in the company of friends, while it reinforces cultural identity and acts as a social adhesive for many among displaced communities. In our study, almost half of informants' reasons for drinking yerba maté were social and cultural, emphasizing the essential social value of this beverage among the study participants. The contribution of yerba maté to gathering with others can be attributed to the atmosphere associated with the way this beverage is consumed and served; this is due to yerba maté being shared as an activity among its drinkers who repeatedly drink and refill glasses with water, share sweets or salty nuts, smoke, and have a discussion simultaneously. Bracesco et al. (2011) have highlighted the social use of yerba maté among South American societies, considering that yerba maté has connotations similar to those of the tea ceremony in some Asian cultures. The daily lifestyle of Syrian people plays a potential role in yerba maté consumption being a habit. Almost one–third of the labour market in Syria is employed in state–owned jobs (Aïta 2009), which are usually not considered strict jobs by many Syrians. They officially start at 8:00 and end at 15:00, but many employees actually leave at 13:00 or even earlier. This free time is often filled by drinking yerba maté. At governmental institutions, it is possible to find several employees gathered around a table full of yerba maté glasses. Daily workers in agriculture, construction, and handcrafts also commonly spend their midday breaks drinking yerba maté. Additionally, the ongoing conflict and its daily news update have created a social pattern where people gather every day around yerba maté cups and discuss the latest news. However, we believe that drinking a beverage as a habit plays a significant function in its widespread presence in some societies. Offering a specific beverage to visitors, as is the case with the yerba maté drink in many areas of Syria, does not necessarily mean that all visitors prefer this beverage, but rather could indicate that the drink is popular and traditional in the region. Furthermore, potential addiction is a crucial factor in the popularity of yerba maté. Young yerba maté leaves contain 0.8–0.9% caffeine, and smaller amounts of caffeic and chlorogenic acids, which stimulate the central nervous system, reduce sleepiness and increase vigilance. Caffeine meets all the requirements for being an addictive substance, including dependence, tolerance, and withdrawal. The symptoms of addiction include nervous irritability, generalized anxiety, and depression (Pohler 2010). That is what we observed in many informants' statements when they described the time they spent without drinking yerba maté.

However, many did not perceive caffeine as addictive, or many did not know that they could be potentially "addicted"/dependent on yerba maté, as was demonstrated by informants' reports in which only 16% openly stated that they are "addicted," from the total of 62% who could not go longer than a week without drinking yerba maté. On the other hand, 46% of informants who cannot tolerate one week of not drinking yerba maté did not realize that they are potentially dependent. However, due to the limitation in the study sample size, potential addiction/dependence among our study informants cannot be generalized to all yerba maté consumers in Syria. An additional potential reason behind yerba maté consumption is its association with tobacco smoking. A strong relationship between caffeine consumption and smoking was previously reported by Swanson et al. (1994), in agreement with our findings that tobacco smoking increases with yerba maté consumption.

When discussing beverage–related social aspects, the current global pandemic must be taken into consideration. COVID–19 has shaken the social, economic, cultural, and religious bases of human life (Vandebroek et al. 2020). Yerba maté culture has been significantly impacted by the pandemic, especially since yerba maté is characterized as a social drink. Despite the change reported by two–thirds of informants in their yerba maté consumption and its rituals, the majority have quickly reacted to the new restrictions and tried to adapt by following several techniques. These techniques are represented mainly by balancing between social distancing and hygiene recommendations, and the social nature of yerba maté rituals. Methods, such as limiting large group meetings, and careful equipment sterilization, enable people to continue yerba maté consumption despite pandemic–related restrictions and health concerns.

The social impact of yerba maté could be considerable in the post–conflict period. In the times of division that resulted from the almost 10–year armed conflict, yerba maté has remained a mutual habit among millions of Syrians. Nowadays, this beverage occupies a place in cafes, meetings among friends, family gatherings, photos on social media, Syrian TV drama series, and even on battlefields. We believe that this drink, as a social habit, could play an indirect role in healing social wounds in the post–war period, when Syrians will sit down and try to find their cultural points of connection as a basis for their shared future.

5.4.2. Health Properties of Yerba Maté

Several health benefits perceived by our study participants have been reported elsewhere in the literature, including increased concentration (Glade 2010), calming effect (de Souza et al. 2018), protection against and treatment of kidney stones (Yasir et al. 2018), treatment of

several digestive and intestinal disorders (Gorzalczany et al. 2001), slimming and weight loss (Arçari et al. 2009; Gambero and Ribeiro 2015), stimulation effect (de Souza et al. 2018), and diuretic activity (Görgen et al. 2005; Heck and De Mejia 2007). On the other hand, there are some medicinal uses that have not been confirmed by laboratory testing but are found to be traditionally used elsewhere for the treatment of health problems such as cold and flu (Hilgert 2001), constipation (Small and Catling 2001), and headache (Filip et al. 2000). Additionally, our study highlighted a few perceived health benefits that have not yet been studied, such as the alleviation of stomach-ache, treatment of pharyngitis, hydration properties, and prevention of urinary inflammation, although some studies suggest an anti–inflammatory activity of yerba maté (Luz et al. 2016). In contrast, there are some medicinal uses of yerba maté, such as cardiovascular protection, that are part of the tradition in South America (Kujawska 2018), but these were not reported in our study. The limited number of informants could be the reason behind the absence of such medical uses in our study.

Aromatic and medicinal herbs are sometimes added to yerba maté in South America (Kujawska 2018), as is the case in our study. The key difference in Syria is that in addition to medicinal purposes, economic factors are also drivers behind the use of such additives. Our study informants, similar to Paraguayan migrants living in Argentina (Kujawska 2018), have shown the use of several shared species such as *Foeniculum vulgare* Mill., *Matricaria chamomilla* L., *Melilotus* spp., *Mentha* spp., *Rosmarinus officinalis* L., *Eriobotrya japonica* (Thunb.) Lindl., *Citrus* spp., *Ruta chalepensis* L., and *Aloysia citriodora* Palau. However, it is not known if this pattern has independently occurred or if it has been transferred with yerba maté culture from South America to Syria.

5.4.3. Cross–Religious and Cross–Continental Comparison of Yerba Maté Consumption

Members of the Alawite and Druze groups being the main consumers of yerba maté (Table 5.1.), followed by Ismailis and Christians, respectively, may be associated with the conditions of minorities in Syria at the turn of the nineteenth and twentieth centuries (Talhamy 2010). These conditions pushed many of them to migrate to South America, and consequently adopt the yerba maté culture and carry it back with them upon their return to their homeland. The influence of place of residence on yerba maté consumption was obvious in the Alawite group, where drinkers in the diaspora consumed yerba maté much less than drinkers residing in Syria. On the other hand, yerba maté drinkers from the Ismaili and Druze communities showed similar consumption patterns regardless of the place of residence. This may possibly reflect the

conservatism of individuals in those groups with regard to preserving their cultural habits after changing their environment. Generally, yerba maté acts as an "identity preserver" and a nostalgia driver for many Syrians in the diaspora, as represented by several informants' statements. More than half of the respondents reported no change in their yerba maté consumption after they left their homeland, which attests to how the drink is rooted in their beverage culture. Similarly, Fischler (1988) highlighted food to be a fundamental element of cultural identity, and Fontefrancesco et al. (2019) illustrated how Albanian and Moroccan migrants in Italy consume their traditional food as a tool to go back to their origin, their childhood, and their national identity.

There was modest variation in yerba maté consumption between male and female respondents: men tend to drink more yerba maté (2.4 times more a week) than women do. The slight difference could be due to gender differences in preferences, prestige issues, or the weekly frequency of meetings with a group of people. Other studies have demonstrated a difference between genders regarding coffee consumption; for example, the study of Demura et al. (2013) reported that young men consumed coffee more than young women, with the taste of coffee being the main reason for the observed difference.

Yerba maté is consumed elsewhere in the Middle East, particularly by the Druze community in Mount Lebanon and the Israeli–occupied Syrian Golan Heights (Goldenberg 2002). Druze community members in the Eastern Mediterranean region, which was divided after the Sykes–Picot Agreement in 1916 into the current national borders, continued practising the yerba maté culture since they underwent the same migration waves to South America at the end of the nineteenth century (Fildis 2011). On the other hand, although Poland is similar to Syria with regard to Polish migrants in South America, yerba maté consumption is not very common in Polish society. An exception is made by those who lived, or whose relatives lived, in South America. The main reason for this difference is that until 1989, when the Soviet Union collapsed, and Poles took over the country's administration, free trade limitations and economic difficulties led to yerba maté not being a welcomed commodity. At that time, the Polish administration did not want any potential competition with the tea imported from China (Matero 2019).

Yerba maté consumption per capita is highest in Uruguay, with 6–8 kg/person/year, followed by Argentina, with 5 kg/person/year (Bracesco et al. 2011). In Paraguay, this figure is 2.5 kg/person/year, while in Brazil it is 0.8 kg/person/year (Statista 2020). However, by dividing the amount of yerba maté imported to Syria in 2018 by 16.91 million, which was the population size that year (World Bank 2018), we find that annual individual consumption is approximately

2 kg, while among the respondents in the present study it is 4.9 kg/person/year. This difference in the average consumption between our study respondents and the general Syrian population derives from two factors: the first is that we specifically targeted participants who drink yerba maté at least once per month. Second, we have included an equal number of participants from several religious groups that do not have equal distribution in the general population. One of these groups is the Sunni, representing the majority of the Syrian population, which showed the lowest consumption of yerba maté in the study.

The original yerba maté ritual has been slightly modified since being introduced into Syria by migrants returning from South America. Reports from 86% of respondents showed that when in a group, each person drinks yerba maté from his/her own glass, considering it better from a hygienic perspective. Whereas, in South America, yerba maté drinking is commonly done from the same vessel, which is usually made from a dried gourd of *Lagenaria vulgaris* Ser. (Small and Catling 2001). Syrians drink yerba maté only with hot water, whereas in South America, besides being drunk with hot water, yerba maté is also served with cold water (*Tereré*), especially during the hot summer days (Kujawska 2018).

5.4.4. Differences in Consumption Patterns between Yerba Maté and Other Stimulant Plants

Coffee and tea are the dominant plant stimulants in many countries. Coffee drinking is most popular in North America and Europe, where per capita consumption is higher than in Latin America, the region with the largest coffee production. Tea consumption prevails in South Asia, North Africa, Russia, and the British Isles. In South America, coffee is the dominant beverage except for some areas where yerba maté is drunk more than coffee (Grigg 2002). In Syria, as a part of the Middle East, coffee consumption started in the fifteenth century. Afterwards, tea replaced coffee as the leading beverage in the Middle East and North Africa (Grigg 2002). According to import data, as well as to our results, yerba maté has become the most preferred stimulant beverage in Syria. However, it is not easy to provide an explanation for these changes and contradictions. Beverage consumption changes significantly over time due to cultural, religious, market, and economic factors. Very similar is the case in Britain and Ireland where, in the year 1700, coffee consumption was ten times that of tea, but by the middle of the eighteenth century, the British had become mainly tea drinkers (Smith 1996). The popularity of a new stimulant plant depends significantly on how a society's perception of the plant is built. For instance, khat has not been welcomed by local communities in the West. The main reason is that western media has emphasized that khat is an "addictive drug," and it has

been confused with the consumption of other more potent stimulants like cocaine and MDMA. An additional reason why khat has not been welcomed is its association with cultural and religious stereotypes, especially in the last two decades, with the focus on the War on Terror (Carrier 2007).

Besides the previously mentioned factors leading to changes and adaptation to a new product, there are also different characteristics of each community, as well as the atmosphere provided when drinking a particular beverage. The social structure in Syria is characterized by strong family relationships and a lot of time spent together, and yerba maté provides an atmosphere suitable for long sessions. Coffee, on the other hand, is considered by many informants as a short–duration drink. Tea in Syria is associated mainly with breakfast or as a post–meal drink and it is rarely offered to visitors. According to OEC (2018a, 2018c), the import value of coffee and tea in Syria in 2018 was USD 45.90 million and USD 2.80 million, respectively. Whereas the import value of yerba maté in the same year was USD 71.70 million. This supports the results of our study regarding the preferred stimulant beverage in Syria. However, coffee, tea, and yerba maté prices are almost the same and go for around SP 10,000 (approximately USD 4.0) per 1 kg. Therefore, it can be estimated that price does not influence a consumer's preference for one of these drinks over the others.

5.5. Conclusion

The present study contributes to the general understanding of yerba maté as an essential element of the Syrian beverage culture. Social and cultural factors are the leading causes of yerba maté popularity within the society, represented mainly by the social environment associated with this drink. The results indicate potential addiction as a hidden motive behind the regular consumption of yerba maté. A comparison between the studied cultural–religious groups showed that the Alawite and Druze groups consume yerba maté the most frequently. When compared to other stimulant drinks, yerba maté was the most prioritized, followed by coffee and tea. Future studies should address the social, ecological, and economic potential of introducing yerba maté cultivation in Syria.

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6. Conclusion

The thesis attempts to cover several aspects of the complex relationship between humans and wild plants during conflict times. These aspects are mainly represented in the four main trajectories: WFPs use during the conflict, socioeconomic dimensions of WFPs use, sustainability aspect of WFPs use, and WPs use as a beverage. The studies were conducted during several field visits from March 2020 until May 2022. The study area was mainly in the Tartus Governorate in the coastal region of Syria. However, in one paper (Chapter 5), we conducted the study with Syrian residents from all over the country and the Syrian diaspora. The aim of conducting an ethnobotanical inventory of the wild plant species used for food and beverage preparation and determining the most culturally important species, was fulfilled in both Chapters (2) and (5). The second aim of analysing the effect of the conflict on wild plant use was covered in both Chapters (2) and (3). Moreover, Chapter (3) fulfilled the aim of investigating the impact of socioeconomic factors on wild plant use. Chapter (4) fulfilled the aim of assessing the environmental sustainability status of the highly used species. In the following subchapters, I will reflect on the main findings, limitations, and recommendations of this thesis.

6.1. The main findings

The first main finding is having an inventory of wild species used by local people in the study area. Based on our knowledge, this inventory is the first of its kind in the Mediterranean region of Syria and among a few other studies in the whole country. Seventy-five species were documented, among which *Teucrium procerum,* which is not previously mentioned in any published literature in WoS. We documented the ethnobotanical knowledge related to the use of all the reported species and the cultural importance of the highly reported species. The species *Origanum syriacum* has been reported by 100% of the study informants, which clearly reflects its significance in the regional food culture as it is the main ingredient of the local common dish *Zaatar* (Chapter 2). In the same chapter, we uncovered the conflict's impact on wild plant use as we found that 64% of the study informants reported an increase in their reliance on wild plants as a source of food during the conflict compared to the pre-conflict time. This result strengthens the theoretical hypothesis that ethnobotanical knowledge functions as a coping method for food shortage. We also demonstrated the change in human perceptions towards wild plant-based food during emergency times; this may be useful in future studies on human behaviour toward food and the surrounding environment. The documented inventory in Chapter

(2) could also be crucially important for future studies on the plant genetic resources as many of the reported species are crop wild relatives, such as *Pyrus syriaca* with *Pyrus communis*, and *Allium ampeloprasum* with both *Allium sativum* and *Allium porrum*.

The second trajectory that was investigated in our study is the socioeconomic dimensions of wild plant use (Chapter 3). We scrutinized how socioeconomic factors influence the use of wild plants for securing food during the conflict time. We found that the reliance level on wild plant use as a food source and the frequency of use were predicted by the informants' gender. The number of wild plants used species increased with the informants' age, while it declined with the increase in household income. War-involved households tended to have a higher reliance on and use of wild plants; however, the relationship was not statistically significant. In the same chapter (3), we also highlighted wild plants' contribution to income generation and livelihood of some local people. The findings could be helpful in understanding the impact of socioeconomic conditions on human behaviour towards food in crisis conditions; in addition, the findings may be crucially important for future projects and studies, especially those related to food insecurity, gender role, and wild biodiversity conservation.

As we found that 64% reported an increase in their use and reliance on wild food plants during the conflict (Chapter 2), this may raise sustainability concerns; hence, we reach the third main studied aspect in this dissertation which is the nexus between foraging and its sustainability (Chapter 4). In a complex study with several Eurasian case studies, we qualitatively assessed both the environmental and social sustainability of diverse patterns of traditional foraging practices in three distinct human ecological environments (horticulturalism-, forestry-, and pastoralism-driven) located in the Eastern Mediterranean (Syria), Eastern Europe (Estonia and SW Ukraine), and North Pakistan. We highlighted the species under environmental pressure as their availability have significantly decreased in recent years, such as *Gundelia tournefortii* and *Thymus vulgaris*. We also highlighted the expected reasons behind such a decrease. The findings of the study may be useful in future biodiversity conservation programs in the study area.

Besides the main contribution of wild plants to the food security of local people in such emergency times, they also played an important role in beverage preparation, especially the culturally important beverages such as *Zoufa* (*Micromeria myrtifolia*) and *yerba maté* (*Ilex paraguariensis*). In the last chapter (Chapter 5), we investigated the role of yerba mate in the local culture and its potential contribution to lining the social wounds of Syrian society as it is a loved drink among all Syrian society spectrum. In addition, we highlighted wild plant species that are added to yerba mate as a method to improve its taste, and/or for medical purposes,

and/or for economic reasons to substitute the amount of the bought yerba mate with free collected wild plants.

6.2. Limitations of the study

The main limitation of the study is that the study area (except in chapter 5) was limited to the Tartus governorate in the coastal region of Syria. I initially aimed to collect data from several parts of the country; however, due to crucial security concerns as well as the covid-19 related restrictions during the time of data collection, I was limited to one governorate. The governorate was relatively quiet; however, it is representative of other governorates of the country in terms of socioeconomic conditions and food security issues (WFP 2021[b]). The governorate went under similar economic conditions to other parts of the country due to economic sanctions, stagnant salaries, and loss of purchase power. The study area also experienced migration waves which led to social, economic, demographic, and landscape changes.

Another limitation of the thesis is the number of respondents which is lower than the initially planned one. The field work was conducted during the breakout of COVID-19 with its associated movement restrictions and the people's fear of close communication. This made conducting in-person interviews a crucial challenge. However, in order to cover this gap, I conducted in-depth interviews with the 50 informants (data are used in Chapters 2, 3, and 4) from various locations and ethnoreligious groups in the study area which provided a sufficient diversity and prevented from a strong autocorrelation effect. The detailed conducted interviews allowed us to perform a qualitative analysis in addition to the quantitative one. Moreover, another 50 respondents were interviewed in the study described in Chapter 5. Hence, the thesis is built on data collected from 100 respondents in total. The field data collection (for Chapters 2, 3, and 4) was limited to the spring season, as it is the main season for wild food plant consumption and collection in the study area.

6.3. The recommendations of the thesis and future perspective of the topic

Further ethnobotanical studies on wild food plants should be conducted in other parts of the country, and in the study area on the semi-domesticated species and wild mushrooms. Similar studies should be conducted in some other conflict spots around the globe in order to enhance our understanding of how conflict impacts the use of wild resources. Review studies on wild plant use during crisis conditions are highly recommended, in order to compare case studies and summarize issues related to the sustainability aspect during times of food-need.

Future studies should consider the potential contribution of the documented species to the nutritional status of local people, as well as the possible role of these species in defeating the nutrition-related diseases in the study area. However, studies should also consider highlighting the potential anti-nutritional properties of some species.

In a recently published article by Sulaiman et al. (2023), where in the author of this dissertation was the first author, the potential of several wild food plants to become possible novel crops was analysed. Species such as *Allium ampeloprasum*, *Anchusa strigosa*, *Crataegus azarolus*, *Gundelia tournefortii*, and *Malva sylvestris* have a high possibility of becoming novel crops as they possess high economic, cultural, and nutritional values. We recommend that the local agricultural authorities consider our highlighted species in future programs related to wild plant domestication.

As the thesis highlights which categories of local people rely more on wild food plants, I recommend that the active international and national organizations in Syria use the findings in planning future projects related to food security in the region and consider involving WFPs in programs related to diet improvement. It is highly recommended that environmental authorities and organizations consider our findings in programs related to wild species conservation (especially *Gundelia tournefortii* and *Thymus vulgaris*). General conservation programs of wild plant natural habitats are highly recommended in the country after a decade of neglecting these habitats and over-utilizing the natural resources. Such programs will protect the genetic resources of many species that may be crucially needed in the future as many of these species are crop-wild relatives.

Educational institutions in Syria could consider including information on wild plants in the curriculums in order to raise awareness among new generations of the importance of wild plants and how to protect their natural habitats. I believe it is vital to improve the non-prestigious perception of the young generation towards wild plant-based food.

In terms of beverages, future studies should address the social, ecological, and economic potential of introducing yerba maté cultivation in Syria. Future studies should consider the possibility of alternative beverages to yerba mate from the local flora, such as *Micromeria myrtifolia*.

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8. Appendices

I. Photos

II. Curriculum vitae

Pictured mountain series in the study area, followed by the Mediterranean Sea on the horizon

A woman searching for wild edible plants

Conducting an interview with a shepherd. The location is *Hosn Suleiman*, an archaeological site dating back to the Phoenician era

The leaf of *Arum maculatum* (the main ingredient of *Louf*, a common wild-plant based soup)

During the fieldwork, April 2020

A view of the vegetation in the study area, olive trees and the Mediterranean maquis seen in the background

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Yerba maté cup as a cover photo of the issue (where the article of the Chapter 5 was published) in the journal of Economic Botany

Curriculum vitae

Personal information

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Education

2018 – present	**Doctoral study** Czech University of Life Sciences Prague Faculty of Tropical AgriSciences Study Programme: Tropical Agrobiology and Bioresource Management Thesis: The Importance of Wild Plants for People During the Conflict in Syria
10/2019 – 12/2019	**Internship/ Study Stay** University of Bonn Institute of Crop Sciences and Resource Conservation
2016 – 2018	**Master's degree** Czech University of Life Sciences Prague Faculty of Tropical AgriSciences Study Programme: Tropical Crop Management and Ecology Thesis: Ethnobotany of Medicinal Plants Used for Making Herbal Teas in Coastal Syria
2009 – 2015	**Bachelor's degree** Tishreen University Faculty of Agricultural Engineering Five years programme (three years in general agriculture, and two years specializing in horticultural studies)

	Thesis: Assessment of the Cut flowers Production in the Coastal Region of Syria

Project participation

2022	Ethnobotany of neglected and underutilized plant species in tropical agroecosystems (IGA FTZ 20223104).
2021	Ethnobotany of Wild and Semi-domesticated Tropical and Subtropical Plant Species (IGA FTZ 20213113).
	Increasing productivity and supporting the development of mango, cassava and organic fertilizer value chains in Western Province, Zambia (Czech Development Agency & Caritas).
2020	Taxonomy, ecology and economic botany of tropical underutilized crops (IGA FTZ 20205009).
	Increasing productivity and supporting the development of mango, cassava and organic fertilizer value chains in Western Province, Zambia (Czech Development Agency & Caritas).
2019	An Ethnobiology of Neglected And Underutilized Tropical Plant Species (IGA FTZ 20195009).
2018	Identification of promising species of useful plants as new potential sources of food, medicine and materials through ethnobiological research (IGA FTZ 20185009).

Language skills

Arabic	Mother tongue
English	Proficient user
Czech	Basic user

Digital skills

MS office	Proficient user
SPSS	Intermediate user
R	Basic user

List of publications

Sulaiman N, Verner V, Polesny Z. 2023. Socioeconomic Dimensions of Wild Food Plant Use During the Conflict in Syria. *Economic Botany*, (under review).

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Membership in the editorial board of academic journals

07.2021 – present	*Journal of Ethnobiology and Ethnomedicine* (Springer; IF: 3.404; Q2 in JCR).

Peer review for academic journals

02.2023 – present	*Genetic Resources and Crop Evolution* (Springer; IF: 1.876; Q3 in JCR).
11.2022 – present	*Journal of Herbal Medicine* (Elsevier; IF: 2.542; Q3 in JCR).
05.2021 – present	*Evidence-based Complementary and Alternative Medicine* (Hindawi; IF: 2.650; Q3 in JCR).
02.2021 – present	*Journal of Ethnobiology and Ethnomedicine* (Springer; IF: 3.404; Q2 in JCR).
11.2020 – present	*Human Ecology* (Springer; IF: 2.728; Q1 in JCR).