Sustainable Resource Management of Medicinal and Aromatic Plants of Afghanistan

Dissertation

zur

Erlangung des Doktorgrades

der Naturwissenschaften

(Dr. rer. nat.)

dem

Fachbereich Pharmazie der

Philipps-Universität Marburg

vorgelegt von

Mohammad Osman Babury

aus **Herat/Afghanistan**

Marburg/Lahn **2019**

Erstgutachter: **Prof. Dr. Michael Keusgen**

Zweitgutachter: **Prof. Dr. Shu-Ming Li**

Eingereicht am **24.07.2019**

Tag der mündlichen Prüfung am **04.09.2019**

Hochschulkennziffer: **1180**

Acknowledgements

I wish to sincerely thank honorable Prof. Dr. M. Keusgen, Dean Faculty of Pharmacy and Head Department of Pharmaceutical Chemistry, at Phillips University of Marburg for his valuable supervision, and support in working and completing this work. This work would not be completed without his constructive and friendly support. At the same time, I want to express my gratitude to the academic and technical team of the Faculty of Pharmacy and Department of Pharmaceutical Chemistry, particularly Mrs. A. Schutte, Mrs. G. Lins, Dr. D. Vornicescu, Mrs. M. Keusgen, Mr. E. Mahran, and Dr. A. Balash, who were extremely supportive in making feasible my research study at Phillips University of Marburg.

I would like to sincerely acknowledge distinguished Prof. Dr. Shu-Ming Li for reviewing this dissertation and also I would like to express my sincere gratitude to him and distinguished Prof. Dr. J. Kockskämper, and Prof. Dr. S-W. Breckle for accepting to be the members of the examination board and for their valuable comments.

I have many organization and people to thank for their effort to support me in providing ideas, data, information, and technical support.

Special thanks and recognition are due Herat Directorate of Agriculture and its natural resource office. Their role in organizing meetings with relevant figures and workshop for the districts agriculture officers of Herat province are appreciated. Mr. Amini and Mr. Gh. Qader Baburi were very valuable in making sure the focal point activity to support and supervise the field teams in all 15 districts. I also wish to acknowledge the efforts of district agricultural officers in Herat province for their valuable cooperation in conducting the assessment in their respective districts.

A special gratitude goes to the relevant ministries, authorities, and schools in giving information, data and certain consultations on different aspects of this study. I want to thank the Central Statistics Organization (CSO), Ministry of Agriculture, Irrigation and Livestock, Ministry of Commerce and Industries, Afghan Raisin, Fruits, and Vegetables Export Promotion Administration, Faculty of Geoscience, and Faculty of Agriculture at Kabul University.

Thanks go to CRS Herat office and especially Mrs. Wahida for their cooperation and support in conducting the assessment in certain districts of Herat province.

I wish to acknowledge the support of the German Academic Exchange Service (DAAD) for making feasible this research study.

During this study, I was supported by my colleagues at the Faculty of Pharmacy at Kabul University. I would like to thank all my colleagues at this faculty and especially members of the department of pharmacognosy for taking some of my responsibilities.

Finally but importantly, I would like to thank my family, who provided me a good environment for the work and taking many responsibilities for making the working condition easier for me.

List of Contents

List of Figures

List of Tables

List of Abbreviations

AGE	Anti-government Elements
AAGR	Annual Average Growth Rate
AGR	Annual Growth Rate
AMA	Afghanistan Meteorological Authority
ARFVEPA	Afghan Raisin, Fruits, and Vegetables Export Promotion Administration
ANDS	Afghanistan National Development Strategy
ANSA	Afghanistan National Standard Authority
API	Avicenna Pharmaceutical Institute
ATM	Afghanistan traditional medicine
CAM	Complementary and Alternative Medicines
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CS	Certification System
CSO	Central Statistics Office
DAIL	District Agriculture, Irrigation and Livestock Office
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
DV	Dependent Variable
EU	European Union
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
GACP	Good Agricultural and Collection Practices
GCP	Good Collection Practices
GDP	Gross Domestic Product
GIS	Geographical Information System
GMP	Good Manufacturing Practices
GNI	Gross National Income
HACCP	Hazard Analysis Critical Control Point
HDI	Human Development Index
HKH	Hindu Kush Himalayan
IPCC	Intergovernmental Panel on Climate Change
ICIMOD	International Center for the Integrated Mountain Development
ISAF	International Security Assistance Force
ISO	International Organization for Standardization
ISPM	International Standards for Phytosanitary Measures
ISSC-MAP	International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants
IUCN	International Union for Conservation of Nature
IV	Independent Variables

LCCS	Land Cover Classification System
LDCs	Least Developed Countries
MAIL	Ministry of Agriculture, Irrigation and Livestock
MAP	Medicinal and Aromatic Plant
MEW	Ministry of Energy and Water
MoCI	Ministry of Commerce and Industries
MoE	Ministry of Education
MoF	Ministry of Finance
MoHE	Ministry of Higher Education
MoPH	Ministry of Public Health
MRRD	Ministry of Rural Rehabilitation and Development
NBSAP	National Biodiversity Strategy and Action Plan
NES	National Export Strategy
NEPA	National Environmental Protection Agency
NGO	Non-Governmental Organizations
NRM	Natural Resource Management
NNRM	National Natural Resource Management Strategy
NWFP	Non-Wood Forest Products
PCCW-MAP	Procedure for Conservation and Collection of Wild Medicinal and Aromatic Plants
SEM	Structural Equation Modeling
SPS	Sanitary and Phytosanitary
TCM	Traditional Chinese Medicine
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNODC	United Nations office on Drugs and Crime
USD	United States Dollar
USAID	United States Agency for International Development
WCS	Wild Conservation Society
WTO	World Trade Organization
WWF	World Wildlife Fund
WHO	World Health Organization
WMO	World Meteorological Organization

Zusammenfassung

Afghanistan ist reich an Historie, natürlicher Ressourcen und traditioneller Medizin. Das Land ist bekannt für seine vielfältigen natürlichen Vorkommen an Heil- und Gewürzpflanzen (medical and aromatic plants, MAPs), die auch über regionale und internationale Märkte vertrieben werden. MAPs sind von großem gesundheitlichem und ökonomischem Stellenwert für Afghanistan, ebenso für seine Biodiversität. Das Land verfügt über eine große Artenvielfalt; die Anzahl der Blütenpflanzen wird auf ca. 5.000 geschätzt, viele davon sind endemisch.

Afghanistan ist ein Binnenland mit einer Vielzahl von Klimazonen, angefangen von den subtropischen Trockenzonen Südwest-Asiens, über kontinentales Klima, Wüstenregionen und Steppe bis hin zu Hochgebirgsklima mit entsprechenden Temperaturen und Niederschlägen.

Der überwiegende Teil der Fläche Afghanistans (insg. 30.243.985 ha) besteht aus Weideland (47%), dem Hauptlebensraum für MAPs. Große saisonale Klimaunterschiede ermöglichen vielfältige Vegetationsformen.

Das Sammeln von wilden MAPs hat eine lange Tradition in Afghanistan; sie werden seit jeher zu Heilzwecken und als Handelsware genutzt. Ca. 50 verschiedene MAPs werden zudem in unverarbeiteter Form exportiert. Gemäß dieser Untersuchungen haben diese Exporte zwischen 2008 und 2016 rapide zugenommen. Während des Zeitraums der Studie konnte ein durchschnittliches jährliches Wachstum von 16,2% beobachtet werden, im Vergleich zu einem globalen Exportwachstum von 2,4%.

Die gestiegene Nutzung wild wachsender Heilpflanzen, langjährige kriegerische Auseinandersetzungen, der Zusammenbruch von Regierungs- und Kontrollstrukturen, Armut, Klimawandel sowie die Anfälligkeit Afghanistans zur Wüstenbildung sind die Hauptgefahren für natürliche MAP-Vorkommen. Weite Teile der Wildflora des Landes verschwinden aufgrund von Abbau und Zerstörung der Biotope. Die zuständigen Behörden konnten in den vergangenen vier Jahrzehnten nur sehr eingeschränkt für deren Erhalt sorgen; deshalb sind die natürlichen MAP-Vorkommen derzeit in einem sehr besorgniserregenden Zustand.

Die vorliegende Studie hat das Ziel, diese natürlichen Vorkommen an MAPs zu erfassen und Ansätze für eine nachhaltige Bewirtschaftung zu entwickeln und vorzuschlagen. Der Fokus liegt dabei auf insgesamt vier Spezies aus Afghanistan, *Glycyrrhiza* sp. *Ferula* sp., *Cuminum* sp. und *Bunium* sp., die von potentiellem Wert für marktfähige Produkte sind.

Im Rahmen der Studie wurden vier Messgrößen natürlicher Ressourcen mit entsprechenden Methoden untersucht: Stand der Vorkommen und Maßnahmen zu deren Erhalt, Sozio-Ökonomie, Handel und Vermarktung sowie technologische Kompetenz für Verarbeitung und Standardisierung der Endprodukte. Jede dieser Messgrößen wurde in bestimmte Kategorien unterteilt (insgesamt 25 Variablen), die anhand ihrer relativen Relevanz und

mittels vorgegebener Maßstäbe bewertet wurden. Aufgrund der Verteilungsmuster der ausgewählten MAPs wurde die Studie auf die Provinz Herat ausgerichtet.

Die Auswertung des Datenmaterials erfolgte mittels der Statistik-Standardsoftware SPSS. Die so gewonnenen Diagramme geben Aufschluss über die Kriterien aller ausgewählten Spezies in allen 15 Regionen der Provinz. Es zeigte sich, dass die Vorkommen und der Erhaltungszustand von *Glycyrrhiza sp.* und *Cuminum sp*. im Gegensatz zu den anderen beiden Spezies vergleichsweise gut sind; der Zustand von *Ferula sp*. ist bedenklich.

Die Studienergebnisse zeigen, dass in den Regionen Chesht-e-Sharif, Kohsan und Pashtun Zarghun die größten Potenziale für die Kultivierung, den Handel und die Vermarktung sowie für die Entwicklung einer Versorgungskette und für Qualitätssteigerungen liegen. Im Gegensatz dazu sind die Vorkommen in den Regionen Obe, Zandajan, Kushk-e-Kohna, Kushk-e-Robat Sangi und Adraskan diesbezüglich am schwächsten ausgeprägt. Bezüglich der Bedrohung der Spezies zeigte sich folgende Abstufung:

Ferula sp. > *Bunium* sp. > *Cuminum* sp. > *Glycyrrhiza* sp.

Für das Potenzial einer nachhaltigen Bewirtschaftung zeigte sich folgende Abstufung:

Glycyrrhiza sp. > *Bunium* sp. > *Ferula* sp.> *Cuminum* sp.

Zur Analyse der Relationen verschiedener Kriterien zueinander wurde das "structural equation modeling" (SEM) eingesetzt. Durch dieses Verfahren konnte gezeigt werden, dass die Vorkommen aller Spezies bezüglich nachhaltiger Bewirtschaftung signifikante Teilregressionskoeffizienten aufweisen (entsprechend 0.33, 0.48, 1.07, 0.2). Dadurch wird deutlich, dass die Größe der Vorkommen Investitionen von verschiedenen „Stakeholdern“ aus unterschiedlichen Teilen der Versorgungskette begünstigt. Gleichzeitig bewirkt das Kriterium „Technologische Kompetenz“ einen negativen Regressionskoeffizienten auf das Potenzial nachhaltiger Bewirtschaftung. Anhand weiterer SEMs wurden Beziehungen von unterschiedlichen Variablen untersucht, um verschiedene Effekte der Faktoren zu quantifizieren.

Auf Grundlage der Ergebnisse der Studie werden verschiedene Ansätze für eine nachhaltige Ressourcenbewirtschaftung in Afghanistan diskutiert, u.a. die Überarbeitung vorhandener Strategien, Entwicklung eines Handlungsplans mit dem Fokus auf gewonnener Fakten, Engagement der Gemeinden für eine nachhaltige Ressourcenbewirtschaftung, Aufbau von Kooperationen zwischen „Stakeholdern“ im Bereich Biodiversität und natürliche Ressourcen, evidenzbasierte Informationen über MAPs, Aufbau eines Zertifizierungssystems sowie Erweiterung der Kapazitäten der Kommunen, der Feldarbeiter und des technischen Personals.

Introduction

The use of medicinal plants for the treatment of diseases dates back to the history of human life, that is, since human beings have sought a tool in their environment to recover from a disease, the use of plants was their only choice of treatment. More than a tenth of the plant species (over 50,000 species) are used in pharmaceutical and cosmetic products in the world (Jamshidi- Kia, Lorigooini & Amini-Khoei, 2018). In many parts of the world, they continue to play a primary role in human health. Even where people have access to hospitals, they often choose to use medicinal plants for a number of reasons. The use of plants is infused with cultural meaning, including connections to spiritual dimensions of health and well-being, making them a preferred form of treatment. Plants have been used as medicine throughout history, compared to the relatively recent dependence on pharmaceutical alternatives. Plant use directly links people with their local ecosystem (Kassam, Baumflek, Morgan, Karamkhudoeva, 2013).

Afghanistan is an ancient country with rich nature and rich traditional medicine. The history of using plants for treating illnesses and traditional medicines among populations of the country goes back many millenniums. Medicinal and aromatic plants (MAPs) in Afghanistan represent important health and economic component of the country's biodiversity. The country has a high floristic diversity; flowering plants are estimated to number about 5,000 species with many of them endemic (Breckle et al, 2013).

The flora and vegetation diversity of Afghanistan is rich due to its diverse habitats. Much of the wild flora of the country is experiencing significant decline on account of habitat loss and degradation and this decline is not only threatening the availability of these valuable natural resources, but also the linked knowledge base resulting from the long history of traditions and experiences of medicinal use. There is an urgent need to properly document such resources, and the related traditional knowledge, for the benefit of future generations. Agriculture has traditionally driven the Afghan economy, accounting for approximately 50% of Gross Domestic Product (GDP) before the Soviet invasion in 1979 (MAIL, 2017). About 80% of Afghans live in rural areas where only a fraction of households are headed by women (FAO, 2016). The Afghan diet mainly consists of grains, dominated by wheat. The sector employs over two-thirds of the workforce and is the backbone of the economy: it is the main provider of income for more than 80% of the population (FAO, 2016).

While many herbal products are commonly used in traditional and folk medicines, Afghanistan has been exporting many such products for decades. A number of these products are well known in the region and even in the world.

Although the country is rich in great natural history; recent human history has not been so kind. A coup in 1978 ended nearly a half-century of peaceful stability and led to the Soviet invasion in 1979. Nine years of war against the Soviet occupation was followed

by a chaotic and tragic civil war, and then the rampage of the Taliban militia; the fighting has never completely stopped. The long conflict and its extensive violence have torn apart Afghanistan society and its natural resources and assets.

Emerging from around forty years of conflict, capped by a severe nationwide drought in recent years, Afghanistan faces a complex and interrelated set of political, administrative, economic, environmental and social challenges. The Afghan people's energy and resilience, which served them well during the years of conflict, now should be channeled into securing their livelihood, rebuilding a credible state, and restoring the country's economy. Their efforts, with Government leadership and support from the international community, have already borne fruit in the form of economic growth, rising incomes, the initial revival of public administration, and other improvements in the daily life of Afghans. Despite these gains, the legacy of a conflict that has plagued Afghanistan and its people for around forty years has damaged not only the country's society and institutions, but also its environment. Continuation of recent positive developments is subject to serious risks - political, security, macroeconomic, institutional, climatic, and drug-related.

Natural Resources in Afghanistan include rangelands, forests, protected areas and wildlife including all flora and fauna. These resources, however, face serious man-made and natural threats (MAIL, 2017). High population growth, poverty, overdependence of rural populations on natural resources together with a low level of awareness about natural resource management and global climate change are the major challenges for the protection and management of natural resources.

The long-lasting unrest in the country leads to serious impacts on the life of the people and environment of Afghanistan. Illegal logging is largely a function of the current security situation and control of local resources by local commanders in collaboration with Pakistani traders. The lack of a legal framework clarifying tenure, user rights, and oversight responsibilities, combined with the collapse of government institutions, has led to the control of resource rents by local elites. Local communities, with the help of non-governmental organizations (NGOs), have attempted to protect forests, but local leaders have disrupted these efforts, leading to the destruction of physical barriers, such as fencing, and the disintegration of social organizations (Kelly et al., 2002). This situation leads to depletion of the resources of many species of MAPs in Afghanistan.

Moreover, there are some other challenges to meet in developing and applying sustainable resource management measures and principles leading to support of a sustainable wild collection of MAP resources. The condition of ecology and habitat put pressures on natural resources of MAPs of Afghanistan. Limitation in research, availability of information and data, and monitoring on harvesting and wild collection of MAPs impedes sustainable management of resources in the country. In Afghanistan, where around 80% of the population relies directly on the natural resource base to meet their daily needs, sustainable resource management is critical to improving livelihoods (Favre and Kamal, 2004). This research aims to study the natural resources of medicinal

and aromatic plants with a view to evaluating their status and condition of the resources, socioeconomic factors, trade, marketing, and technological aspects as well as the establishment of appropriate approaches to the sustainable management of them.

1. Review of literature

1.1. Afghanistan, geography and climate

Afghanistan has a long recorded history of about 6,000 years. In the beginning, its name was Ariana (3300 B.C. until 9th century A.D.). The famous dynasties in this period are Ariana Empire, Achaemenia Empire, Graeco-Bactria, Kushanids and Ephthalites. Most important source on the ancient history of Afghanistan in the period of Ariana Empire is "Avesta", a remarkable sample of the ancient history of Afghanistan from which we have learned the names of a number of historical-cultural areas in the territory of Afghanistan dating to the 1st Millennium B.C. Although many people have tried to conquer this rugged landscape with its independent tribes, none have been able to control the region for long. The Graeco-Macedonian army dealt a finishing blow at the decrepit Achaemenian Empire 330 B.C., after which the Graeco-Bactria civilization began. Alexander the Great invaded the area in this year, and even married a Bactrian princess in the city of Balkh. The landscape retained elements of Greek culture as the Kingdom of Bactria (250-150 B.C.). Bactria played an important role in the spreading of Hellenistic culture through Central Asia, e.g. the Ghandhera culture (Younus et al., 1987). In the 1st century A.D. Buddhism became widespread in the period of Kushans Empire (Robinett et al., 2008). Afghanistan was also influenced by the Indian Civilization. After a brief period of Buddhism, the country fell to Muslim invaders in the 7th century A.D., and Islam became dominant. The particular location of Afghanistan has made it throughout its history, an endless battleground and area of struggle and contention for the big western empires (Greece and Persia), the eastern empires (Mongol), later the British via the India subcontinent, and finally the northern empires (Tsarist Russia and the Soviet Union). The particular location of Afghanistan and its proximity to Iran, the regions of Central Asia (Turkestan) and Monsoon Asia (India and Pakistan), has made it, since antiquity, one of the most important centers in Asia (Younus et al., 1987).

The Arab expedition to Afghanistan began in the middle of the 7th century. In many regions the local rulers and the population offered fierce resistance and the caliphs and their vicegerents often had to dispatch troops once again to subdue the recalcitrant. At the turn of the 9th century, there was a growth in the private land holdings and conventional holdings. Islam expanded in South and Central Asia through Afghanistan after the 9th century. After the expansion of the Islamic religion in 9th century its name became Khorasan. Khorasan was one part of the Baghdad Empire. Khorasan was the first Islamic country which was independent from Baghdad Empire by Taher Fushanji (821-873). The famous governments in this period are the Ghaznavids Empire, Moghul Empire, Safavids Empire, Shaibanids and Hotakioes. Afghanistan was overwhelmed by Genghis Khan (13th century) and Tamerlane (14th century). Genghis Khan conquered the area in 1220 AD and destroyed cities like Ghaznı, Herat, Mazar-e Sharıf, and Bamian.

Later, from his base in Kabul, Babur (1483-1530), established the Moghul Empire in the north of the Indian Subcontinent (Younus et al., 1987). In 1747, Ahmad Shah Dorani named the country Afghanistan.

During the mid-1800s through the 1900s, Afghanistan was caught between the British Empire in India and the Russian empire to the north. The country was in the middle of a tug-of-war between the two great powers for nearly 100 yr. All present-day boundaries of Afghanistan were forced on the country by the British, the Russians, or a combination of the two. At about 1885 Wakhan has been established as a neutral zone between the British and Russian empires and then it became part of contemporary Afghanistan. Russia consolidated its control in Central Asia by incorporating Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan, and Kyrgyzstan into the Soviet Union in the 1920s (Robinett et al., 2008). By 1919, this vestige of foreign interference was removed, and Afghanistan became a member (in many cases a founding member) of the United Nations (U.N.) and other international bodies. King Amir Abdur Rahman Khan (1880-1901) laid the groundwork for the modern Afghan state by establishing a standing army and by instituting a more efficient administration that enhanced tax assessments and collection, and improved it beyond the capital by dividing the country first into six provinces. Successor Afghan rulers gradually added to the state's administrative goals and capacity, and cautiously attempted modernization. While much of Amir Habibullah Khan's (1901-1919) reign was spent fending off foreign encroachment and protecting royal power, he accomplished several educational and cultural reforms (Evans et al., 2004). Amanullah (1919-1929), who assumed power after his father's assassination, introduced the country's first constitution. The 1923 Constitution formed a modern executive, but kept legislative powers in the hands of the king and his seven-member cabinet. It granted virtual equality to women, abolished slavery and gave rights to non-Muslim minorities, while abolishing many traditional executive privileges and limiting the power of religious court judges. Primary education was declared compulsory in a system of national schools, while intermediate and secondary were set up in Kabul and provincial capitals. Amanullah instituted direct taxation of farmers and traders, and regular budgeting and accounting procedures. But his attempts to use state administration to impose these reforms prompted oppositions from conservative religious and tribal leaders (Evans et al., 2004).

Mohammad Nader Shah (1929-1933) and his son Mohammad Zahir Shah (1933-1973) pursued a reformist agenda by promoting industry, banking, education, agriculture and governance. In 1964, King Zahir Shah convened a "loya jirga" (grand assembly) to ratify a new constitution that envisaged a constitutional monarchy with a bi-cameral parliament comprising a popularly elected lower house and a partially elected upper chamber. In addition, the constitution's expansion of civic rights and protection of minorities went far beyond any previous provisions (Evans et al., 2004).

Increasingly polarized politics, policy stagnation, and a crippling drought during 1971-1972, set the stage for the return of Daoud to power in a military-led, communist-assisted

coup in 1973. Abolishing the 1964 Constitution and the monarchy, Daoud declared Afghanistan a republic with himself as president. Daoud soon distanced himself from the socialist ideas that originally motivated backers of the coup (Evans et al., 2004). The communist factions, in particular, felt bitter and marginalized, and united to mount anti-government demonstrations and, with support from the pro-Soviet military, staged a full-fledged coup in April 1978, killing Daoud.

The new communist regime, led by Noor Mohamad Taraki and Hafizullah Amin, aimed to reform Afghan society and reorient its economy. Using inherited administrative structures but classic Marxist rhetoric, the communist government decreed a wide range reforms that included land reform, elimination of landless peasant's debts, and equal rights for women. However, the government underestimated the alienating effect these reforms would have on a conservative population, which perceived them as socially and economically disruptive and a threat to traditional culture. Populations were further antagonized by the dispatch of young party activists to the provinces and by the communists' use the military-backed political repression that included arbitrary arrests and detention, secret trials, and executions without trial. Localized revolts, most carrying the banner of Islam, broke out in the summer of 1978 and soon spread throughout the country.

By the early 1980s, much of the countryside stood outside the central government's effective control. Kabul continued to appoint governors, but their full writ extended only in the vicinity of provincial capitals. Most districts and villages were under the influence of Islamic mujahidin factions, strongly supported by Pakistan, the United States and Saudi Arabia. As the state structures gradually crumbled, various nongovernment organizations (NGOs) and the U.N. delivered basic services to the population by forging direct relations with local leaders and mujahidin commanders, and creating de-facto decentralization (Evans et al., 2004).

The last Soviet troops departed Afghanistan in early 1989, leaving the Afghan communist regime to struggle on in a civil war. Without its benefactor, Najibullah's government survived longer than expected, but eventually collapsed in April 1992. An interim mujahidin government took control of Kabul, while regional militias, financed by foreign backers, arms smuggling and drug trafficking, took over most of the rest of the country. Over the next four years, the state largely ceased to exist, its economy in ruins. The various mujahidin parties battled among themselves for control of the capital, while anarchy reigned elsewhere. Militia leaders and regional warlords exacted road taxes and transit fees from cross-border traffic, and engaged in various other forms of extortions, including kidnapping (Evans et al., 2004).

Taliban arrived on the Afghan scene in 1994 with little warning and vowed to install a traditional Islamic government and end the fighting among the mujahedeen. It overthrew the mujahedeen regime in Kabul, capturing the capital in September 1996. Order was largely restored and authority centralized with the emergence of the Taliban (Johnson and Mason, 2007).

The Taliban's ouster in November 2001 left the newly installed Afghan authorities with the major goals of restoring security and directing the country's rehabilitation and reconstruction. Following the signing of the Bonn Agreement on December 22nd, 2001, an interim administration was established under the leadership of Chairman Hamid Karzai. This was replaced by a transitional authority and the appointment of Hamid Karzai as president, following the Emergency Loya Jirga in June 2002. The Bonn Agreement reinstated the provisions of the 1964 Constitution, unless they were amended by the Bonn Agreement itself (Evans et al., 2004).

Afghanistan emerged in late 2001 as a state that was devastated without many parallels in modern history. The extent of destruction of the country's physical, institutional, human and social capital left Afghanistan with a monumental task to build a pluralist state governed by the rule of law, in which all Afghans have the opportunity to live in peace with dignity, to reach their economic potential, to access basic public services and to participate fully as equal citizens (ANDS, 2008).

The Afghanistan economic outlook has improved significantly since the collapse of the Taliban regime. Agriculture grew in 2003 with the end of a four-year drought, but drought conditions returned for the southern half of the country in 2004 and then severe droughts occurred in 2006, 2008, 2011 (Shroder & Ahamdzai, 2016) and 2018. In spite of remarkable progresses in many aspects of life, politics, good governance, education, health and other areas, today, the country remains devastated with a large part of the economy, physical and institutional infrastructure destroyed or severely damaged. Afghanistan faces a complex and interrelated set of ecological, environmental, economic, administrative and political challenges. Widespread poverty, insecurity which impedes service delivery, climate change and repeated droughts, weak governance and corruption, a poor environment for private sector investment as well as the corrosive effects of a growing narcotics industry are the major problems. However, the Afghanistan government and international donors remain committed to improving access to these basic necessities by prioritizing infrastructure development, education, housing development, jobs programs, and economic reform over the next years. The Afghan people will remain handicapped in discovering their full human potential unless a better balance is struck between development, security and political strategies that are sensitive to both Afghan culture and resource constraints (ANDS, 2008). It will probably take some years and continuing international cooperation and attention to raise Afghanistan's living standards from its current status among the lowest in the world.

Meeting the challenges of recovery and rebuilding a country that can provide the basis for sustained economic development will take many years and require consistent policies, strategies and of course commitment of the political leaders in the country and international support. When empowered with appropriate tools, skills, political support, and respect for human rights, the Afghan people, facilitated by their Government and international partners, will be the key to comprehensive recovery and a durable peace.

1.1.1. Geography

Afghanistan is a landlocked country located in south and Central Asia, The northernmost border of Afghanistan is at the northern end (Maimai, Badakhshan) 38° 40`N, the southernmost border of Afghanistan in the south (Koshtagan mountain, Helmand) 29° 35`N latitude; the easternmost point of Afghanistan in the Yuli valley in Wakhan 74° 55`E and westernmost elevation of (Malik Seiah mountain, Nimroz) 60° 31`E longitude. Thus, Afghanistan is located in the northern hemisphere between the eastern longitude and the northern latitudes, with an area of 653,915 km^2 (Arez, 2007). Around 63% of the country is mountainous while the southwestern part of the country is mostly flatlands where the Helmand Rivers' drainage basin lies. Afghanistan's landscapes are predominantly shaped by mountain ranges, in particular by the snowy summits of the Hindu Kush. Remaining parts of the landlocked country are mainly composed of lowlands and river valleys. The Hari-Rud Fault and the Chaman-Mukur Fault divide the relief units in three clods further subdivided into six units in total (Dittmann, 2014).

Afghanistan is surrounded by six states. It shares borders with Turkmenistan, Uzbekistan and Tajikistan in the north, with China in the northwest, with Pakistan in the southwest and with Iran in the west (Dittmann, 2014). 85% of the 30.55 million inhabitants rely directly or indirectly on agriculture as their main livelihood, which constitutes 28% of Gross Domestic Product (GDP). Significant growth in GDP has been evident since 2002, and averages in the double digits, though most recently, growth fell substantially to 3.6% in 2013 from 14.4% in 2012 and 2.5% in 2017 (World Bank, 2016; ADB, 2018).

The Central Statistic Organization (CSO) of Afghanistan reported that the current population of Afghanistan is around 29.2 million as of Thursday August 17, 2017, equivalent to 0.45% of the total world population. Afghanistan ranks number 40 in the list of countries and dependencies by population. The annual growth rate is estimated 2.4%. Median age is 17.8 years and total fertility rate to 4.49%. Urban population is 27% and rural population has estimated 73% with 1.5 million nomadic families. The almost 4 decades of war left 3.3% of women as household heads. The high ration of growth rate, fertility and dependency has been a core constraint to economic growth. The population growth rate indicates a double increase since the last census in 1979 (13.05 million). 50% of total population is lower than 15 years (CSO, 2017 a).

Around four decades of war, not only threatened the live and livelihood of population in Afghanistan which is culturally highly diverse, but also, curtailed the country's access to some very primary living assets including electricity and alternative energy (Malekiar, 2017 b).

Beginning in December 5th, 2001, the Bonn Agreement guided Afghanistan's transformation towards a new era of democratic self-governance. Shortly after the Bonn meeting, an Interim Authority convened an Emergency Loya Jirga, the first genuinely representative Afghan national forum in decades, and it established a Transitional

Administration. In 2004, Afghanistan adopted its new Constitution in three decades, laying the political and development foundations for the country (ANDS, 2008).

Afghanistan's security environment has been deteriorated since 2008. The increased conflict appears to be holding back business and consumer confidence from recovering fully from the impact of the security transition in 2014. Economic growth has increased moderately from 2014-15, when the lowest growth rate was recorded since 2003. Proxy data for the first half of 2017 indicates that economic activity is continuing to languish, while business sentiment, gauged from the quarterly business perception surveys, appears to have improved slightly between the first and second quarters of 2017, though it remains lower than in the second quarter of 2016. Growth is projected to edge up to 3.2 % in 2018, assuming no further deterioration in the security environment. While this constitutes a moderate improvement compared to 2014 and 2015, it is still significantly below the 9.6 % average annual rate recorded in the period from 2003 to 2012 (World Bank, 2017).

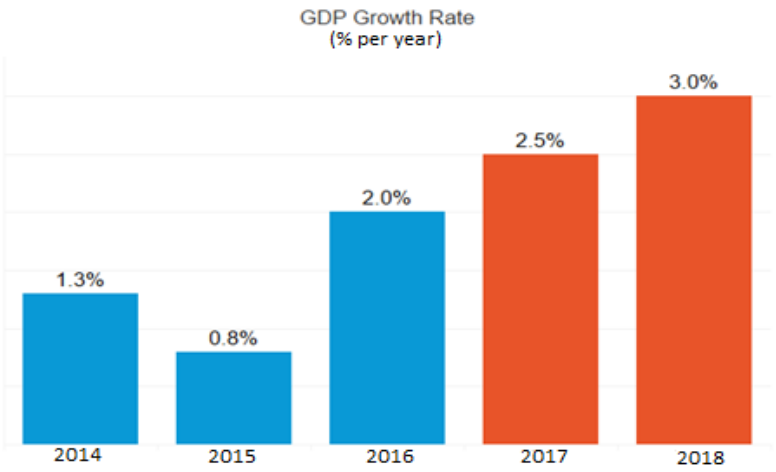


Figure 1.1: Afghanistan GDP growth rate per year (ADB, 2017 a).

The GDP growth rate of Afghanistan in 2017 is the lowest among countries in the region. The details are demonstrated in below figure.

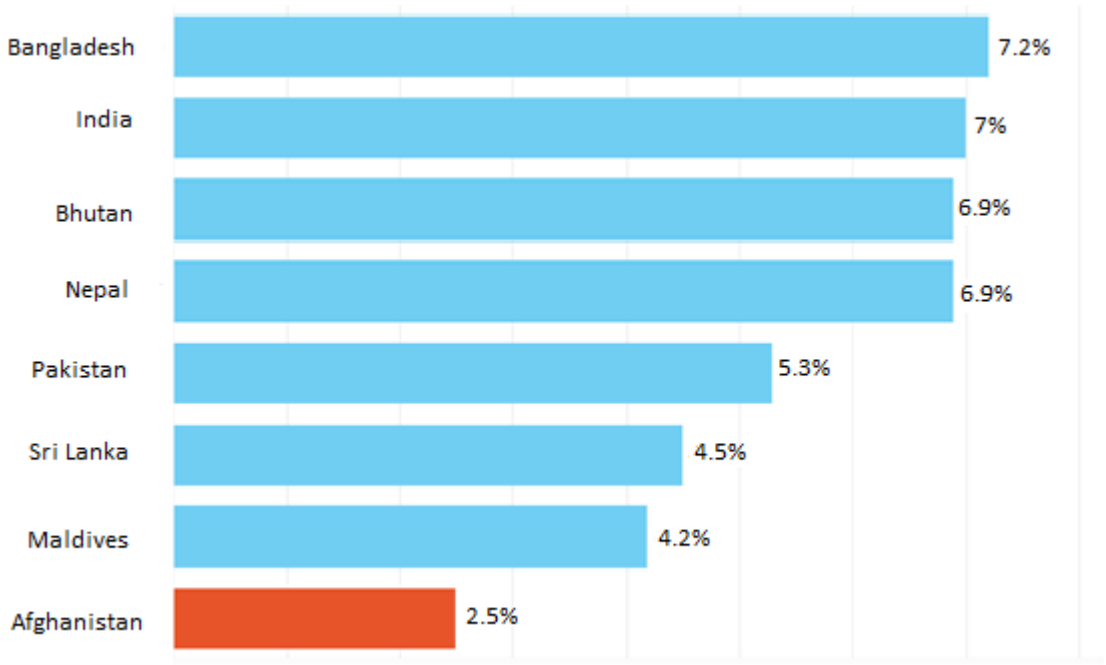


Figure 1.2: Comparison of GDP growth rate of Afghanistan in 2017 with other regional countries (World Bank, 2017 a).

Anecdotal evidence showed growth in Afghanistan picking up slightly in the first half of 2017, though the poor security situation continued to restrain investment and consumption and thus the economy.

Hunger is a global challenge. Nearly 795 million people are undernourished globally; an estimated 490 million of them are living in Asia and the Pacific. However, regional improvements in tackling hunger vary across sub-region and country. The proportion of the undernourished population in South and South-West Asia decreased from 22.9 % in the early 1990s to 14.9 % in the period 2014-2016, but due to large population increases in the sub-region, the number of people affected by hunger has remained at nearly 300 million. Furthermore, only limited improvements have been made in some other countries. In Afghanistan the decline in the percentage of people affected by hunger, was from 29.5 to 26.8 % during this period (UNDP, 2016).

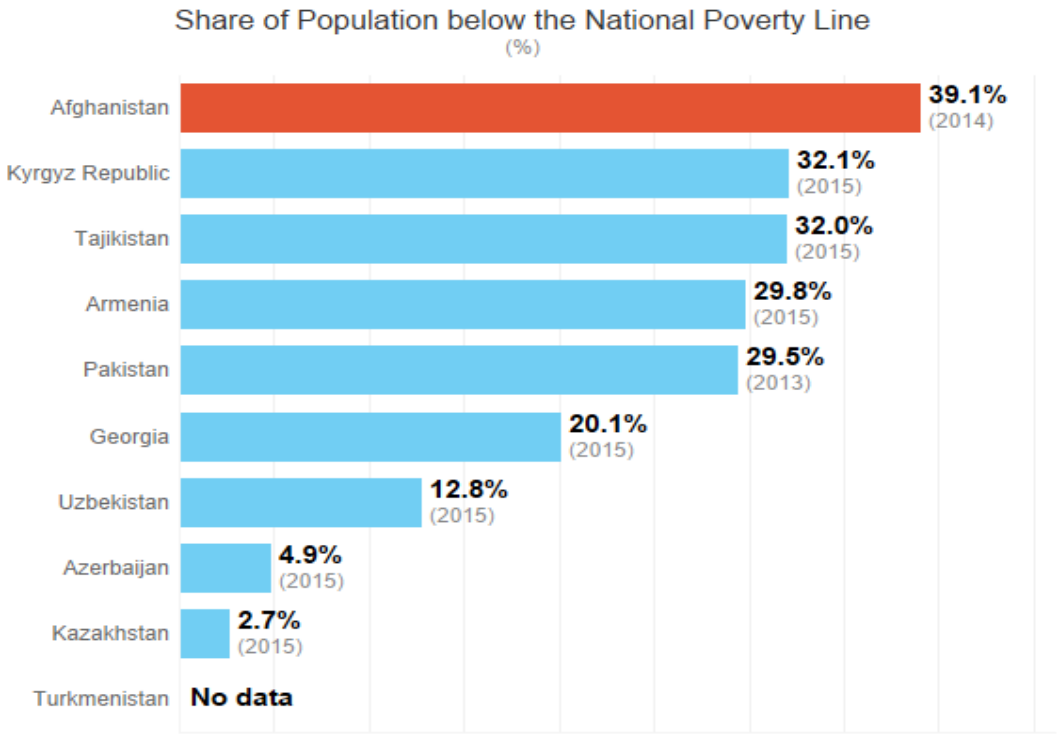


Figure 1.3: Share of populations below the National Poverty Line (ADB, 2017 a).

An overview of economic situation in Afghanistan shows that the service sector contributes the largest share to GDP at 28%, while industry contributes around 20%, but is expected to grow in the future due to development within the mining industry. Agriculture presents room for continued growth and recovery for Afghanistan, but also, since the majority of agriculture is rain-fed, it presents instability to GDP and causes the majority of Afghans to be vulnerable to climate shocks. The country has one of the lowest life expectancies at birth (60 years) in Asia, 46% of the population has access to safe drinking water, and the percentage of the population with electricity is around 30%, which is among the lowest in the world (UNDP, 2016). However, there has been progress in human development indicators since 2002, with school enrollment increasing from 1 million to 8.6 million. Girls' school enrollment has also increased substantially from 191,000 to more than 3.6 million. In 2016, 14.4% of college age population in Afghanistan had access to tertiary education (Babury & Hayward, 2017). Moreover, around 85% of Afghans now live in areas with access to basic health services and infant and under-5 child mortality have decreased (World Bank, 2016).

The Human Development Index (HDI) is a summary measure for assessing progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. Afghanistan's HDI value for 2015 is 0.479 - which put the country in the low human development category - positioning it at 169 out of 188 countries and territories.

Between 1990 and 2015, Afghanistan's HDI value increased from 0.295 to 0.479, an increase of 62.5%. The below table reviews Afghanistan's progress in each of the HDI

indicators. Between 1990 and 2015, Afghanistan's life expectancy at birth increased by 10.8 years, mean years of schooling increased by 2.1 years and expected years of schooling increased by 7.5 years. Afghanistan's Gross National Income (GNI) per capita decreased by about 9.7% between 1990 and 2015 (World Bank, 2016).

Table 1.1: Afghanistan's HDI trends based on consistent time series data.

Year	HDI value	GNI per capita (2011 PPP$)	Mean years of schooling	Expected years of schooling	Life expectancy at birth
1990	0.295	2,071	1.5	2.6	49.9
1995	0.324	1,180	1.9	4.2	53.1
2000	0.340	775	2.2	5.9	55.1
2005	0.405	1,188	2.6	8.1	57.0
2010	0.454	1,630	3.2	9.5	59.0
2011	0.463	1,721	3.3	9.8	59.3
2012	0.470	1,850	3.4	9.9	59.7
2013	0.476	1,912	3.5	10.0	60.0
2014	0.479	1,895	3.6	10.1	60.4
2015	0.479	1,871	3.6	10.1	60.7

Figure 1.4 in below shows the contribution of each component index to Afghanistan's HDI since 1990.

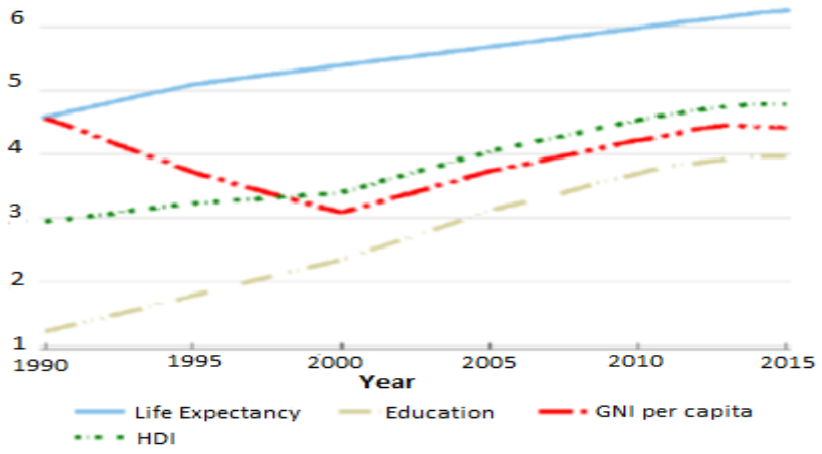


Figure 1.4: Trends in Afghanistan's HDI component indices 1990-2015 (UNDP, 2016).

The human development progress, as measured by the HDI, can usefully be compared to other countries. For instance, during the period between 1990 and 2015, Afghanistan, Bangladesh and Nepal experienced different degrees of progress toward increasing their HDIs (See Fig. 1.5).

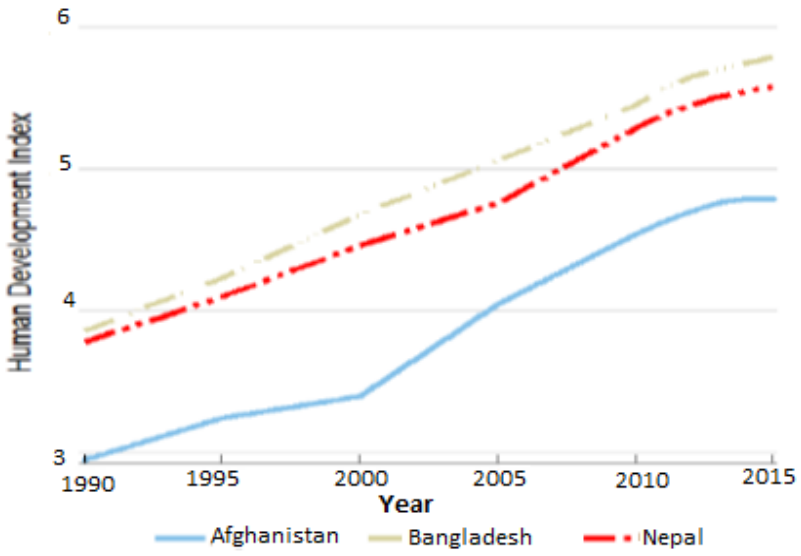


Figure 1.5: HDI trends for Afghanistan, Bangladesh and Nepal, 1990-2015 (UNDP, 2016).

Afghanistan's 2015 HDI of 0.479 is below the average of 0.497 for countries in the low human development group and below the average of 0.621 for countries in South Asia. From South Asia, countries which are close to Afghanistan in 2015 HDI rank and to some extent in population size are Nepal and Pakistan, which have HDIs ranked 144 and 147, respectively. Table 1.2 below lists the important indicators of human development for 2015.

Table 1.2: Afghanistan Human Development Indicators, 2015 (UNDP, 2016).

#	Indicator	Value
1	Life expectancy at birth (years)	60.7
2	Adult mortality rate, female (per 1,000 people)	238
3	Adult mortality rate, male (per 1,000 people)	281
4	HIV prevalence, adult (% ages 15-49), total	0.1
5	Infant mortality rate (per 1,000 live births)	66.3
6	Public health expenditure (% of GDP)	2.9
7	Under-five mortality rate (per 1,000 live births)	91.1
8	Expected years of schooling (years)	10.1
9	Adult literacy rate (% ages 15 and older)	38.2
10	Gross enrolment ratio, primary (% of primary school-age population)	112

11	Gross enrolment ratio, secondary (% of secondary school-age population)	56
12	Gross enrolment ratio, tertiary (% of tertiary school-age population)	9
13	Mean years of schooling (years)	3.5
14	Population with at least some secondary education (% aged 25 and older)	22.2
15	Gross national income (GNI) per capita (2011 PPP$)	1,871
16	Gross domestic product (GDP) per capita (2011 PPP $)	1,820
17	Gross domestic product (GDP), total (2011 PPP $ billions)	59.2
18	Gender Development Index (GDI)	0.609
19	Adolescent birth rate (births per 1,000 women ages 15-19)	74
20	Estimated gross national income per capita, female (2011 PPP$)	511
21	Estimated gross national income per capita, male (2011 PPP$)	3,148
22	Gender Inequality Index (GII)	0.667
23	Human Development Index (HDI), female	0.348
24	Human Development Index (HDI), male	0.572
25	Human Development Index	0.479
26	Labour force participation rate, female (% ages 15 and older)	19.1
27	Labour force participation rate, male (% ages 15 and older)	83.6
28	Legislators, senior officials and managers, female (% of total)	n.a.
29	Life expectancy at birth, female (years)	62
30	Life expectancy at birth, male (years)	59.5
31	Maternal mortality ratio (deaths per 100,000 live births)	396
32	Mean years of schooling, female (years)	1.6
33	Mean years of schooling, male (years)	5.8
34	Unemployment rate (total), female to male ratio	1.5
35	Youth unemployment rate, female to male ratio	1
36	Multidimensional Poverty Index (MPI), HDRO specifications	0.293
37	Population in multidimensional poverty, headcount (%)	58.8
38	Population in multidimensional poverty, headcount (thousands)	16,942
39	Population in multidimensional poverty, intensity of deprivation (%)	49.9
40	Population in severe multidimensional poverty (%)	29.8
41	Employment to population ratio (% ages 15 and older)	47.5
42	Child labour (% ages 5-14)	29

43	Labour force participation rate (% ages 15 and older)	52.5
44	Total unemployment rate (% of labour force)	9.6
45	Youth unemployment rate (% ages 15-24)	19.9
46	Homeless people due to natural disaster (average annual per million people)	281
47	Refugees by country of origin (thousands)	2,663.00
48	Exports and imports (% of GDP)	53.2
49	Foreign direct investment, net inflows (% of GDP)	0.9
50	Net migration rate (per 1,000 people)	3.1
51	Carbon dioxide emissions per capita (tones)	0.7
52	Forest area (% of total land area)	2.1
53	Natural resource depletion (% of GNI)	1.6
54	Renewable energy consumption (% of total final energy consumption)	10.8
55	Population, total (millions)	32.5
56	Population, ages 15–64 (millions)	17.4
57	Population, ages 65 and older (millions)	0.8
58	Population, under age 5 (millions)	5
59	Population, urban (%)	26.7
60	Rank	169

Approximately 80% of the population in Afghanistan (estimated at 33 million people) live in rural areas and have been harshly affected by the collapse in infrastructure and fragmentation of the economy over the conflict years, as well as the destruction of fledgling systems for technical assistance and finance. Yet the extraordinary nature of Afghan resilience and their adaptability to a shifting and insecure environment have somehow ensured their survival. The rural sector is currently home to the bulk of the poor of Afghanistan: about half of the rural population lives on less than $1 per day (Ritchie, 2010). In Afghanistan the wealthiest households are concentrated in urban areas. Almost all of the urban population falls in the fourth and highest wealth quintiles, with most of the rural population is in the three lowest wealth quintiles. There are large provincial variations in wealth. In Kabul, 67% of the population is concentrated in the highest wealth quintiles, while a large majority of the population in Ghor (76%), Bamyan (69%), and Daykundi (65%) is concentrated in the lowest wealth quintile (CSO, MoPH & ICF, 2017).

1.1.2. Physiography

The physical geography of Afghanistan is characteristically fairly spectacular, from the rather huge around 7 km of relief from lowest altitudes in the northwest Amu Darya (258 m) region to the highest at Naushaq (7,492 m) mountain in the northeast. This more than 7 km of maximum relief in Afghanistan is exemplary of the potential energy in the environment of the ground surface, as well as the high atmospheric energy associated with the hydrologic cycle that drives so many of the natural processes at work in the country. Coupled with the exceptionally strong geologic forces of plate tectonics in the region; the result is combined exo- and endo-genetically driven, hydrological sources of considerable significance to the area (Shroder & Ahamdzai, 2016).

Afghanistan is situated in the subtropical, dry zones of Southwest Asia that have continental types of climate characterized by desert, steppe, and highland temperature and precipitation regimes (Humlum, 1959; Shroder, 2014). The new Koppen-Geiger climate map of Afghanistan (de Bie et al., 2007; Shroder, 2014) shows Bsh subtropical steppes; Bsk midlatitude steppes; Bwh subtropical deserts; Bwk midlatitude deserts; Csa humid subtropics; Csb Mediterranean mild with dry summer; Dsa humid continental with severe dry winter; Dsb humid continental with severe warm dry summers; Dsc humid continental with severe cool summers; ET tundra with no true summer (also includes some ice) (Fig. 1.6) (Shroder & Ahamdzai, 2016).

Afghanistan is thus a mostly rather arid country with extreme minimum of perhaps <50 mm of precipitation in the Seistan Basin of the southwest, and around 1,100–1,400 mm in the mountains of the central Hindu Kush to the Wakhan Corridor to the northeast. Precipitation measured about 300 mm along much of the northern border. Some of the tropical rainfall measuring mission data show much of those same trends, but especially the general monsoonal variation, whereas the snow-water equivalent measured by satellite radar shows the same general trends in a different remote-sensing medium. In general, precipitation increases with altitude, especially in the high Hindu Kush and Pamir mountains to the northeast, but also to the northwest toward the Turkmenistan regions (Breckle et al., 2010; Shroder, 2014) (Shroder & Ahamdzai, 2016). The lowland plains in the south of Afghanistan experience extreme seasonal variations in temperature, with average summer (June, July and August) temperatures exceeding 33°C and mean winter (December, January and February) temperatures of around 10°C. Much of the country is at very high altitude and experiences much lower temperatures all year round, with average summer temperatures not exceeding 15°C, and winter temperatures below zero in the highest regions (Savage, Dougherty, Hamza, Butterfield & Bharwani, 2009).

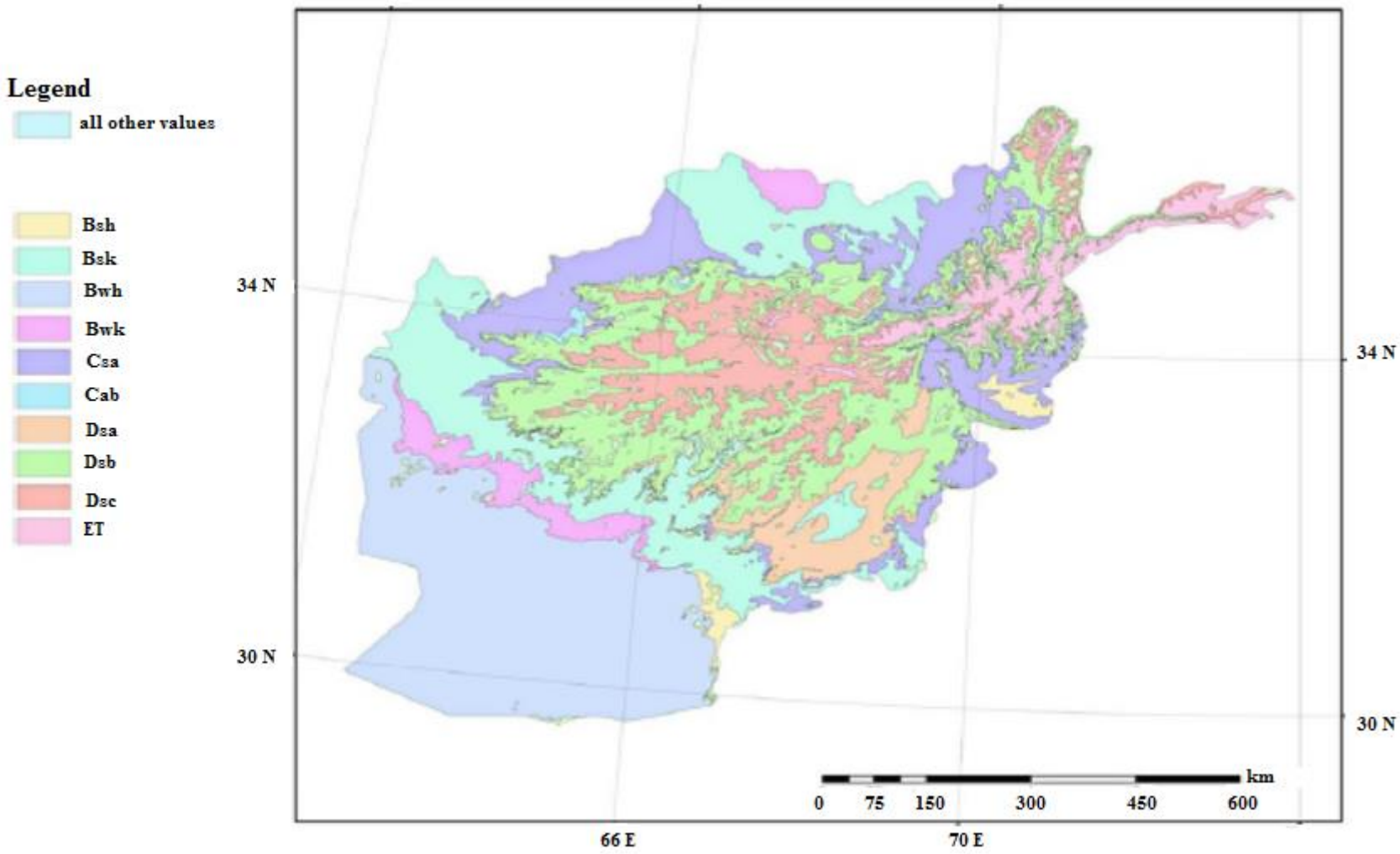


Figure 1.6: Climate map of Afghanistan (Shroder & Ahamdzai, 2016)

In the winter season, of course, much of the precipitation comes down as snow, but in the summer season only the high altitudes generally above 5000 m will ensure that any moisture arrives in frozen form. In either case with snow and ice precipitation, of course, after the passage of 3–5 years without melting away, thick snow and ice accumulations will recrystallize enough to begin flowing downhill as a glacier. Glacier-ice masses in the high Hindu Kush and Pamir of Afghanistan constitute a long-term system of ice storage that serves as a vital late summer-early fall form of delayed melt-water release for irrigation in second cropping. According to Shroder (1980, 2014) and Bishop et al. (2014) the problem with this traditional outlook is that climate change has been melting away altogether too much of the lower-altitude ice of Afghanistan so that some of smaller glaciers have disappeared. As Porter (2014) ascribed, many of these smaller glaciers had existed for centuries high in their deep cirques as diminutive remnants of once larger ice masses, but still able to survive because they were shadowed for most of the time by the high mountains that surrounded them. In the more modern times with climatic warming underway, their continued existence at relatively lower altitudes compared to the higher altitude examples in the nearby western Himalaya of Pakistan, has become no longer possible in many cases. The results are less melt-water downstream later in each year (Shroder & Ahamdzai, 2016).

The hydrology of Afghanistan is an essential attribute that has received increasing scientific attention because intensive study of this critical resource is a necessity for dealing with that which must be preserved to ensure an adequate future. For a dominantly semiarid to arid country, with a treasure house of natural water renewal systems in its highlands, establishment of a strong hydro-knowledge base is a critical part of maintaining the peace in an unstable region.

The highland mountain terrains of Central and Southwest Asia that host the glaciers and snow that provide so much of the local water supplies begin with the so-called “Pamir Knot,” which is located in Central Asia. The Pamir Mountains are formed by the junction or “knot” of the Tian Shan, Karakoram Himalaya, Kunlun, and Hindu Kush ranges. They are among the world's highest-altitude cluster of mountains. They are also known by the Chinese name of Congling “葱嶺” or “Onion Mountains.” The region of the Pamir Knot is centered in the Tajikistan region of Gorno-Badakhshan. Parts of the Pamir knot also lie in the countries of Kyrgyzstan, Afghanistan, and Pakistan. South of Gorno-Badakhshan, the Wakhan Corridor of Afghanistan runs through the Pamir region, along with the Hindu Kush and Hindu Raj mountains, which also include the northern extremes of the Khyber Paktunkhwa (old North-West Frontier) Province and the northern extremes of the northern areas of Pakistan, part of which (Siachen Glacier) in the Karakoram Himalaya is contested with India (Shroder & Ahamdzai, 2016). The mountain range of Afghanistan linked to Pamir in the east, gradually adding to its height, and in some places it soared by 4.000 to 7.000m. The Hindukush is the largest range in Afghanistan. The western link of Hindu Kush adjunct with Safed Kuh (Firuz Kuh) forms the branches of the Alborz, thus the Hindu Kush range is a branch of the Himalayan and alpine system that coincide with each other in terms of organization and formation (Arez, 2007). As a

whole this region is characterized by being the highland source of numerous rivers that emanate from the melt of the profuse snow and glaciers of the region, coupled with plentiful precipitation from the westerly and monsoonal moisture sources (Shroder & Ahamdzai, 2016).

As Egypt has been called the “gift of Nile”, it would be appropriate to call Afghanistan as a “gift of the Hindu Kush" (Arez, 2007).

The altitude of mountain ridges of Afghanistan are considered in the following order: mountainous areas with a height of 5,000m; mountainous areas between 3,000-5,000 m; and mountainous areas between 1,000 and 3,000 m high (Arez, 2007).

The Hindu Kush ranges runs along the Kuh-e-Pamir and extends from the north-east to the south-west endurance and encompasses vast areas in central Afghanistan, extending its central reach. In the central area of the country, there are various ridges and branches, each of which is called by local names. The Hindu Kush Mountain divides Afghanistan into northern and southern pages of two geographic regions, thus separating the waters of the Kabul and Helmand regions from the waters of the Amu basin (Arez, 2007).

The range of Kuh-i-baba, commencing somewhat to the south of the Hindukush and connected with it by the Shibar pass, must be regarded as orographically a continuation of it. This is the largest mountain range after the Hindu-Kush with peaks from 5,090 to 3,989 m above sea-level (Linchevsky and Prozorovsky, 1949).

The most low-lying are the plains of Afghan Turkestan which about on the Amu Darya, situated at altitudes of about 300-400 m above sea-level and forming the immediate continuation of the desert plains of Central Asia (Transcaspian depression). The western and southern desert plains of Afghanistan, occupying a territory of about 150,000 km^2, bordering on eastern Iran and northern Baluchistan, are situated at heights of 500-800 m. above sea-level. Lastly, a small level region is represented by the Jelalabad depression, situated in the eastern part of Afghanistan, and formed by the extensive inter-montane valley of the Kabul river, which here lies at an altitude of about 600 m above sea-level (Linchevsky and Prozorovsky, 1949).

The physiographic regions of Afghanistan can be classified in the following order (Malekiar, 2017 b):

1. The desert region (500-1,000 m elevation) of Dasht-e-Margo, a desolate steppe with salt flats and Registan desert covered by windblown sand on the southwestern side of the Hindu Kush mountain range.
2. The steppe and semi-desert region (900-1,800 m elevation) between the desert and central highlands on the southern portion of the Hindu Kush Mountain range.
3. Central highlands (2,000-7,000 m elevation), part of the great Alpine-Himalayan mountain chain. This region covers an area of approximately 256.000 km^2. Most of the forests of Afghanistan is located in this region.

4. The semi-arid plains along Amu Darya (300-400 m elevation) on the north side of the Hindu Kush, part of the central Asian steppes. This region covers an area of approximately 6,400 km^2.
5. The sub-tropical region (400-1,200 m elevation) of the eastern part of Afghanistan.

The flow of water streams in different directions and stalwart depend on the layout of the Hindu Kush ranges. The benefits of this series are that the natural resources of the country lie in the rich and important mines lands, its water basins also bring opportunities for agricultural activities. The fields of forests, pastures, and vegetation in each of the Hindu Kush valleys encouraged the population to settle (Arez, 2007). Afghanistan's water resources and watersheds source form the Hindu Kush ridge and its highlands. The permanent snowfall in Wakhan and Pamir, the Hindu Kush, the eastern and western parts of the Hindu Kush, and the Kuhe Baba, are melting in the spring and summer, creating rivers in different areas (Arez, 2007).

Every stream, or segment of a river, is surrounded by its drainage basin, which is the total area of the land surface that contributes water to the stream. These drainage basins are also referred to as watersheds, or the area which sheds its water. The high-point line or region that separates one drainage basin from another is a drainage divide (Shroder & Ahamdzai, 2016).

Due to the snow and rain fall in the winter and spring, the volume of water is higher in the spring and early summer, and sometimes it is fluctuating and stormy. Due to the lack of sufficient vegetation on the land surface, the watersheds destroy agricultural land and cause erosion and degradation of land and adjacent areas due to the stream flows (Arez, 2007).
The flow of the waters in the vast majority parts of the country is rapid because the streams of water of the main and adjacent rivers originate at high altitudes, causing land degradation. For example, the Amu Darya, due to the difference in altitude between the Pamir and Khamaab areas (lowest point of the country), which is more than (2,700 m), transmits 250 million m^3 of soil and sediment each year. The damage is very high in the Hairatan area. On the other hand, the lands of Afghanistan have sedimentary soils, and their rocks have more water penetration capacity, which has caused the formation of submerged water storage, springs and karizes in different parts of Afghanistan (Arez, 2007).

Afghanistan's current water lattice is very small in proportion to temperate and tropical regions. This is because, firstly, Afghanistan is in a semi-desert environment, the annual amount of water flowing in the rivers of Afghanistan, is on average equal to 40 km^3 per sec, reaching 1.7 liters per sec per km^2 in the country. Therefore, the debit of water in different parts of the country, comparing the area of each part is not high and reflects the characteristics of semi-desert. This affects meeting the needs of agriculture (Arez, 2007).

There are five river basins in Afghanistan:

1. Panj-Amu Darya basin
2. Northern river basin
3. Hari Rud-Murghab river basin
4. Helmand river Basin
5. Kabul river basin

The Kabul River and the Panjshir River join at the Sarobi confluence, before going on into the Jalalabad Basin to receive the Kunar River tributary and thereafter flow across the border with Pakistan to receive the Swat River tributary before joining the Indus River at Attock. The drainage basin of the Kabul River thus includes most of eastern Afghanistan and part of Khyber Pakhtunkhwa Province in Pakistan. Similarly, the headwaters of the large Panj River tributary between Afghanistan and Tajikistan begin in the high-altitude Wakhan Corridor of Afghanistan before flowing generally to the northwest as a major tributary of the Amu Darya and ultimately draining into the Aral Sea. Several other major tributaries of the Amu Darya begin either in Afghanistan or in Tajikistan and contribute greatly to the Nile-sized river flow (Shroder & Ahamdzai, 2016).

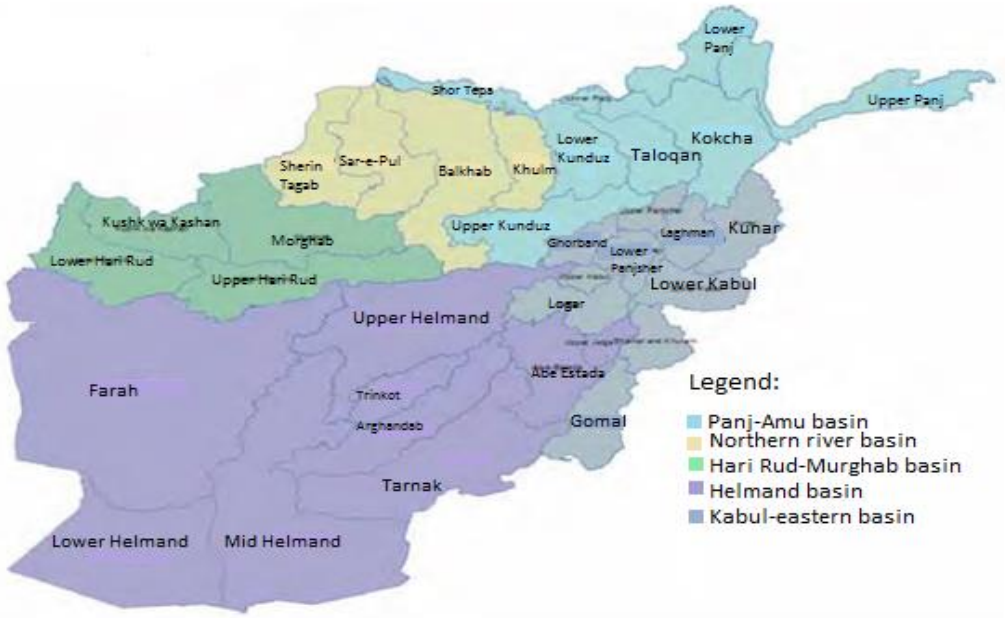


Figure 1.7: Hydrological basins of Afghanistan (based on IWRM basin and watershed maps) (FAO, 2016).

More than 5 billion m^3 of water per year are drawn from Amu Darya and its tributaries in northern Afghanistan to irrigate 385,000 ha of farmland (Rasul, 2014). The Helmand River, Hari Rud, Murghab, and a number of other river systems rise entirely within Afghanistan and flow out over the borders into the surrounding countries (Shroder & Ahamdzai, 2016).

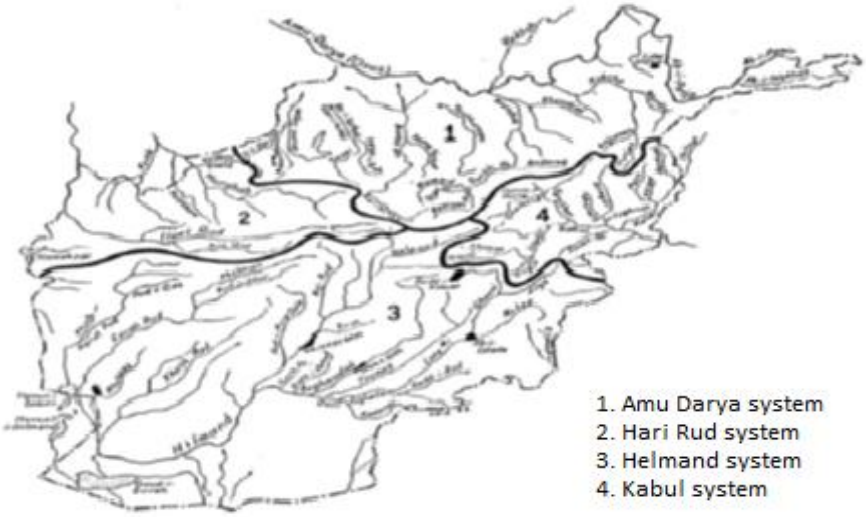


Figure 1.8: Map of the main drainage basins of Afghanistan (Shroder, 2014).

The last few decades has seen dramatic rise in the demand for water in Afghanistan due to variety of environmental and socioeconomic processes and also demographic trends. Between a rapidly growing population and eventually changing socioeconomic status and a shifting climate, water stress and therefore water risk is increasing in the country. Water stress indices are commonly used to visualize water resources vulnerability on a global scale. One of the indicators in exploring the water resources and commonly presented in the literature is the Falkenmark Indicator. Since the introduction of the Falkenmark Indicator in 1989, a multitude of alternative water stress indices have emerged, each with their own unique set of assumptions and goals. The Falkenmark Indicator is dependent on two variables: surface runoff (m^3/yr.) and population (Ruess, 2015).

Table 1.3: Water stress index proposed by Falkenmark, 1989 (Ruess, 2015).

FI (m^3/capita/year)	**Stress Level**
>1,700	No Stress
1,000-1,700	Stress
500-1,000	Scarcity
<500	Absolute Scarcity

Falkenmark water stress indicator shows that Afghanistan shows at a mid-stress level at the national level with one river basin below the stress threshold. The estimation of water stress distribution per river basin in Afghanistan, after sharing with the neighbouring countries, shows that Panj River has the highest Falkenmark Indicator as per calculation based on Favre & Kamal (2004) (Thomas & Eqrar, 2011), while the northern basin has

the lowest level of this indicator, which is lower than the water scarcity treshold. Water stress distribution per river basin in Afghanistan after sharing with neighbouring countries varies sharply. Panj-Amu Darya Basin has the highest Falkenmark index (7.412), while the northern basin makes the lowest index. The details of the water stress distribution per river basin and Afghanistan are illustrated in Fig. 1.9. Favre and Kamal calculated water stress index for Afghanistan in 2004.

Afghanistan is not water scarce, but the geographical distribution of water is significantly uneven (Thomas & Eqrar, 2011). The MAIL in its National Natural Resource Management Strategy (NNRM) (2017-202) claims that even though Afghanistan as a whole is not water scarce, at least in terms of per capita water volume, lack of access to water at the right time in the right place is still the single most serious challenge facing socioeconomic development of Afghanistan, especially in the rural area (MAIL, 2017). In the same time as Beekma and Fiddes noted, in terms of general water-related hazards in Afghanistan at the national level, the country is not water scarce, even though water can be classified as scarce in one basin and many sub-basins (Shroder & Ahamdzai, 2016).

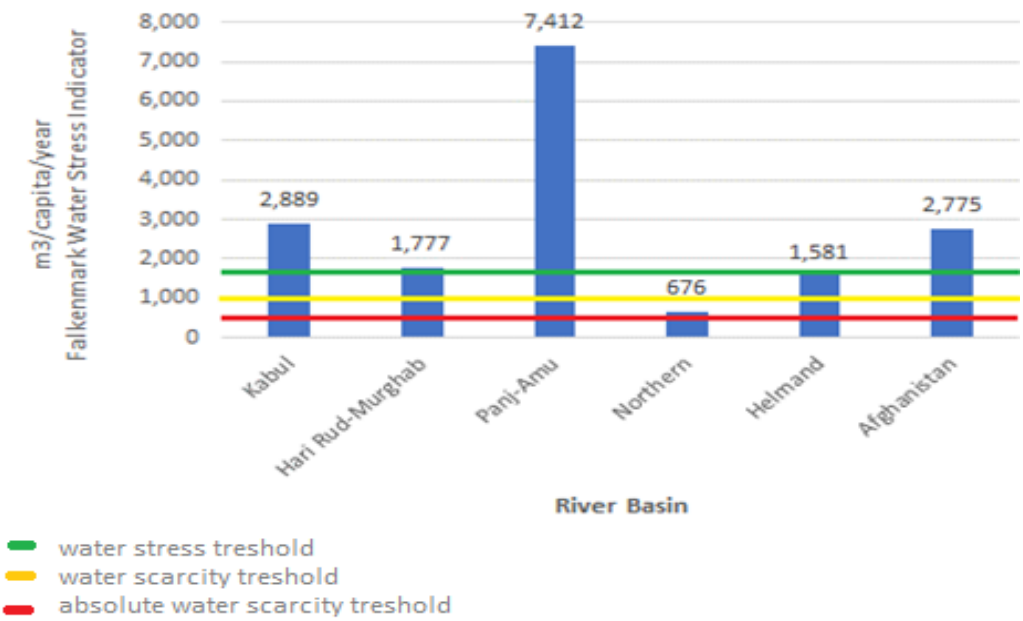


Figure 1.9: Water stress distribution per river in Afghanistan after sharing with neighboring countries (from total of 57 billionm3 surface water availability and based on CSO population per River Basin 20014) (Adapted from Government of Afghanistan, 2008; Favre & Kamal, 2004, in Thomas & Eqrar, 2011).

On the other hand, Afghanistan definitely can be considered water scarce if the needs for flows to maintain the environment are taken into consideration. Also, it should be noted that Afghanistan is not particularly distinct or much different from other countries in the world's dry regions in terms of outcomes measured through most drought indicators. Afghanistan does have a high sensitivity to drought if socioeconomic conditions are considered, including the overwhelming dependence on agriculture for generation of employment and income. From another point of view, Afghanistan is also vulnerable to

drought because of poor access to improved water resources and generally poor rural access (Shroder & Ahamdzai, 2016). The biggest natural challenge is that the rainy season of Afghanistan falls in the winter season and does not coincide with the agriculturally active season. Most of the summer crops have to depend on irrigation. Rain-fed cultivation is very limited and not always reliable. Besides these natural factors, there are several human-related issues at work: firstly, there is a general lack of adequate physical infrastructure for water diversion, harvesting, storage, and distribution; secondly, the demand for water has been increasing due to increase in population, economic activities and water waste; thirdly, inadequate social institutions to develop, manage and distribute water resources are also the cause of the lack of water access in many cases (MAIL, 2017).

Estimation shows that the five river basins creating the water resources in Afghanistan, have the following capacity tendency:

- 57 billion m^3 surface water (1980),
- 49 billion m^3 in 2016,
- 43.3 billion m^3 in 2030.

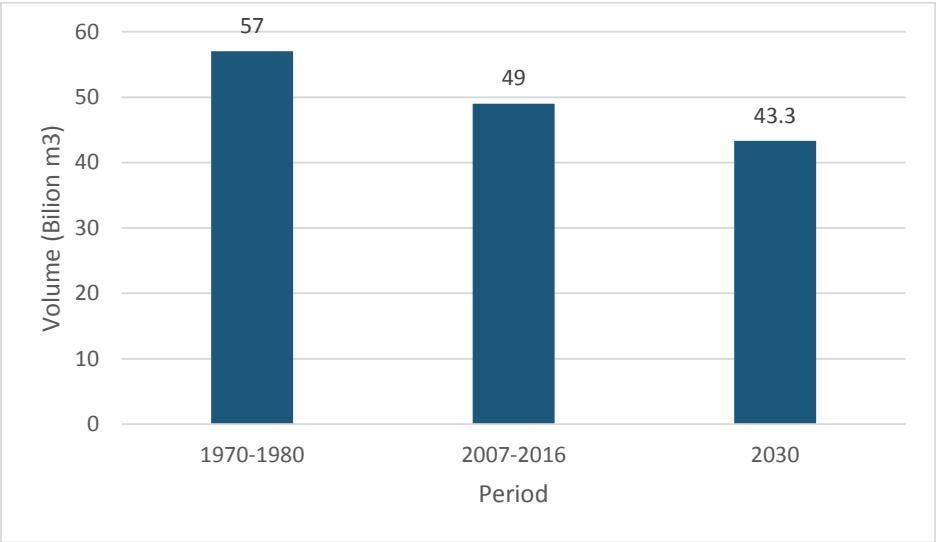


Figure 1.10: Water resource availability in Afghanistan (Thomas & Eqrar, 2011).

In addition, the ground water capacity in 1980 has been estimated around 18 billion m^3 (Thomas & Eqrar, 2011), Water resources in Afghanistan are distributed unevenly in both temporal and spatial terms. Most of the country has a very long dry season from May to October and a cold rainy season from November to April (MAIL, 2017).

1.1.3. Climate

The climates of the Earth are controlled largely by the amount of precipitation and temperature delivered at different times and places as a function of latitude, altitude, and position on a continent relative to ocean water masses. Mountainous and desertic countries such as Afghanistan and all its neighboring countries, have interiors, most of which are far from oceanic moisture sources and subject to the vicissitudes of variable winds and erratic supplies of precipitation; all are characterized also by extremes of what is called continentally wherein winters can be quite cold and summers excessively hot and dry so that any water derived from snow melt and rainstorm precipitation, which is essential, evaporates quickly (Shroder & Ahamdzai, 2016).

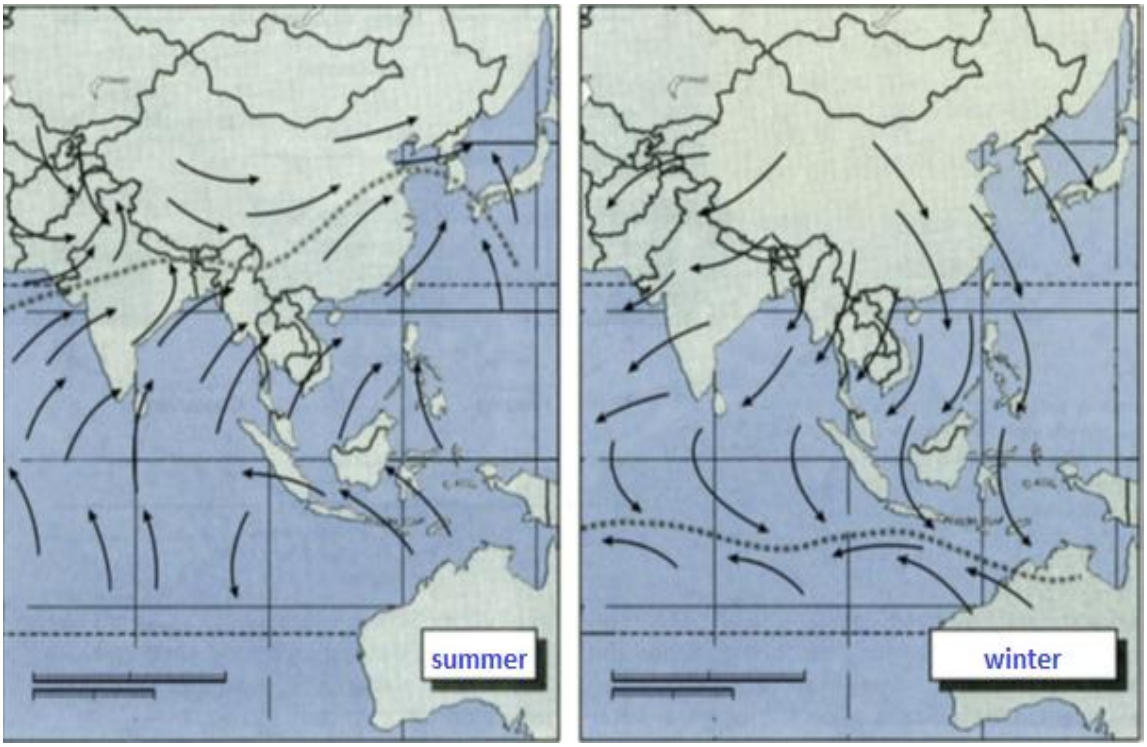
An important issue that focuses on the land of Afghanistan is the existence of its Hindu Kush ridge, which has created various mountainous branches in different valleys with distinct climates. The structure of the land and the height of much of the region has a significant effect on the general profile of the climate. Although Afghanistan is not more than 500 km from the Indian Ocean, the effect of the monsoon cannot predictably affect the climate in the country, with the exception of Paktia, and Nangarhar, in most neighbourhoods of the country (Arez, 2007). Certainly, the high ridges of the mountain hamper the influence of the monsoon in the wider areas in Afghanistan.

The climate of Afghanistan can be well defined in terms of land use and its location. Afghanistan is located in the heart of Asia, and due to the distance from sea and the high-pressure zone under a tropical climate it has dry climate.

In general, the climate of Afghanistan is distinguished by the marked dryness of the atmosphere, low degree of cloudiness, small quantity of precipitation, hot summers and cold winters, with sharp fluctuations of temperature even in the course of 24 hours. These features of the climate of Afghanistan, characteristic of the continental regions of the temperate zones of the globe in general, are determined by its situation in the high-pressure belt of the northern hemisphere, remote from sea-coasts, from which, moreover, it is cut off by high mountain chains (Linchevsky and Prozorovsky, 1949).

In general, Afghanistan and its neighboring countries are dominantly arid to semiarid regions, except in the frontal or foothill mountains where more orographic precipitation is caused when air masses are forced to rise and the attendant cooling causes condensation of moisture out of the air. The amount of precipitation increases to the northeast in Afghanistan. Average annual precipitation is commonly less than 210 mm in many areas, declining to less than110 mm in the southwestern deserts, and increasing to more than 1,000 mm in the high mountains. In all, over 80% of the Afghanistan's water resources have their origin in the mountains more than 2,000 m in altitude, which function as a natural storage of snow and ice that supports perennial flow in all the major rivers in summer (Shroder & Ahamdzai, 2016).

In Afghanistan, the main period of precipitation in winter is borne on the westerly winds and extends from November to May, but is shortened in the south to December through April. About half of the precipitation occurs in winter (January to March), mostly as snow. A further third of the moisture falls in spring (April to June). In the summer season some monsoonal precipitation makes it into the extreme southeastern parts of Afghanistan along the border with Pakistan, although occasionally monsoon moisture sources go well into the Hindu Kush in Central and Northern Afghanistan as well.



(A) (B)

Figure 1. 11: Seasonal maps of Asia in summer (A), and winter (B) (Shroder & Ahamdzai, 2016).

The map above showing dominant wind directions and positions of the intertropical convergence zone (ITCZ) of the stormy, moisture-laden air masses that rise because of their warmth and cause monsoonal precipitation. The thermal low pressure in the summer season over Pakistan and part of Afghanistan shows the patterns of winds in the region at that time.

A basic distinguishing factor of the climate in Afghanistan is the small amount of precipitation throughout the country. The climate of the country is affected by the high mountain network and also its location in the subtropical dry winter rain zone of the old world.

The climatic conditions in Afghanistan are largely controlled by amount of rainfall and of course other factors like temperature, altitude and remoteness from ocean as well. Regarding the distribution patterns of rainfall, five main landscape units can be defined.

They differ from each other depending on their general topography (Breckle & Rafiqpoor, 2010):

1. The high mountain of Hindu-Kush (over 4,500 m) with more than 700 mm mean annual rainfall.
2. The mountainous region of Central Afghanistan including Kohe Baba, Ferozkoh and Tirband-e Turkistan (450- 1,250 m) with 700- 200 mm mean annual rainfall.
3. The semi-desert and steppe regions of the south-west and those of north Afghanistan (1,250-to less than 500 m) with 100-200 mm mean annual rainfall.
4. The arid desert low-lands of south-west Afghanistan (100 to less than 50 m), with less than 100 mm mean annual rainfall.
5. A narrow strip of the east part of the country comes under the influence of the Indian summer monsoon where a secondary maximum of rainfall occurs. This region has 500 to more than 1,000 mm mean annual precipitation. In this so called "summer rain strip", the basins of Jalalabad and Laghman receive yearly less than 500 mm precipitation.

There is another classification of climate in Afghanistan which is conforming to the above one. With regard to heat, humidity, rainfall and atmospheric pressure of Afghanistan's climate zones, the following types of climate can be classified (Arez, 2007):

- Desert climate in the southwest of the country
- Monson climate in the south east
- Mediterranean climate on the east (central region of Nangarhar)
- The climate of the steep is in smooth spans between 1,000 and 3,000 m
- The climate of the Alpine area is between 2,500 and 3,000 m
- Mountainous climate of 3,000 m and above.

The soils of Afghanistan are for the greater part referable to as serozyoms (greys soils), distinguished by low humus (1-3%) and high carbonate-content. Serozyoms are widespread throughout the whole of northern, western, central and southern Afghanistan, differing in different regions in degree of development and salinity. In broad basins, and along the margins of oases and river valleys, solonchak soils are common, being especially widely distributed in the south-west of Afghanistan in the basin of Lake Hamoon. In the most low-lying regions (by the Amu Darya, and in the south in Registan) considerable areas are occupied by sands (Linchevsky and Prozorovsky, 1949).

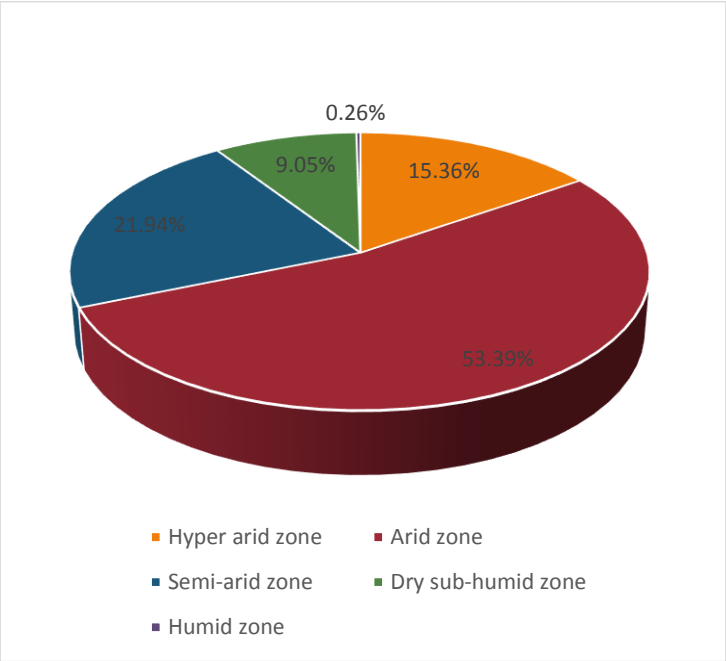
As plants have a full adaptation with the climatic zones, sometime the climate can be classified according to the vegetation. Hence, one of the scholars of the former Soviet Union, Groznysky, classified the climate of Afghanistan according to the vegetation into the following five regions (Arez, 2007):

1. Desert climate including Greshk, Registan in Dasht-e Bakava, Dasht-e-Margo, Khashrood desert and Sistan.

2. The region of the Steppe, whose major areas are Kandahar, Chaman, Herat and plains of northern Afghanistan. (Relative humidity in these areas is between 20 to 40%).

3. The subtropical climate of Jalalabad, which is slightly cold during the winter, and freezing is rare.
4. Moderate climate including the lower region of Kabul, the Kunar valley, Khost, Roodat, lower Kokcheh and the Upper Kunduz area. In winter, some of these neighborhoods are frozen and the annual relative humidity is lower than 40%, the minimum average annual temperature reaches to 5°C for the months of the year.
5. Region of the Alpine Tundra: This type of climate is specific for mountains above 2,000 m high. The lowest temperature in this region reaches less than 5 ° C and the maximum does not exceed 10°C.

From the rainfall and ETP data collected by Nezrabshah Dehzad 1981, Sayed Sharif Shobair in 2001 and Raphy Favre during 2004 and by using UNEP formula the country is divided to 5 zones which are shown in the following table (Thomas & Eqrar, 2011).



Afghanistan aridity index

Hyper arid zone	15.36%
Arid zone	53.39%
Semi-arid zone	21.94%
Dry sub-humid zone	9.05%
Humid zone	0.26%

Figure 1.12: Classification of aridity zones in Afghanistan based on the aridity index ((Thomas & Eqrar, 2011).

1.1.4. Land cover of Afghanistan

Dearth of reliable and detailed information about the land cover of Afghanistan was one of the major problem in physiography and natural aspects of the country. However in the 1990's, the FAO promoted the development of the land cover dataset of the Islamic Republic of Afghanistan with the objective to produce land cover related statistical information for the agricultural sector and assist the international rehabilitation effort being undertaken at that time. This dataset was generated using Landsat TM1 satellite imagery (30 m resolution) with emphasis on agricultural lands, orchards and forests (FAO, 2016). Ten land cover types were identified:

1. Urban Areas
2. Orchards/Fruit Trees
3. Irrigated Agricultural land
4. Rain Fed Agricultural Lands
5. Pistachio Forests
6. Natural Forests
7. Rangeland
8. Barren lands,
9. Marsh/Swamp Areas
10. Water Bodies

For many years, this 1990-93 land cover dataset has been a valuable source of land cover and agricultural coverage information for Afghanistan.

After 20 years, the FAO has been engaged in the task of updating the 1990-93 land cover dataset with higher resolution satellite imagery and using modern state-of-the-art tools and techniques developed by FAO.

The Land Cover Atlas of Afghanistan for the year 2010 was initially prepared in the framework of the FAO Government Cooperative Program under the auspices of the project on "Strengthening Agricultural Economics, Market Information and Statistics Services". The project was formulated upon the request from the Government of the Islamic Republic of Afghanistan and funded by the European Commission (FAO, 2016).

The Afghanistan 2010 land cover legend, was prepared using the Land Cover Classification System (LCCS), which is a comprehensive, standardized a priori classification system that enables comparison and correlation of land cover classes regardless of mapping scale, land cover type, data collection method or geographical location. The LCCS legend was compiled for the creation of the 2010 national land cover database.

The 25 original land cover classes were aggregated into 11 generalized and self-explicative classes. The aim of the aggregation of the land cover classes was to provide

an appropriate basis for provision of statistical data for the agriculturally important land covers, without going into unnecessary detail in respect of other land cover classes.

A summary of the hectarages of the various land covers and their respective percentage coverage of Afghanistan is shown in below table.

Table 1.4: Summary of land cover statistics extracted from the 2010 land cover database (FAO, 2016).

#	Land Cover		Hectarage	% of the country land
1	Built up	Urban	280,478	0.44
		Non-Urban	26,377	0.04
		Total	306,855	0.48
2	Fruit trees	Fruit trees	117,642	0.18
3	Vineyard	Vineyard	82,450	0.13
4	Irrigated agricultural land	Intensively cultivated (2 crops/year)	349,618	0.54
		Intensively cultivated (1-2 crops/year)	1,887,106	2.93
		Active Karez system Agriculture	253,756	0.39
		Total	2,490,480	3.87
5	Marginal agricultural land: poorly irrigated/non active Karez	Total	1,109,730	1.72
6	Rainfed	Flat lying areas	906,273	1.41
		Sloping areas	2,828,221	4.39
		Total	3,734,494	5.80
7	Natural needle leaved forests	Closed needle-leaf trees	83,277	0.13
		Open needle-leaf trees	891,764	1.38
		Total	975.041	1.51
8	Closed to open undifferentiated trees	Closed to open undifferentiated trees	234,399	0.36
9	High shrubs	High Shrubs	571,605	0.89
10	Rangeland	Rangeland	30,243,985	46.97
11	Bare areas	Bare soil/rock outcrops	17,404,540	27.03
		Sand covered areas	2,008,008	3.12
		Sand dunes	2,770,41	4.30
		Total	22,183,289	34.45
12	Marshland	Permanent marsh	98,552	0.15
		Seasonally inundated vegetation	312,244	0.48
		Total	410,796	0.64
13	Water bodies	Permanent lake	96,426	0.15
		Seasonal lake	312,409	0.49

		Total	408,835	0.63
14	River	River	128,438	0.20
15	River bank	River bank	897,906	1.39
16	Snow covered area	Snow covered area	497,236	0.77

The new land cover database provides reliable information on the current state of land cover and the distribution of major land cover classes in Afghanistan. The updated land cover information is instrumental to support agricultural statistical analysis as well natural resources assessment, monitoring and management. The updated land cover data provides reliable information on the current state of land cover over the whole country regardless of its remoteness, security situation or accessibility. The details of the areas and respective percentages are listed in Tab. 1.5.

The information shows that the main part of the land cover of Afghanistan, 30,243,985 ha is made up of rangeland (47%). Irrigated agricultural land makes up 5.6% and rainfed agricultural lands makes up almost the same percentage of the land cover (5.8%). Barren land occupies a considerable portion of the total land cover of Afghanistan (27%). This updated land cover shows that 1,781,045 ha (2.8%) are occupied by forest.

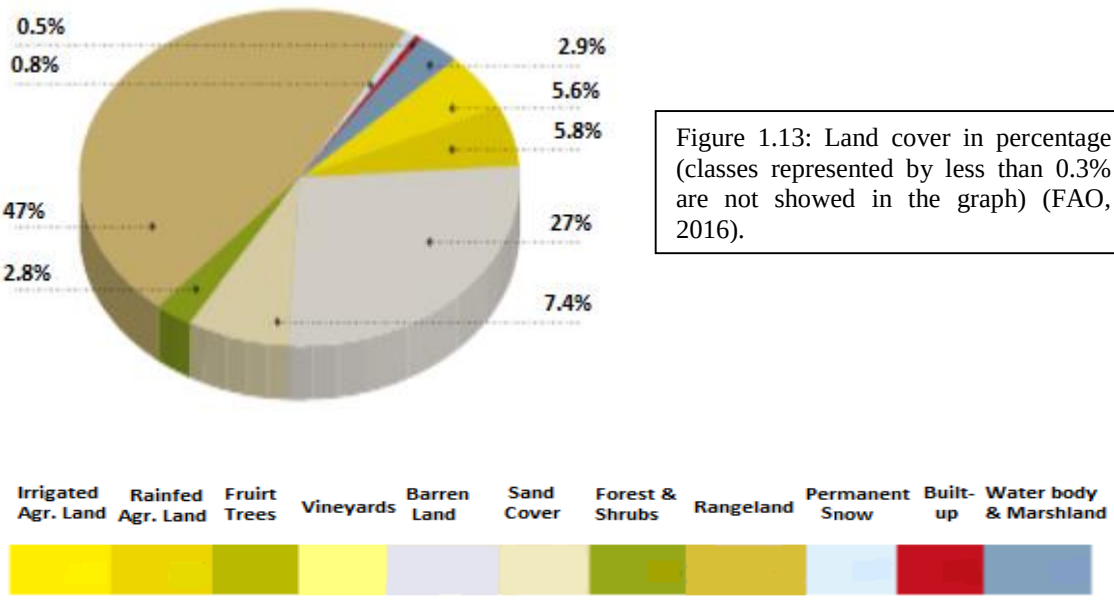


Figure 1.13: Land cover in percentage (classes represented by less than 0.3% are not showed in the graph) (FAO, 2016).

The share of rangelands occupies 47% and this figure is the lowest among given such information before releasing this data. This land is seconded by barren lands which occupies with sand covered and dunes area 34.5% of the country land. Only around 12% of the total land area is arable, of which 5.6% are irrigated agriculture land and 5.80% are rain-fed agriculture lands.

Table 1.5: The land cover of Afghanistan. (FAO, 2016)

#	Province	Irrigated agr. land	Rainfed agr. land	Fruit tree	Vineyard	Barren land	Sand cover	Forest & shrubs	Rangeland	Permanent snow	Built-up	Water body & marshland	Total land
1	Badakhshan	55,957	310,786	8,741	0	840,425	79	30,384	2,687,860	324,823	4,961	81,993	4,346,008
2	Badghis	42,470	368,567	907	73	16,535	0	157,052	1,468,428	0	5,909	10,983	2,070,924
3	Baghlan	97,164	177,866	3,945	0	135,419	1,328	64,375	1,202,761	66,034	10,550	20,887	1,780,331
4	Balkh	266,006	271,690	4,222	585	74,062	480,806	6,820	484,356	0	22,838	65,536	1,676,921
5	Bamyan	59,343	15,984	1,946	0	137,354	0	323	1,544,152	17,265	2,208	10,635	1,789,211
6	Daykundi	49,026	10,007	6,291	5	168,852	0	16,402	1,316,777	49	1,762	8,685	1,577,856
7	Farah	241,479	52	420	1,032	3,532,202	7	9,489	876,531	0	8,699	289,165	4,959,077
8	Faryab	112,683	439,651	1,327	7,124	22,541	300,442	6,634	1,148,068	0	13,411	19,968	2,071,848
9	Ghazni	267,357	50,714	8,146	10,173	171,571	0	10,380	1,548,219	0	16,506	83,722	2,166,787
10	Ghor	66,349	98,514	1,280	0	193,797	0	6,204	3,307,506	2,356	4,550	32,593	3,713,149
11	Hilmand	342,172	555	1,957	949	3,436,966	954,091	3,534	1,003,204	0	25,828	231,595	6,000,851
12	Herat	259,975	559,141	1,717	7,561	2,390,020	2,903	53,595	2,028,430	0	24,808	165,637	5,493,787
13	Jawzjan	186,258	139,448	339	557	12,904	508,624	1,009	217,708	0	9,179	35,970	1,111,996
14	Kabul	66,748	4,340	4,000	10,600	47,998	0	9,244	288,908	0	26,350	7,340	465,528
15	Kandahar	312,465	82,892	8,599	19,840	1,402,853	1,839,000	32,258	1,566,255	0	21,237	131,091	5,416,490
16	Kapisa	22,594	1,323	4,208	930	6,949	0	15,143	131,640	130	2,735	2,500	188,152
17	Khost	54,519	374	203	2	11,453	0	120,088	224,536	0	8,114	9,145	428,434
18	Kunar	29,013	57	308	4	12,775	0	316,258	116,808	0	2,231	7,371	484,824
19	Kunduz	151,136	94,096	1,521	213	65,344	223,210	3,006	191,670	0	11,384	48,775	790,355
20	Laghman	21,876	32	700	4	68,803	0	97,619	183,915	2	2,444	8,156	383,550
21	Logar	46,540	12,153	861	1,053	82,870	0	16,646	270,151	0	5,717	3,509	439,500

22	Nangarhar	106,079	13	4,286	281	244,879	0	70,594	271,049	0	13,576	28,962	739,720
23	Nimrooz	95,037	2	13	385	3,157,980	466,487	784	9,792	0	4,339	369,069	4,103,889
24	Nuristan	8,931	405	424	1	55,423	0	231,907	579,163	16,854	169	5,394	898,671
25	Paktika	149,147	9,645	2,022	732	223,281	1,672	305,640	1,173,886	0	8,643	32,032	1,906,700
26	Paktia	70,119	4,651	732	285	18,927	0	107,220	316,615	0	4,666	4,271	527,486
27	Panjsher	9,302	795	1,450	0	8,634	0	3,110	319,797	25,474	465	3,959	372,987
28	Parwan	38,226	8,165	7,121	6,373	63,146	0	991	411,924	12,235	6,075	4,176	558,971
29	Samangan	27,190	284,410	1,459	561	78,593	0	11,906	877,603	0	4,505	5,032	1,291,259
30	Sari Pul	44,245	322,067	2,037	7,398	45,658	0	5,432	1,085,825	0	6,809	7,297	1,529,768
31	Takhar	85,655	418,657	3,815	105	79,416	0	26,953	530,743	23,506	12,319	53,780	1,231,949
32	Uruzgan	51,127	1,647	10,560	23	158,827	0	15,727	826,184	0	4,175	17,931	1,086,200
33	Wardak	67,110	24,402	8,727	72	70,789	0	931	868,185	8,508	4,906	4,357	1,057,985
34	Zabul	99,913	21,392	13,358	5,529	367,294	99	23,385	1,165,336	0	4,790	33,922	1,735,018
35	Total (ha)	3,600,210	3,734,494	117,642	82,450	17,404,540	4,778,750	1,781,045	30,243,985	497,236	306,855	1,845,976	64,393,183
36	Total (%)	5.6	5.8	0.2	0.1	27	7.3	2.8	47	0.8	0.5	2.9	100

1.2. Flora and vegetation

The grazing of small flocks of closely herded sheep and goats over the last 4,000–5,000 years has been an important factor in shaping the development of Afghan plant communities (FAO, 2016). The northern foothills of the Hindu Kush, the major mountain range of Afghanistan, are within the historic range of the domestication of wheat and barley and sheep and goats some 10,000 to 11,000 yr. ago (Robinett, 2008).

Information about vegetation in Afghanistan seems to be sparse. In spite of the many publications and literatures on flora, the country is lacking a comprehensive source such as Flora listing all natural vegetation of the country. The study and exploration of the flora of Afghanistan and vegetation started in the middle of the 19th century. At this time of British involvement and warfare, the troops had not only military goals but also had scientists with them. Some botanists studying the Afghan flora and vegetation during those troubled times were Moorcroft (c.1830), Griffith (c.1840) and Aithchison (c1880). Many specific epithets of plant names commemorate them and their collections (e.g. *Primula moorcrofti, Ceris griffithii, Eremurus aithchisonii*) (Breckle & Rafiqpoor, 2010).

The second major studies resumed in the sixties of the last century. During the last six decades, many initiatives and activities took place in regard to research and study in ecology, botany, natural resources and other fields of Afghanistan. In spite of the unrest in the country, there were some programs aiming the study and conservation of vegetation. The valuable work of "Field Guide Afghanistan: Flora and Vegetation" was published in 2010 by Prof. Dr. S. W. Breckle and Dr. M. D. Rafiqpoor as the Pictorial Flora of Afghanistan with a general part on geography, flora and vegetation, economic plants, ecology and nature conservation. This book proceeded by another important work "Vascular Plants of Afghanistan – an Augmented Checklist" authored by S. W. Breckle, I. C. Hedge and M. D. Rafiqpoor. This book gives a synoptic overview of all the known vascular plants in Afghanistan as an augmented checklist for the country, which was compiled from many information sources, especially Flora Iranica (1963 ff.). Another important initiative is taken by Prof. Dr. M. Keusgen, dean faculty of pharmacy of Philipps Marburg University, who initiated and organized some scientific expeditions to north, northeast, central and western parts of Afghanistan with the aim to study the flora and identify new interested species particularly belong to *Allium* sp. The results of these expeditions have been brought up in respective annual scientific workshops and are being published.

Relations with Germany also played an important role on study of the flora of Afghanistan. The relations go back to before World War I. The second German-Afghan meeting between Habibullah Khan and a 23-member German delegation took place in 1915 (Spencer Trucker, 2005). After 1960, an intensive exchange and research started. The affiliation programs between German and Afghan universities with a joint treaty in

1962 facilitated such projects. In 1963, the firs fascicle of Flora Iranica by Rechinger (Vienna) was published. This flora covers N Iraq, Iran, Afghanistan and highland Pakistan and is now almost completed (Breckle & Rafiqpoor, 2010).

Although the most important collections of Afghan plants are to be found in European herbaria, particularly in the Natural History Museum in Vienna, a start has been made at the Botany Department of Kabul University in association with the University of Bonn to build up a herbarium of native plants. The herbarium contains many of the important specimens collected by H. F. Neubauer between 1949 and 1951 and from 1962 until 1965 (Breckle et al., 1969). This collection was gradually enriched and nearly 25,000 plants at the herbarium were largely collected and donated by Afghan, German, Scottish and other scientist up to civil war in Kabul in 1992. The herbarium was restored by the U.S. Agency for International Development (USAID) led consortium, including U. C. Davis and Texas A&M University which helped Kabul University restore its once-threatened collection in 2010. Along with the restoration, it was photograph and electronically recorded data on its approximately 23,700 plant species were collected.

Another smaller collection of mainly medicinal plants was established in Kabul University at the school of pharmacy in 2003. This herbarium was the initiative of the department of pharmacognosy at this school and contains about 3,000 medicinal plant species. The digitization and electronic record of this collection are being processed.

The sharp climatic seasonality gives rise to the extensive development in Afghanistan of peculiar desert types of vegetation, consisting principally of groups of half-shrubs and small shrubs scattered over the whole profile of the mountains-from their bases to the high-mountain regions (Linchevsky and Prozorovsky, 1949).

Afghanistan's biodiversity is extensive. There are 16 distinct eco-regions of the 867 land-based ecoregions of the world, as identified by the World Wildlife Fund and others (WWF et. al. 2001). Each of these ecoregions represents specific types of forest, steppe, and desert ecosystems. Freintag (1971, 1972) published a very influential vegetative classification of Afghanistan. He proposed 5 types of vegetation, which was later refined by Breckle (2007) to 16 plant communities (Shank, Ch. et al., 2009). For the details, see Fig. 1.15.

The wild vegetation of the most part of Afghanistan is rangeland, woodland and forest, and this is strongly influenced by Afghanistan's topography and geology. The highland rangelands are the major habitats for Afghanistan's rich biodiversity. These rangelands are critical for supplying Afghanistan with livestock products, fuels for heating and cooking, building materials, medicinal plants, and habitat for wildlife. Rangeland watersheds feed the springs, streams, and rivers, and are the lifeblood of the country, nourishing nearly 4,000,000 ha of irrigated lands (Robinett et al. 2008). Afghanistan is one of the most significant centers of origin of domestic plants and animals, as evidenced by the numerous local landraces of wheat, other crops, nine local breeds of sheep, eight of cattle, and seven of goats. As (Saidajan, 2012) noted the principal plant species whose

wild ancestors are still found in Afghanistan are the pistachio (*Pistacia vera, P. khinjuk*), pear (*Pyrus* spp.), apple (*Malus* spp.), plum (*Prunus* spp.), almond (*Prunus dulcis Mill.*), and cereals (e.g., *Triticum* sp.) (MAIL, 2017). Afghanistan has some 3,500 to 4,000 indigenous species of vascular plants of which 20% to 30% are endemic (about 700-1,200 species) (UNEP, 2008; Agakhanjanz & Breckle, 2002). The recent calculation and estimation shows that Afghanistan flora has more than 5,000 taxa, about 4,835 species with 24% degree of the endemism (Breckle, Hedge and Rafiqpoor, 2013). The number of families, genera, species, taxa and endemics in Afghanistan flora as per the checklist prepared by last authors are indicated in below table:

Table 1.6: Number of families, genera, species, taxa and endemics in flora of Afghanistan (Breckle, Hedge and Rafiqpoor, 2013).

Taxon group	Number of families	Number of genera	Number of species	Number of taxa	Number of endemics and sub-endemics	Number of introduced species
Pteridophytes	11	23	50	56	0	0
Gymnosperms	4	8	24	24	2	3
Monocotyledons	28	195	817	840	75	40
Dicotyledons	106	860	3935	4115	1138	148
Total	149	1086	4826	5035	1215	191

The major plant families in Afghanistan are: *Fabaceae, Asteraceae, Brassicaceae, Lamiaceae, Poaceae, Apiaceae, Caryophyllaceae, Chenopodiaceae, Ranunculaceae, Liliaceae, Iridaceae, Boraginaceae, Plumbaginaceae, Polygonaceae, Rosaceae, Primulaceae, Rubiaceae, Solanaceae* and *Scrophulariaceae* (Breckle et al., 2013). The first seven largest plant families comprise more than half of all species in the country (Breckle et al., 2013). Fig. 1.14 indicates the number of species in the larger plant families. It is obvious that the seven largest plant families comprise more than half of all species in the flora of Afghanistan.

There are many classifications of the vegetation in Afghanistan. Based on the climatic characteristics (Arez, 2007), the vegetation can be grouped in the following order:

1. Vegetation of the monsoon area
2. Mediterranean vegetation
3. Vegetation of the steppe
4. Vegetation of the desert and semi-desert region
5. Vegetation of the alpine tundra area
6. Highland mountainous vegetation

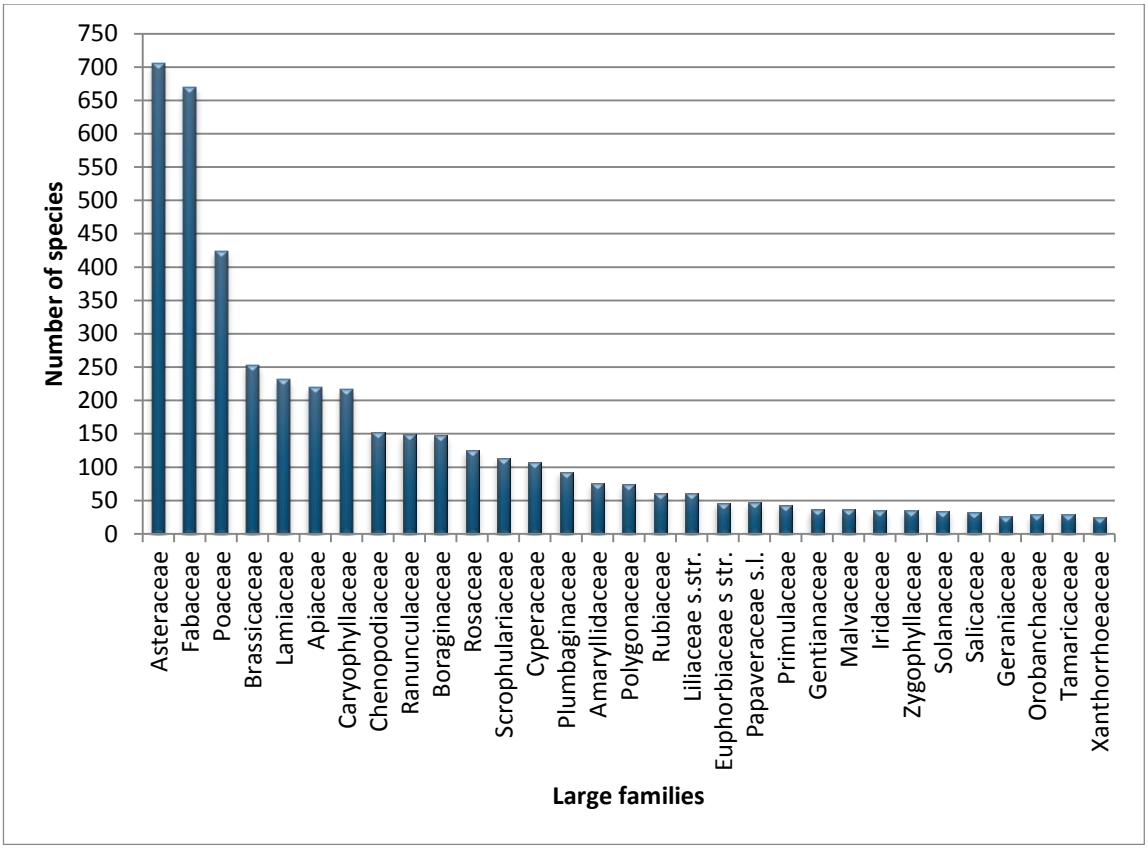


Figure 1.14: Number of species in large plant families (Breckle et al., 2013).

According to earlier analysis (Linchevsky & Prozorovsky, 1949) the plant communities, in Afghanistan, can be classified under three main types: 1) desert vegetation, 2) herbaceous vegetation, 3) tree and shrub vegetation. There are other detailed classifications of vegetation types.

However, the following types of desert vegetation may be distinguished:

- Desert semi-fruticulose vegetation (wormwood communities, teresken communities, saxaul communities, solonchak-saltwort communities),
- Desert semi-fruticose vegetation (occupies rather considerable tracts on the sands of southern, western and northern Afghanistan and includes white-saxaul communities; dzhuzgun communities; black-saxaul communities ; *Zygophyllum* communities);
- Tragacanth vegetation (occupies apparently a rather extensive tract in the mountainous part of Afghanistan,
- Desert annual-saltwort vegetation (it is represented by stands of annual fleshy saltwort: annuals altwort communities, lasswort communities, gamanthus communities and apparently characteristic of northern, western and southern Afghanistan-in the regions of distribution of saline soils).

Herbaceous vegetation is composed mainly of perennial (more rarely annual) herbs, and has a rather considerable distribution in Afghanistan. The following types (groups of formations) of herbaceous vegetation can be classified:

- Meadow-like ephemeral vegetation (is composed principally of dwarf annuals, completely burnt up in the period of drought),
- Meadow-like ephemeroid vegetation (composed principally of dwarf ephemeroids, vegetating during the wet season of the year and completely dying off in the season of drought),
- Caespitose-grass vegetation (composed principally of perennial caespitose narrow-leaved drought-resistant grasses, chiefly fescue (*Festucas ulcata*) and feather-grass like species of Stipa),
- Sclerophyll-mixed-herb vegetation (composed of coarse, sclerophyllous, perennial-herbaceous, drought-resisting plants with stout woody roots like *Cousinia*), and
- Meadows (composed principally of perennial mesophytic herbs distributed in Afghanistan in the mountains, where there are sufficient precipitations or snow-waters, and in plain-like conditions. They may accordingly be divided into mountain and lowland meadows.

Tree and shrub vegetation in Afghanistan are distributed mainly in Nuristan and the Sefid-kuh. In the remainder of Afghanistan it is developed only along the river-valleys, and much more rarely on mountains lopes (more frequently in northern Afghanistan). The tree and shrub vegetation of Afghanistan may be divided into coniferous forests, deciduous forests and scrub communities (Linchevsky & Prozorovsky, 1949). Deciduous forests are distributed for the most part along river valleys (walnut, birch, poplar and olive woods), and on mountains lopes (birch in the high-mountain tracts, maple, oak in Nuristan and the Sefid-Kuh, almond, pistachio, judas-tree and karkas woods). Scrub communities are distributed chiefly in the river valleys, but play a large part also on the mountain slopes amongst woods, and sometimes in the highlands (in the subalpine zone). They may be divided into scrub communities of the river valleys, and scrub communities of the mountain slopes (Linchevsky & Prozorovsky, 1949).

Afghanistan is predominantly known for producing different fruits. The main fruits grown in Afghanistan according to the FAO (2004) have been shown to be grape, followed by apples and almonds, with pomegranates and apricots representing the highest percentage of orchard area all over the country. However, in the east of the country (Nangarhar) farmers grow sub-tropical tress (mainly orange trees) where there are suitable climatic conditions. Kandahar, Balkh, Nimroz and Kapisa are the provinces where pomegranates are grown with their valuable native varieties (Yousufi, 2016).

According to Freitag (1971), Nedjalkov (1983) and Breckle (1973, 1981, 1983 and 2007) the main zonal vegetation categories on normal ecological sites are shown in the map (Fig.1.15) under No. 1 to No. 8. Those with the predominant influence of one ecological factor, namely additional water supply or high salinity are summarized in the map under category No. 9. In this map, the following specific vegetation types can be identified in the natural vegetation of Afghanistan:

1. Desert and semi-deserts:

- Caliigonum-Stipagrostis of sand deserts (1a)
- Haloxylon salicornicum communities of gravel deserts (1b)
- Other shrubby or sub-shruby chenopod deserts and semi-deserts (1c)
- Ephemeral semi-deserts of loess soils (1d)
- Shrubby Amygdalus semi-deserts (1e)

2. Deciduous and Juniperus woodlands
    - Pistacia vera communities (3a)
    - Pistacia atlantica communities (3b)
    - Amygdalus communities (3c)
    - Juniperus excels/semiglobosa communities (3d)
3. Evergreen broad-leaved woodlands and forests in east Afghanistan
    - Dry Sideroxylon (Reptonia)/Olea woodlands (4a)
    - Sclerophyllous and lauriphyllous oak forests (4b)
4. Temperate coniferous forests and woodlands in east Afghanistan (5)
5. Subalpine and alpine vegetation
    - Subalpine Juniperus and Rhododendron scrub (6)
    - Subalpine thorn-cushion shrub-lands (7a)
    - Alipne semi-deserts , steppes and meadows (7b)
6. Nival belt (approaching the snow line at c. 4,800 to 5,000m north-exposed slopes to 5,400m south-exposed) (8)
7. Azonal vegetation (9)
    - Riverine vegetation/lakes and swamps (9a)
    - Alkaline lakes, saline flats (9b)

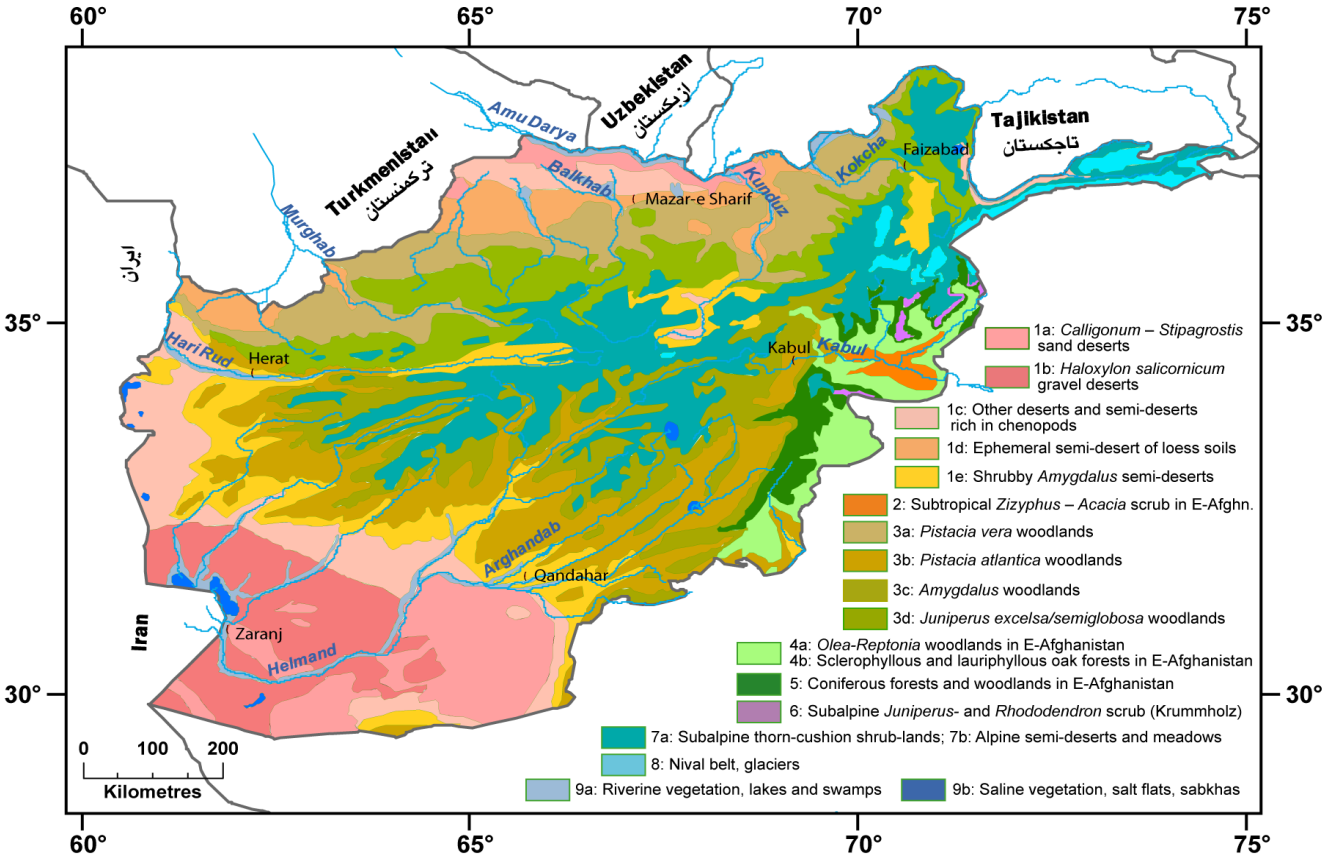


Figure 1.15: Natural vegetation of Afghanistan (Breckle, Hedge and Rafiqpoor, 2013).

1.3. Medicinal and aromatic plants (MAPs)

From the early beginning, man has suffered from illness and has used medicine to cure and eliminate it. Therefore, the history of medicine and medicinal plants as main source of curing materials is very long-standing, and goes back to the creation of mankind. Determining the exact time of using plants as drug is very difficult. Evidence indicates that plants have been cultivated as drugs approximately 60,000 years ago (Jamshidi-Kia et al., 2018).The natural ingredients used today in medicine are either from plant, animal or mineral resources. Natural substances from plants or animals are called biological medicines, because their essential active substances, which are medicinal, are produced in living organism.

Medicinal plants can be defined as: "[plants] that are commonly used in treating and preventing specific ailments and diseases, and that are generally considered to play a beneficial role in health care" (Ritchie, 2010). The useful plant material includes the bark, leaves, fruits, seeds, flowers, and roots. Since ancient times, such plant parts have formed the basis of traditional medicines used to heal or cure diseases and to improve health and wellbeing. Today medicinal plants are still used by the majority of populations in developing nations, particularly in Asia where traditional medicine is recognized and often integrated into the public health systems (e.g. China and India).

According to Lange and Schippmann (1997); Srivastava et al. (1996) and Xiao Pengen (1991) the great majority of MAP species in trade are wild-collected and relatively few MAP species are cultivated (Leaman, 2008). Leaman (2008) states that this trend is likely to continue over the long term due to numerous factors, including:

- Little is known about the growth and reproduction requirements of most MAP species, which are derived from many taxonomic groups for which there is little or no experience of cultivation.
- The time, research, and experience leading to domestication and cultivation are costly, and relatively few MAP species have the large and reliable markets required to support these inputs.
- In many communities where wild collection of MAP is an important source of income, land for cultivation of non-food crops is limited.

According to the International Union for Conservation of Nature and the World Wildlife Fund, there are between 50,000 and 80,000 flowering plant species used for medicinal purposes worldwide. Among these, about 15,000 species are threatened with extinction from overharvesting and habitat destruction and 20% of their wild resources have already been nearly exhausted with the increasing human population and plant consumption. Although this threat has been known for decades, the accelerated loss of species and habitat destruction worldwide has increased the risk of extinction of medicinal plants, especially in many countries (Chen et al., 2016).

Further than traditional medicine, medicinal plants are also used widely in health/food products including phyto-pharmaceuticals, intermediates for drug manufacturing, herbal teas, health foods, galenicals and industrial/pharmaceutical/auxiliary products. In the last three decades, there has been a significant increase in such herbal product markets across the world with rising levels of exports, particularly from Asia.

The distribution of medicinal plants is not uniform across the world. For example, China and India have the highest numbers of medicinal plants used, with 11,146 and 7,500 species, respectively, followed by Colombia, South Africa, the United States, and another 16 countries with percentages of medicinal plants ranging from 7% in Malaysia to 44% in India versus their total numbers of plant species (Chen et al., 2016).

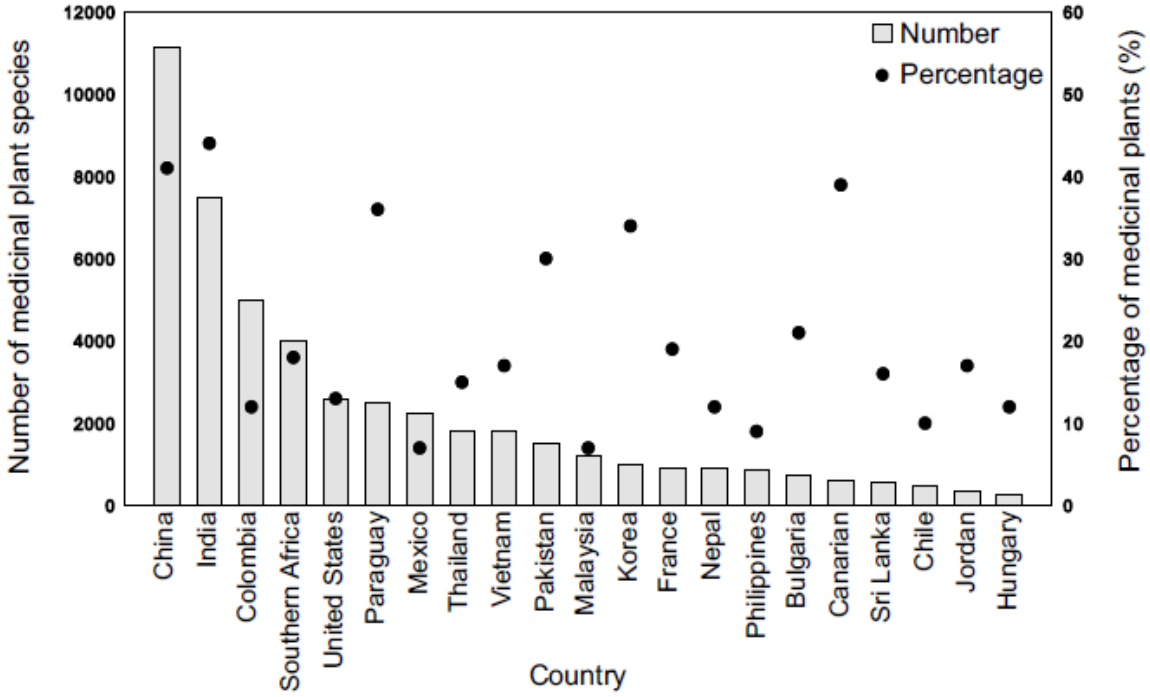


Figure 1.16: Number and percentage of medicinal plant species in different countries. The light bars indicate the number of medicinal plant species, and the dark dots indicate the percentage of medicinal plants compared with the total number of plant species (Data sources from Rafieian-Kopaei, Hamilton, Marcy et al., and Srujana et al. in Chen et al., 2016).

Medicinal and aromatic plants play a major role in expanding alternative medicine markets both domestically (where species are found) and in foreign markets, with total of 30% of all drugs sold worldwide containing compounds derived from natural plant material (Ritchie, 2010). The World Health Organization (WHO) predicts that demand for plant-based medicines is growing, and that in coming decades up to 80% of populations may demand plant-based medicines (Ahmad et al., 2017). Yet, whilst this increase in demand for raw plant material in global markets is providing income-generating opportunities for rural populations in developing supplier countries, it is putting pressure on resources (often wild). These are often collected in an unregulated and uncontrolled manner, threatening ecosystems and local biodiversity. Processing also

typically takes place outside of poor producer countries, and thus little of the final high value of products is captured within the supplier country. In some countries such as China and India, the export of plant material (e.g. licorice roots) is banned. This aims to control the exploitation of resources for immediate sale, and force the processing of plant material to take place within the country (Ritchie, 2010).

1.3.1. Medicinal and aromatic plants of Afghanistan

Biogeographically, Afghanistan is at the convergence of several vegetation types with its great altitudinal range adding to diversity. The floristic composition and the state of the grazing lands of Afghanistan are not well documented and little or no up-to-date information is available. In general, Artemisia steppe is by far the predominant grazing vegetation and there is high-quality pasture in the upper alpine zones, for a short season. Through most of its range, *Artemisia maritima* is associated with the viviparous grass *Poa bulbosa; Stipa* spp. are also quite frequent. Other sub-shrubs associated with *Artemisia* include *Acantholium* spp. (*Plumbaginaceae*), *Acanthophyllum* spp. (*Caryophllaceae*), *Astragulus* spp. *(Fabaceae), Cousinia* spp. *(Asteraceae*) and *Ephedra spp. (Ephedraceae).* In eastern areas where rainfall is adequate *Cymbopogon, Chrysopogon, Heteropogaon* and *Aristida* and other grasses of the monsoon areas occur; often associated with *Acacia modesta* and *Olea cuspidate*. In the warmer areas of Mediterranean climate, including Farah and the northern plain, the leguminous sub-shrub *Alhagi* is a widespread colonizer on disturbed land and provides useful browsing for small stock and camels (Breckle and Rafiqpoor, 2010).

Afghanistan is an important exporter of medicinal plants; each year more than 45 different species are being exporting to different countries. Reports show that during 2016 about 25 different medicinal plants (78,440 tons) with total value of USD 167,631,003 have been exported (CSO, 2017 a). *Glycyrrhiza* sp. (licorice) and *Ferula* sp. oleo-gum-resin (Asa foetida) are the major export items of the country and are mainly exported as roots and oleo-gum-resin but not with contribution of value chain and processing inside the country.

Global imports showed continuous growth over the last five years and medicinal plants (under which *Glycyrrhiza* sp. and *Ferula* sp.) enjoy wider recognition for the application possibilities in the pharmaceutical and confectionary industry. Among least developed countries, Afghanistan after Sudan is the dominant exporters in this group over the period 1998-2002.

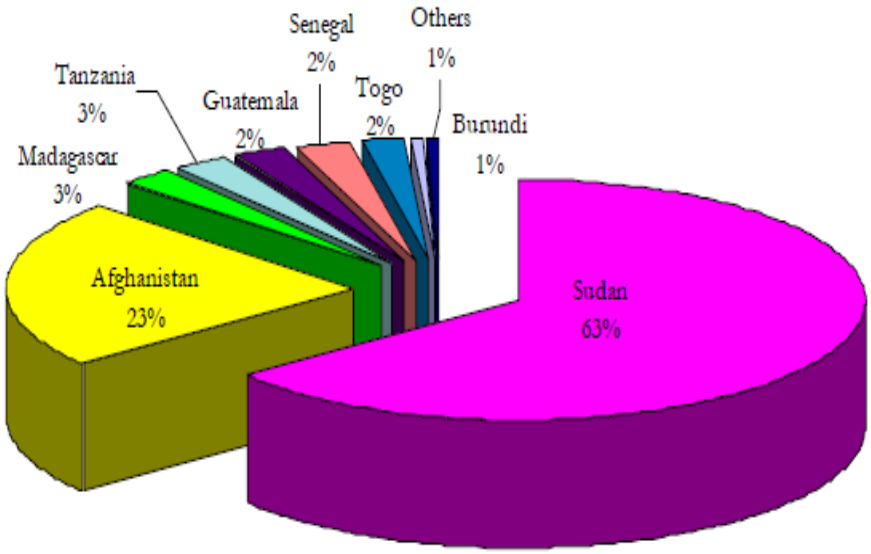


Figure 1.17: Percentage share of total the least developed countries (LDCs) exports volume of medicinal plants, by major exporters, average 1998-2002 (FAO, 2004).

Global market conditions for licorice root, Asa foetida, and other herbal products looks fairly good, because of the basic high quality and competition in the international markets. Mostly Pakistan, India, USA, UAE, EU (notably the UK, Italy, France, Spain, The Netherlands and Germany), Japan and Israel are the most important markets for Afghan *Glycyrrhiza* sp. root (licorice), *Ferula* sp. oleo-gum-resin (Asa foetida) and other wild medicinal plants (MAIL, 2017).

The trend of the export of medicinal and aromatic plants product has an exponential tendency during last 15 years. The main items exported sustainably to regional and international markets are around 25 products. The following table lists the volume and value data of the exports for these products.

Table 1.7: The volume in value of export of MAP products in 2016 (data sources from CSO, 2017).

#	Plant	Product	Local name	2016	
				Volume (MT)	Value (000 USD)
1	*Ocimum* sp.	Basil	Raihan	340.0	753.7
2	*Peganum harmala L.*	Harmal seed	Esfand	854.0	623.1
3	*Carum carvi L.* (cult.)	Caraway	Karabia	289.0	591.3
4	*Dorema* sp.	Oleo-gum-resin	Kandal	0.0	0.0
5	Langash *		Langash	720.0	468.1
6	*Cuminum cyminum L.*	Cumin	Zeera Safid	3,850.0	14,840.3
7	*Bunium* sp.	Black cumin	Zeera sia	457.0	2,115.8
8	*Cuminum* sp.	Green wild cumin	Zeera sabz	1,361.5	6,388.6

9	*Coriandrum sativum L.*	Coriander seed	Gashneez	223.8	458.3
10	*Cucumis melo L.*	Melon seed	Tokhme Kharbuza	381.5	419.7
11	*Crocus sativus L.*	Saffron	Zafran	2.4	3,868.7**
12	*Sesamum indicum L.*	Sesame seed	Kunjed	15,283.0	20,481.2
13	Kunjara***	Oilseed cake	Kunjara	59.9	65.9
14	*Papaver somniferum l.*	Poppy seed	Khashkhash dana	6,694.7	18,343.8
15	*Ferula sp.*	Oleo-gum-resin	Heng	286.2	24,321.7
16	*Glycyrrhiza glabra L.*	Licorice	Sherin booia	40,264.1	54,755.0
17	*Dorema* sp.	Oleo-gum-resin	Heng	69.2	6,235.4
18	*Salvia* sp.		Gushte Adam	0.0	0.0
19	*Alkana* sp.	Dyer's Alkanet	Yarlang, Rodang	221.8	502.5
20	Macrofungi	Mushroom	Semaroq	13.7	164.5
21	*Carum carvi L. (wild)*	Caraway wild	Zere safid	254.3	658.8
22	*Citrullus lanatus (Thunb.) Matsum. & Nakai.*	Watermelon seed	Tokhme Tarbuz	2,069.1	3,539.9
23	*Medicago sativa L.*	Alfalfa	Tokhme Shabdar	1,745.4	3,592.7
24	*Trifolium repens L.*	White clover	Tokhme Reshqa	2,979.1	4,397.7
25	*Punica granatum L.*	Pomegranate seed	Nafae Anar	16.0	43.2
26	Total			78,435.7	167,630

* Langash is a root of the plant collected from the southern part of Afghanistan.

** According to MoC & I (2018), Afghanistan exported US$17 million of saffron to international markets in 2016.

*** Kunjara is the oilseed cake or waste material left after producing oil and containing protein, fiber, and oil.

Among the important economic plants in the country, cumin is one of the principal spices that is exported internationally. The valleys of Badakhshan produce the highest quality cumin in the world. The seeds of this herb have been exported along the ancient Silk Road trade route for thousands of years (MAIL, 2017). Based on the volume and value of the exports of medicinal plants during last decade cumin occupies the next place after *Glycyrrhiza* sp. root and *Ferula* sp. oleo-gum-resin.

The emerging phenomena of saffron in production and export of this product attracted organizations and authorities working in economic sector of Afghanistan. While saffron production in Afghanistan dates back more than 100 years, cultivation remained marginal until a few decades ago. Saffron is experiencing a revival in the country for a number of reasons. First, the high value that it commands in the international market bolsters its attractiveness because it has a high value-to-volume ratio, making it easy and profitable to export. Second, agronomic and climatic conditions make Afghanistan an ideal location to grow high-quality saffron. The distinct attractiveness of Afghan saffron has been validated on numerous occasions, most recently in 2016, when Afghan saffron was ranked first out of 30 competing regions at the International Taste and Quality Institute

of Brussels (MoC & I, 2018). The analysis of samples of saffron from a major Herat producer by the Food Science and Human Nutrition Department at Washington State University indicated the high quality of the samples (Wyeth & Malik, 2007). The results are shown in Table 1.8.

Table 1.8: Results of the analysis for a saffron sample from Herat compared to the ISO criteria for category I (best) saffron (Wyeth & Malik, 2007 & Hadizadeh et al., 2008).

Main active constituents	ISO 3632 Category I	With styles	Stigmas only
Picrocrocine (flavour – bitterness)[1]	70	60.05	88.67
Safranal (aroma)[2]	20–50	25.42	35.03
Crocines (colour)[3]	190	141.12	244.195

(1) Bitterness, expressed as direct reading of the absorbance of picrocrocin at about 257 nm, (2) Safranal expressed as direct reading of the absorbance at about 330 nm, (3) Colouring strength, expressed as direct reading of the absorbance of crocin at about 440 nm.

The results for the tests on almost pure stigmas indicate that the saffron is of high quality, being well above the minimum for Category I.

While Afghan saffron is a new entrant in the global market, Afghanistan became one of the largest exporters of saffron in 2016. Based on its remarkable growth rate of 36% annually between 2012 and 2016, Afghanistan could be a serious competitor against other major exporters with much lower growth rates. A new entrant and fast-growing exporter of saffron is Hong Kong (China), which marked an exported value of US $5.2 million in 2016 and export growth of 123% between 2012 and 2016 (MoC & I, 2018).

There are many key comparative advantages of saffron production in Afghanistan. Saffron benefits from stable high prices; growing demand in international markets; high resistance to extreme temperatures, diseases and irregular supply of inputs; and is relatively easy to handle and transport. Saffron's high value-to-weight ratio is especially appealing to Afghan traders, as it opens up air transport as a viable, cost-effective shipping option (MoC & I, 2018).

In terms of social benefits, saffron production is highly labour-intensive, with women capturing a high share of labour-related income. Even in culturally conservative Afghanistan, there is the perception that the detail-oriented work involved in saffron crop maintenance and harvesting/processing is especially suitable for female workers. Additionally, saffron is harvested in autumn, after the harvesting period of other local crops. The result is the high availability of seasonal workers who are able to boost their annual income during a period where they may otherwise be idle (Wyeth and Malik, 2007).

Another social benefit is saffron's ability to compete with opium in terms of alternative livelihood. In a country where the crime of opium production is rarely prosecuted, a farmer must have economic incentives to turn away from this illicit narcotic.

With all factors taken into consideration, the business case for growing saffron in Afghanistan is strong. The United States Agency for International Development (USAID) estimates that within the next 10–15 years, the Afghan saffron industry could reach a value between US$50 million and US$100 million, with exports constituting up to 80% of the market: an ambitious target. However, a number of recent developments point to favourable growth prospects (MoC & I, 2018).

Saffron production has reached 31 provinces (out of 34 total), from just one province a decade ago. MAIL is currently planning the deployment of a large-scale training programme aimed at saffron farmers. From the perspective of socioeconomic development, the high labour requirements of the saffron industry offer employment opportunities in both peak and off-peak seasons (especially for women) (MoC & I, 2018). Additionally, the high profitability of saffron provides incentives for farmers to cultivate it instead of opium. As a result of these factors, there is wide consensus among leaders in the Afghan public and private sectors, as well as the international development community, that there are significant economic and social benefits to increased saffron production in Afghanistan. In this regard, the Government has embarked in a five-year national plan for saffron development, led by MAIL.

Figure 1.18: Saffron plantation in Herat (Photo by Babury, 2017).

This Strategy is driven by the following overall vision: "Saffron: spicing up Afghan exports." To achieve this vision, the Strategy focuses on the following three strategic objectives (MoC & I, 2018, p. 1):

Strategic objective 1: Increase production and productivity through improved supply-side conditions.

Strategic objective 2: Strengthen the organization of the sector's ecosystem through greater collaboration and efficiency.

Strategic objective 3: Spur market penetration and development through integrated quality management, packaging and branding operations.

Beside medicinal and aromatic plants, Afghanistan has very few large-scale fruit producers. According to FAO in the 1970s, Afghanistan supplied over 30% of all dried apricots, 18% of raisins, 12% of pistachios, and roughly 6% of grapes and fresh apricots traded in international markets (World Bank, 2017b). Afghanistan's most dominant fresh fruit product is grapes, followed by apples and apricots. All three of these fruits are cultivated throughout the country. Cherries are grown in Kabul Province, while citrus fruits flourish in the warmer weather, particularly in the south-eastern provinces of Laghman and Nangarhar. Pomegranates are harvested in the southern part of the country, while melons are cultivated in abundance in the northern provinces of Farah, Jawzjan, Faryab, Baghlan and Samangan. Production of vegetables largely takes place in the provinces of Parwan, Kapisa, Nangarhar, Bamyan and Balkh. Tomatoes are grown in plentiful quantities around the northern provincial capital of Mazar-e-Sharif, while potato cultivation is concentrated in the provinces of Bamyan, Nangarhar, Panjshir, Parwan, Samangan, Sar-e Pol, Takhar, Uruzgan and Wardak. Onions grow exceptionally well in the warmer climes of Paktia, Herat and Kandahar.

Fresh fruits generally garner higher prices on the market than their dried counterparts. Consequently, farmers and traders focus on pushing most of their fresh fruit stock into the fresh produce market. Approximately 75% of total farm production is currently sold on the fresh market, while excess supply is designated for drying or consumed privately. Due to damage and spoilage resulting from rough ground trips in lorries with no refrigeration capacity, an inordinate quantity of fresh produce is lost to spoilage, with much of the remainder losing value due to damage (MoC & I, 2018).

Fresh fruits and vegetables exports accounted for around 21% of total Afghan exports in 2016, valued at nearly US $168 million. Promisingly, sector exports have increased by a factor of seven over the last 10 years. With the addition of more export destinations, the Afghan Fresh fruits and vegetables sector has grown strongly since 2012. In particular, remarkable growth in shipments to India has boosted the fresh produce sector's export performance.

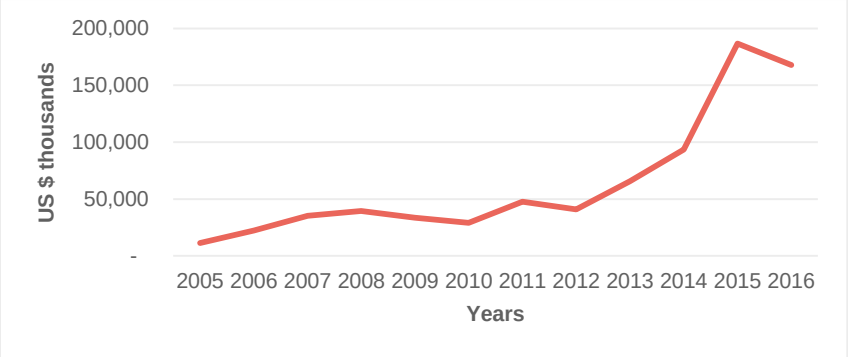


Figure 1.19: Exports of fresh fruits and vegetables, 2005–2016 (US$ thousands) (MoCI, 2018, based on ITC data).

1.4. Traditional medicine

Mankind through its creation, resorted to nature to eliminate hunger and heal the pain and disease, and found that what was around him was created to help him survive. Man gradually became familiar with the properties of plants, minerals and animals, and steadily passed on the empiric knowledge to the next generations. This dependency and the use of natural resources along with the search for new remedies were pooled by curiosity and exploration of nature and human organism.

Due to the complexity of the organism and the variety of morbidity, there were several centuries and millennia involved in the formulation of basic ideas and beliefs about organism, health, and ways of treating illness and the use of medicines. These theories were largely observational and empirical perception, and the role of different beliefs and cultures in their formation was profound. As a result, various theoretical and philosophical theories were developed. Various medical and philosophical theories and philosophies were developed in different periods of human civilization to explain the mysteries of health and diseases. Usually, the opinions of these scholars on the issues of health and diseases have been philosophical, religious or mixed with it. In addition, cultural, political and social differences along the geographical location and the place of residence provided a platform for different interpretations of diseases in various ancient communities. In this way, different ways of treating common diseases were created in various communities. Gradually, with the growth and development of medicine, and in general, folk culture, and more familiar with the healing effects of medicinal herbs and other natural materials, traditional medicine was widely used in different professions.

Practices of traditional medicine vary greatly from country to country, and from region to region, as they are influenced by factors such as culture, history, personal attitudes and philosophy. In many cases, their theory and application are quite different from those of conventional medicine. Long historical use of many practices of traditional medicine, including experience passed on from generation to generation, has demonstrated the safety and efficacy of traditional medicine. However, scientific research is needed to provide additional evidence of its safety and efficacy.

The WHO defines traditional medicine as "the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness" (WHO, 2013).

Three major types of traditional medicine are currently practiced globally: Traditional Chinese Medicine (TCM), Indian Ayurvedic medicine and Unani medicine. Other alternative or 'complementary' medicines also exist, and are gaining in popularity. In developed countries, use of such medicines is not (yet) common however (under 50% of the population), although demand is growing (Ritchie, 2010).

1.4.1. Traditional medicine of Afghanistan

Afghanistan has a long history of use of medicinal plants resources for health care. The medicinal uses of these species are recorded in many famous traditional sources of Afghanistan traditional medicine including Unani Medicine and as well as reported in the folk traditions of different ethnic communities across the country. Afghanistan traditional medicine (ATM) is one of the complementary and alternative medicines (CAM) that has played an important role to prevent and treat diseases in various stages of life. ATM is based on a set of systematic philosophical doctrines originating from Greek medicine and classical Greek philosophy. ATM medicine also includes a wide variety of therapeutic methods and medicinal preparations that can be attributed to the influence of Persian, Arab, and Indian Ayurvedic, medicine.

The role of traditional medicine in the east and Middle East has been of great importance in spreading significant achievements in Arab medicine. The founders of the ancient tribal territories are the Sumerites. The Sumerians, the Wakadians, founded several states in Mesopotamia (between the Tigris and Euphrates) several thousand years ago. Archaeological excavations around the Sumerian civilizations show that at that time numerous medicinal herbs were used for the treatment of diseases. With the discovery of the Assur Bonipal (Sandanapal, 668 B.C.) famous library, archaeologists revealed 33 different tableau, each of which was engraved with inscriptions and instructions on medicinal herbs and animal products. These tableaus were dedicated to various diseases. Each of them has been split into three columns, respectively, in the first column the names of the plants, and the second is the diseases for which the plants have been used, and the third is their use. The traditional Persian tradition of Zoroastrianism is known as the Old Iranian fuehrer (about ten centuries B.C.). Traditions indicate that Zoroaster has written the oldest Avesta historical and cultural work, which, apart from the religious, social and cultural issues related to the Bactrian, includes various medical themes and aspects. In Avesta, repeatedly mentioned various medicinal herbs, extracts and resin such as Asa foetida and other products (Babury, 2012).

The famous king of the western land Mithridates 1 (the 2nd century B.C.) learned with special enthusiasm poisons and spices. As narrated, he introduced the first form of compound drug called "theriaca" (opium), a highly concentrated, honey-like state. As

long as this term has been preserved throughout the country, it is referred to as the latex of poppy's capsule (Babury, 2015).

During the same period in Greece, a highly sophisticated system of medicine developed. Hospitals and medical schools attached to temples were founded where therapeutic measures included calm and quiet regimen, diet, music and sleep. Physicians placed emphasis on hydrotherapy, herbal treatment and massage. The Sicilian School of medicine was founded in the 5th century BCE by Empedocles, who first put forth the theory of the four elements (Fire, Water, Air, Earth), which was further developed in the times of Plato and Aristotle. The ideas of Greek medicine are recorded in the so-called Hippocratic Corpus (Latin - Corpus Hippocraticum), which is a collection of about 70 treatises on various medical topics. After the conquest by Alexander the Great (4th century B.C.) the influence of the Greek culture reached Egypt and South-West and Central Asia as far as China.

Unani medicine originated from Greece under the patronage of Hippocrates (460 –377 B.C.) and from the fusion of diverse thoughts and experiences of nations with ancient cultural heritages, and advanced with the wealth of scientific thought of that age (Chaudhury & Rafei, 2001).

With the advent of Islam and the conquests of Muslims, some traditional medicines, especially Persian medicine, was influenced by Arabic medicine. During this period, extensive efforts were made to develop the culture of Muslim regions as well as medicine. Nevertheless, popular schools were established (Alexandria, Gundishapur, Baghdad, etc.), which at that time were the world's most popular centers of culture, home to a teaching hospital, had libraries and centers of higher learning. Rapidly, Arabic medicine was built on the basis of the theories and practices of ancient Greek medicine (Babury, 2015).

In the 7th century, when Arabs captured Iran, Syria and Egypt, Greek science and philosophy started to develop in the scientific centers of these countries. The most renowned centers at that time were the Alexandrian School in Egypt and the Christian Nestorian School in Gundishapur (Jundishapur) in the South of Iran **(**Abdukadir et al. 2015).

From the 9th to 12th centuries, Central Asia became one of the major centers of scientific thought in the east. After the collapse of the Caliphate in the late 9th century, the governor of Maverannahr (a territory in Central Asia) and Khurasan (a territory in Afghanistan and Iran), Ismail Samanid, who ruled from 892 to 907, consolidated these lands; Persian Dari (Farsi) remained the spoken language of the Samanid state, while Arabic was the language of religion and science. Bukhara, one of the most prosperous cities of the east, became the capital of the Samanid state (Abdukadir et al. 2015).

One of the prominent scientists who made the most significant contributions to the development of humoral medicine is Abu Bakr Muhammad bin Zakharia al-Razi (Razes;

865-923 C.E.). At the beginning of the 10th century the main canon of Greek medical works had been translated from Greek to Arabic, and this laid the foundation for further research. The translation was done by al-Razi, who could be compared to Claudius Galen (circa 129-200), the great doctor of Roman period due to the role that he played in the development of Arab medicine. Al-Razi is thought to come from the Persian town of Ray, near Tehran. In Persia and Khorasan, on the territory of modern Uzbekistan and Tajikistan, he received a well-rounded education which included philosophy and metaphysics. At the age of thirty, in Bagdad, al-Razi began his medical studies, and quickly became renowned for his medical skills. Al-Razi wrote papers on philosophy, medicine, ethics, theology, logic, astronomy, physics and chemistry. The most well-known among his works is the 10-volume Kitab al-Mansuri, a treatise on internal medicine and clinical practice devoted to Caliph Mansur. Other works include Kitab al-Zhadari va-l'-hasba, A treatise on smallpox and measles", Kitab al-Tibb al-Rukhani, which describes disease pathology and includes his comments on Galen. After his death, his works were compiled into a 25-volume medical encyclopedia called Kitab al-Havi, which also included extracts from Greek, Indian and Arab authors (Abdukadir et al. 2015).

Ali ibn al-Abbas al-Majusi (Masoudi, Latin - Haly Abbas, circa 925-994) is an author whose works may be the second in importance only to "The Canon" by Ibn Sina (Avicenna, 980 -1037). The main work of al-Majusi, "The Complete Book of the Medical Art" (Arabic: كامِل الصناعة الطبية, Kamil al-inaa al-ibbıya) is also known as "The Royal Book" (Arabi:الكتاب الملكي, Al-Kitab al-Malakı), provides a comprehensive survey of Greek-Arab medicine of the 10th century, with clear and consistent representations of theory and practice. The great scholar al-Farabi (870-950) wrote several medical treatises: "Theory of Natural Kinds: Hot, Cold, Damp and Dryness", "Theory of Aza Function", "Theory of Neurology", "Theory of Spirit Character", "Theory of Nature Life", "Theory of Mentality". The medical theories of Al-Farabi had a significant influence on the teaching of Avicenna, another great doctor and philosopher (Abdukadir A. et al. 2015). The legacy of this great scientist, philosopher, doctor and poet is truly immense, and his works should be counted amongst the most outstanding creations that have enriched world culture. Among Avicenna's books in Arabic and Persian languages, there are philosophic treatises in many volumes, as well as poetic books. His main medical works include the seventeen-volume "Kitab ash-shifa" (The Book of Healing) and the five-volume "al-Kanun fi-t-tibb" (Canon of Medicine), both of which were used as primary manuals of medicine throughout Islamic and European countries until the 17th century. Avicenna influenced by Galen's idea profoundly (Abdukadir et al. 2015).

Studies on traditional medicine in Afghanistan indicate that in the formation of this traditional medicine Persian, Greek, Ayurvedic and Arabic medicines have played an important role (Babury, 2015). Historical transformations sparked the spread of the culture of civilizations and empires in this country. However, the ancient Greek culture after the invasion of Great Alexander (330 B.C.) and later on the establishment of the Bactrians (250-150 B.C.) influenced the land, and so on, Arabic culture, including

Traditional Arabic Medicine, with the overthrow of the country to Islam, influenced in the culture of this country deeply. Subsequently, during the reign of Babur Shah (1438-1530) and the establishment of the Mogholian rule in the Indian continent, with the creation of cultural relations, Indian Medicine as part of other cultural areas interested the people of Afghanistan. Abundancy and diversity of medicinal herbs practiced in Ayurvedic medicine and its historical features increased the influence of this medicine in Afghanistan traditional medicine (ATM) (Babury, 2012).

On the other hand, the close relationship between ATM and ancient Greek medical philosophy is also noteworthy. The knowledge and beliefs of the traditional healers ("hakims") in Afghanistan based on the four humors philosophy, marked consistent with the ancient Greek-medical theories of philosophy (in Ayurvedic medicine the theory of tertiary liquefication is dominant) (Pankala: 1978).

Study about medicinal plants used in traditional medicines of Afghanistan shows that 29% (62 items) of medicinal plants are imported mainly from India (Younus et al. 1987). Of the approximately 5,000 species of flowering plants in Afghanistan, more than 200 of these are known as medicinal plants. Although the distribution of medicinal plants is not uniform across the world, the number of known MAPs in Afghanistan is much lesser than some other countries ranging from 7% in Malaysia to 44% in India versus their total numbers of plant species (Chen et al., 2016). The details of origin and growth of the most commonly used herbs of traditional plants in Afghanistan are demonstrated in below table.

Table 1.9: Origin and habitat of MAP used in traditional medicine of Afghanistan (Younus, et al. 1987).

#	**Origin**	**Number species**	**%**
1	Imported	62	29
2	Cultivated	51	24
3	Indigenous	43	20
4	Wild, arid, steppic	17	8
5	E and S dry subtropical steppes	16	7
6	Wild, humid region	14	6
7	Central high region (Hindukush)	8	4
8	S-W Mediterranean	4	2
Total		215	100

The medicines used in ATM are divided into two parts: singular and compound. Singular medicines are made of herbal, animal and mineral materials, which are used singly or with water, honey, oil, sugar, *"sekanjebin"* (water, sugar, vinegar and menthe), "*terangibin*" (manna produced form the *Alhagi* sp.), and so on. Compounded medicines consist of mixing two or more medicines together or with different substances (Babury, 2015).

ATM is sometimes known as “Unani” (Greek) and based on the ancient systems of the curing of diseases. The main sources of the theories for ATM are Greek, Indian, Persian and Arabic traditional medicines. Studies about the origins of traditional medicine in Afghanistan demonstrate that both the Greek and Ayurvedic medicines have contributed to the formation of the four temperaments theory (humourism). It is revealed that the civilization before the Indian Valley (Indus Valley) included some of Afghanistan's contemporary areas, and later it penetrated the west through this area as knowledge and information (Pankala 1978).The existence of several Indian herbal products in traditional medicine in ATM can be an indication of this claim.

Information from the Avicenna Pharmaceutical Institute (API) indicates that there are about 3,500 traditional Unani practitioners in Afghanistan. They are not institutionally trained, but gained knowledge through their family traditions. During the last decade the API has attempted to establish new bylaw and regulate the activities of these practitioners. API is a governmental body within the Ministry of Public Health (MoPH) working to regulate this sector alongside of other pharmaceutical areas in Afghanistan. Based on that, so for five sessions of examination for the attestation of these practitioners have been held in Kabul and only 105 of the practitioners have been certified as registered traditional practitioners (API Planning Dep., personal communication, May 21, 2018). API is drafting the new regulation on ATM.

Studies in some provinces of the country show that the following types of traditional healers exist in various part of the country (Babury, 2012):

1. Unani physician (“Tabibe Unani”), who are not trained institutionally, but has gained knowledge and skills through his family traditions. The scientific knowledge and experiences among these physicians, usually held within the family, and passed from ancestors to offspring.
2. Limited number of "Unani healers" who practice traditional medicines of Afghanistan have trained as institutionally qualified physicians in programs in Afghanistan, India, Iran or Pakistan.

(A) (B)

Figure 1.20: Traditional healer clinic (A) and "*Attaari*" in Kabul (B) (Photo by Babury, 2018).

3. A number of Unani physicians ("Tabibane Unani") were trained in a special training programs through courses sponsored by a corporation "De Buto Sehami Sherkat" with the support of the MoPH in 1970s in Kabul.

Although in some provinces (Herat), some prominent traditional hakims have been trained in the field of traditional medicine, the share of experiences is rarely evident among them.

The vast majority of natural products practiced by these hakims are endemic products and at the same time imported products mainly with Indian origin are also significant in the nomenclature of the traditional medicines (Babury, 2015).

Folk medicine in Afghanistan based on empirical practice comprised of treatments believed appropriate by both practitioners and patients; however, they have neither philosophical nor theoretical foundations. Some folk medicines have textual sources, but these are only handwritten copies with limited circulation, for example, the ones that belong to a particular region or ethnic group.

Folk healers in Afghanistan are called "*Attaar*" and their place of working "*Attaari*". The word "*Attaar* "is derived from '*Attar*" which in Arabic means perfume. "*Attaar"* means the person selling perfume and usually, they sell different herbal and other natural products. The office of "*Attaar*" is called "*Attaari*". Many of the "*Attars*" have knowledge and experience in the products that they sell.

In the past, "*Attaari* "used to serve as medicinal, and traditional medicine products selling place (traditional medicine pharmacy), which procured, prepared and sold dozens of herbal and traditional medicines to some extent in accepted traditional dosage forms. A number of traditional healers in "*Attaari*" have been performing consultation and treatment of the patients by prescribing medications or performing chiropractic. However, in big cities such as Herat, Balkh and Kabul, most of the traditional physicians had a separate clinic for the reception, consultation, prescription and performing chiropractic.

Figure 1.21: "*Attaari*" in Mazare Sharif (Photo by Babury, 2005).

Nowadays, despite the fact that "*Attaari*" is a symbol of traditional medicine, most often they only sell herbal and traditional medicine products, in most cities of the country. "*Attaari*" is the busiest shop for selling various natural products and herbal medicines. In some parts of the country, such as Kabul, Nangarhar, Kandahar, etc. Hindus and Sikhs are more likely to work in this profession than others. Some of "*Attars*" have good knowledge and skills in ATM through their family traditions (API Planning Dep., personal communication, May 21, 2018), while others do not have adequate knowledge of traditional medicine and they are able to sell herbal and other natural products and traditional medicines in accordance with the customer's request.

1.5. Natural resources of MAPs in Afghanistan

1.5.1. Present status

The livelihoods of over three-quarter of Afghans, depends on natural resources (MAIL, 2017). Natural resources in Afghanistan include rangelands; forests; protected areas and wildlife including all flora and fauna. Rangelands (47%) accord the largest land cover type of Afghanistan (See Tab. 1.4), seconded by barren lands. Only around 12% of the

total land area is arable. Forests account for 2.8% of the total area. Most of the rest is extensive grazing, desert or high mountain permanent ice. By far, the greatest part of the land surface of Afghanistan is extensive grazing land-desert, semi-desert or high or steep mountains; only about 40% is said to be suitable for winter grazing (MAIL, 2017).

The primary use of rangelands is for livestock grazing. The survey in 2002-2003 (FAO, 2006) reported a total number of 3.7 million cattle, 8.8 million sheep, 7 million goats, 1.59 million donkeys, 0.18 million camels, 0.14 million horses and 12.2million poultry in Afghanistan. Livestock production contributes 3.8% of National GDP and 15% of agricultural GDP. It employs 1.1 million men and women, particularly amongst the most economically impoverished (MAIL, 2016). Livestock production based on the extensive use of the rangeland resources. is an essential component of the local farming system and livelihood strategy for over 80% of the Afghanistan household. All the animals depend entirely or partially on the rangelands resources for fodder and forage and therefore, the quantity and quality of the rangelands will have a direct bearing on the subsistence and sustainable development of rural communities and the nation as a whole (FAO, 2006).

These rangelands have been classified by different authors into different broad categories using different criteria, e.g., alpine, subtropical and arid types by climatic factors, or winter pastures (16.2 million ha.), spring and autumn pastures (16 millions) and the summer pastures (22.5 million ha.) by seasonal uses. There is to date, no in-depth nationwide study on the floristic composition of the rangelands (Breckle et al, 2010; MAIL, 2017).

Rangelands are considered as the main habitat of wild MAPs in the country. Therefore, another use of the rangelands is for the collection of MAPs. Estimates show that around 5000 species of higher plants found in the country (Breckle et al, 2013) and more than 200 of them are known as medicinal plants (Younus et al., 1987). In addition, there are many other interesting plant communities in the country, which require more study and investigation. The collection of medicinal plants after medicinal use in folk and traditional medicines, as a source of income, has a socioeconomic background in Afghanistan. For many decades people in rural areas have collected different wild plants which have traditional uses in the country and also exported to other countries. Presently, medicinal plants are the main source of income generation and alternative livelihood for many rural people. According to provincial DAILs reports, one can collect and sell around 70-105 kg of licorice every day which brings in a daily income of 600–800 Afghanis (8.5-11.5 USD) (MAIL, 2017). This source of livelihood is of critical importance in many parts of the country.

Rangeland and medicinal plants provide specific values to the development of agricultural products, handicrafts, economic development, and rural livelihood development. Besides, feeding domestic animals, providing MAPs for people, rangelands are also the important or sole supplier of some critically important ecosystem services and goods in Afghanistan: providing fire wood for people, and habitat for biodiversity and pastoral culture, preserving soil and water, and regulating climate (e.g.,

worldwide, rangelands are second only to forests in its capacity for carbon sequestration) (MAIL, 2017). This multiple functionality of the rangelands has gained increasing recognition by the users. MAP resources include different types of plants in a wide diversity of habitats.

However, the reliance of the rural population and communities on rangelands and particularly MAPs as a source of livelihood does not seem to be viable in the long run due to multiple factors and challenges.

Afghanistan's resource base has been dramatically and negatively affected over the course of the last forty years from near constant conflict and associated pressures related to the destruction of infrastructure, movement of large number of internally displaced people, extreme poverty, and an almost total lack of enforcement. Coupled with severe drought, the results have been that rangelands have deteriorated, forests have been felled, and biodiversity will be lost.

The importance of the implementation preservation and conservation biodiversity is limitedly acknowledged in the country. Unfortunately, enforcement of laws and regulations pertaining to biodiversity is a grand challenge throughout Afghanistan. Over-collection of MAPs due to vulnerability and also market demands seems to be a major challenge in most parts of the country. Generally, there is very little attention to the legally recognized protected areas and thus there is continued losses of this inheritance treasury.

Regrettably, lack of the required resource management initiatives and coordination likely cause additional losses to the country's biodiversity. The last challenge impacted by low professional capacity and training, limited technology and outreach to the public. Well-trained and specialized professionals and well-equipped research facilities do not exist to address the aforementioned issues. Eventually, the ecosystem in Afghanistan was gradually damaged over years of war and in recent years the biological fertility of the ecosystem has also been damaged due to severe deforestation, overgrazing and other manmade damage that resulted in soil and ecosystem erosion.

Lack of information and evidences about natural resources and especially wild medicinal plants is another problem in this regard. Such information and knowledge is either unavailable or outdated. Information like floristic composition of provinces and different geographical areas, rangelands, wild and cultivated medicinal plants, production of biomass is either scarce or does not exist.

With 80% of Afghan dependent on the country's natural resource base, long term stability will be directly dependent on sustainable management of natural resources (MAIL, 2017).

1.5.2. Challenges

According to the International Union for Conservation of Nature and the World Wildlife Fund, there are between 50,000 and 80,000 flowering plant species used for medicinal purposes worldwide. Among these, about 15,000 species are threatened with extinction from overharvesting and habitat destruction and according to Ross (2005) 20% of their wild resources have already been nearly exhausted with the increasing human population and plant consumption (Chen et al., 2016).

Increased consumption of medicinal plants, through expansion of local, regional, and global markets, has increased pressure on resources that are largely harvested from the depleted wild populations in shrinking wild habitats. The wide range of habitats, taxonomic groups, and the variety of cultural, social, and economic conditions affecting their use, present substantial challenges for conservation and management efforts for these resources. At the same time, the capacity, experience, and expertise developed in meeting these challenges for medicinal plant resource management will contribute more broadly to biodiversity resource management capability in any natural and social environment where plants are used as medicines.

It is worth to mention that at the global scale, political arena of natural resources has another dimension. The resource-conflict nexus had emerged among scholars in the early 1980s. According to Klare it referred to the Soviet movements in Afghanistan, the Middle East and Africa, which were perceived as threats to US access to important natural resources (Bayramov, 2017). Ironically, despite the alarmist assumptions, the idea of a resource war turned out to be misguided. Stern (2016) explains that the reason for this was the misperception of scholars at the time, who exaggerated the threats arising to these resources and particularly oil. Considering the conditions of the Cold War, one may claim that any attempt at a resource grab by one of the Great Powers would be subsumed under the propaganda of war (Bayramov, 2017).

The term ‘resource curse meanwhile,’ emerged in the late 1980s as a way to address the economic crises being experienced by resource rich countries. The resource curse theory was first introduced by Richard Auty in 1993. According to Andersen & Ross (2014) and Ross (2012) resource curse adherents argue that an abundance of resources and particularly oil in developing countries weakens the economic, democratic, and institutional capacities of national governments, making their societies vulnerable to armed disputes (Bayramov, 2017).

The legacy of conflict that has plagued Afghanistan and its people for nearly 40 years has damaged not only the country’s society and institutions, but also its environment. The main impacts are the depletion and overuse of natural resources, which exacerbate the stressful socio-economic conditions and the impact of natural hazards; reduced access to natural resources, erosion of the rule of law; collapse of traditional governance systems and processes; pollution with toxic rocket fuel, spilled oil and land mines making essential lands and pastures unsafe to use (Emadi, 2011). Severe degradation of

rangeland ecosystem continues to remain a major cause for concern. Afghanistan is highly susceptible to desertification. It is believed that the process of desertification is advancing in several areas of Afghanistan's arid northern, western and southern regions. Rangelands are at particular risk from desertification, where widespread grazing has reduced vegetation cover and exposed soils to erosion. Many communities have had to reduce or dispose of livestock because of reduced quality of rangelands. Even though there is an increasing recognition that the reduced ecosystem functions of the rangelands may partly be due to the climatic variability characterized by frequent droughts, it is also inadequate management that has impacted these ecosystems (MAIL, 2017).

Throughout the region of Afghanistan and the surrounding countries, the removal of vegetation through deforestation, dearbification or "deshrubification" (Shroder, 2014), overgrazing, and widespread despoliation of landscapes is a scourge of environments that adds hugely to the diminution of water supplies. In spite of the attendant decrease in transpiration with plant loss, the fact that devegetation contributes so much to soil erosion because plant roots hold the soil in place against soil loss, the result is that devegetation contributes to a direct decrease in infiltration of soil water, surface runoff is accelerated and adds to ever greater soil erosion, and downstream floods increase as well (Shroder & Ahamdzai, 2016).

Poverty and natural resource degradation coexist in many countries including Afghanistan. Over 80% of the Afghan population lives in rural areas practicing agricultural and related rural activities – reliant on the use of natural resources (Emadi, 2011) The decades of conflict, continual instability, lack of effective governance and service delivery, high population growth, poverty, overdependence of rural populations on natural resources coupled with a low level of awareness about natural resource management and climate change, socio-economic insecurity, susceptibility to droughts and other natural hazards, and influx of displaced and returning population, have all exacted a heavy toll on the natural resource base of the country. As a result, the country's vulnerability to natural disasters and food shortages has increased. In this light natural resources, however, face serious manmade and natural threats. Reduction of the country's natural resource repository during the armed conflict years has reduced livelihood options for local communities, making them even more dependent on the existing degraded natural resource base for meeting their daily requirements (MAIL, 2017). Deforestation has resulted in higher incidence of landslides and floods.

Most of the country's valuable forests have been degraded during the years of war and social unrest. According to UNEP (2003) it is estimated that between 1978 and 2002 the area under conifer forests in the eastern part of the country was reduced by 50% (Emadi, 2011). In 2000, Afghanistan experienced its worst food crisis ever recorded because of a very severe drought. Such low levels of recorded rainfall had not been seen in the country since the 1950s. The southern parts of the country were badly affected, and farmlands produced 40% of their expected yields. Half of the wells in the country dried up during the drought, and the lake feeding the Arghandab dam dried up for the first time since

1952. The barley crops were destroyed and the wheat crops were almost wiped out. In the middle of 2000, the drought's consequences were felt in Kabul, when more and more displaced people were migrating to the capital. The prices of staple foods have also increased in different parts of the country because demand is much higher than supply. A large segment of the Afghan population depends on food imported from abroad or distributed by aid organizations.

Scarcity is a complex term and it should not be equated with only natural resources. As it is explained by Kester (2016) some countries may suffer from scarcity of technical, knowledge and human capacity rather than natural resources. In light of this, without a proper capacity it is also possible to have scarcity within abundancy of resources. While supporting the scarcity argument, Andrews-Speed (2015) offer an alternative explanation that natural resources are not physically scarce but there are indeed economic, political, environmental and equity barriers that can lead to a scarcity of natural resources (Bayramov, 2017).

Government agencies have had a limited role in conservation work over the last four decades, with most of the work being undertaken by NGOs. However, during last 17 years after the collapse of Taliban government there were many initiatives by the government of Afghanistan. The NGOs have worked directly with local communities and "*shuras*", with the focus of activities being livelihood sustenance based on horticulture and agroforestry interventions. While the NGO contribution has been large, there has been little coordination of the program and limited any evaluation (Kelly, 2002).

Disturbance or collapse of the natural resource management systems, especially traditional management institutions and increase in demand due to rapid population growth and illegal trading of products from natural resources have also contributed to depletion in natural resources. Local communities have lost control of their resources; disintegration of indigenous systems and institutions for natural resource management during the last four decades resulted from the decline of the management system. This is mainly due to unclear resource ownership. For example, traditionally forest resources were owned communally; as the demand for commercial timber increased community members sold their rights to timber traders or local commanders owned these resources.

At the same time insecurity and armed conflict affected a large part of the country, leading to significant protection concerns, and large scale displacement in villages that resulted to institutions weakness, their engagement and supervision of natural resources and ultimately affected resource degradation. Rapid urbanization can put pressure on water, natural resources, energy and food resources, and lead to instability. An assessment in major cities of Afghanistan shows that unplanned urban expansion in cities is emerging as a critical challenge for the populations and environment of the country. This assessment (Malekiar, 2017 a) revealed that urban expansion reached in Kabul at 83%, Mazar-e Sharif at 67%, Herat at 45%, Pole Khumri at 97%, Kandahar at 64%, Jalal Abad at 82% and Faizabad at 93% of the total area of these cities.

In summary the following factors affecting wild MAP resources in Afghanistan:

1.5.2.1. Demand for fuel wood

Fuel shortage is a critical issue in rural Afghanistan. More than 60 % of Afghanistan's population lives in rural areas and have no access to modern forms of energy, such as electricity, gas, and liquid fuels. Most of them depend on traditional energy sources such as fuel wood, cow dung, agricultural crop residue, and kerosene for cooking, heating, and lighting (MAIL, 2017). The increasing demand for energy arising from a growing population has created increasing pressure on traditional rural energy sources, particularly on fuel wood and rangeland shrubs. Because of the long winters and cold climate of the country, Afghan people have to use large amounts of fuel wood for survival. Data from a survey by International Centre for the Integrated Mountain Development (ICIMOD) (2007) indicated that on an average, a rural family requires 800 kg of fuel wood per month in the summer and 1,200 kg in the winter [This also coincides with Don's (2010) figure of 7,000-8,000 kg per year]. Such tremendous pressure on fuel wood has created serious pressure on forests (MAIL, 2017). The demand for fuelwood by communities is estimated to be less damaging than illegal logging, but is nevertheless destructive. According to National Environmental Protection Agency (NEPA) (2003) forest cover in Afghanistan declined steadily over four decades of armed conflict. As it was discussed earlier, it is estimated that between 1978 and 2002 the area under conifer forests in the eastern part of the country was reduced by 50% (Emadi, 2003).

According to Freitag (1970, 1972) the massive forests (without the inclusion of pine forests) estimated around 5%, or 34,000 km^2 of the territory of Afghanistan (NEPA, 2014). Natural forest cover has decreased by over 50% during that period (MAIL, 2017).

1.5.2.2. Overgrazing

Overusing rangeland through overgrazing in Afghanistan is another threat to natural resources. The animal number in Afghanistan has been fluctuating over the years. However, even at its lowest level, the total number of animals is still very high compared to the total fodder production from the natural rangelands. In 2003, for example, according to FAO (2006), Afghanistan had roughly 43 million sheep Livestock Units (Sheep, not excluding the large number of poultry). If each animal needs 1.5kg dry matter per day, this would require a total fodder supply of at least 23 million tons. This requires an average fodder productivity of around 0.8 tons/ha, which is hardly the case in Afghanistan. As a result, most of the rangelands are overused. The seasonality of fodder supply has further exacerbated the situation (MAIL, 2017).

It should be noted that due to the highly variable annual rainfall in Afghanistan, most of the rangelands in Afghanistan are not in equilibrium, its system dynamics being mainly controlled by climatic factors such as frequent drought or low temperature. In such cases, the usefulness of policies and management measures based on conventional terms such

as “overgrazing”, “degradation” and “carrying capacity” has to be questioned and cautiously applied. However, it also contributes to rampant overgrazing, especially along mountain slopes and rangelands. This both leads to deforestation and further exacerbates the process of land degradation, making natural afforestation more complex (NEPA, 2015a). Overgrazing coupled with frequent droughts has made Afghanistan highly susceptible to desertification (MAIL, 2017).

1.5.2.3. Over-collection of MAPs

Poverty, illegal trades, lack of any monitoring by governmental entities of natural resources and finally the collapse of institutional management increased the demand for wild collection of medicinal plants in most parts of the country. However, current reliance of rural population on medicinal plan as a source of livelihood is unplanned that causes further degradation and depletion of these resources. This leads sometimes to making these resources rare and even endanger some common species of medicinal and aromatic plants like ferula in certain parts of Afghanistan.

Conversion of rangelands into rain-fed farming lands either for fodder production or for other speculative production purposes as communities are attempted ways to mitigate the effects of drought and population pressure in some areas in recent years. This practice has caused a visible decrease in available rangeland area, respectively MAPs resources and is also bringing about serious erosion problems (MAIL, 2017). These activities have resulted in the widespread degradation of both forests and rangeland, flooding, water scarcity, and, in many areas, severe soil degradation.

Furthermore, as it was ascribed in Sec. 1.3 “Medicinal and Aromatic Plants of Afghanistan”, a significant portion of the population in remote areas of the country and even in the cities are involved in collection and production of medicinal plants ingredients. Security deterioration, unemployment and lack of social security, foster reliance on the natural resources and wild collection in the country. Moreover, over-collection pushed by market demand and lack of management initiatives lead to the depletion of these resources.

1.5.2.4. Illegal logging

Illegal logging is largely a function of the current security situation and control of local resources by local commanders in collaboration with Pakistani traders. The lack of a legal framework clarifying tenure, user rights, and oversight responsibilities, combined with the collapse of government institutions, has led to the control of resource rents by local elites. Local communities, with the help of NGOs, have attempted to protect forests, but local leaders have disrupted these efforts, leading to the destruction of physical barriers, such as fencing, and the disintegration of social organizations (Kelly et al., 2002). Hunting and trapping of large mammals and birds also is still rampant despite efforts of the government and improved capacities of local communities. Wildlife suffered during the war years. Waterfowl is still hunted during the winter months and

even sports hunting of large mammals continues by the elite. Local people also continue to hunt as and when the opportunity arises. However, large mammals are so rare to find that many avid hunters have given up. The fur trade is still thriving in Kabul, Mazar-e-Sharif and other places (MAIL, 2017). This practice seems to be destructive for the natural resource of the country.

As the forests disappear, so do other plants and animals, including many endangered species. This loss affects food security, resilience to natural disasters, energy security and access to clean water and raw materials. It is particularly devastating for the 80% of Afghans who live in rural areas and rely on natural resources to make a living.

The Afghan government had an ambitious plan to increase the proportion of forest from more than 2.5% to 10% by 2017. However, institutions lack the resources, outreach and staff capacity to enforce anti-logging legislation in most parts of the country. Illegal logging, combined with limited understanding of the value of biodiversity, remains the most immediate threat to forests and the livelihoods of those who depend on them.

1.5.2.5. Agriculture and food security

Average predicted increases in temperature in Afghanistan will be between 2°C and 6.2°C by 2090s dependent on global emissions scenarios resulting in drier conditions (Savage et al., 2009). Farmers in the northern and western river basins where more than 60% of land is rain fed will be seriously impacted. Agricultural productivity and choice of crops will be further affected by increased soil loss, reduced river flow and less frequent rain during peak cultivation seasons. Drought will lead to a decrease in livestock numbers. It is predicted that the number may be reduced by 50% as a result of outward migration and starvation due the lack of animal feed and overall lower budgets for animal husbandry. Forecasts indicate that by 2060 the agricultural economy will become marginal unless there is substantial investment in water management and irrigation (MAIL, 2017).

Warmer winters in Afghanistan will result in reduced snow cover and subsequently less water for the growing season for forests and agriculture, leading to their drought-induced decline. Biodiversity will be negatively impacted by a combination of factors that include climate change with deforestation, land use changes, habitat degradation and fragmentation. However, more in-depth studies are required to look at how climate change in Afghanistan will impact species composition and population.

1.5.2.6. Poppy cultivation

The production of opium in Afghanistan is considered another socioeconomic factor pressuring natural resources of the country. Expansion of agricultural land and collapse of the sustainable supply chain in production of natural ingredients are among pertaining factors. Opium production surged during last years in part due to a new genetically modified poppy seed introduced from China in 2015. Particularly, the production soared

in 2017 and according to "Afghanistan Opium survey 2017" released by the United Nations office on Drugs and Crime (UNODC), there is no single reason for the massive 2017 increase in opium poppy cultivation in Afghanistan. The multiple drivers are complex and geographically diverse, as many elements continue to influence farmers' decision regarding opium poppy cultivation. Rule of law-related challenges, such as political instability, lack of government control and security have been found to be main drivers of illicit cultivation (UNODC a, 2018).

Socio-economic factors also impact farmers' decision, for example scarce employment opportunity, lack of quality education and limited access to markets and financial services continue to contribute to the vulnerability of farmers towards opium poppy cultivation.

A combination of events may have exacerbated some of these elements and may have led to the large increase in 2017. The shift in strategy by the Afghan government - focusing its efforts against anti-government elements (AGE) in densely populated areas may have made the rural population more vulnerable to the influence of AGE.

Political instability and increased insecurity particularly affected the northern region, where opium poppy cultivation expanded drastically over the last couple of years. Increased poverty and vulnerability towards external shocks, in combination with the economic down-turn after the withdrawal of the international troops, may have caused many farmers to resort to opium poppy cultivation to sustain their livelihoods (UNODC a, 2018).

Opium poppy cultivation soared by an estimated 63% in 2017, increasing by 127,000 hectares from 2016's already high level to an unprecedented 328,000 hectares. This blows away all previous cultivation records, exceeding the previous record (in 2014) by an astonishing 46%, and coming in at more than three and a half times the peak level of poppy cultivation in the 1990s when the Taliban regime was in charge of the country. In fact, just the increase in cultivation in 2017 exceeds total poppy cultivation in Afghanistan in all years prior to 2004 and, indeed, in the majority of all years since 1995. Half of the total increase in national poppy cultivation occurred in Helmand province, which remains far and away the country's largest opium producer, now accounting for 44% of the national total. Five other provinces (Kandahar, Badghis, Faryab, Uruzgan, and Nangarhar) account for most of the rest. Opium production became more widespread in 2017, encompassing 24 of Afghanistan's 34 provinces compared to 21 the previous year, and some smaller producers such as Jawzjan, Herat, Dai Kundi, and Ghor provinces saw their cultivation up by several hundred percent (UNODC b, 2017).

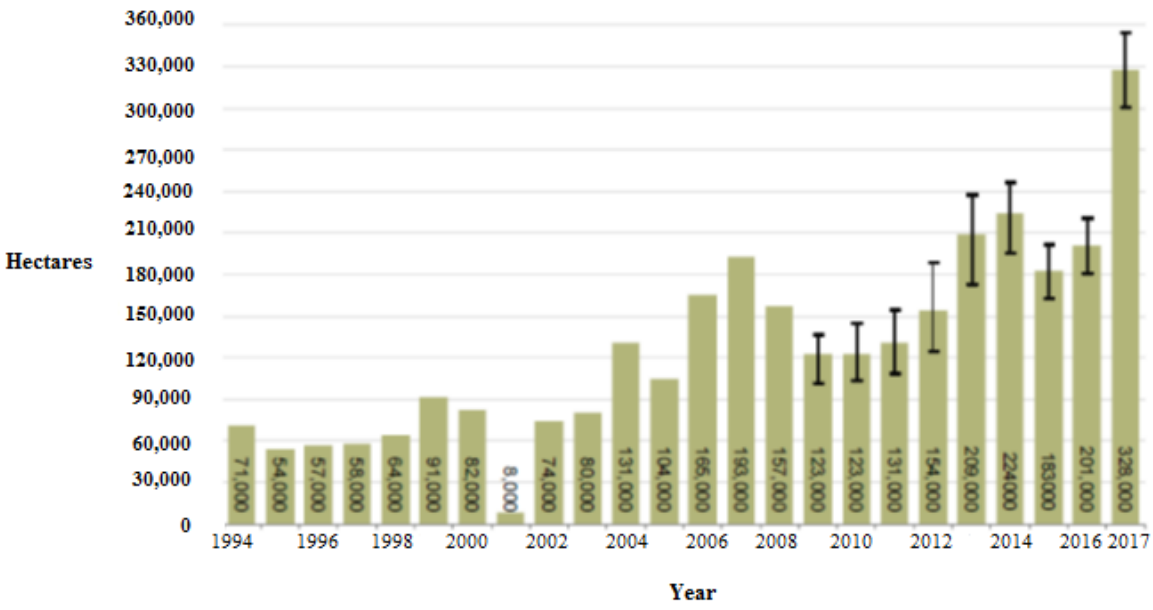


Figure 1.22: Opium poppy cultivation in Afghanistan 1994-2017 (hectares) (UNODC b, 2018)

Indeed, the production of opium poppy and illicit trafficking of opiates further support instability, insurgency and increase funding to terrorist groups in Afghanistan.

1.5.2.7. Climate Change

The change in weather pattern distributed over the globe since some decades became an alarming risk for human being and all biodiversity. According to the Intergovernmental Panel on Climate Change (IPCC) fifth assessment report (2013), global mean surface temperatures have risen by 0.84 C since 1880, which have substantial ecological, economic and societal impacts (YOU Qing-Long, 2017). Afghanistan is already prone to natural hazards, and the effects of climate change will worsen the situation through declining mean precipitation and more frequent extreme rainfall and high temperature events. Natural hazards such as earthquakes, floods, droughts, avalanches, and landslides affect thousands of Afghans every year and have a disproportionate impact on the poor, who often live in disaster-prone areas (ADB, 2017 b).

Climate change data for Afghanistan remain scarce. Moreover, large parts the historical data sets were lost during the political chaos in the country. However, according to climatic norms used by the World Meteorological Organization (WMO), since 1960 the mean annual temperature has increased by 0.6°C and by 0.13°C on average per decade (Savage et al., 2009).

Historic norms and analysis of available data from surrounding countries indicates a trend of increasing mean temperatures, an increase in the number of hot days, and a reduction in cold night temperatures. Mean rainfall over Afghanistan has decreased slightly (at an average rate of 0.5 mm per month (or 2% per decade) since 1960. This is mainly due to decreases of around 2.7 mm per month (6.6% per decade) in spring rainfall,

but is offset by small increases in summer and autumn. Current models indicate significant warming across all regions of Afghanistan. These increases are consistent with the broad regional observed temperature trends in Central Asia. By 2030s, mean annual temperatures are likely to rise by about 1.4°C compared to long-term averages with little change in overall precipitation. By the 2090s, increases in average temperature are likely to be between 2-6°C dependent upon global emissions scenarios. Conditions will become drier, specifically in spring (March, April and May) with reductions in rainfall of between 10- 40 mm and drier conditions in the south (Savage et al., 2009).

In the 2030s, rainfall is projected to increase over much of Afghanistan though by little more than about 10-20 mm. The increase is largest in the far northeast (20-50mm) and results from increases in spring and winter. Mean annual rainfall changes in the 2090s show conditions are generally drier depending on emissions scenario (-40 mm high, -20 mm medium, -10 mm low) over much of Afghanistan. Much of the drying is due to change in spring with decreases arising largely due to reductions in the wet season rainfalls. Autumn is projected to be slightly wetter, especially in the north (Savage et al., 2009).

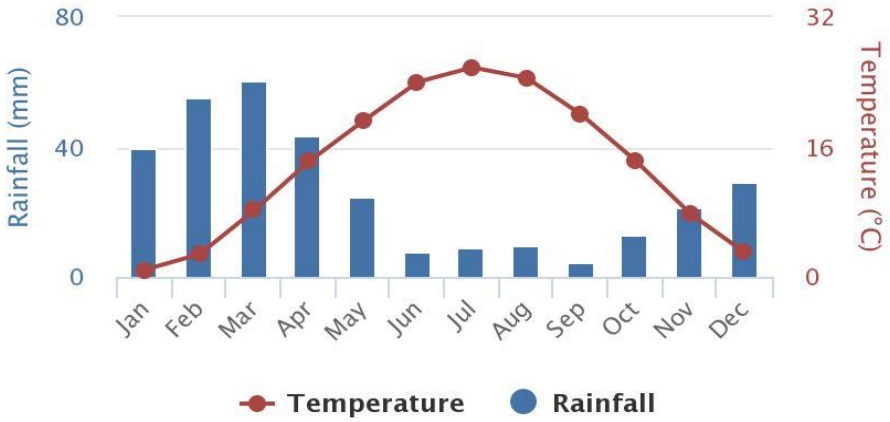


Figure 1.23: Monthly average of temperature and rainfall values in Afghanistan during 1991-2015 (World Bank, 2016).

In South Asia the food, water, and energy nexus has a strong regional dimension, with upstream actions often having downstream effects (Rasul, 2014). The Hindu Kush Himalayan (HKH) region encompassing more than 4.3 million km^2 area includes areas of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan, as well as comprises of many of the Earth's highest mountains and most extensive basins, including the Tianshan Mountains, Himalayas, Pamir, Hengduan Mountains, and Changtang Plateau, and is one of the greatest mountain systems in the world. These mountains in the HKH region are often referred to as the water towers of Asia and many high-altitude regions store water as snow and/or glacier, forming a region of perplexing hydroclimate changes. Ten major river basins originating from the HKH are Yangtze, Yellow, Mekong, Salween, Irrawaddy, Brahmaputra, Gangers, Tarim, Indus, and Amu

Darya Rivers, respectively. Consequently, water availability in these river basins has a huge influence on the livelihood of great human population on this planet (YOU Qing-Long, 2017).

According to Mukhopadhyay (2012) and Prasad et al. (2009) in recent years, the glaciers and snowfields of the HKH region are found to be the fastest receding glacier and snow covers in the world. The impacts of climate change on water availability in these river basins have huge influences on the livelihood of large numbers of populations, especially in downstream regions. The HKH experienced an overall rapid warming during the global warming period and the warming hiatus period, which further influenced the climate extremes and hydrological cycles in the regions (YOU Qing-Long, 2017).

Climate warming and ununiformed precipitation patterns across the HKH region have an important influence on water resources and food security for the downstream population (Rasul, 2014). Elevated temperature will cause glacier to shrink, leading to increase in melt water caused by subsequent decline with reduced glacier mass. Increased uncertainties in surrounding precipitation and socioeconomic changes limit any conclusive assessment of how water availability will be affected (YOU Qing-Long, 2017).

Projections by other climate change models highlight water resources, forestry and rangeland, agricultural production, biodiversity, and health as sectors most likely to be adversely affected by climate change in Afghanistan. Persistent drought is projected to 2030 as the norm rather than a temporary or cyclical event. Unseasonal rainfall increases the risk of floods while the general increase in temperature increases the risk of more rapid spring snow melt. The combined impact of these two factors is likely to be land degradation, loss of vegetative cover, land mismanagement, floods and landslides resulting in large scale human loss of life as was the case in Badakhshan in spring of 2014, and damage to infrastructure (Parto & Mihran, 2014). As Figure below indicates, all sectors relying on water availability will face significant challenges over the coming decades as a result of climate change. Since Afghanistan's economy is highly dependent on agriculture, prolonged pressures as a result of water shortages will have substantial adverse impacts on the country in general and on the rural communities in particular.

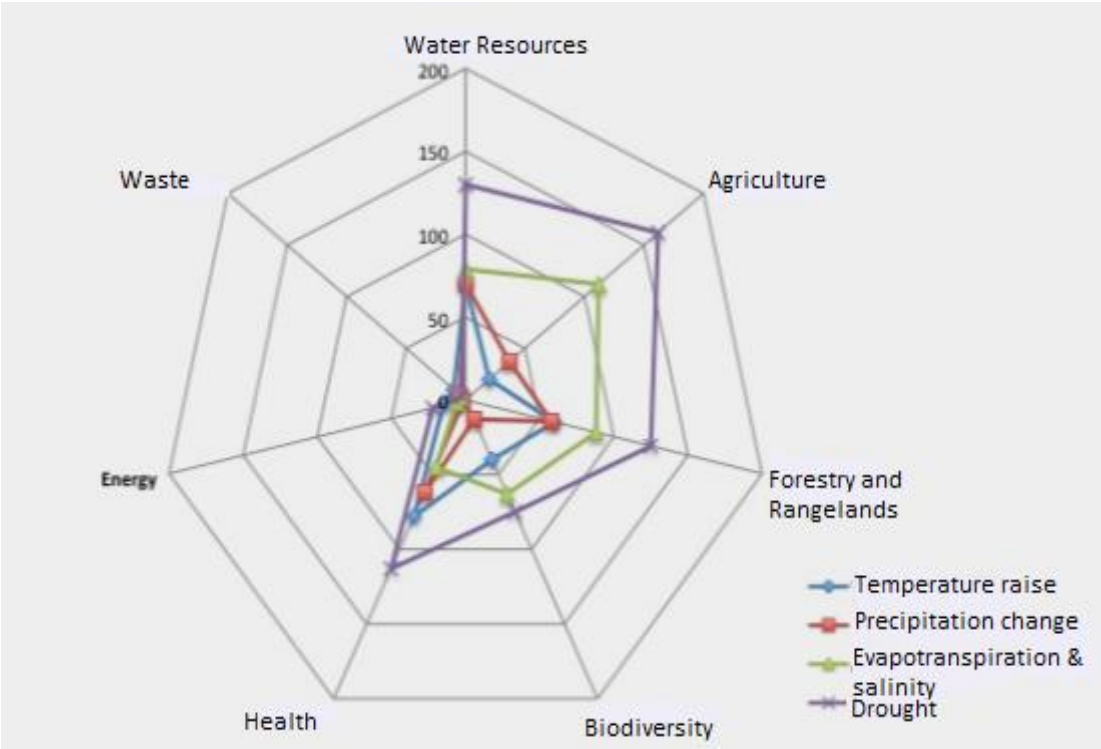


Figure 1.24: Sector vulnerability in Afghanistan to climate change (Based on source data from NCSA/NAPA by NEPA et al., 2009; Parto & Mihran, 2014).

It is now quite obvious that Afghanistan is indeed subject to serious climate change, and is clearly suffering from the early consequences of global warming. UNEP (2014) also has noted that Afghanistan has been identified as one of the most vulnerable countries in the world to climate change. The persistent droughts and floods in Afghanistan that have resulted from serious land degradation and outright desertification (Shroder, 2012) ultimately increase the burden of poverty, disease, and mass-population displacement. The incidence and intensity of these disasters are seen to increase as climate change deteriorates further.

Despite the isolation of rural communities in Afghanistan, environmental issues are not just a matter of local concern. Afghanistan plays a critical role on the global political stage, especially given the existence of nearby borders with China, Pakistan, India and Tajikistan. This is a volatile region and cultural dissolution can have regional and even global repercussions. If environmental conditions continue to degrade, people will no longer be able to carve a living out of the fragile steppe, desert, and mountains as they have for centuries. The increasing effects of drought in Afghanistan will obviously threaten the water supplies of entire communities in the country and thereby lead to a greater range of humanitarian crises, including population displacement, disease, and violent conflict. The lack of water availability will force Afghanistan and surrounding states to try to claim the greatest shares of the total regional water supply, which will further add to regional violence (Savage et al., 2008). Each year in Afghanistan, the condition of the vegetation and the agriculture is the result of available water.

Droughts in Afghanistan, as with most other drought-affected parts of the world, have three distinguishing features: (1) intensity; (2) duration, and (3) spatial extent. Such data are difficult to obtain in a country with few observation or monitoring stations or cognizant meteorological personnel. The four most severe droughts occurred in 1998–2003, 2006, 2008, 2011 and 2018. These droughts affected some 2,580,000, 1,900,000, and 1,750,000 people, respectively. According to United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) (2012) the 2011 drought resulted in nutritional problems for roughly 2.6 million people, which included 210,350 pregnant and lactating women, and 523,876 children less than 5 years of age. Of those children who were the most affected, 73,622 were projected to be acutely malnourished and 25,242 were judged to be "severely acutely malnourished" (Shroder & Ahamdzai, 2016).

It is obvious that the country needs to establish an appropriate system of the monitoring and data collection on climate.

1.5.3. Conservation measures

Management and conservation of Afghanistan biodiversity is a vital question for the country. These tasks require time and collaborative plans of action by the Afghanistan government and the public. Afghanistan has suffered from health hazards and huge economic losses as a result of deforestation, food insecurity, poverty, environmental problems, and pollution. Restoring and enhancing biodiversity is the responsibility of the Afghanistan government and its people.

Climate change poses a threat to Afghanistan's natural resources, of which the majority of Afghans depend for their livelihoods. Therefore the country has a crucial need to promote and strengthen adaptation strategies that aim at improving water management and use efficiency; improved agricultural practices and research; rangeland management; development of a disaster management strategy; development and research into climate and early warning systems; improved food security; and diversification of livelihoods (World bank, 2016).

The Government of Afghanistan has recognized these dire predictions and has attempted to respond as best it can in whatever limited ways would seem to make the most sense: (1) ratifying the Kyoto protocol that will require drawing up plans to develop low carbon energy footprints in transport and industry; (2) improved water management and use efficiency; (3) community-based watershed management; (4) improved terracing, agroforestry, and agro-silvo pastoral systems; (5) climate-related research and early-warning systems; (6) improved food security; and (7) better rangeland management. Education about the need for these factors, and the development of vocational skills for communities are also a focus of the attempts by Government to respond in a logical fashion to these newly recognized climate threats (Shroder, 2014).

For decades, some biological areas have been protected in Afghanistan and benefited from some level of official management to protect significant biodiversity values. In the

1970's some sites were declared national parks, sanctuaries or reserves, and some were even gazette for formal legal protection and management. This includes areas of global significance such as Band-e-Amir and the Wakhan Corridor. During the past 30 years others areas and sites have been proposed for legal designation, protection and management of outstanding biological values (Shroder, 2014).

The biological and ecological values of all these areas have suffered from civil conflict, war, environmental abuse, and drought that have occurred in Afghanistan since 1979. Some, such as the Ajar Valley Wildlife Reserve, were once of global significance for wildlife resources, but have now been degraded to a shadow of what natural resources once existed. The legal status of all protected areas is currently in question, pending passage of protected areas regulations under the Environment Law (ANDS, 2008). Even though the protected areas regulations and management plans are currently under development, no management is taking place to protect and conserve their ecological integrity and wildlife until the regulations and management plans are finalized.

Despite frequent natural disasters and the impact of climate change, Afghanistan remains a country, rich in natural resources such as over 1.781 million hectares of forest (2.879% of the total surface of the country), over 30.243 million hectares of rangelands (46.97% of the total surface of the country) (FAO, 2016), 75 billion m^3 of fresh water, 515 bird species, 150 mammals, 112 reptiles, 8 amphibians, 139 fish, 245 butterflies, around 5,000 vascular plant species, between 600 – 1200 endemic plant species. Natural resources have a significant economic, social and cultural value. 80% Afghans depend directly on natural resources to meet their livelihood requirements (UNEP 2009c). The biological resources and the ecological processes in Afghanistan are crucial for survival of local people. Barring the most arid deserts and frozen mountains, virtually every other ecosystem in the country has been used from time immemorial, be it for farming, livestock grazing, fuel wood and medicinal plant collection or hunting (UNEP, 2003).

Conservation efforts in Afghanistan go back to the 1960s and 1970s when international conservation organizations, with the encouragement of the Afghan government, conducted countrywide surveys of wildlife. This resulted in a proposal by the Food and Agriculture Organization (FAO) that 14 locations across Afghanistan should be designated as protected areas. Four of these lay within snow leopard range in north-eastern Afghanistan. However, in the aftermath of the 1979 Soviet invasion, and the protracted period of conflict that followed, these recommendations remained unrealized. It was not until the collapse of the Taliban regime in 2001 that conservation efforts were resumed. Consequently sustained and coherent snow leopard conservation interventions are a relatively new phenomenon in Afghanistan (Moheb & Paley, 2016).

Revival and conservation of ecosystems, related services and relevant traditional knowledge are critical for the survival of local communities and overall development of the country. Securing the resource base plays the dual purpose of mitigating impacts from climate change while enhancing the adaptive capacity and climate change resilience of

the country's population and strengthening natural resource-based livelihoods (MAIL, 2017).

One of the major uncertainties is the climatic and hydrological status due to scarce data in the country. Therefore, it is necessary to have comprehensive studies of hydro-meteorological process in the country because climate change and hydrological cycle might have induced natural disaster and hazards not only within the country, but in this region as well.

These issues need to be addressed within a policy framework for rural energy needs that incorporates provisions for community or social forestry programs.

Traditional coping and mitigation strategies have broken down under growing population pressures, the collapse of the rural economy, and control by local elites. These strategies must be rebuilt within the context of the community development approach and effective natural resource management. In the future, vulnerability to drought must be significantly reduced by incorporating a range of technologies and by strengthening off-farm income-generating activities. Any tendency to misuse natural resources must be countered by appropriate environmental management institutions backed by legislation (Kelly et al., 2002). At present, no agency in Afghanistan has overall responsibility for the protection of its natural resources

Natural resource management and conservation of biological diversity is a critical component of reconstruction and development in Afghanistan. There are certain attempts especially in term of developing some documents and principles to conserve biodiversity and its natural resources during last years since new governments in Afghanistan, however, the developed documents are not mainstreamed into the planning and activities of relevant sectors in the country adequately.

At present, responsibility for managing and regulating biological diversity resources is shared between the two agencies: the National Environmental Protection Agency (NEPA) and the MAIL (NEPA, 2014). Both governmental offices are active at the provincial and central level. Together with other international organizations, the Wild Conservation Society (WCS), UNEP and ICIMOD play some role in biological diversity assessment and conservation of natural resources. However, financial and human resources capacity are relatively low for the effective conservation of biological diversity and its adjustment.

One of the achievements in the conservation of biodiversity is the approval of National Biodiversity Strategy and Action Plan (NBSAP) of Afghanistan 2014-2017, which has been prepared by NEPA and aimed at protecting all aspects of Afghanistan's biodiversity.

The NBSAP is the principal instruments for implementing the Convention on Biological Diversity at the national level. This document targets different aspects of the biodiversity including to continue ongoing assessment of animal and plant communities (Fauna and

Flora) to better understand the biodiversity of the country and their conservation requirements, to expand the protected areas particularly, areas that are of prime importance to conservation or natural heritage, to prevent illegal and unsustainable use of biological diversity sources, to develop and implement mechanisms to ensure sustainable use of biodiversity resources, including funding, capacity and policy considerations, designing and implementing mechanisms to prevent the destruction of ecosystems by invading invasive alien species and control of the adverse effects of climate change, desertification and pollution on biodiversity and its resources (NEPA, 2014). This document has been quite well developed and attached a short action plan foreseeing pragmatic measures and actions.

The National Natural Resource Management Strategy (2017-2021) is another documents developed by MAIL recently. This document tracks four strategic objectives (MAIL, 2017):

1. Community-based forest management that includes conservation, restoration, reforestation, afforestation, sustainable utilization & local-based value addition, and watersheds improvement for resilient, climate adapted and sustainable economy of rural and pre-urban communities.

2. Community based management of rangeland and medicinal plants through strengthening community-based interventions, introducing of good practices, and up-scaling indigenous knowledge, for a better livelihood of local and herder communities, desertification control and subsequently combat negative impacts of climate change.

3. Co-management and conservation of protected areas to protect biodiversity, promote ecotourism and increase resilience to climate change.

4. Institutional and human capacity development to build an enabling environment for meeting expected outcome of this strategy.

The National Comprehensive Agriculture Development Priority Program 2016 – 2021 is another strategic framework for agriculture sector development and reform developed by the MAIL. This framework covers key institutional and sectoral priorities for the MAIL in the areas of improved service delivery, food security, and greater productivity to enhance national revenue. The specific redirection of priorities is in the following sectors in the form of seven Strategic Priorities (MAIL, 2016): (1) Irrigation; (2) Wheat and cereal production; (3) Horticulture value-chain; (4) Livestock Production; (5) Climate-sensitive Natural Resources Management; (6) Food and Nutrition Security and Resilience building; and (7) Institutional reform and capacity development.

The aforementioned documents have been approved by the MAIL and it is hoped to be mainstreamed in planning and activities in all pertaining aspects of natural resources of the country.

In this research it is attempt to shad lights to Herat and the research study will be focused on this province. The modality and the details of the methodology for selecting Herat are ascribed in the Sec. 3 “Materials and Methods”.

1.6. Brief introduction of Herat

Herat was the cradle of Afghanistan’s history and civilization. Herat, dating back to five thousand years, has been at the crossroads of world trade and travel. The ancient Silk Road from Rome to China passed through this area (Dietl, 2004). Herat is one of the largest provinces in Afghanistan in terms of population. It is located in the western region of the country and is bordered by Badghis in the north east, Ghor in the east, and Farah in the south. Herat also shares international borders with Iran in the west and Turkmenistan in the north, making it an important trading province. The province lies at coordinates 34.39 N, 62.21 E and at a distance of 640 km from country’s capital, Kabul (CSO, 2017 b).

Figure 1.25: Map of Herat in Afghanistan (Babury, 2018).

Herat is situated at an elevation of 920 m above sea level and covers a land area of 55,869 km^2, representing 8.56% of the total Afghan territory (CSO, 2017 b).

In Avesta, as the oldest written text of the ancient times in Persian (Farsi), Herat implies its historic date. Herat, according to historians, in all ages and centuries, as the heart of Khorasan is the key to Asia and the Gate of Afghanistan and even the Indian subcontinent. This city has been of prime importance all along the history and before the attack of the Genghis Khan of Mongol, it was considered the center of the civilization. (Mujtabavi, 2010). As Bosworth (2007) indicates, in post-Mangol time it had a great florescence as a cultural and artistic center under the Timurids. In the late seventh and early sixth centuries BC, the land of Haraiva fell to the Medes and then was one of the Achaemenid Satraps (provinces). During the Sassanid period, Herat has been one of the major military and border areas in the struggle against Haftalians (Hepatalians). In the era of Arabs, in the middle ages, Herat, along with Neyshabur, Marw and Balkh, was one

of the four parts of the state of Khorasan (Mujtabavi, 2010). From the mid-19th century onwards, Herat was a point of dispute between the rulers in Persia and the Amirs of Afghanistan, the latter, from the middle years of the 19th century backed by the British, who were anxious to protect India from possible threats posed by the Russian advance into Central Asia.

It has a long history of rebuilding and restoration. Herat was destroyed twice by the Mongols, in the 1221 A.D. and 1338 A.D. and then was rehabilitated as the capital of Central Asia's Timurid Empire in the fifteenth century. Herat's long list of conquerors and occupants had much to do with its desirable position along the Silk Road between Europe and Asia.

From the mid-19th century onwards, Herat was a point of dispute between the rulers in Persia and the Amirs of Afghanistan, the latter, from the middle years of the 19th century backed by the British, who were anxious to protect India from possible threats posed by the Russian advance into Central Asia (Bosworth, 2007).

Herat became a developed center during the Timurid era, and the fifteenth century was the golden age of Herat. For Herat, during this period, was renowned as "Florence Asia" for the sake of educating its painters, architects and musicians. At that time, mosques and beautiful palaces were built which until this time was the centerpiece of this city.

Figure 1.26: View from "Qalae Ikhtyaruddin", the Citadel of Herat (by Khaama Press NA).

Among them, the martyrs of Herat and the school, and the mosque with twelve minarets around them, are more significant. From this collection, which was built on the orders of Queen Goharshad, now only five minarets are left. In contemporary Afghanistan's history, Herat suffered from domestic tyranny, extortion, fanaticism and foreign aggression more than other parts of the country (HPO, 2015).

Its two hundred square miles of irrigated farmland in a valley rimmed by mountains was considered to have the richest soil in Central Asia. Agriculture and trade ensured an affluent economy and generated art and architecture; culture and literature (Dietl, 2004).

Herat has been under the umbrella of United Nations Educational, Scientific and Cultural Organization (UNESCO) since 1974, and it is supposed to be as one of the ancient cities of the world, on the World Heritage List (HPO, 2015).

Herat province's economy is now relying on agriculture, livestock and industrial production. The main products of this province are fruits and varieties of vegetables, rice, barley, juice, cotton, saffron, silkworm and silk production, which is higher than other provinces. Herat is famous for the cultivation and production of saffron, grapes, pistachios, cashmere, wool (CSO, 2017) and many other natural products. Of the 15 districts, Kushk-e-Robat Sangi was the most productive in Herat, contributing 18.23% of the Herat's agriculture production. Pashtun Zarghoon followed with 10.64%. Obe district come first in terms of fruit production (2 thousand MT) in 2008 (USAID, 2008).

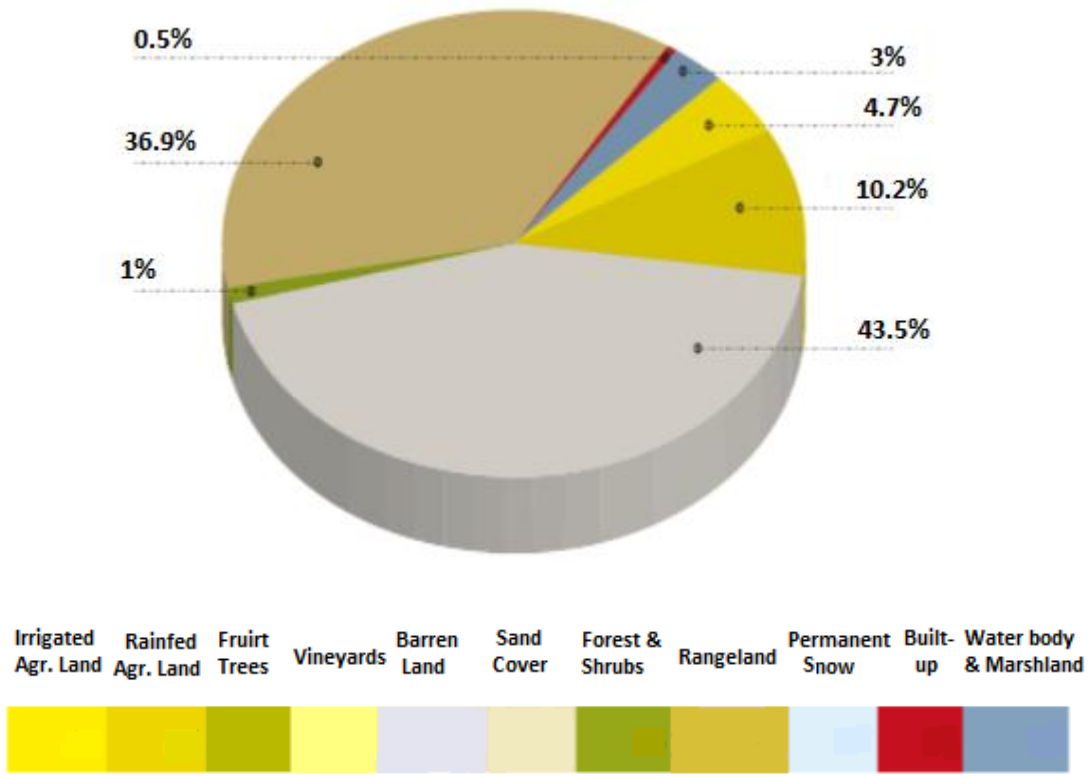


Figure 1.27: Land cover of Herat (FAO, 2016).

The land cover of Herat province demonstrates that 43% of the territory of this province occupied by barren lands and almost 37% made by rangeland. The irrigated and rain-fed areas make respectively 4.7% and 10.2% of the land cover (FAO, 2016). The details of the areas and respective percentages are illustrated and listed in below figure and table.

Its capital is Herat City and the 15 districts are Injil, Guzara, Pashtun Zarghun, Karrukh, Kushk (Rubat-E-Sangi), Gulran, Kohsan, Ghoryan, Zendajan, Adraskan, Shindand, Fersi, Obe, Chisht-E-Sharif and Kushk-E-Kuhna (See Fig.1.28). In a socio-demographic and economic survey conducted in 2016, among the districts/city in the province, Herat City, the Provincial Center, had the largest share of the population in the province, comprising 40.1% of the total population, followed by Enjil making up 11.1%. Chisht-E-Sharif had the lowest proportion of the total population with 1.5% followed by Zendajan with 2.4% (CSO, 2017 b).

Figure 1.28: Herat districts map (FAO, 2016).

In the irrigated and rain-fed areas cereal crops like wheat, barley and rice are produced. During last 20 years, rice cultivation area has decreased significantly due to scarcity of water. Leguminous crops like pea, bean, mong and mash are cultivated in irrigated land some time as a second crop. Oil seed crops like sesame is also cultivated on both rain-fed and irrigated land. In past cotton was also a major crop providing cotton for textile industries and cotton seed for oil industry (MRRD, 2007).

Herat with its ancient history, is the cradle of various scholars, including Abu Mansoor Moaffaq Herawi (a prominent pharmacognosics), Imam Fakhre Razi, Maulana Abdurrahman Jami, Khaje Abdullah Ansari, Imam Shishnoor and dozens of prominent scientific and philosophical figures.

Table 1.10: Land cover statistics of Herat (FAO, 2016).

#	District	Irrigated agr. land	Rain-fed agr. land	Fruit tree	Vine yard	Barren land	Sand cover	Forest & shrubs	Rangeland	Perma -nent snow	Built up	Water body & marsh-land	Total land
1	Adraskan	16,092	7,802	46	4	659,078	0	7,312	281,852	0	522	25,685	998,393
2	Chisht-e-Sharif	4,105	4,786	622	37	17,303	0	7,769	231,976	0	279	1,759	250,637
3	Farsi	7,180	9,882	19	0	22,287	0	2,200	161,799	0	155	497	204,018
4	Ghoryan	22,509	54,932	13	565	421,528	0	0	184,574	0	1,640	50,196	735,958
5	Gulran	1,703	153,925	15	68	233,931	1,803	2,427	202,267	0	1,580	12,596	610,316
6	Guzara	35,133	15,193	61	3,286	134,112	0	0	69,775	0	2,867	5,260	265,687
7	Herat	1,568	0	67	231	1,994	0	0	1,088	0	3,170	231	8,332
8	Injil	36,112	8,672	117	1,401	36,856	0	0	46,228	0	4,019	5,858	139,262
9	Karukh	19,630	21,712	62	130	31,903	0	3,118	114,600	0	682	7,618	199,454
10	Kohsan	12,146	12,037	2	15	144,343	0	0	43,524	0	951	9,859	222,876
11	Kushke RS	4,151	161,919	46	23	21,044	1,099	14	94,683	0	1,948	3,629	288,555
12	Kushke-e-Kohna	1,511	56,140	25	2	2,585	0	20,082	83,730	0	509	1,621	166,103
13	Obe	13,564	20,844	345	716	24,004	0	7,872	189,340	0	841	4,813	262,339
14	Pashtun Zarghun	27,299	12,680	237	551	52,753	0	1,431	84,051	0	972	9,831	189,803
15	Shindand	39,238	0	30	268	482,915	0	1,371	154,519	0	3,816	17,423	699,579
16	Zindajan	18,035	18,617	10	264	103,385	0	0	102,525	0	859	8,778	252,473
17	Total (ha)	29,975	559,141	1,717	7,561	2,390,020	2,903	53,595	2,028,430	0	24,808	165,637	5,493,787
18	Total (%)	4.7	10.2	0.0	0.1	43.5	0.1	1.0	36.9	0.0	0.5	3.0	100

Herat is the hub for business activities mainly due to its accessibility to Iran and Turkmenistan as both the countries has borders with the province. A lot of import and export is going on between Herat and these two countries. Handicraft, carpets and rugs production business is also a major activity in the province. The textile, silk, oil and cements factories exist in the provincial center but are not fully operation and has the potential to be revitalized for economic regeneration. Other small businesses like shops, workshops and IT industry is also growing in the provincial center.

Traditional medicine in Afghanistan is knotted to the history and certain natural and historical opportunities of this province. Many physicians in this province were trained as traditional proficient physicians, including chiropractic healers as prominent regional and national figures. There are many prominent traditional healers ("Tabibe Yunani") in the province, who is, in fact, the successor and heir of the prominent physicians of the past. The existence of diverse medicinal plants and the transformation of the city into a commercial hub of the country have played an important role in the development of traditional medicine in this province.

Nowadays, with its seven universities and other important centers of art, science and education, this province is at the vanguard of the country's cultural, scientific and economic life.

2. Objectives

Afghanistan is known as a resource base for many wild-collected medicinal and aromatic plants that are known in regional and international markets. There is a long tradition of collection and trade in natural ingredients, though they are mostly exported without much value-addition. The local use of wild-collected plants as food, medicine and/or cosmetics is also common. However, the legacy of conflict that has plagued Afghanistan and its people for around 40 years has damaged not only the country's society and institutions, but also its wild vegetation, natural resources, and environment.

The main impacts are the depletion and overuse of natural resources, which exacerbate stressful socio-economic conditions and the impact of natural hazards; reduce access to natural resources; erode the rule of law; lead to the collapse of traditional governance systems and processes; create pollution; result in land mines making essential lands and pastures unsafe to use. Hence, in this study, the following three questions have been identified as problems:

1. What is the status of medicinal plants as natural resources in Afghanistan?
2. What are the socioeconomic, trade, marketing and processing aspects of the wild medicinal plants?
3. Have national policies, laws, and regulations in relation to natural resources and management been developed? If so, do they respond to critical needs or not?

This research has the following two objectives:

1. Resource analysis of potential species of MAP, and
2. Approaches for sustainable resource management of wild medicinal plants.

3. Materials and Methods

The ongoing conflict in Afghanistan has made it nearly impossible for researchers to conduct on the ground fieldwork to find out the status of species such as the selected wild medicinal plants in the field. Therefore, the methodology of this research is descriptive and associational.

In order to achieve the expected objectives, the following steps have been taken in consideration:

1. Review of the export of medicinal plants of the country,
2. Identify the most important and potential items among MAPs and products,
3. Assess the geographic distribution of these items in Afghanistan and identify the geographic area for further study, and
4. Develop appropriate approaches (frameworks) to study the following important dimensions of natural resources of medicinal plants:
    a) Resource assessment of MAPs,

b) Socio-economic dimension of the wild collection,
c) Trade and marketing of medicinal plants and its products, and
d) Technological proficiencies for the processing and standardization of medicinal and aromatic plant products.

3.1. Verification measures

The assessment of different aspects of MAP natural resources using the frameworks emphasizing the obtainment of reliable and realistic information for every framework by a team made of relevant technical people is considered a reliable approach. Nonetheless, to assurance of the reliability of the data provided by 15 teams from 15 districts in Herat, the following measures were set:

1. The data gathering process was supported by a parallel assessment conducted by CRS teams available in 7 out of 15 districts of Herat province. CRS is an international humanitarian agency and began supporting development efforts in Afghanistan in 1998. It focuses on poverty and risk reduction and human development in western and central Afghanistan through the increase and diversify of agricultural livelihood security and improvement in education. Livelihoods programming has emphasized Natural Resource Management (NRM), improved agricultural productivity, and supporting community members to develop business enterprises in rural communities.

2. Appointment of two local focal points from the provincial directorate of MAIL (Head of the Natural Resources Dep., N. Ahmad Amini) and Herat Institute of Agriculture (Lecturer, Gh. Qader Baburi) for instruction, guidance and support to the teams in districts for clarification of any questions and also for the integrity of the data. The two focal points were on regular contact with the fields on semiweekly basis. The way of contact and interactions with the fields optimized by a terms of reference (ToR) agreed in the first workshop in Herat (See App. 8.2- 8.4; report on the expedition for resource assessment of MAPs to Herat, workshop program, list of participants, ToR of focal points and the program of the follow up workshop).

3. The researcher monitored the process of the work by the 15 teams and two focal points within the frameworks on a regular basis and provided required information and guidance during the period of 10 months of work as needed.

3.2. Identification of potential products

The average volume of exports and its respective value shows that some items are predominantly exported during last years (See Tab. 4.1). Data from previous decades also show that certain items are exported traditionally from Afghanistan. The scarcity of data and reliable information about MAPs and their products hampers the assessment of the potential candidates for export.

With a view to rank the main items, the criteria like source of supply, export volume, sustainability and socioeconomic factors have been set. These criteria reflect the important aspects of the herbal product in the country. The calculation of these criteria has been performed based on the information and data available in the literatures (Ministry of Commerce & Industries, 2018; FAO, 2016; Sidiqi, 2014; Breckle et al, 2013; Emadi, 2011; Breckle et al, 2010; Arez, 2007; Younus, et. al 1987). Meanwhile, extensive consultations with experts in agriculture, trades, elders of communities and wholesalers were supportive to finalize the methodology and data particularly in the areas of socioeconomic and sustainability.

With regard to this study a special importance given to two workshops organized in Herat in October 28, 2017 and April 5, 2018. The first workshop organized with the following four objectives:

1. Introduce the concept of sustainable resource management of MAPs
2. Discuss and finalize the screening methodology for the selection of potential MAPs
3. Finalize the draft criteria and approaches for the resource assessment of MAPs
4. Consensus on methodology and timeline of the study

Figure 3.1: Workshop on resource assessment of MAPs in Herat, Oct 28, 2017 (Photo by M Ehsan: 2017).

This workshop conducted by the cooperation of the Directorate of Agriculture, Irrigation and Livestock (DAIL) and Herat University. The main participants of the workshop were

officers of the district offices of agriculture, officials from DAIL, representatives and faculty members of the faculty of Agriculture, Herat University and Herat Institute of Agriculture and MAPs traders.

The program, list of participants and report of the workshop within the report of the expedition to Herat included in appendixes 8.1, 8.2., and 8.3.

The following criteria has been set for the screening of the main exported products:

- **Source of supply:** This criterion demonstrates the diversity and the number of provinces and area that product is supplied by. In fact this criterion is formed by the distribution and abundancy of the species with the consideration of socioeconomic, value chain and sustainable supply chain of the plants. In the same time this criterion define the volume of the supply at the national level.

  Since increased productivity in the agricultural sector and wild natural resources is a fundamental effort to meet domestic and export demand, substitute imports, and potentially promote exports in the short-and medium-term, therefore, it was decided to select this criterion in the screening of the exported plants.

- **Export volume:** The subject of trade particularly in agriculture and natural products is a daily topic in national level in the country. Indeed, this subject has a crucial importance for the reviving economy in war-torn Afghanistan.

  Since 2002 one main focus of the government of Afghanistan has been to address the necessity for increasing export from the country. In spite of all efforts the trade balance in Afghanistan is alarming. In 2016, Afghanistan exported $ 1.2 B and imported $ 9 B, resulting in a negative trade balance of $ 7.81 B (Trading Economics, 2018).

  Afghanistan main exports are: carpets and rugs; dried fruits and medical plans. Many agricultural commodities and especially wild collected plants and their products play an important role in trade balance. Hence, the export of medicinal plants and their products has been selected as a criterion for the screening of the potential items.

- **Sustainability:** The ability of the product to be maintained at related level in supply chain and in export has importance in all aspects particularly in reviving system of economy in Afghanistan. Though, no study and work has been carried out on supply chain of medicinal plants and their product and its sustainability, the experience and information in trade of these product in Afghanistan overall demonstrate a unpleasant picture from the sustainability.

  Sustainable commercial exploitation of medicinal plants in a manner that would maintain and enhance biodiversity in the country is a key question in management of sustainable supply chain of these product. Based on such reality and

consultations with stakeholders it was decided to formulate it as a factor for the screening of the potential items among main exported medicinal plants.

- **Socioeconomic factor:** the social and economic practices and relations that frame the trade and exporting of medicinal plants and their product has crucial importance in screening. The wild collection and marketing of medicinal plants is an important source of livelihood for a some number of households in Afghanistan, who live in rural areas.

  Having realized the complexity of wild collection, processing, trading and not well developed supply chain of these product in context of Afghanistan, the socioeconomic aspect emerges vitally and require to shed light on this factor. Furthermore, long lasting war in the country formed new relations and trends in socioeconomic life of the populations. This context affect the production of natural ingredients. In the same time medicinal plants and natural ingredients in the country contribute in multiple ways to supporting sustainable livelihoods and alleviating poverty.

  Socioeconomic factors are likely vary widely between exported items. Consultations emphasized on the importance of the inclusion of this factor among criteria for screening of the main exported medicinal plants and their products.

Figure 3.2: Workshop on resource assessment of MAPs in Herat, Oct 28, 2017 (Photo by M Ehsan: 2017).

The evaluation criteria for source of supply, sustainability and socioeconomic factor were weighted by score 1-100 according to their relative significance. The export volume has been calculated as the average percent of the products exported during last nine years. The horizontal sum of these four criteria scores yields the total score for each MAP and eventually based on the total score the product were ranked.

Table 3.1: Screening of the main medicinal and aromatic plants of Afghanistan.

#	Plant	Product	Local name	Evaluation criteria				Total score	Rank
				Source of supply	Exp. volume	Sustainability	Socioeconomic		
1	Ocimum sp.	Basil	Raihan	45	0.3	60	20	125.3	23
2	Peganum harmala L.	Harmal seed	Esfand	70	4.3	100	30	204.3	9
3	Carum carvi L. (wild)	caraway	Karabia	40	1.7	100	60	201.7	10
4	Dorema sp.	Oleo-gum-resin	Kandal	50	0.9	70	30	150.9	10
5	Ciser sp.	Langash *	Langash	40	1.0	100	45	186.0	13
6	Cuminum cyminum L.	Cumin	Zeera Safid	45	3.9	100	60	208.9	6
7	Bunium sp.	Black cumin	Zeera sia	65	1.1	100	45	211.1	5
8	Cuminum sp.	Green wild cumin	Zeera sabz	50	2.2	100	60	212.2	4
9	Coriandrum sativum L.	Coriander seed	Gashneez	65	0.5	80	30	175.5	15
10	Cucumis melo L.	Melon seed	Tokhme Kharbuza	55	0.2	100	40	195.2	12
11	Crocus sativus L.	Saffron	Zafran	40	0.0	100	30	170.0	17
12	Sesamum indicum L.	Sesame seed	Kunjed	55	33.3	90	30	208.3	7
13	Sesamum indicum L. Helianthus annus L. Linum usitatissimum L.	Oilseed cake	Kunjara	60	0.4	90	20	170.4	16
14	Papaver somniferum l.	Poppy seed	Khashkhash dana	65	2.0	0	0	67.0	25
15	Ferula sp.	Oleo-gum-resin	Heng surkh	70	1.4	100	70	241.4	3
16	Glycyrrhiza glabrs L.	Licorice	Sherin booia	80	30.1	100	80	290.1	1
17	Ferula sp.	Oleo-gum-resin	Heng safed	80	1.3	100	70	251.3	2
18	Salvia sp.		Gushte Adam	30	0.1	80	35	145.1	22
19	Alkana sp.	Dyer's Alkanet	Yarlang, Rodang	40	0.5	90	55	185.5	14
20	Macrofungi	Mushroom	Semaroq	20	0.0	60	30	110.0	24
21	Carum carvi L. (cultiv.)	Caraway wild	Zere safid	35	1.2	100	60	196.2	11
22	Citrullus vulgaris	Watermelon seed	Tokhme Tarbuz	55	10.6	100	40	205.6	8

23	Medicago sativa L.	Alfalfa	Tokhme Shabdar	40	0.7	80	30	150.7	21
24	Trifolium repens L.	White clover	Tokhme Reshqa	40	1.9	80	30	151.9	19
25	Punica granatum L.	Pomegranate seed	Nafae Anar	35	0.0	90	40	165.0	18

The figures show that the following items ranked as the potentially viable products among the wild collections in the country:

1. *Glycyrrihiza* sp. (Licorice)

The roots and rhizomes of different species of *Glycyrrhiza* sp. or licorice (Sherin Buia, Makh) (See Tab. 3.2) is a valuable plant-product which is used widely in pharmacy and food industries. In Afghanistan it is harvested from wild resources. Licorice have been in the traditional use of Afghanistan for centuries and exported since many decades. According to the information from the Ministry of Industry and Commerce, Licorice is among firsts exported items from Afghanistan since the fifties last century.

According to data from local traders of Licorice, in 2016 (1395) Herat exported around 6500 MT to India and Pakistan (See App. 8.1, Tab 8.4). The share of other smaller neighboring provinces (Badghis and Ghor) who usually trade their products via Herat market as a hub in the region should be considered.

Glycyrrhiza sp. is widely distributed in Afghanistan. It is distributed in all districts of Herat and the wild collection of the root is traditionally common in most of these districts. Another species of the plant including G. *uralensis* Fisch. are found in the country. (Babury & Seddiqi, 2009). Nevertheless, information from the districts indicates that certain factors particularly the low price of the raw material, drought and emergence of saffron cultivation decline the tradition of collection in a longer period of time.

2. *Ferula* sp. (Asa foetida, Heng)

Asa foetida or Heng is the dried latex exuded from the underground organs of different species of *Ferula* sp. The details of the distribution of these species are listed in the Tab.3.2. This plant is not collected in worthwhile capacities in the following districts of Herat:

1. Chisht-e-Sharif
2. Farsi
3. Guzara
4. Injil
5. Obe

The product was known in ancient times in eastern, western, and Mediterranean territories and Afghanistan is considered one of the world supplier of the product. The information from traders indicate that Herat is one of the main supplier of this oleo-gum-resin to India and Pakistan. Meanwhile, information show that large volume of the oleo-

gum-resin from Dorema sp. ("Kundal") also exporting to Iran and two mentioned countries (See App. 8.1, Tab 8.4).

The oleo-gum-resin obtained from the roots of different *Ferula* sp. native to central Asia, particularly Afghanistan and eastern Iran, from where it is exported to the rest of the world. Asa foetida is used in different countries for various purposes. Asa foetida has a characteristic sulfurous odor and a bitter taste. It is used as a flavoring spice in a variety of foods, particularly in India, Nepal, Malaysia and Fiji. In Nepal it is regularly consumed in their daily diets, and it is believed that Asa foetida has aphrodisiac, sedative and diuretic properties. Asa foetida is not only used as a culinary spice but also traditionally used to treat various diseases, including asthma, gastrointestinal disorders, intestinal parasites, etc. This oleo-gum-resin has been known to possess antifungal, anti-diabetic, anti-inflammatory, anti-mutagenic and antiviral activities (Iranshahy and Iranshahi, 2011).

In spite of its history of usage in traditional medicine of India and other country, the product does not have common use in Afghanistan.

The information from traders indicate that Herat in 2016 (1395) exported around 400 MT of this oleo-gum-resin to India and Pakistan. Meanwhile, information show that large volume of the oleo-gum-resin from Dorema sp. ("Kundal") (170 MT) also exported during this year to Iran and two mentioned countries (See App. 8.1, Tab 8.4).

3. *Cuminum* sp. (wild green cumin)

Fructus Cumini (Cumin) in Afghanistan is known as "Zeere Sabz". The product is the seed of different species of *Cuminum* sp. distributed in northern, northwestern and southern provinces of Afghanistan. This product like black cumin is well-known and popular as culinary spice and used in traditional and folk medicines of Afghanistan because the presence of aromatic and other substances in the fruit (cumin seed) of the plant. The product is used as a spasmolytic and for digestion problems including meteorism, diarrhea, and colic. Cumin seed as a spice and flavored agent has a special reputation in culinary of Afghanistan.

Cumin seed has yellow to brownish-gray color and therefore it is known in Afghanistan as "Zeere Sabz" and "Zeere Kuhi".

Cumin is widely used in Ayurvedic medicine for the treatment of dyspepsia, diarrhoea and jaundice. It also has stomachic, diuretic, carminative, emmenogogic and antispasmodic properties (Dhandapani et al., 2002), therefore beside Iran and Pakistan, India is the main detination of this product from Afghanistan. The strong anti-fungal effect of cumin has also been reported (Sekine et al., 2007).

The product wildly collected from northern, north western and western provinces of Afghanistan. According to Afghan Raisin, Fruit, vegetables and Medicinal Plants Export

Promotion Administration, Herat counts as one of the main producers of the cumin in Afghanistan. Furthermore, cumin is among main exported items during last decades from Afghanistan to regional and international markets. *Cuminum sp.* is distributed in most of the districts of Herat, however, the districts of Chisht-e-Sharif, Farsi, and Injil do not have this plant in a meaningful capacities.

According to data provided by local traders in Herat (See App. 8.1, Tab 8.4) in 2016 (1395), Herat exported around 1200 MT to Iran, India, and Pakistan. The share of other smaller neighboring provinces (Badghis and Ghor) who normally trade their products via Herat market as a hub should not be forgotten.

4 *Bunium* sp. (wild black cumin)

Fructus Bunii (black cumin) in Afghanistan produced by different species of *Bunium* sp. and is known as "Zeere Siah" and "Zeere Siah Kuhi". Since the establishment of the genera *Carum* and *Bunium* in 1753, their taxonomic history has been very complicated. Initially, many species of this group were described in *Carum* but later in the critical works of Drude (1898), Korovin (1927), Wolff (1927) and Kljuykov (1988) clearer boundaries between these genera were proposed. One of the most important diagnostic characters of the two genera is the presence or absence of a tuber. All *Bunium* species have spherical or oval tuberiform storage roots while all *Carum* species have non-tuberous taproots (Zakharova, EA et al., 2014).

This product is well-known in traditional medicine and culinary of Afghanistan. Meanwhile, it is one of the important items among exports of MAPs products from Afghanistan. The species are distributed in eastern (Badakhshan), northwestern and western provinces of Afghanistan and it is widely produced in these provinces, but Herat is one of the main producers. Due to increase in market demands of this product, the plant is also cultivated in Herat, Kandahar, Helmand and some other provinces of the country.

Black cumin has been widely used as an additive in food stuff such as in bread cooking, rice and yoghurt for its digestive, carminative, anti-dyspepsia and antispasmodic effects. It has a special place in the traditional medicine of Afghanistan. Anti - fungal effect of this plant has also been reported (Sekine et al., 2007).

According to data from MAP traders in Herat, the province in 2016 (1395) exported black cumin around 2300 MT (See App. 8.1, Tab 8.4).

The plant is widely distributed in different provinces of the country (See Tab. 3.2) and has specific place in culinary and traditional medicine of the country.

Carum carvi L. (Caraway) is the next plant following Bunium sp. in the screening and since the seed of the plant is collected not wildly alone and the main portion of the export made by cultivated product, therefore it was disregarded from the list of the studied plants.

3.3. Geographic distribution of the selected species

As it was mentioned in the literature review, Afghanistan has a diverse vegetation, and it is obvious that the diversity has arisen due to geophysical and geographical diversification. On the other hand, the socioeconomic situation in the country demonstrates profound differences, which undoubtedly affect the status of resources, their use and the sustainability of these resources. As the consequence of unregulated harvesting of these plants and destruction of natural habitats, their resources are undergoing alarming depletion. As a first step towards management of the resources and conservation of biological diversity in the country, an inventory of medicinal plants to assess the quality and quantity of available and commercially viable species is a basic pre-requisite.

Inventory of existing level of medicinal plants distribution and spatial patterns of biodiversity are essential for short as well as long term resource management and developing national strategies. In order to study the status of wildlife resources and to launch a resource assessment of these plants, it is crucial to assess the geographical distribution of the selected items in the country. The use of modern spatial technology and particularly Geographic Information System (GIS) becomes increasingly useful and has a distinct value in such assessment.

It was endeavored to launch a resource assessment by the support of national and international active agencies in Afghanistan (MAIL, FAO and USAID). Nevertheless, unfortunately, the lack of resources and the preparation of these agencies for conducting such an assessment was such that did not provide the basis for carrying out this resource assessment in a sophisticated manner. Thus, based on the available information and references about the geographic distribution of these plants in Afghanistan (information from Afghan Raisin, Fruit, vegetables and Medicinal Plants Export Promotion Administration; Kabul and Herat markets of MAPs, Breckle and Rafiqpoor, 2010; Breckle et al 2013, MAIL, Younus et al. 1987, and CSO), their geographic distribution maps were developed.

The details are set out in the Tab. 3.2.

Table 3.2: Distribution and supply capacity of selected medicinal plants in provinces of Afghanistan

#	Province	Species and supply capacity of the selected medicinal plants							
		***Glycyrrhiza* sp.**		***Ferula* sp.**		***Cuminum* sp.**		***Bunium* sp.**	
		Supply cap	**Species**	**Supply cap**	**Species**	**Supply cap**	**Species**	**Supply cap**	**Species**
1	Khost	-	*G. uralensis* Fisch. ex DC.	-	*F. hedgeana* Pimenov & Kljuykov *F. lehmannii* Boiss. *F. narthex Boiss* *F. ovina (Boiss) Boiss in Boiss.*	X		X	*B. cylindricum* Boiss. & Hohen. *B. kandaharicum* Rech. f. in Rech.
2	Paktia	X	*G. glabra* L. *G. aspera* Pall	X	*F. hedgeana* Pimenov & Kljuykov *F. hindukushensis* Kitam. *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss.				
3	Badaksha n	XX	*G. glabra L.* *G. uralensis* Fisch. ex DC.	X	*F. badra-kema* *F. grigoriewii* B. Fedtsch *F. narthex* Boiss *F. trachyphylla* Rech. f. & Riedl	X		x	*B. badachshanicum* Kamelin. *B. kuhitangi* Nevski *B. lindbergii* Rech.f. & Riedl *B. longipes* Freyn, *B. persicum* (Boiss) B. Fedtsch.

4	Baghlan	X	*G. glabra L.* *G. uralensis* Fisch. ex DC.	XX	*F. hindukushensis* Kitam. *F. hedgeana* Pimenov & Kljuykov *F. kokanica* Regel & Schmalh *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss.	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. cylindricum* Boiss. & Hohen. *B. persicum* (Boiss) B. Fedtsch
5	Bamyan	X	*G. uralensis* Fisch. ex DC.	XX	*F. hedgeana* Pimenov & Kljuykov *F. hindukushensis* Kitam. *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss. *F. stenoloba* Rech. f.	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. chaerophylloides* Regel & Schamalh. *B. persicum* (Boiss) B. Fedtsch
6	Herat	XX	*G. glabra L.* *G triphylia Fisch.& CA Mey*	XX	*F. vulgaris, F. badghisi, F. badra-kema, F. foetida* (Bunge) Regel *F. heratensis* Pimenov & Kljuykov *F. oopoda* Boiss. & Bushe *F. ovina* (Boiss) Boiss in Boiss. *F. racemosa-umbellata (*Gilli) Rech. f. In Rech. *F. schatschurowskiana* Regel.& Schmalh *F. szovitsiana* DC.	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	XX	*B. afghanicum* Beauv. *B. cylindricum* Boiss. & Hohen. *B. intermedium* Korovin *B. lindbergii* Rech.f. & Riedl *B. longipes* Freyn, *B. persicum* (Boiss) B. Fedtsch.

7	Ghor	XX	*G.glabra L.* *G. uralensis* Fisch. ex DC.	XX	*F. hedgeana* Pimenov & Kljuykov *F. kokanica* Regel & Schmalh *F. lehmannii* Boiss. *F. ovina (Boiss)* Boiss in Boiss. *F. racemosa-umbellata* (Gilli) Rech. f. In Rech. *F. trachelocarpa* Rech.f. in Rech. f.			X	*B. cylindricum* Boiss. & Hohen. *B. persicum* (Boiss) B. Fedtsch.
8	Farah	X	*G. glabra L.*	X	*F. ghorana* Rech *F. heratensis* Pimenov & Kljuykov *F. ovina* (Boiss) *F. szovitsiana* DC. *F. xanthocarpa* Rech. f. In Rech. f.	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	x	*B. cylindricum* Boiss. & Hohen. *B. kandaharicum* Rech. f. in Rech. *B. persicum* (Boiss) B. Fedtsch.
9	Faryab	XX	*G. glabra L.*	XX	*F. badra-kema,* *F. foetida* (Bunge) Regel *F. karakalensis* Korovin *F. narthex* Boiss	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. chaerophylloides* Regel & Schamalh. *B. intermedium* Korovin *B. kandaharicum* Rech. f. in Rech.
10	Kabul	-	*G glabra L.* *G triphylia Fisch & CA Mey*	-	*F. afghanicus* *F. lehmannii* Boiss. *F. narthex* Boiss *F. oopoda* Boiss. & Bushe *F. stenoloba* Rech. f.			-	*B. badghisi* (Korovin) Korovin in Kom. *B. chaerophylloides* Regel & Schamalh. *B. persicum* (Boiss) B. Fedtsch.

11	Kapisa	X	*G. trphylia Fisch & CA Mey* *G. uralensis* Fisch. ex DC. *G. aspera Pall*	-	*F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina (Boiss) Boiss in Boiss.*	-		-	*B. persicum (*Boiss) B. Fedtsch.
12	Parwan	X	*G. glabra L.* *G. uralensis* Fisch. ex DC.	X	*F. hindukushensis* Kitam. *F. hedgeana* Pimenov & Kljuykov *F. kokanica* Regel & Schmalh *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss. *F. stenoloba* Rech. f. *F. trachyphylla* Rech. f. & Riedl			-	*B. cylindricum* Boiss. & Hohen. *B. persicum* (Boiss) B. Fedtsch.
13	Wardak-Miedan	X	*G. uralensis* Fisch. ex DC.	X	*F. castata* *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss. *F. trachyphylla* Rech. f. & Riedl			-	*B. badghisi* (Korovin) Korovin in Kom. *B. cylindricum* Boiss. & Hohen.
14	Logar	X	*G. uralensis* Fisch. ex DC.	X	*F. glabra* rech. *F. hedgeana* Pimenov & Kljuykov *F. lehmannii* Boiss. *F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss.				

15	Paktika	X	*G. uralensis* Fisch. ex DC. *G. triphylia Fisch.& CA Mey, Ur,triph,asp*	-	*F. hedgeana* Pimenov & Kljuykov *F. hindukushensis* Kitam. *F. lehmannii* Boiss. *F. ovina* (Boiss) Boiss in Boiss			X	*B. kandaharicum* Rech. f. in Rech.
16	Ghazni	XX	*G. aspera Pall.*	X	*F. narthex* Boiss *F. ovina* (Boiss) Boiss in Boiss.				
17	Nangahar	-	*G. glabra L.* *G. aspera Pall.*	-	*F. lehmannii* Boiss. *F. narthex* Boiss			-	*B. persicum* (Boiss) B. Fedtsch.
18	Laghman			-	*F. lehmannii* Boiss. *F. narthex* Boiss *F. racemosa-umbellata* (Gilli) Rech. f. In Rech.			-	*B. persicum* (Boiss) B. Fedtsch.
19	Konar			x	*F. badra-kema* *F. narthex* Boiss. in Boiss.				
20	Noristan			x	*F. nuristanica* Rech. f.			-	*B. persicum* (Boiss) B. Fedtsch.
21	Takhar	X	*Glycyrrhiza sp.*	XX	*F. kokanica* Regel & Schmalh			X	*B. chaerophylloides* Regel & Schamalh.
22	Kunduz	XX	*G. bucharica*	X	*F. foetida* Bunge *F. hedgeana* Pimenov & Kljuykov *F. narthex* Boiss *F. trachyphylla* Rech. f. & Riedl			-	*B. persicum* (Boiss) B. Fedtsch.

23	Samangan	X	*Glycyrrhiza sp.*	XX	*F. foetida* (Bunge) Regel *F. hindukushensis* Kitam. *F. kokanica* Regel & Schmalh *F. lehmannii* Boiss. *F. narthex Boiss.* *F. ovina* (Boiss) Boiss in Boiss. *F. stenoloba* Rech. f. *F. trachyphylla* Rech. f. & Riedl	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. chaerophylloides Regel & Schamalh.* *B. persicum* (Boiss) B. Fedtsch.
24	Balkh	XX	*Glycyrrhiza sp.*	XX	*F. vulgaris,* *F. dictyocarpa,* *F. Foetida* (Bunge) Regel *F. glabra* Rech. *F. hedgeana* Pimenov & Kljuykov *F. hindukushensis* Kitam. *F. pachycaulos* Rech. f. *F. rechingeri* D. F. Chamb. *F. schatschurowskiana* Regel.& Schmalh	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	-	*B. alatum Pimenov Ljuylkov* *B. chaerophylloides Regel & Schamalh*
25	Sar-i-Pul	XX	*Glycyrrhiza sp.*	XX	*F. kokanica* Regel & Schmalh *F. hindukushensis* Kitam. *F. lehmannii* Boiss. *F. ovina* (Boiss) Boiss in Boiss. *F. trachyphylla* Rech. f. & Riedl	X	*Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. chaerophylloides Regel & Schamalh.* *B. persicum* (Boiss) B. Fedtsch.

26	Jawuzjan	XX	*Glycyrrhiza sp.*	X	*F. vulgaris,* *F. trachyphylla* Rech. f. & Riedl			x	*B. chaerophylloides* Regel & Schamalh. *B. intermedium* Korovin *B. kuhitangi* Nevski *B. longipes* Freyn,
27	Bagdis	XX	*Glycyrrhiza sp.*	X	*F. badra-kema*			X	*B. badghisi (*Korovin) Korovin in Kom. *B. chaerophylloides* Regel & Schamalh. *B. cylindricum* Boiss. & Hohen. *B. intermedium* Korovin *B. persicum* (Boiss) B. Fedtsch.
28	Urozghan	-	*G triphylia Fisch.& CA Mey,*	X	*F. racemosa-umbellata (*Gilli) Rech. f. In Rech.	-	*Cuminum cyminum* L. *Cuminum setifolium* (Boiss.) Koso-Pol.	-	*B. kandaharicum* Rech. f. in Rech.
29	Nimrooz	-	-	-	-	-	-	-	-
30	Helmand	-	*G triphylia Fisch.& CA Mey,*	-	*F. diversivittata* *F. racemosa-umbellata* (Gilli) Rech. f. In Rech.	X	*Cuminum cyminum* L.	XX	*B. kandaharicum* Rech. f. in Rech.

31	Kandahar	X	*G triphylia Fisch.& CA Mey,*	-	*F. castata* *F. kandaharica Rech.* *F. narthex Boiss. in Boiss.* *F. racemosa-umbellata (Gilli) Rech. f. In Rech.*	X	*Cuminum cyminum* L. *Cuminum setifolium* (Boiss.) Koso-Pol.	X	*B. kandaharicum* Rech. f. in Rech
32	Zabul			-	*F. narthex Boiss. in Boiss.* *F. racemosa-umbellata (Gilli) Rech. f. In Rech.*			x	*B.* cylindricum Boiss. & Hohen.
33	Dikundi	-	*G. uralensis* Fisch. ex DC. *G triphylia Fisch.& CA Mey,*	XX	*F. hedgeana Pimenov & Kljuykov* *F. lehmannii Boiss.* *F. myrioloba Rech. f.* *F. ovina (Boiss) Boiss in Boiss.* *F. racemosa-umbellata (Gilli) Rech. f. In Rech.*	X		X	*B. chaerophylloides* Regel & Schamalh. *B. kandaharicum* Rech. f. in Rech. *B. persicum* (Boiss) B. Fedtsch.
34	Panjshir			X	*F. lehmannii Boiss.* *F. narthex Boiss. in Boiss.* *F. stenoloba Rech. f.*	X		-	*B. persicum* (Boiss) B. Fedtsch.
	Number of species		∑ 9 sp.		∑ 32 sp.		∑ 2 sp.		∑12 sp.

Legends:
x poor capacity
X medium capacity
XX rich capacity
- no supply

3.4. Development of appropriate approaches (frameworks) for studying of natural resources of MAPs.

In order to conduct resource assessment of the selected species, frameworks for the evaluation of different aspects of natural resources was adapted. These frameworks are based on the selection matrices developed by UNCTAD's BioTrade initiative under the BioTrade Facilitation Programme (BTFP) (United Nations, 2009). The criteria, scales and the methodology for assessing the criteria have been adapted according to the condition and realities of Afghanistan. The frameworks were extensively discussed and finalized in Herat workshop (See App.8.1). The aim of this activity is to determine the state of natural resources of medicinal plants through an accurate and realistic approach. This method is based on the assessment of different aspects of medicinal plants natural resources, which comprised four major groups of natural resources aspects of wild MAPs. They are:

(a) Resource assessment of MAPs,
(b) Socioeconomic aspects of the wild collection,
(c) Trade and marketing of medicinal plants and their products, and
(d) Technological proficiencies for the processing and standardization of natural products

To scrutinize every aspect, certain realistic criteria has been adopted. The criteria chosen for this assessment based on the components of the aspect and contributing factors such as multi-stakeholder engagement of the government, NGO and community in collection, processing and trading of MAPs, illegal export of MAPs and politico-economic and socioeconomic state of the resources and communities. Therefore, a bunch of such factors have been listed and eventually the most potential and relevant factors have been finalized via consultations, meetings and workshop with relevant experts in MAIL, CSO, Kabul and Herat universities and Herat DAIL. These criteria were brought up in the first workshop in Herat (See App. 8.1).

In fact the selected criteria should extremely ascribe the status of MAPs resources and follow the purpose of this multidimensional assessment. In the same time it was attempt to respect the insight for feasibility of the scoring and quantifying the status of the criteria.

In order to quantify these aspects, appropriate frameworks have been developed. In fact, the frameworks should be considered a tool for the measuring of sitting criteria. The development of these frameworks based on appropriate criteria and mechanism for assessing these criteria. Every criterion is weighted (scored) by 0 (least important) to 3 (most important) according to their relative significance through focusing on defined benchmarks. Furthermore, the criteria scored by clear justifications of the real status. It is worth to mention, that the evaluation and scoring of the ongoing progress and rehabilitation efforts in respective areas in the country have been considered in scoring range of the relevant criteria and weighted by 1.

Figure 3.3: Workshop on resource assessment of MAPs in Herat, Oct 28, 2017 (Photo by M Ehsan: 2017).

To focus on detailed assessment of natural resources and avoid errors in evaluating these criteria, for each of these aspects, the exact description of the status for the scoring was determined along with the specific indicators that should be considered in the scoring to evaluate these criteria.

The score should be well justified through indicators. These are qualitative statements that indicate how each score can be obtained. Further explanation can be given regarding which people or organizations will provide information about every criterion.

In view to perform the assessment through these frameworks accurately, it seemed reasonable and also practical to complete this task by a local team of professionals, available in the field to evaluate these criteria. The teams were identified following a series of consultations with various departments and experts in different sectors and also after consultations in Herat workshop (October 2017) for this purpose in the following manner:

1. For the resource assessment of MAPs:
    a) Officer of the district agricultural office,
    b) One of the collectors who had experience in this area for at least 5 years, and
    c) One of the elders / landowners of the district.

2. For the assessment of socioeconomic aspect of the wild collection:
    a) Officer of the district agricultural office,
    b) One of the collectors who had experience in this area for at least 5 years, and
    c) One of the elders / landowners of the district.

3. For the assessment of trade and marketing aspect:

a) Officer of the district agricultural office,
b) One of the collectors who had experience in this area for at least 5 years, and
c) Local trader involved in the trade of herbs and natural products.

4. For the assessment of technological aspect for the processing and standardization of plant products:

a) Officer of the district agricultural office,
b) One of the collectors who have had experience in this area for at least 5 years
c) Local traders involved in the trade of medicinal plants and natural products.

The activity of the teams was led by the officer of the district agricultural office. As it was mentioned in the verification measures for information (See section 3.1), the process of data collection was supported by a parallel assessment conducted by CRS teams available in the following districts:

1. Adraskan,
2. Karukh,
3. Kohsan,
4. Kushk-e-Raobat Sangi,
5. Kushk-e-Kohna,
6. Shindand, and
7. Zandajan

The results from these seven districts were close to the one received from the fields by aforementioned teams and the mean of these two groups' results have been calculated.

The appointment of two local focal points from the provincial directorate of MAIL and Herat Institute of Agriculture has mediated the data collection process on a regular basis efficiently. As it was ascribed before, the details and mechanism of communications with the fields optimized by a terms of reference (ToR) agreed in the first workshop in Herat. (See App. 8.3). The researcher followed and monitored the process of the work by the teams and two focal points on a regular basis and provided required information and guidance during the period of 10 months (November 2017- August 2018) of work as needed.

3.4.1. Resource assessments of MAPs

The evaluation of plant resources is a multi-dimensional and interrelated issue. Nevertheless, in order to assess the pertaining features of wild resources of the selected plants, the following ecological, environmental and regulatory criteria have been selected:

1. Abundance and state of conservation of the species,
2. Potential for sustainable management,
3. Impact of harvesting for production on the species,

4. There are guidelines/regulations for the implementation of good collection practices, and
5. Availability of an environmental or any other certification mechanism.

All the selected criteria reflex the essential status of the wild resources of MAPs. For the abundance of the species, the mechanism of inventory based on the calculation of the number of the individual plants in a sample plot and multiplying it by the area containing the plant was taught in the workshop.

Given the measure and urgency of sustainability issues, the inventory provide the only realistic means for assessing the population status and harvest potential of target resource species. Realizing the fact that inventory is fundamental for assessment of the conservation status of wild populations, and prerequisite for addressing harvesting sustainability of key or target species there were substantial emphasize in workshop on the achieving this task.

The criterion number 4 “there are guidelines/regulations for the implementation of good collection practices”, enquires the awareness of the communities and implication of the role of “Procedure of Conservation and Wild Collection of Medicinal Plants” issued in 2002 and then updated in 2013 by MAIL. Realizing the fact that the transition from the state of “de facto” to state of “de jure” and the rule of law in the country is a fragile process, and how much the communities take initiative for the conservation of the resources, this criterion has been set in this aspect of assessment.

In the same time by the establishment of National Environmental Protection Agency of Afghanistan (NEPA) in 2005 multidimensional efforts initiated in various aspects and in view to assess the introduction of any mechanism or certification in protection of environment by this agency or any other NGO, the last criterion has been included.

The final framework for assessing the natural resources of medicinal plants was finalized in Tab. 3.3.

3.4.2. Trade and marketing of MAPs

Generally, trade in medicinal plants is difficult to estimate precisely because much of the local trade is either unrecorded or because some medicinal plants are also used in non-medicinal purposes and not reported separately. The long lasting war in the country has hampered the growing demands for the development of improved system for the trading in the country. The unregulated and illegal export of medicinal plants and their product particularly via the Durand line into Pakistan makes this issue more ambiguous. It is, therefore, almost not possible to assess national trade in all medicinal plants accurately (FAO, 2014).

In spite of these drawbacks due to exponential trends in regional and international markets, the trade of MAPs products is growing in the country. Trade and marketing of

medicinal plants and their natural products, and its impact on the wild resources, has been selected as a major aspects of resource analysis in this study. The market outlets in Afghanistan can be for local use and for export. As for local use, most of the products could reach the consumer directly while some others have to be further processed.

In order to evaluate this aspect, the following criteria have been identified as relevant to Afghanistan context:

1. Quantity and quality of the information about the existing market,
2. Potential market demand,
3. Experience of the product in the market,
4. Competition (as a threat to maintaining the market status),
5. Evaluation of financial feasibility (analysis of economic viability of investment),
6. Quality of production, and
7. Potential for certification in the market.

These criteria demonstrate the crucial aspects of the trade and marketing of MAPs in Herat and in the country. The identified benchmarks for every criterion in the framework helps the teams to orientate straightforwardly to the respective criteria.

The final framework for assessing the trade and marketing of medicinal plants and their products has been finalized in Tab. 3.4.

3.4.3. Socioeconomic aspects of the wild collection of MAPs

In view to assess the socioeconomic aspects of the direct or indirect contribution of medicinal plants need to be focused. Because of the long history of wild collection by village inhabitants, the critical need for employability of the populations and, on the other hand, poppy cultivation and opium production over the past three decades in some provinces of the country and eventually the importance of alternative livelihoods for the villagers and remote populations, the following six criteria have been identified as important socioeconomic aspect:

1. Potential for generation of employment,
2. Suitability of production for the livelihood of the communities,
3. Suitability of production for alternative livelihood of the communities,
4. Suitability of production for local communities or small entrepreneurs,
5. Experience of local communities with the product, and
6. Additional benefits to small businesses.

Every criterion reveals the important contribution of MAPs in socioeconomic aspects and for easier concentration for the assessment every criterion is ascribed by clearly stated benchmarks.

The final framework for assessing the socioeconomic aspects of the wild collection of medicinal plants has been finalized in Tab. 3.5.

3.4. 4. Technological proficiencies for the processing and standardization of MAPs

There are certain limitations associated with the processing of medicinal plants which resulted in reducing their quality and competitiveness in regional and global markets. Indeed, the situation in the domestic market is different, however, even in this market for some products competitiveness with some imported products seems to be challenging.

The development of any processing technology and activity has to be linked to the specific needs, socio-cultural background, resource potential and the technological capabilities of the country. Therefore, another assessment aspect has been the processing aspect.

Despite the fact that some limited initiatives have been taken in certain cases, there is still no adequate and appropriate technology for post harvesting treatment of the collected medicinal plants. Hence, a complex of factors such as the criteria for assessing the processing of the medicinal plants have been identified and incorporated in the next framework as the following:

1. Abilities and skills,
2. Human resources,
3. Technological requirements for improving processes,
4. State of infrastructure,
5. Quality control requirements, and
6. Availability of technical support.

A framework for assessing technological proficiencies for the processing and standardization of plant products was finalized in Tab. 3.6.

The results of the frameworks have been analyzed by Statistical Package of Social Science (SPSS) and the structural equation modeling (SEM) is used to evaluate the relationship between indirect (mediated) and direct effects of criteria.

Table 3.3: Framework for resource assessment of MAPs.

Criteria	Scale	Score	Explanation	Benchmarks	Comment
Abundance and state of conservation of the species	Abundant and required state of conservation	3	The source of the species for the product is abundant and it is not under ecological threat.	• Get reliable information about the capacity • Mapping • Resources are under threats • Subject to extinction	If there is unreliable or insufficient information, please refer to focal points. For *Glycyrrhiza* sp. -Abundant means occurrence of 4 or more plants in a plot. - Sufficient means 2-3 plants. - Under threat means 1 plant
	Sufficient and uncertain state of conservation	2	The source of the species is abundant enough to supply demand, but there are no clear mechanisms to secure conservation in the long term.		
	Some initiatives are under development to improve conservation	1	The source of the species for the product is normal; it is at risk of threatening; local/national authority takes some initiatives to secure conservation		
	Under threat	0	The source of the species for the product is scarce; it is at risk of local extinction.		
Potential for sustainable management	High	3	The species have potential for exploitation subject to sustainable use practices that will ensure conservation in the long term.	• Trend for community engagement • Relationship between resource capacity/ exploitation rate • Any activity for the conservation	If there is unreliable or insufficient information, please refer to focal points.
	Moderate	2	The species have potential for exploitation subject to sustainable use practices, but complementary activities must be developed to ensure conservation (such as breeding, *in vitro* management, repopulation, extension).		
	Mild	1	The species have moderate potential for exploitation subject to sustainable use practices, but some activities have been initiated		
	Low	0	The species cannot be exploited from the environment in question – to do so would threaten its survival.		
Impact of harvesting on the species and its habitats	Positive	3	Productive practices contribute to improvements in the populations of the species in question and the quality of their habitats.	• Harvesting rate • Impact on habitat • Relationship between harvesting and habitat	If there is unreliable or insufficient information, please refer to focal points.

	Neutral Negative Critical	2 1 0	Production practices do not alter the populations of the species being used, or the current state of the habitats. Production and harvesting practices have a negative impact on the populations of the species being used and on their habitats. Production and harvesting practices can alert the population of the species in the future		
There are guidelines for the implementation of good collection practices	Guidelines exist and they are being used. Guidelines exist, but they need improving. Development of guideline is under process No guidelines exist	3 2 1 0	The management of the species is conducted using clear guidelines, which can be implemented. The management of the species is conducted using specific guidelines, but the system needs to be improved. The development of the guidelines is under process. There are no clear guidelines for the management of the species.	• Is there guideline? • Is there any rule? • Anything under the process?	Is the Procedure for "Conservation and Collection of Wild MAPs" introduced in practice?
Availability of a suitable environmental or any other certification mechanism	There is a mechanism and it is being used. There is a mechanism, but it is not being used, or it needs improvements. Some initiatives have been taken to introduce certification. There is no any mechanism.	3 2 1 0	There is a valid environmental certification mechanism for the product. There is a suitable environmental certification mechanism for the product, but it has not been used, or it needs improvements. The MAIL directorate or any company engaged in collection working on the development of certificate or it introducing to practices There is no suitable environmental certification mechanism for the product.	• Existence of any certificate • Anything under the process	
SUB TOTAL					

Table 3.4: Framework for assessment of trade and marketing aspect of MAPs.

Criteria	Scale	Score	Explanation	Benchmark	Comment
Quantity and quality of the information about the existing market	Sufficient/ reliable Inadequate/ imprecise Is being developed Non-existent/ unreliable	**3** **2** **1** **0**	There is enough information about the market to predict demand accurately. Existing market information can only offer some approximations about demand. Initiatives have been taken to create information There is insufficient information to predict demand.	• Quantity of information • Reliability of information • Accuracy of information	If there is unreliable or insufficient information, please refer to focal points.
Potential market demand	High Moderate Mild Limited	**3** **2** **1** **0**	There is knowledge that market demand for the product is high. The current market demand for this product is moderate, The current market demand for this product is mild, but it has the potential to increase. Market demand for this product is small at present and its behavior is uncertain.	• Local market demand • National market demand	For accurate information, please consult with traders in local district market.
Scale of production	High Moderate Mild Low	**3** **2** **1** **0**	Production is well organized and commercially viable. Production is moderately organized and could be commercially viable. Production has limited capacity (there are not enough companies to meet demand). The scale is not commercially viable.	• Sustainable supply chain (does it mean for the product?) • Are there companies/ entrepreneurs for local organization and purchasing?	For accurate information, please consult with traders in local district market.
Experience of the product in the market	Already on the market	**3**	The product is already on sale.	• Availability in the market	For accurate information, please consult with traders in local district market.

	In development There are opportunities to be on the market No development currently taking place	**2** **1** **0**	The product is being developed at present, and will soon be on sale. The product is not on the market, but there are opportunities to introduce in the market The product is not on the market, and no work to develop it has been started.	• Interest in market for the product • The product is known in regional market	
Competition (as a threat to maintaining the market place)	Weak Mild Moderate Strong	**3** **2** **1** **0**	There is no any alternative source to this product, and the probability of it being substituted or replaced is excluded. There are few alternative sources to this product, and the probability of it being substituted or replaced is small. There are several sources of this product, or it could be easily substituted or replaced. There is great current or potential competition for the supply of this product.	• Availability of alternatives to the product • Degree of the alternatives	For accurate information, please consult with traders in local district market.
Evaluation of financial feasibility (analysis of economic viability of investment)	Good profitability Moderate profitability Mild profitability Low profitability	**3** **2** **1** **0**	The financial feasibility evaluation prepared is reliable and predicts good profits. The financial feasibility evaluation prepared is reliable and predicts moderate profits. The financial feasibility evaluation prepared is reliable and predicts mild profits. No reliable financial feasibility evaluations have been prepared, or else those that have been prepared are unreliable.	• International and regional market demand • Financial condition • Performance condition	For accurate information refer to “Arbab” (elder) of the district and to focal points.

Quality of production	Good Moderate Mild Low	**3** **2** **1** **0**	Companies are complying with adequate quality standards for the product. Companies are complying with adequate quality standards for the product, but these need to be improved. Some initiatives are being undertaken to apply adequate quality standards for the product Companies do not apply adequate quality standards for the product.	• Availability of standards • Interview with companies/ entrepreneurs for getting the picture about standards status.	For accurate information, please consult with traders in local district market.
Potential for certification in the market	High Moderate Mild Low	3 2 1 0	The product can be certified through existing mechanisms. The product can be certified, but the market is not very differentiated. The product can be certified, but the market is uncertain. The product cannot be certified.	• Is there a differentiated market for the product at local and national level? • Potential for certification: MAIL, MoC, CoC?	For accurate information, please consult with focal points.
SUB TOTAL					

Table 3.5: Framework for assessment of socioeconomic aspect of MAPs.

criteria	Scale	Score	Explanation	Benchmarks	Comments
Potential for generation of employment	High Moderate Mild Low	**3** **2** **1** **0**	There are many opportunities to create new jobs. There are few opportunities to create new jobs. Some initiatives are under development to create new jobs. There are no opportunities to create new jobs.	• Resource capacity, • Demand from the market, • Number of people engaged/can be engaged	If there is insufficient information please refer to District Office.

Suitability of production for the livelihood of the communities (Natural Capital)	High Moderate Mild Low	**3** **2** **1** **0**	Households and communities are able to meet their basic needs. Households and communities are able to meet partially their basic needs. It can be considered as an opportunity for future of households and communities to meet their basic needs. Households and communities are not able to meet partially their basic needs.	• Daily/ monthly outcome of the family	If there is insufficient information please refer to District Office.
Suitability of production for alternative livelihood of the communities	High Moderate Mild Low	**3** **2** **1** **0**	There are many opportunities to introduce it as an alternative livelihood. There are some opportunities to introduce it as an alternative livelihood. There are few opportunities to introduce it as an alternative livelihood. There is no opportunities to introduce it as an alternative livelihood.	• Need for alternative livelihood • Resource potential • Market needs	If there is insufficient information please refer to District Office.
Suitability of production for local communities or small entrepreneurs	Very suitable Moderately suitable Mildly suitable Unsuitable	**3** **2** **1** **0**	Preferably, raw materials are produced by small entrepreneurs. Raw materials are sourced from local communities or families. Raw materials are produced by small companies or local communities, but encounter difficulties in the productive system. Raw materials are principally supplied by large companies in the private sector.	• Is there any productive system? • Who engaged: local communities or small entrepreneurs?	
Experience of local communities with the product	Considerable	**3**	Local communities have considerable experience in the production and sale of the raw materials.	• Have people from small businesses or local communities had similar experience?	For accurate information refer to “Arbab” (elder) of the district.

	Moderate Mild Little	**2** **1** **0**	Local communities have little experience in the production and sale of the raw materials. Some initiatives are under development to organize training/capacity building for local communities Local communities do not have experience in the production and sale of the raw materials.	• Who would take responsibility for passing on this knowledge and offering training? • Would the people concerned want to share their knowledge?	
Additional benefits to small businesses	Many Moderate Mild Few	**3** **2** **1** **0**	There are obvious benefits for small businesses producing the raw materials. There are few or insignificant benefits for small businesses producing the raw materials. Initiatives are under development to improve benefits for small business producing the raw materials There are no obvious benefits for small businesses producing the raw materials.	• In view of the present kind of trade, is there benefit? If so, in which level? • MAIL/ any local authority working to improve benefit	What kinds of benefits can be obtained?
SUB TOTAL					

Table 3.6: Framework for assessment of technological proficiencies for the processing and standardization of MAPs.

Criteria	Scale	Score	Explanation	Benchmarks	Comment
Abilities and skills	High Moderate Mild	**3** **2** **1**	The abilities and skills of the collectors/labor forces are sufficient. Collectors/labor forces are developing some additional skills, in order to reach production objectives. Some initiatives are under process to develop some additional skills in order to reach production objectives.	• Technological abilities and skills of the collectors/labor force • Do entrepreneurs have plan to develop the skills and abilities • Any initiative under taken by authority	For reliable information consult with focal points.

	Low	**0**	There is a great need for training.		
Human resources	Available Moderate Mild Limited	**3** **2** **1** **0**	There is a large number of skilled collectors who have the experience needed to reach production objectives. There is a reasonable number of collectors. There is an inadequate number of collectors; this situation can affect production. There is no one with the right profile to meet production objectives; production is therefore seriously affected.	• Number of skilled staff	If there is insufficient information please refer to District Office.
Technological requirements for improving processes	Low Mild Moderate High	**3** **2** **1** **0**	The technology required is simple and available locally. The technology required is simple, but it is not available locally or in the short time. The technology required is complex, or it is not available locally. The technology required is inaccessible.	• Simplicity or complexity of technology • Availability of technology • Accessibility to technology	For reliable information, please consult with focal points.
State of infrastructure	High Moderate Mild Low	**3** **2** **1** **0**	The existing local infrastructure is appropriate for production and processing needs. Infrastructure is being developed, and could be used in the short term. Additional infrastructure should be developed, and could be used in the short term. The necessary infrastructure is expensive and inaccessible.	• Availability of infrastructure • Completeness of infrastructure • Status (functionality) and advancement of infrastructure	

Quality control requirements	Low Mild Moderate High	**3** **2** **1** **0**	Quality control standards can be easily met, or already exist. The quality control standards can easily be met, but they need to be monitored carefully and they involve additional training. The quality control standards can be met, but it requires infrastructure and capacity building. The quality control standards are high or impossible to meet.	• Availability of the standards • How much standards are achievable • Is there any initiative to standardize the product?	For accurate information, please consult with traders in local district market.
Availability of technical support	Available Moderate Mild Limited	**3** **2** **1** **0**	The technical support necessary to meet production objectives is easily accessible. There are some inadequate technical support, but it should be improved. Technical support has to be provided from somewhere else. There is very little or no capacity to offer technical support.	• Availability of technical support (during collection, PHT, stocking, quality control etc.)	For reliable information, please consult with focal points.
SUBTOTAL					
GRAND TOTAL					
RANKS					

The comprehensive list of all criteria (variables) is presented in below. These variables in the study are dependent, while the districts and the species are the independent variables.

Resource assessment:

1. Abundance and state of conservation of the species
2. Potential for sustainable management
3. Impact on harvesting on the species and it's habitats
4. There are guidelines for the implementation of good collection practices
5. Availability of a suitable environmental or any other certification mechanism

Trade and marketing aspect:

1. Quantity and quality of the information about the existing market
2. Potential market demand
3. Scale of production
4. Experience of the product in the market
5. Competition as a threat to maintaining the market place
6. Evaluation of financial feasibility (analysis of economic viability of investment)
7. Quality of production
8. Potential for certification in the market

Socioeconomic aspect:

1. Potential for generation of employment
2. Suitability of production for the livelihood of the communities (Natural Capita)
3. Suitability of production for alternative livelihood of the communities
4. Suitability of production for local communities or small entrepreneurs
5. Experience of local communities with the product
6. Additional benefits to small businesses

Technological proficiencies for the processing and standardization:

1. Abilities and skills
2. Human resources
3. Technological requirements for improving processes
4. State of infrastructure
5. Quality control requirements
6. Availability of technical support

4. Results

4.1. Export of MAPs

4.1.1. Review of the export of Afghanistan MAPs

An overview of the Afghanistan Statistical Yearbooks produced by the Central Statistics Organization (CSO), as the only official statistical body in the country, chronicles the Afghanistan export of certain items of medicinal plants and natural ingredients to the regional and international markets from the fifties to the present. Among those, products such as Licorice, Asa foetida (Heng), Sesame, and Cumin are most prominent.

The CSO is the responsible authority for the collection of data in Afghanistan. Though, the data should be collected by the Ministry of Commerce where normally all the movement of trade should be recorded and available, but in reality there are no systematic and accurate data available from them. Study of the export data shows that statistics produced by the CSO are more regular and reliable than that of Ministry of Commerce and the Ministry of Finance. As a result, the data provided below are collected from the CSO.

The export of MAPs and their products in terms of quantity, volume and value through the eighties exhibited a tendency to grow, but after that, due to periodical political changes, unrest and the beginning of the war in the country, there were various fluctuations. In the meantime, the beginning of a new regime in 2002 brought new horizons in an effort to revive economic and social life in Afghanistan. The natural and wildlife of Afghanistan, which were severely damaged by nearly three decades of war, got an opportunity to be revived. While all aspects of the lives of Afghans were in a critical condition, extensive work was undertaken to revitalize and diversify life in Afghanistan, including of its natural resources.

The study of these figures over the past 17 years shows that in the early years of the establishment of the new post-Taliban government, the irregularity of these figures are evident. The situation becomes more regular and reliable moving ahead during the following decade. Therefore, the focus has been on the export figures for medicinal plants and their products over the past nine years.

Because of the relatively large number of exported items and their differences in terms of origin and type, the focus of this research will be limited to some specific items. Hence, it was decided to take into account the volume of exports, which actually captures the volume of production, and the value of exports over the past nine years during 2008-2016. The volume and value of the exports of the major items of medicinal plants and herbal products of the country are listed in the table below.

Table 4.1: The volume and value of MAP export during 2008-2016 (Kg, USD).

#	Plant	Product	Local name	2008		2009		2010	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
1	*Ocimum* sp.	Basil	Raihan	139	153	33,305	36,635	36,120	39,732
2	*Peganum harmala* L.	Harmal seed	Esfand	641,182	212,535	1,289,738	902,816	2,049,023	1,414,597
3	*Carum carvi* L. (wild)	Caraway	Karabia	0	0	0	0	0	0
4	*Dorema* sp.	Oleo-gum-resin	Kandal	0	0	0	0	0	0
5	*Ciser* sp.	Langash *	Langash	0	0	0	0	0	0
6	*Cuminum cyminum* L.	Cumin	Zeera Safid	64,478	132,924	831,096	2,571,951	1,220,188	3,452,726
7	*Bunium* sp.	Black cumin	Zeera sia	173,393	433,122	463,172	1,595,170	573,761	1,662,352
8	*Cuminum* sp.	Green wild cumin	Zeera sabz	0	0	138,666	443,731	253,323	782,561
9	*Coriandrum sativum* L.	Coriander seed	Gashneez	0	0	40,552	72,994	33,180	64,890
10	*Cucumis melo* L.	Melon seed	Tokhme Kharbuza	16,036	16,036	150,458	75,229	44,000	48,400
11	*Crocus sativus* L.	Saffron	Zafran	0	0	0	0	7,920	7,920,000
12	Sesamum indicum L.	Sesame seed	Kunjed	4,463,063	3,388,234	8,930,621	14,288,994	14,519,149	24,640,300
13	*Helianthus annus* L. *Linum usitatissimum* L. *Sesamum indicum* L.	Oilseed cake	Kunjara	22,337	13,402	55,808	500,180	66,079	39,647
14	*Papaver somniferum* L.	Poppy seed	Khashkhash dana	0	0	0	0	0	0
15	*Ferula* sp.	Oleo-gum-resin (red)	Heng surkh	3,768,242	1,873,121	34,213	1,710,650	11,852	664,639
16	*Glycyrrhiza glabrs* L.	Licorice	Sherin booia	9,509,000	13,218,000	7,335,159	17,896,803	7,819,436	21,079,925
17	*Ferula* sp.	Oleo-gum-resin (white)	Heng safed	2,128,000	7,447,000	227,732	10,475,672	336,935	18,040,299
18	*Salvia* sp.		Gushte Adam	9,000	6,000	31,996	169,579	23,523	142,776
19	*Alkana* sp.	Dyer's Alkanet	Yarlang, Rodang	309,000	268,000	23,064	41,515	47,819	124,329
20	*Macrofungi*	Mushroom	Semaroq	0	0	4,216	32,042	1,350	13,095
21	*Carum carvi* L.(cultiv)	Caraway wild	Zere safid	224,000	318,000	631,058	1,077,560	266,066	346,995

#	Plant	Product	Local name	2008		2009		2010	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
22	*Citrullus vulgaris*	Watermelon seed	Tokhme Tarbuz	5,458,000	6,076,000	8,781,626	9,359,206	3,601,293	4,380,493
23	*Medicago sativa* L.	Alfalfa	Tokhme Shabdar	431,000	650,000	9,867	14,800	77,050	115,575
24	*Trifolium repens* L.	White clover	Tokhme Reshqa	16,000	32,000	35,050	52,575	100,020	150,030
25	*Punica granatum* L.	Pomegranate seed	Nafae Anar	0	0	1,596	2,554	0	0
26	Total			27,232,870	34,084,374	29,048,993	61,320,656	31,088,087	85,123,362

Continued

#	Plant	Product	Local name	2011		2012		2013	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
1	*Ocimum* sp.	Basil	Raihan	30,320	18,192	177,703	127,382	94,930	69,253
2	*Peganum harmala* L.	Harmal seed	Esfand	473,680	341,442	638,575	455,793	1,477,113	889,475
3	*Carum carvi* L. (wild)	Caraway	Karabia	0	0	0	0	0	0
4	*Dorema* sp.	Oleo-gum-resin	Kandal	0	0	0	0	0	0
5	*Ciser* sp.	Langash *	Langash	0	0	0	0	0	0
6	*Cuminum cyminum* L.	Cumin	Zeera Safid	1,131,670	1,983,789	23,096	36,631	1,670,934	2,489,828
7	*Bunium* sp.	Black cumin	Zeera sia	58,695	121,769	438,026	788,447	575,727	978,736
8	*Cuminum* sp.	Green wild cumin	Zeera sabz	162,621	361,754	1,568,507	3,063,034	2,320,226	4,408,429
9	*Coriandrum sativum* L.	Coriander seed	Gashneez	68,863	122,328	1,164,777	2,095,324	23,429	39,829
10	*Cucumis melo* L.	Melon seed	Tokhme Kharbuza	44,000	8,800	0	0	12,800	2,560
11	*Crocus sativus* L.	Saffron	Zafran	2,225	2,225,000	3,127	3,824,427	940	940,000
12	*Sesamum indicum* L.	Sesame seed	Kunjed	11,161,042	18,826,717	24,591,475	35,065,778	10,693,973	11,995,968

Continued

#	Plant	Product	Local name	2011		2012		2013	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
13	*Helianthus annus* L. *Linum usitatissimum* L. *Sesamum indicum* L.	Oilseed cake	Kunjara	762,540	762,294	5,004	5,504	318,889	303,410
14	*Papaver somniferum* L.	Poppy seed	Khashkhash dana	0	0	0	0	0	0
15	*Ferula* sp.	Oleo-gum-resin (red)	Heng surkh	38,542	2,088,976	288,662	16,155,733	169,082	11,010,626
16	*Glycyrrhiza glabrs* L.	Licorice	Sherin booia	10,290,192	23,546,036	6,533,144	17,925,325	8,540,367	22,204,955
17	*Ferula* sp.	Oleo-gum-resin (white)	Heng safed	414,080	21,803,965	139,265	6,726,500	736,000	44,932,000
18	*Salvia* sp.		Gushte Adam	28,040	173,494	0	0	21,000	68,000
19	*Alkana* sp.	Dyer's Alkanet	Yarlang, Rodang	50,535	126,338	14,950	29,900	346,246	623,242
20	*Macrofungi*	Mushroom	Semaroq	2,060	19,158	0	0	0	0
21	*Carum carvi* L. (cultiv.)	Caraway wild	Zere safid	485,912	525,069	255,830	290,589	197,076	216,783
22	*Citrullus vulgaris*	Watermelon seed	Tokhme Tarbuz	3,199,782	3,839,738	3,324,863	3,989,836	5,977,485	6,872,982
23	*Medicago sativa* L.	Alfalfa	Tokhme Shabdar	49,750	69,650	0	0	0	0
24	*Trifolium repens* L.	White clover	Tokhme Reshqa	117,590	176,433	2,250,199	3,310,298	1,004,870	1,406,818
25	*Punica granatum* L.	Pomegranate seed	Nafae Anar	0	0	0	0	1,700	3,910
26	Total			28,572,139	77,122,751	41,417,203	93,890,497	34,182,787	109,456,804

Continued

#	Plant	Product	Local name	2014		2015		2016	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
1	*Ocimum* sp.	Basil	Raihan	246,205	174,784	153,499	171,126	340,341	753,728
2	*Peganum harmala* L.	Harmal seed	Esfand	4,700,196	2,820,118	3,472,035	2,003,207	854,531	623,155
3	*Carum carvi* L. (wild)	Caraway	Karabia	2,489,060	5,077,682	3,301,520	6,735,101	289,864	591,322
4	*Dorema* sp.	Oleo-gum-resin	Kandal	87,054	1,319,739	3,330,000	7,154,738	0	0
5	*Ciser* sp.	Langash *	Langash	742,390	482,554	2,363,250	1,120,360	720,201	468,131
6	*Cuminum cyminum* L.	Cumin	Zeera Safid	1,894,506	7,598,206	3,674,547	14,794,715	3,850,553	14,840,319
7	*Bunium* sp.	Black cumin	Zeera sia	606,055	2,070,212	673,540	3,073,340	457,975	2,115,899
8	*Cuminum* sp.	Green wild cumin	Zeera sabz	1,188,983	3,776,545	1,203,936	4,497,630	1,361,509	6,388,641
9	*Coriandrum sativum* L.	Coriander seed	Gashneez	15,000	22,500	401,964	632,598	223,854	458,385
10	*Cucumis melo* L.	Melon seed	Tokhme Kharbuza	3,150	2,835	215,724	175,559	381,558	419,714
11	*Crocus sativus* L.	Saffron	Zafran	2,814	3,644,856	2,188	3,305,447	2,402	3,868,724
12	Sesamum indicum L.	Sesame seed	Kunjed	13,369,334	19,879,928	18,735,458	25,316,765	15,283,514	20,481,298
13	*Helianthus annus* L. *Linum usitatissimum* L. *Sesamum indicum* L.	Oilseed cake	Kunjara	246,800	271,480	104,000	114,400	59,910	65,901
14	*Papaver somniferum* L.	Poppy seed	Khashkhash dana	0	0	645,144	1,656,803	6,694,729	18,343,871
15	*Ferula* sp.	Oleo-gum-resin (red)	Heng surkh	323,881	22,757,882	216,872	17,581,198	286,138	24,321,772
16	*Glycyrrhiza glabrs* L.	Licorice	Sherin booia	11,048,391	21,487,960	8,645,758	25,133,694	40,264,114	54,755,060
17	*Ferula* sp.	Oleo-gum-resin (white)	Heng safed	249,234	14,134,507	611,717	37,932,006	69,282	6,235,424
18	*Salvia* sp.		Gushte Adam	0	0	69,829	244,375	0	0
19	*Alkana* sp.	Dyer’s Alkanet	Yarlang, Rodang	468,264	978,226	427,510	892,353	221,779	502,545

#	Plant	Product	Local name	2014		2015		2016	
				Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)	Volume (Kg)	Value (USD)
20	*Macrofungi*	Mushroom	Semaroq	821	14,368	3,167	47,155	13,739	164,577
21	*Carum carvi* L. (cultiv.)	Caraway wild	Zere safid	145,574	247,476	2,052,161	4,149,696	254,319	658,823
22	*Citrullus vulgaris*	Watermelon seed	Tokhme Tarbuz	3,582,660	6,994,851	2,835,915	3,981,683	2,069,110	3,539,973
23	*Medicago sativa* L.	Alfalfa	Tokhme Shabdar	69,830	13,966	144,170	294,919	1,745,489	3,592,774
24	*Trifolium repens* L.	White clover	Tokhme Reshqa	283,060	396,284	187,404	266,242	2,979,189	4,397,737
25	*Punica granatum* L.	Pomegranate seed	Nafae Anar	1,800	4,140	48,984	95,702	16,011	43,229
26	Total			41,765,062	114,171,096	53,520,295	161,370,812	78,440,112	167,631,003

Table 4.2: Average volume and value of MAP export during last three years (2014-2016).

#	Plant	Product	Local name	Total last 9 years		Average volume in Kg, last 3 years	Average value (USD), last 3 years
				Volume (Kg)	Value (USD)		
1	*Ocimum* sp.	Basil	Raihan	1,112,562	1,390,985	246,682	366,546
2	*Peganum harmala* L.	Harmal seed	Esfand	15,596,073	9,663,136	3,008,921	1,815,493
3	*Carum carvi* L. (wild)	Caraway	Karabia	6,080,444	12,404,106	2,026,815	4,134,702
4	*Dorema* sp.	Oleo-gum-resin	Kandal	3,417,054	8,474,476	1,139,018	2,824,825
5	*Ciser* sp.	Langash *	Langash	3,825,841	2,071,044	1,275,280	690,348
6	*Cuminum cyminum* L.	Cumin	Zeera Safid	14,361,068	47,901,089	3,139,869	12,411,080
7	*Bunium* sp.	Black cumin	Zeera sia	4,020,344	12,839,047	579,190	2,419,817
8	*Cuminum* sp.	Green wild cumin	Zeera sabz	8,197,771	23,722,325	1,251,476	4,887,605
9	*Coriandrum sativum* L.	Coriander seed	Gashneez	1,971,619	3,508,848	213,606	371,161
10	*Cucumis melo* L.	Melon seed	Tokhme Kharbuza	867,726	749,133	200,144	199,369
11	*Crocus sativus* L.	Saffron	Zafran	21,616	25,728,453	2,468	3,606,342

#	Plant	Product	Local name	Total last 9 years		Average volume in Kg, last 3 years	Average value (USD), last 3 years
				Volume (Kg)	Value (USD)		
12	Sesamum indicum L.	Sesame seed	Kunjed	121,747,630	173,883,982	15,796,102	21,892,664
13	*Helianthus annus* L. *Linum usitatissimum* L. *Sesamum indicum* L.	Oilseed cake	Kunjara	1,641,367	2,076,219	136,903	150,594
14	*Papaver somniferum* L.	Poppy seed	Khashkhash dana	7,339,873	20,000,674	2,446,624	6,666,891
15	*Ferula* sp.	Oleo-gum-resin (red)	Heng surkh	5,137,485	98,164,598	275,630	21,553,617
16	*Glycyrrhiza glabrs* L.	Licorice	Sherin booia	109,985,562	217,247,758	19,986,088	33,792,238
17	*Ferula* sp.	Oleo-gum-resin (white)	Heng safed	4,912,246	167,727,374	310,078	19,433,979
18	*Salvia* sp.		Gushte Adam	183,388	804,224	23,276	81,458
19	*Alkana* sp.	Dyer's Alkanet	Yarlang, Rodang	1,909,167	3,586,449	372,518	791,041
20	*Macrofungi*	Mushroom	Semaroq	25,353	290,394	5,909	75,366
21	*Carum carvi* L. (cultiv.)	Caraway wild	Zere safid	4,511,996	7,830,992	817,351	1,685,332
22	*Citrullus vulgaris*	Watermelon seed	Tokhme Tarbuz	38,830,734	49,034,761	2,829,228	4,838,836
23	*Medicago sativa* L.	Alfalfa	Tokhme Shabdar	2,527,156	4,751,684	653,163	1,300,553
24	*Trifolium repens* L.	White clover	Tokhme Reshqa	6,973,382	10,188,417	1,149,884	1,686,754
25	*Punica granatum* L.	Pomegranate seed	Nafae Anar	70,091	149,535	22,265	47,690
26	Total			365,267,548	904,189,701	57,908,490	147,724,304

For the calculation of the average export volume and value of MAPs, the last three years of studied period have been based. During these three years export of MAPs has more and less stable tendency. The average volume and values of MAPs export listed in Tab. 4.2.

Analysis of the records on export of MAPs products from Afghanistan during last decade shows that there is an exponential trend in the marketing and export of these products. Improvement in security in remote areas and increasing regional market demands seem to be the main reasons for this trend. (See Tab. 4.1). The table lists the export volumes and values of these products during 2008-2016. The study suggests that over the years, the extent of Afghanistan exports of the MAPs has increased sharply from 2008 to 2016. However, this growth on an annual basis shows some deviations and did not grow steadily. In the data for the last three years, 2014-2016, this stability is observed.

Despite the fact that after a limited number of years, security has become challenging again, export of MAPs and their products have tended to grow as is revealed by the data.

For the period studied, the growth tendency of exported items on yearly basis, with some deviation in quantity of volume (Kg) and value (USD), is demonstrated in the following figure.

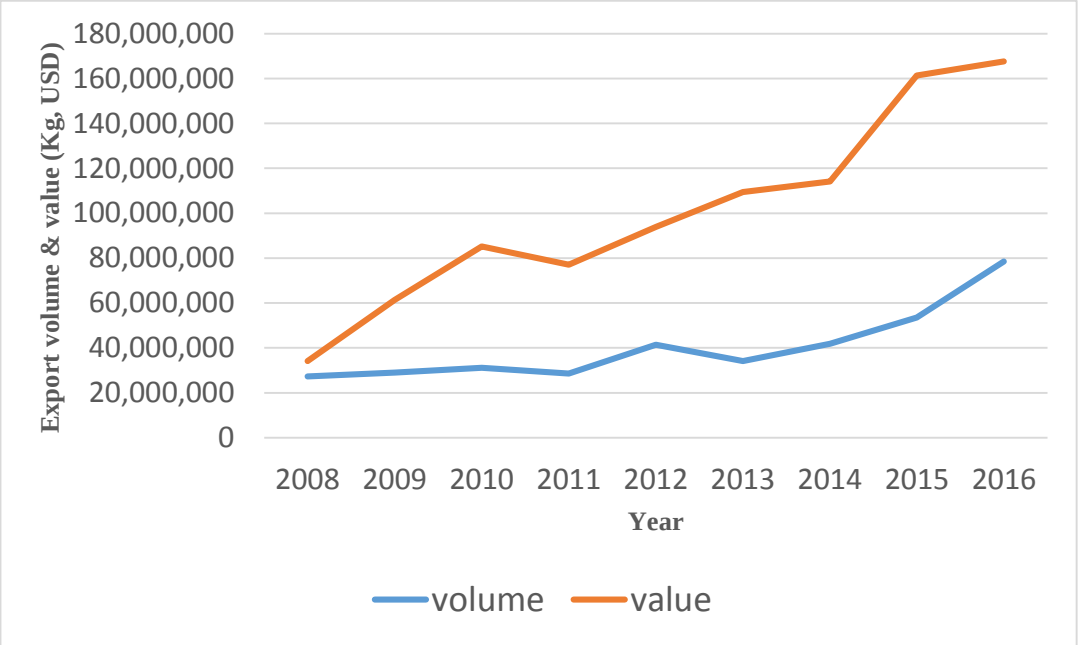


Figure 4.1: Trends in annual growth of export volume and value of MAPs (Kg, USD).

In view to obtain detailed picture of the tendency, the annual growth rate (AGR) has been calculated. Table 4.3 lists the details of these calculations.

Table 4.3: Annual growth rate (AGR) in volume and value of export of MAPs.

#	Year	Volume		Value	
		Amount (Kg)	AGR (%)	Amount (USD)	AGR (%)
1	2008	27,232,870		34,084,374	
2	2009	29,048,993	6.7	61,320,656	79.9
3	2010	31,088,087	7.0	85,123,362	38.8
4	2011	28,572,139	-8.1	77,122,751	-9.4
5	2012	41,417,203	45.0	93,890,497	21.7
6	2013	34,182,787	-17.5	109,456,804	16.6
7	2014	41,765,062	22.2	114,171,096	4.3
8	2015	53,520,295	28.1	161,370,812	41.3
9	2016	78,440,112	46.6	167,631,003	3.9

The graphical demonstration of Annual Growth Rate (AGR) in volume of exports is presented below:

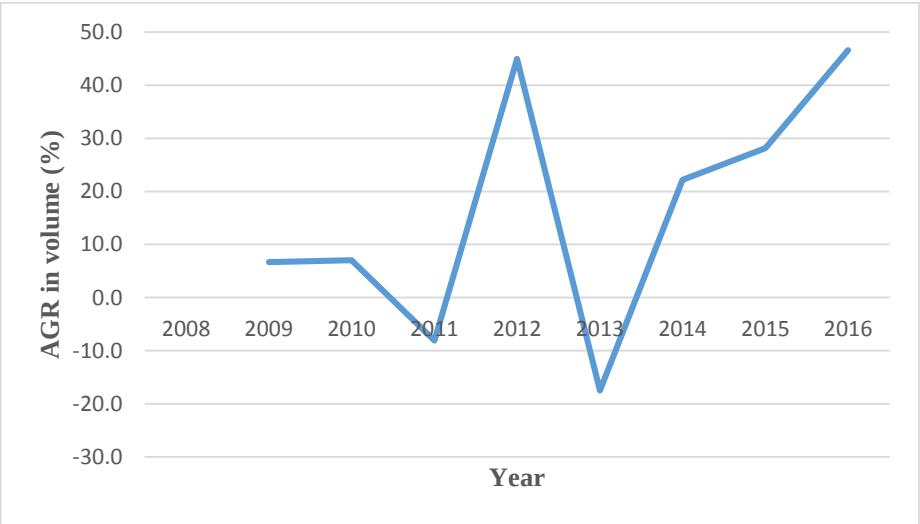


Figure 4.2: Trends in annual growth rate of export volume of MAPs.

This graph suggests that in 2011 and 2013 AGR has declined compared to previous respective years.

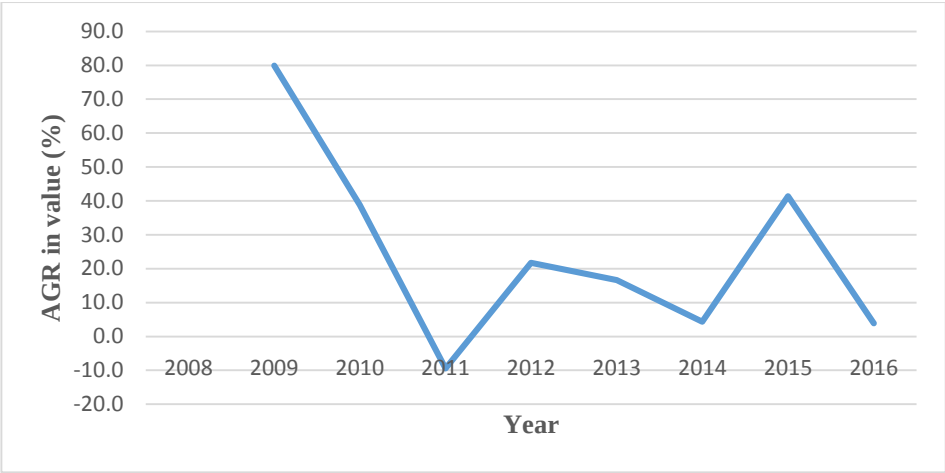


Figure 4.3: Trends in annual growth rate of export value of MAPs.

The correlation of export volume and value of MAPs is presented in the following figure:

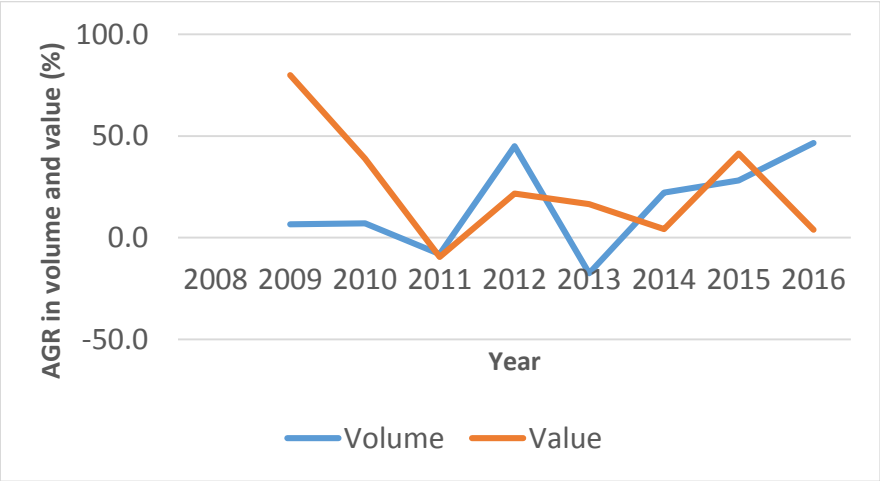


Figure 4.4: Trends in annual growth rate of export volume and value of MAPs.

The annual volume of exports has shown some volatilities moving up and down and the volume and value lines do not match each other. This discrepancy is caused by different factors: the most important can be argued to be the significant role of saffron production and also the instability in the regional market prices for the Afghanistan MAPs. Furthermore, the security deterioration in certain provinces producing these items and illegal export of MAPs can affect this trend as well.

For the study period, an annual average growth rate (AAGR) of 16.2% with comparison to 2.4% in the volumes of export in global trade (Vasisht, Sharma & Karan, 2016) was observed. The total worldwide export of 538,374 tons in the year 2001 increased to 696,686 tons in the year 2014 with an average annual growth rate (AAGR) of 2.4% from 2001 to 2014 (Vasisht et al., 2016). During the same period the AAGR of the total value of exports registered was 24.6% in comparison to 9.2% of the AAGR of the value of export in global trade (from USD 1.04 billion in 2001 to USD 3.60 billion in 2014).

Based on the volume and value of the export, distribution pattern, sustainability of the supply chain and socioeconomic factors, the products were ranked accordingly (See Tab. 4.4). The highest potential items have been selected as per the results of the calculation in Tab. 3.1. The following table lists the selected medicinal and aromatic plants for study in this research:

Table 4.4: List of selected medicinal and aromatic plants.

#	Item	Local Name	Rank
1	*Glycyrrihiza* sp.	Sherin booia	1
2	*Ferula* sp.	Heng	2
3	*Cuminum* sp.	Zeera sabz	3
4	*Bunium* sp.	Zeera sia	4
5	*Carum* sp.	Zeera Safid	5

The last product is the dominantly cultivated *Carum carvi* L. produced in many provinces, particularly in western provinces of Herat, Farah and Badghis. Since this plant is collected both wildly and the main portion of the export made by cultivated product, therefore it was omitted from the list of the studied plants.

4.1.2. Distribution of selected MAPs

The distribution pattern of selected MAPs was studied on the basis of the available literature and documents on flora of the country. As was discussed earlier, the lack of any resource assessment in Afghanistan has hampered any reliable speculation in this regard. Nevertheless, according to available sources (Ministry of Commerce & Industries, 2018; FAO, 2016; Sidiqi, 2014; Breckle et al, 2013; Emadi, 2011; Breckle et al, 2010; Arez, 2007; Younus, et. al 1987) the following mapping can be established:

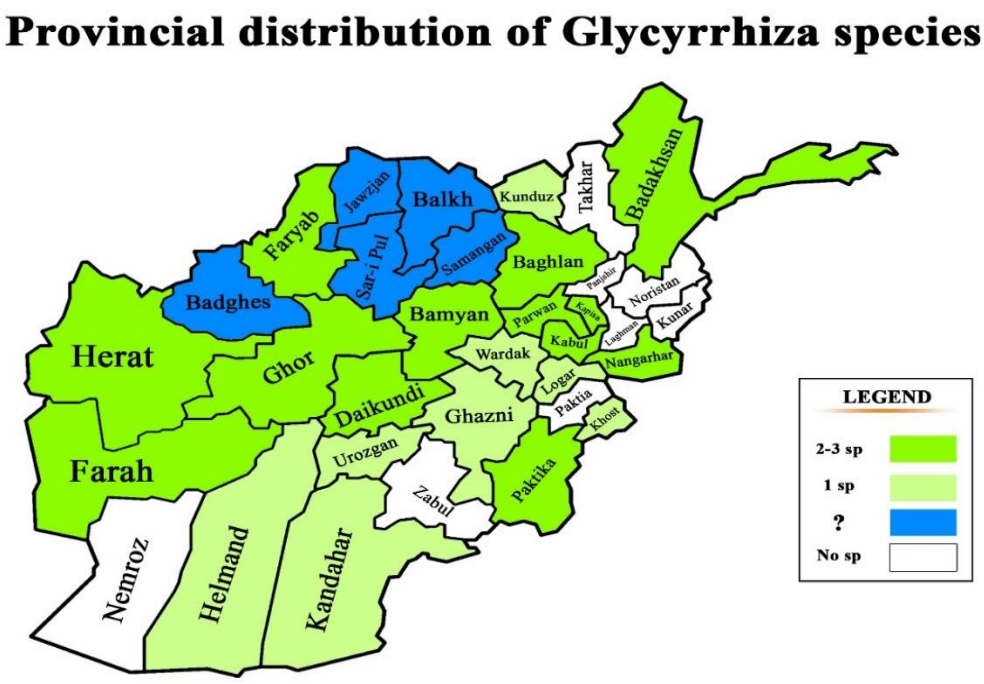


Figure 4.5: Distribution pattern of *Glycyrrhiza* sp. in the provinces of Afghanistan.

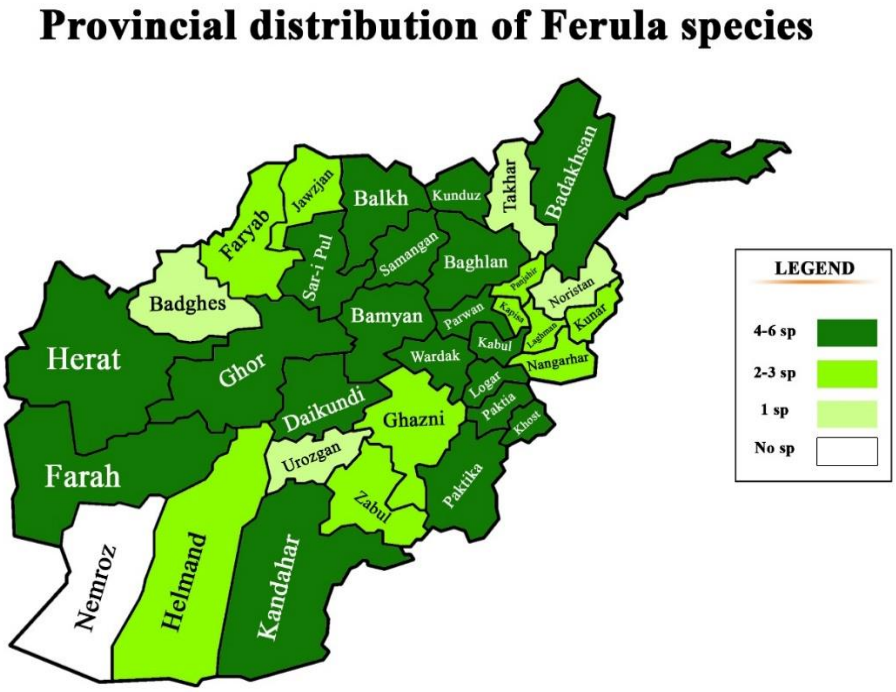


Figure 4.6: Distribution pattern of *Ferula* sp. in the provinces of Afghanistan.

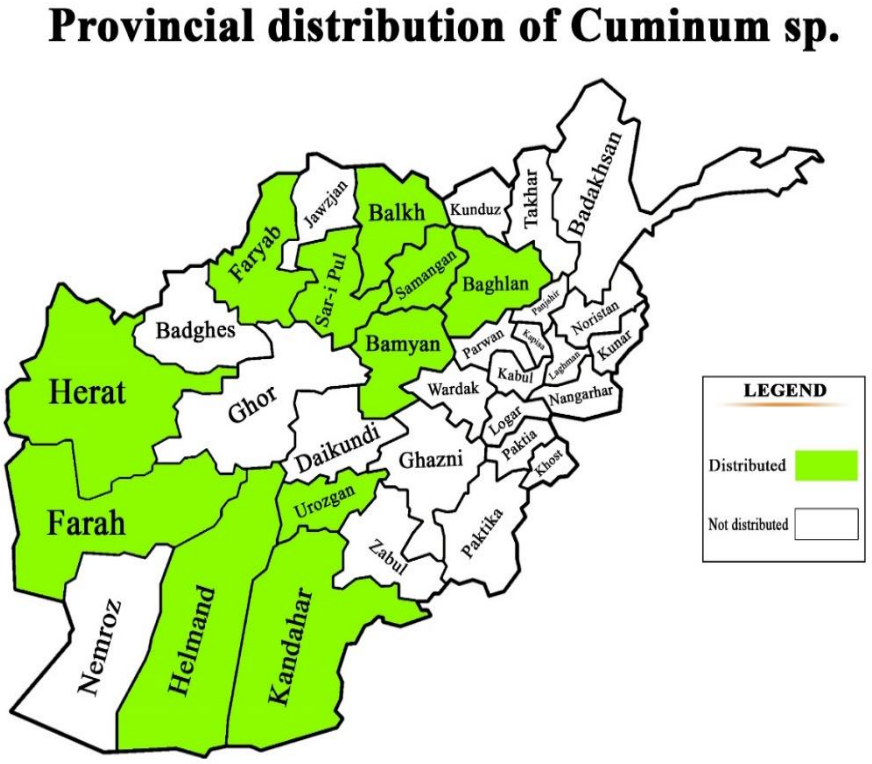


Figure 4.7: Distribution pattern of *Cuminum* sp. in the provinces of Afghanistan.

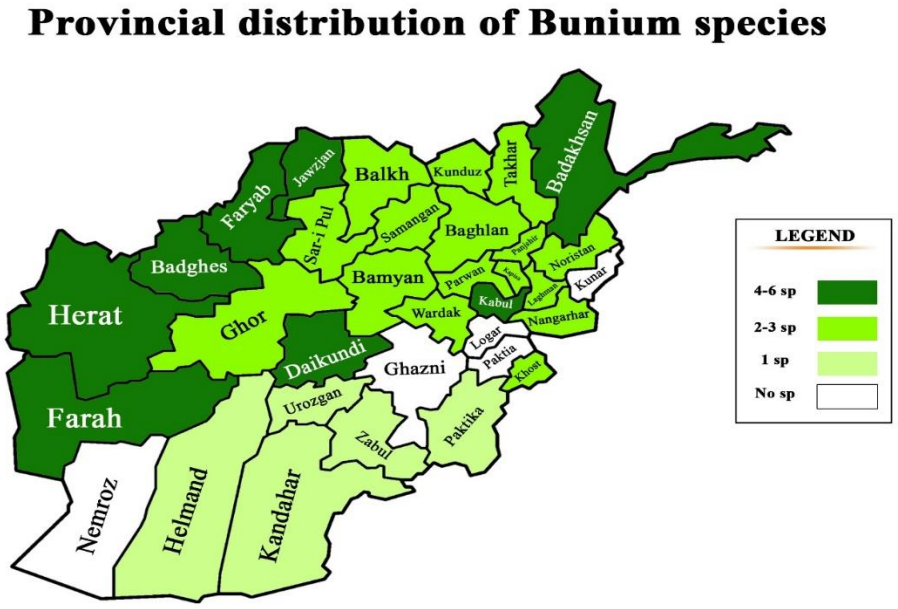


Figure 4.8: Distribution pattern of *Bunium* sp. in the provinces of Afghanistan.

Comparative study of these distribution maps reveals that Herat has bigger and richer numbers of the focused MAPs. Furthermore, the security situation compared to other similar provinces with potential capacities of the selected MAPs is better. Herat, once declared the ‘deadliest province for landmines’ was declared ‘landmine free’ in February 2018 (EASO, 2018). The availability of the motivated staff of agriculture in the districts offices of agriculture was another reason for conducting this study in this province.

Herat is one of Afghanistan's major trading hubs and has strong historical trade ties with Iran and Turkmenistan and is expanding to India and other countries because of its international airport. Small- and medium-sized enterprise industries are well developed in Herat, particularly in handicrafts, rugs, silk and medicinal plants products. The province has industry including shoes, mobile-phones, refrigerators and some other factories.

Therefore, for the aforementioned reasons, the resource assessment study targets Herat Province. Herat has 15 following districts:

1. Adraskan
2. Chesht-e-Sharif
3. Farsi
4. Ghorian
5. Gulran
6. Guzara
7. Injil
8. Karokh
9. Kohsan
10. Kushk-e-Robat Sangi
11. Kushk-e-Kohna
12. Obe
13. Pashtun Zarghun
14. Shendand
15. Zendajan

The two districts of Guzara and Injil surround the city of Herat in the North, South, and West and the expansion of urban areas in Herat city has made a critical impact on undermining the rangeland and agricultural areas of these districts. Therefore, these two districts don't play a tangible role in wild collection and production of natural ingredients in Herat.

The order of the lists of districts respected in result generation in respective tables and figures in below.

The detailed land cover information for Herat is demonstrated in Fig. 1.9., and Tab. 1.22.

The study was conducted according to the section "Materials and Methods" and targeted four crucial dimensions of the natural resources of MAPs. The scoring process lasted 10 months (October 2017 –August 2018). Verification measures were taken to obtain reliable data from the fields (See page 83).

The results of four different aspects of assessments for every targeted MAP are listed in respective tables below.

4.2. *Glycyrrhiza* sp. (Licorice)

Unlike other selected MAPs, *Glycyrrhiza* sp. is distributed and produced in all districts of the province.

(A) (B)

Figure 4.9: *Glycyrrhiza* sp. (A) and its community (B) in Paktia (Photo by Babury, 2005).

The results of resource assessment of the MAPs are listed in the following table.

Table 4.5: Results of resource assessment of *Glycyrrhiza* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abundance and state of conservation of the species	Abundant and required state of conservation	3															
		Sufficient and uncertain state of conservation	2	2	2	2	2	2						2		2	2	
		Some initiatives are under development to improve conservation	1								1	1			1			1
		Under threat	0						0	0			0					
2	Potential for sustainable management	High	3															
		Moderate	2		2	2	2	2				2				2		
		Mild	1	1					1	1	1		1	1	1		1	1
		Low	0															
3	Impact of production for harvesting on the species and its habitats	Positive	3															
		Neutral	2		2	2	2	2		2		2					2	
		Negative	1	1					1		1		1	1	1			1
		Critical	0													0		
4	There are guidelines for	Guidelines exist and they are being used	3															

	the implementation of good collection practices	Guidelines exist, but they need improving	2					2			2	2	2		2		2	
		Development of guideline is under process	1															
		No guidelines exist	0	0	0	0	0		0	0				0		0		0
5	Availability of a suitable environmental or any other certification mechanism	There is a mechanism and it is being used	3															
		There is a mechanism, but it is not being used, or it needs improvements	2															
		Some initiatives have been taken to introduce certification	1															
		There is no mechanism	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SUB TOTAL			4	6	6	6	8	2	3	5	7	4	5	4	4	7	3

Table 4.6: Results of trade and marketing assessment of *Glycyrrhiza* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Quantity and quality of the	Sufficient/ reliable	3		3	3		3					3	3				
		Inadequate/ imprecise	2	2			2					2				2		2

	information about the existing market	Is being developed	1						1								1	
		Non-existent/ unreliable	0							0	0				0			
2	Potential market demand	High	3	3	3	3							3	3	3	3	3	
		Moderate	2				2	2	2	2		2						
		Mild	1								1							1
		Limited	0															
3	Scale of production	High	3		3												3	
		Moderate	2			2	2	2						2				
		Mild	1	1							1	1	1		1	1		1
		Low	0						0	0								
4	Experience of the product in the market	Already on the market	3	3	3	3		3		3	3				3			
		In development	2				2						2	2			2	
		There are opportunities to be on the market	1						1			1				1		1
		No development currently taking place	0															
5	Competition (as a threat to maintaining the market place)	Weak	3	3	3	3		3	3	3		3	3					3
		Mild	2				2				2				2	2		
		Moderate	1											1			1	
		Strong	0															

6	Evaluation of financial feasibility (analysis of economic viability of investment)	Good profitability	3					3				3						
		Moderate profitability	2	2			2		2		2		2			2		
		Mild profitability	1											1				
		Low profitability	0		0	0				0					0			0
7	Quality of production	Good	3	3	3	3												
		Moderate	2					2			2						2	
		Mild	1				1					1				1		1
		Low	0						0	0			0	0	0			
8	Potential for certification in the market	High	3		3	3					3							
		Moderate	2				2	2				2		2		2	2	
		Mild	1	1					1	1			1		1			1
		Low	0															
	SUB TOTAL			18	21	20	15	20	10	9	14	15	15	14	10	14	14	10

Table 4.7: Results of socioeconomic assessment of *Glycyrrhiza* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Potential for generation of employment	High	3		3	3		3										
		Moderate	2									2					2	2

		Mild	1	1			1		1	1	1		1	1	1	1		
		Low	0															
2	Suitability of production for the livelihood of the communities (Natural Capital)	High	3		3	3						3				3		
		Moderate	2				2	2			2		2	2			2	2
		Mild	1	1					1	1					1			
		Low	0															
3	Suitability of production for alternative livelihood of the communities	High	3															
		Moderate	2				2										2	2
		Mild	1	1				1	1	1	1	1		1	1			
		Low	0		0	0							0			0		
4	Suitability of production for local communities or small entrepreneur	Very suitable	3									3					3	
		Moderately suitable	2	2	2	2	2	2	2				2	2	2			2
		Mildly suitable	1							1	1					1		
		Unsuitable	0															
5	Experience of local communities with the product	Considerable	3		3	3		3										
		Moderate	2	2			2					2	2	2	2		2	2
		Mild	1						1	1	1					1		
		Little	0															
6	Additional benefits to small businesses	Many	3		3	3												
		Moderate	2				2	2			2	2			2		2	

		Mild	1	1					1	1								1
		Few	0										0	0		0		
	SUB TOTAL			8	14	14	11	13	7	6	8	13	7	8	9	6	13	11

Table 4.8: Results of assessment of technological proficiencies of *Glycyrrhiza* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abilities and skills	High	3															
		Moderate	2	2			2	2									2	
		Mild	1						1		1					1		1
		Low	0		0	0				0		0	0	0	0			
2	Human resources	Available	3															
		Moderate	2															
		Mild	1	1	1		1	1	1				1			1	1	1
		Limited	0			0				0	0	0		0	0			
3	Technological requirements for improving processes	Low	3															
		Mild	2			2	2	2				2					2	2
		Moderate	1															
		High	0	0	0				0	0	0		0	0	0	0		

4	State of infrastructure	High	3															
		Moderate	2					2										2
		Mild	1	1			1			1		1			1	1	1	
		Low	0		0	0			0		0		0	0				
5	Quality control requirements	Low	3															
		Mild	2		2	2	2				2	2			2			
		Moderate	1	1				1		1				1		1	1	1
		High	0						0				0					
6	Availability of technical support	Available	3															
		Moderate	2	2			2										2	
		Mild	1					1			1							
		Limited	0		0	0			0	0		0	0	0	0	0		0
	SUB TOTAL			7	3	4	10	9	2	2	4	5	1	1	3	4	9	7
	Grand Total			37	44	44	42	50	21	20	31	40	27	28	26	28	43	31
	Ranks			6	2	2	4	1	11	12	7	5	9	8	10	8	3	7

The results of the resource assessment in Tab 4.5 show that districts Gulran (8), Kohsan (7) and Shendand (7) have respectively the highest and Guzara (2), Injil (3) and Zendajan (3) have the lowest value (from the highest composite score of 15) in status of the resources.

The results of trade and marketing assessments in Tab. 4.6 demonstrate that districts Chesht-e-Sharif (21), Farsi (20), and Adraskan (18) have respectively the highest and Injil (6), Pashtun Zarghun (6), Guzara (7), and Kushk-e-Robat Sangi (7) have respectively the lowest value (from the highest composite score of 24).

The results of the socioeconomic assessment in Tab. 4.7 show that districts Chesht-e-Sharif (14), Farsi (14), and Gulran (13), Kohsan (13), and Shendand (13) have respectively the highest and Injil (6), Pashtun Zarghun (6), Guzara (7), and Kushk-e-Robat Sangi (7) have the lowest value (from the highest composite score of 18).

The results of the technological proficiencies assessment in Tab. 4.8 demonstrate that districts Ghorian (10), Gulran (9) and Shendand (9) have respectively the highest and Kushk-e-Robat Sangi (1), Kushk-e-Kohna (1), Guzara (2) and Injil (2) have the lowest value (from the highest composite score of 18).

The grand totals of results of the four assessment frameworks of *Glycyrrhiza* sp. demonstrate the following ranking of the districts:

Table 4.9: Ranking of districts based on results of the *Glycyrrhiza* sp. assessment.

#	District	Grand total of scoring	Rank
1	Adraskan	37	6
2	Chesht-e-Sharif	44	2
3	Farsi	44	2
4	Ghorian	42	4
5	Gulran	50	1
6	Guzara	21	11
7	Injil	20	12
8	Karokh	31	7
9	Kohsan	40	5
10	Kushk-e-Robat Sangi	27	9
11	Kushk-e-Kohna	28	8
12	Obe	26	10
13	Pashtun Zarghun	28	8
14	Shendand	43	3

15	Zendajan	31	7

The table depicts that from the highest composite score of 75, Gulran occupies the first (50), Chesht-e-Sharif (44) and Frasi (44) the second and Shendand (43) the third place in overall aspects of the assessment; however, districts of Obe (26), Kushk-e-Robat Sangi (27), and Kushk-e- Kohna (28) occupy the lowest places respectively. As it has been discussed earlier the two districts of Guzara and Ingil should be disregarded from this assessment because of the expansion of urbanization in these areas.

4.3. *Bunium* sp. (black cumin)

The plant is widely distributed in different provinces of the country (See Tab. 3.3) and has a specific place in culinary and traditional medicine of the country.

This plant is not distributed in significant quantities in the following districts of Herat:

1. Ghorian (4)
2. Guzara (6)
3. Injil (7)
4. Kohsan (9)
5. Obe (12)

The results of the assessment of different dimensions of Fructus *Bunii* (black cumin) are listed in the Tab. 8.8 - Tab. 8.11 in Appendix 8.5.

The results of the resource assessment in Tab. 8.8 show that districts Chesht-e-Sharif (8), Karokh (8) and Pashtun Zarghun (8) have the highest and Zendajan (2) has the lowest value (from the highest composite score of 15) in status of the *Bunium* sp. resources.

The results of trade and marketing assessments in Tab. 8.9 demonstrate that districts Chesht-e-Sharif (22), Farsi (20), have respectively the highest and Zendajan (6), and Kushk-e-Kohna (8) have respectively the lowest value (from the highest composite score of 24).

The results of the socioeconomic assessment in Tab 8.10 show that districts Chesht-e-Sharif (14) and Farsi (14) have the highest and Kushk-e-Robat Sangi (5) has the lowest value (from the highest composite score of 18).

The results of the technological proficiencies assessment in Tab. 8.11 demonstrate that districts and Shendand (10) has the highest and Zendajan (3) has the lowest value (from the highest composite score of 18).

The grand total of results of the four assessment frameworks of *Bunium* sp. demonstrate the following ranking of the districts:

Table 4.10: Ranking of districts based on results of the *Bunium* sp. assessment.

#	District	# Dist. in framework	Grand total of scoring	Rank
1	Adraskan	1	37	5
2	Chesht-e-Sharif	2	50	1
3	Farsi	3	46	2
4	Gulran	5	28	7
5	Karokh	8	38	4
6	Kushk-e-Robat Sangi	10	27	8
7	Kushk-e-Kohna	11	24	9
8	Pashtun Zarghun	13	42	3
9	Shendand	14	33	6
10	Zendajan	15	19	10

In ten producing districts of *Bunium* sp. in Herat, from the highest composite score of 75 Chesht-e-Sharif (50), Farsi (46) and Pashtun Zarghun (42) take respectively the first, second and third positions in this assessment; meanwhile, Zendajan (19), Kushk-e-Kohna (24) and Kushke-e-Robat Sangi (27) take the lowest positions.

4.4. *Cuminum* sp. (Cumin)

This plant is not distributed in significant quantities in the following districts of Herat:

1. Chisht-e-Sharif
2. Farsi
3. Injil

The results of the assessment of different dimensions of *Cuminum* sp. (cumin) are listed in the Tab. 8.12 - Tab. 8.15 in Appendix 8.5.

The results of the resource assessment of *Cuminum* sp. in Tab. 8.12 show that districts Karokh (9), Pashtun Zarghun (9), and Kohsan (8) have respectively the highest and Zendajan (0), Ghorian (1), and Gulran (2) have the lowest value (from the highest composite score of 15) in status of the resources.

The results of trade and marketing assessments in Tab. 8.13 demonstrate that districts Adraskan (18), Kohsan (18), and Kushk-e-Robat Sangi (17) have respectively the highest and Zendajan (8) has the lowest value (from the highest composite score of 24).

The results of the socioeconomic assessment in Tab. 8.14 show that districts Kohsan (16) has the highest and Gulran (5) has the lowest value (from the highest composite score of 18).

The results of the technological proficiencies assessment in Tab. 8.15 demonstrate that district Gulran (10) has the highest and Kushk-e-Robat Sangi (3), Kushk-e-Kohna (1) has the lowest value (from the highest composite score of 18).

The grand total of results of the four assessment frameworks of *Cuminum* sp. demonstrate the following ranking of the districts:

Table 4.11: Ranking of districts based on results of the *Cuminum* sp. assessment.

#	District	# Dist. in framework	Grand total of scoring	Rank
1	Adraskan	1	40	4
2	Ghorian	4	25	11
3	Gulran	5	32	9
4	Guzara	6	29	10
5	Karokh	8	38	6
6	Kohsan	9	49	1
7	Kushk-e-Robat Sangi	10	39	5
8	Kushk-e-Kohna	11	33	8
9	Obe	12	34	7
10	Pashtun Zarghun	13	43	2
11	Shendand	14	43	3
12	Zendajan	15	19	12

In the list of districts producing cumin in Herat, from the highest composite score of 75 districts of Kohsan (49), Pashtun Zarghoon (43), and Shendand (43) take respectively the first and second positions in this assessment, while Ghorian (25), and Gulran (9) count for the lowest rank in the assessment.

4.5. *Ferula* sp. (Asa foetida, Heng)

The product is not collected in significant amount in the following districts of Herat:

1. Chisht-e-Sharif (2)
2. Farsi (3)
3. Guzara (6)
4. Injil (7)
5. Obe (12)

The product was known in ancient times in eastern, western, and Mediterranean territories. Afghanistan is considered as one of the world suppliers of the product. The information from traders indicate that Herat in 2015/2016 (1395) exported around 400 MT of this oleo-gum-resin to India and Pakistan. Meanwhile, information shows that large volumes of the oleo-gum-resin from Dorema sp. ("Kundal") also were exported during this year to Iran and two other countries (See Tab. 8.4, App. 8.1).

The results of the assessment of different aspects of *Ferula* sp. are listed in Tab. 8.16 - Tab. 8.19 in Appendix 8.5.

The results of the resource assessment of *Ferula* sp. in Tab. 8.16 show that the resources and the conservation status of this species are in critical status. The districts of Pashtun Zarghun (7) and Shendand (7), and Kohsan (6) have the medium status, while Kushk-e-Robat Sangi (2) has the lowest value (from the highest composite score of 15) in status of the resources.

The results of trade and marketing assessments in Tab. 8.17 depict that district Kohsan (16) occupies the highest place and Kushk-e-Kohna (1) makes the lowest degree (from the highest composite score of 24).

The results of the socioeconomic assessment in Tab. 8.18 demonstrate the promising socioeconomic role of the species in the districts. They show that Kushk-e-Robat Sangi (14) and Kushk-e-Kohna (13) have the highest and Gulran (7) and Shendand (7) have the lowest value (from the highest composite score of 18).

The results of the technological proficiencies assessment in Tab. 8.19 demonstrate that district Shendand (9) and Karokh (7) respectively occupy the highest places and Kushk-e-Robat Sangi (2), Kushk-e-Kohna (2), and Adraskan (3) occupy the lowest places respectively (from the highest composite score of 18).

The grand total of results of the four assessment frameworks of *Ferula* sp. demonstrate the following ranking by district:

Table 4.12: Ranking of districts based on results of the *Ferula* sp. assessment.

#	District	# District in framework	Grand total of scoring	Rank
1	Adraskan	1	24	7
2	Ghorian	4	27	5
3	Gulran	5	27	5
4	Karokh	8	32	4
5	Kohsan	9	38	1
6	Kushk-e-Robat Sangi	10	24	7
7	Kushk-e-Kohna	11	20	8
8	Pashtun Zarghun	13	33	3
9	Shendand	14	36	2
10	Zendajan	15	25	6

The Tab. 4.24 demonstrates that from the highest composite score of 75, Kohhsan (38), Shendand (36), and Pashtun Zarghun (33) respectively take the highest rank in this assessment; meanwhile, Adraskan (24), and Kushk-e-Kohna (20) count for the lowest rank in the assessment.

4.6. Calculation of mean values of assessment results

In order to obtain a decent picture of the assessment, the mean of every aspect of the assessment has been calculated and the values are shown in the following tables and histograms. The analysis of the dataset has been calculated by Statistical Package of Social Science (SPSS), which is popular in other areas of sciences. The package enables us to obtain statistics ranging from simple descriptive numbers to complex analyses of multivariate matrices (Arkkelin, 2014). The package provide the possibility to plot the data in histograms, scatterplots, and other ways.

The mean value of every aspect of the assessment in the following tables and figures has been abbreviated as follows:

- Mean results of resource assessment as RAmean
- Mean results of trade and marketing as TMmean
- Mean results of socioeconomic as SEmean
- Mean results of technological proficiency as Techmean

Table 4.13: Mean values of the four aspects of the assessment of MAPs.

#	Mean value	N	Range	Minimum	Maximum	Sum	Mean	Std. deviation
1	RAmean	47	1.80	0.000	1.800	44.800	0.953	0.448
2	TMmean	47	2.63	0.125	2.750	79.500	1.691	0.562
3	SEmean	47	2.00	0.667	2.667	73.500	1.564	0.508
4	Techmean	47	1.50	0.167	1.667	43.500	0.926	0.406

TMmean has the highest value, while the lowest place is occupied by the Tech mean.

The value of mean for every aspect, plant and district is illustrated in histograms in the figures below. These figures allow a comparative revelation of the level of every criterion for every plant and district.

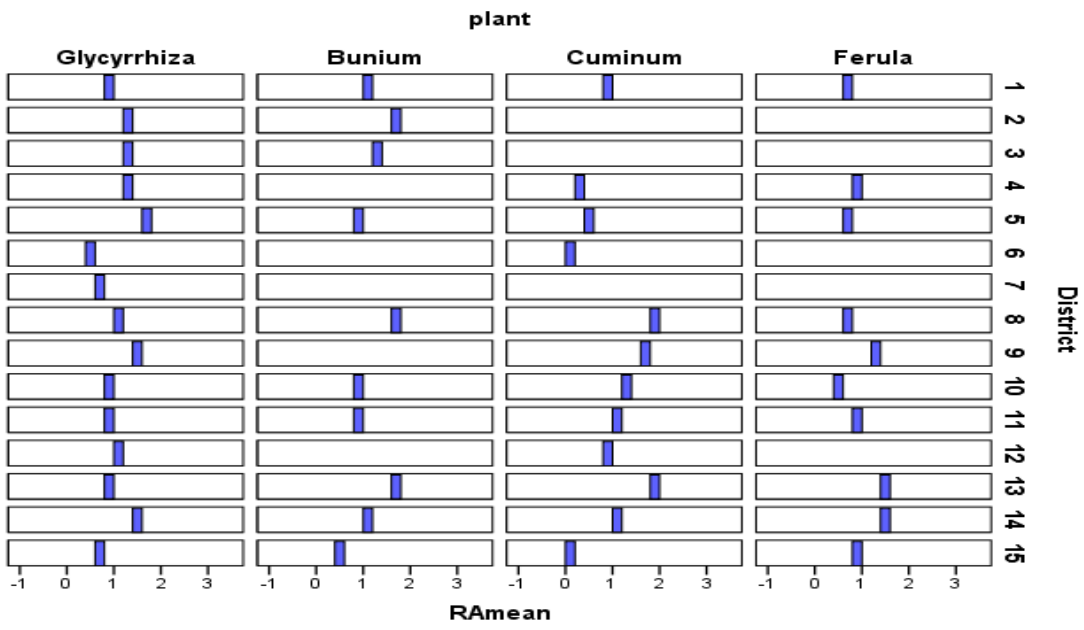


Figure 4.10: The mean values of resource analysis (RAmean) of studied plants.

RAmean has lower values than TMmean and SE mean, and it has slightly better position for *Glycyrrhiza* sp. than other three plants.

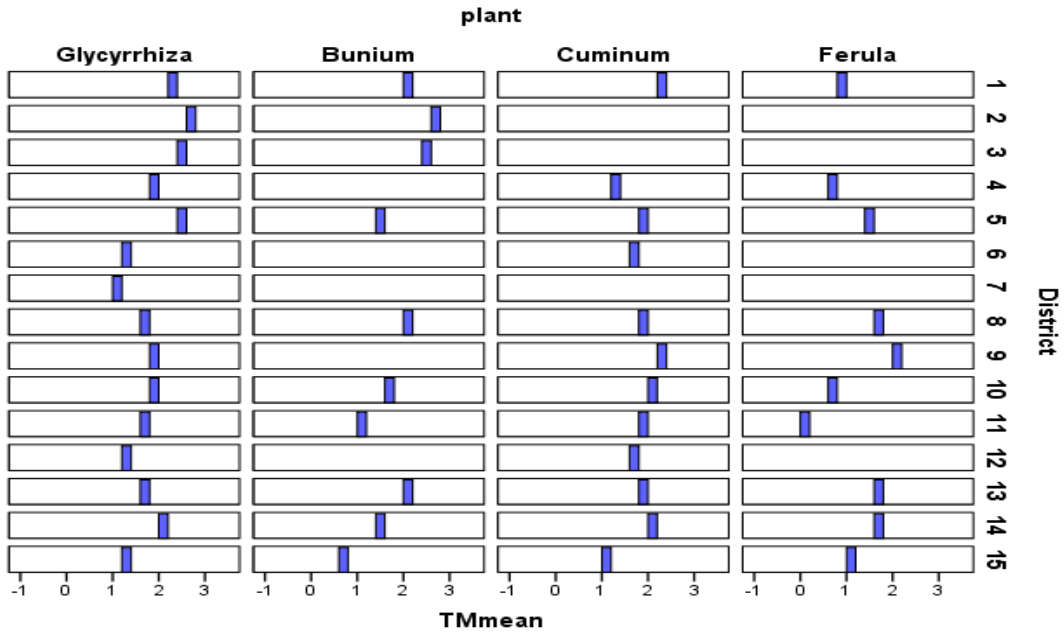


Figure 4.11: The mean values of trade and marketing assessment (TMmean) of studied plants.

TM mean has almost the same values as the RA mean for all studied species and the situation is a slightly better position for *Glycyrrhiza* sp. than the other three plants.

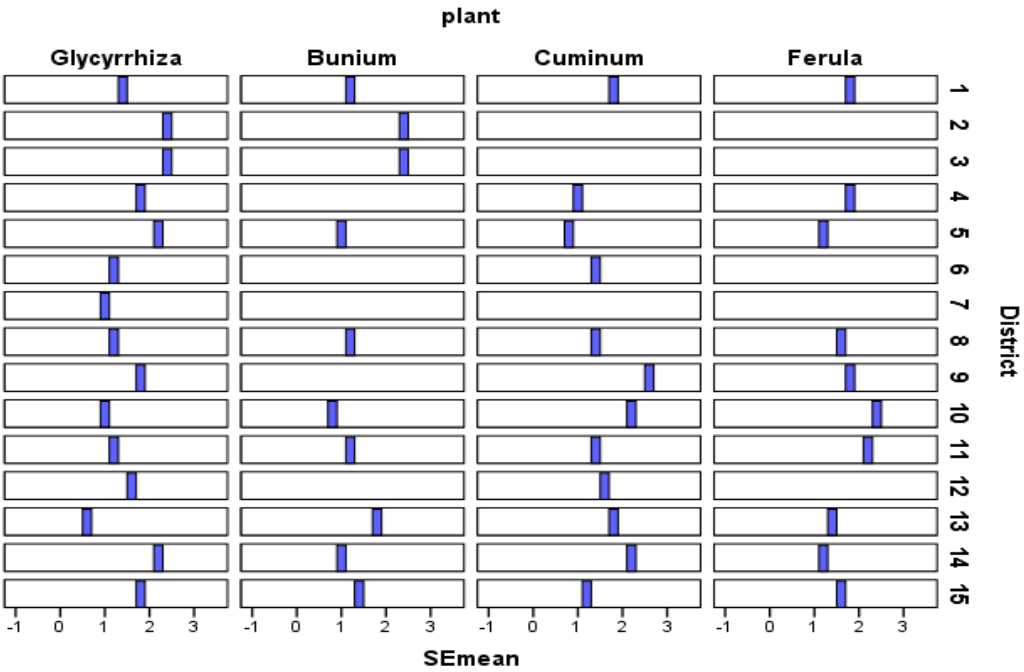


Figure 4.12: The mean values of socioeconomic assessment (SEmean) of studied plants.

All MAPs have relatively good SEmean value, however, *Ferula* sp. has highest values.

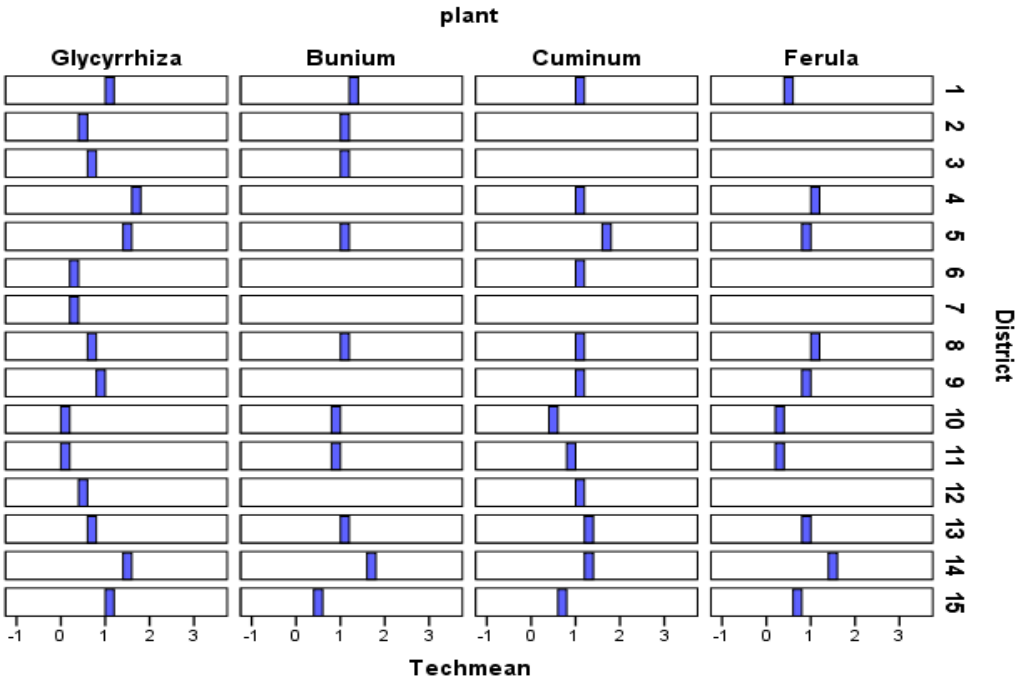


Figure 4.13: The mean values of technological proficiency assessment (Techmean) of studied plants.

Techmean has the lowest value for *Glycyrrhiza* sp. and districts 4, 5 and 14 have the highest value among the districts.

4.7. Review of descriptive statistics

In order to have a detailed data, the required descriptive statistics have been calculated and listed in the bellow table:

Table 4.14: Detailed descriptive statistics of the assessment of MAPs

#	Variables	N	Range	Minimum	Maximum	Sum	Mean
1	District	47	14	1	15	400.0	8.51
2	Plant	4	3.00	1.00	4.00	111.0	2.3617
3	RAmean	47	1.80	0.00	1.80	44.8	0.9532
4	TMmean	47	2.63	0.13	2.75	79.5	1.6915
5	SEmean	47	2.00	0.67	2.67	73.5	1.5638
6	Techmean	47	1.50	0.17	1.67	43.5	0.9255
7	RA1	47	3	0	3	54	1.15
8	RA2	47	3	0	3	60	1.28
9	RA3	47	2.0	0.0	2.0	55.00	1.1702
10	RA4	47	2.0	0.0	2.0	46.00	0.9787
11	RA5	47	1.0	0.0	1.0	9.00	0.1915
12	TM1	47	3.0	0.0	3.0	70.00	1.4894
13	TM2	47	2.0	1.0	3.0	108.00	2.2979
14	TM3	47	3.0	0.0	3.0	62.00	1.3191
15	TM4	47	3.0	0.0	3.0	84.00	1.7872
16	TM5	47	3.0	0.0	3.0	97.00	2.0638
17	TM6	47	3.0	0.0	3.0	75.00	1.5957
18	TM7	47	3.0	0.0	3.0	57.00	1.2128
19	TM8	47	3.0	0.0	3.0	83.00	1.7660
20	SE1	47	3.0	0.0	3.0	84.00	1.7872
21	SE2	47	3.0	0.0	3.0	75.00	1.5957
22	SE3	47	3.0	0.0	3.0	48.00	1.0213
23	SE4	47	3.0	0.0	3.0	81.00	1.7234
24	SE5	47	3.0	0.0	3.0	79.00	1.6809
25	SE6	47	3.0	0.0	3.0	74.00	1.5745
26	Tech1	47	2.0	0.0	2.0	28.00	0.5957
27	Tech2	47	2.0	0.0	2.0	51.00	1.0851
28	Tech3	47	3.0	0.0	3.0	64.00	1.3617
29	Tech4	47	2.0	0.0	2.0	32.00	0.6809
30	Tech5	47	3.0	0.0	3.0	61.00	1.2979
31	Tech6	47	2.0	0.0	2.0	25.00	0.5319

4.8. Review of individual criteria

In order to analyze the detailed status of the resources of MAPs, certain criteria are elaborated.

4.8.1. Abundance and state of conservation

The abundance and state of the conservation of the plants studied is the first criteria in resource assessment and it has an essential importance in the resource assessment. The details of this criterion are depicted in figures below. They demonstrate that the abundancy and state of conservation for *Glycyrrhiza* sp. and *Cuminum* sp. are much better compared to the two other plants. The figures reveal that the status of Ferula sp. is critical.

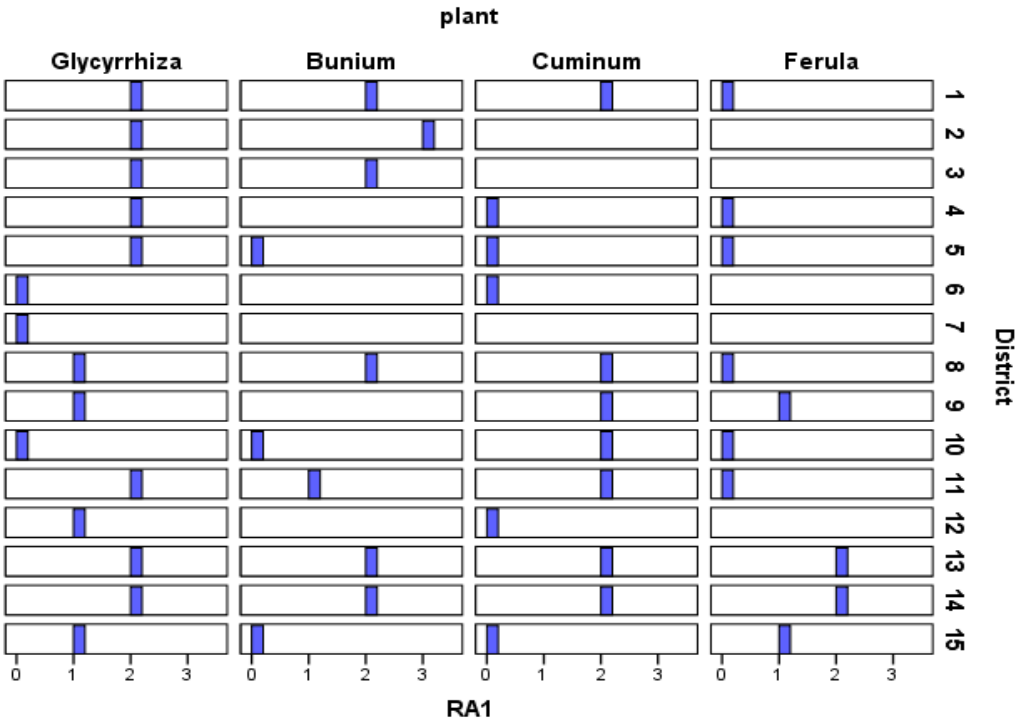


Figure 4.14: The Abundance and state of conservation assessment (RA1) of studied plants.

4.8.2. Impact of harvesting on the species and its habitats

Assessment of harvest impact on the viability of studied species reveals that obviously the resources of *Glycyrrhiza* sp. haven't been affected by the impact of the wild collection but in some way *Bunium* sp., *Cuminum* sp, and particularly *Ferula* sp. suffer more from harvesting. The last species suffers from destructive harvesting of oleo-gum-resin from the taproot and consequently has been seriously depleted and became under threat in six districts and the district offices of DAIL in two districts (Ghorian and Shendand) called a moratorium on the harvesting of the product in 2017.

It should be noted that *Glycyrrhiza* sp. and in somewise *Bunium* sp. and *Cuminum* sp. do not have a narrow geographic distribution in the country, nor are they habitat specific and do not have a sizeable population in the areas of distribution, hence overharvesting is not a very significant factor for them.

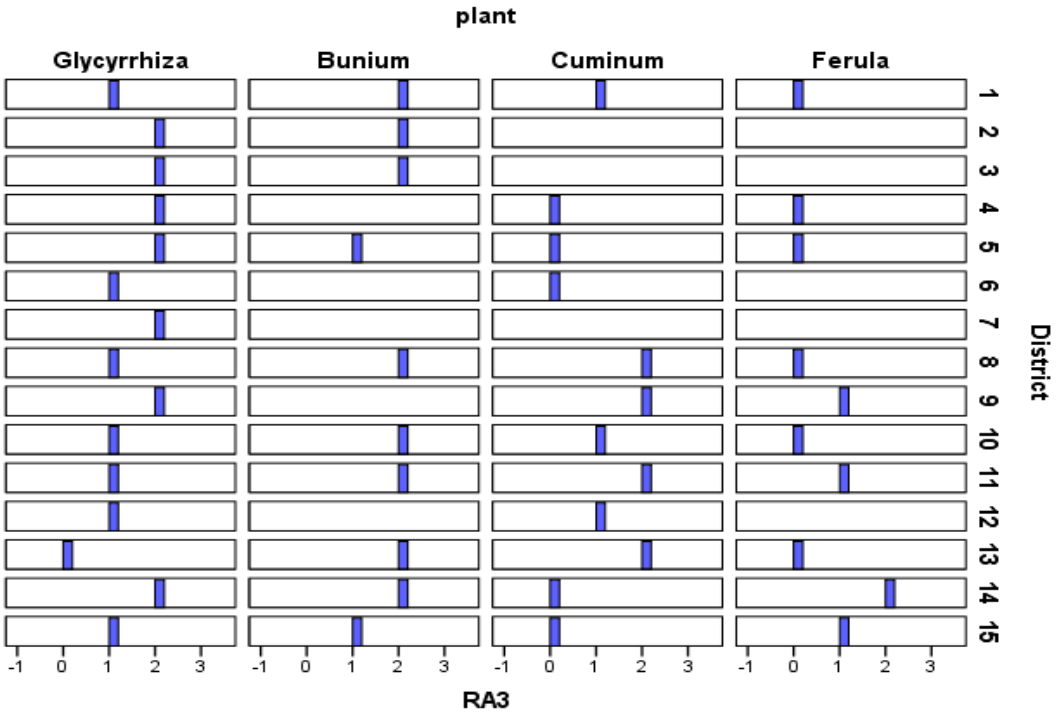


Figure 4.15: The impact of harvesting on the plant abundance and its habitat assessment (RA3) of studied plants.

4.8.3. Scale of production

The scale of production from the perspective of the market is one dimension, but from the natural resource point of view it could have a negative impact on the resources, particularly when the product has only wild resources. However, when this criteria is placed in a trade and marketing framework and the scale of product is considered as a positive factor to response the market needs.

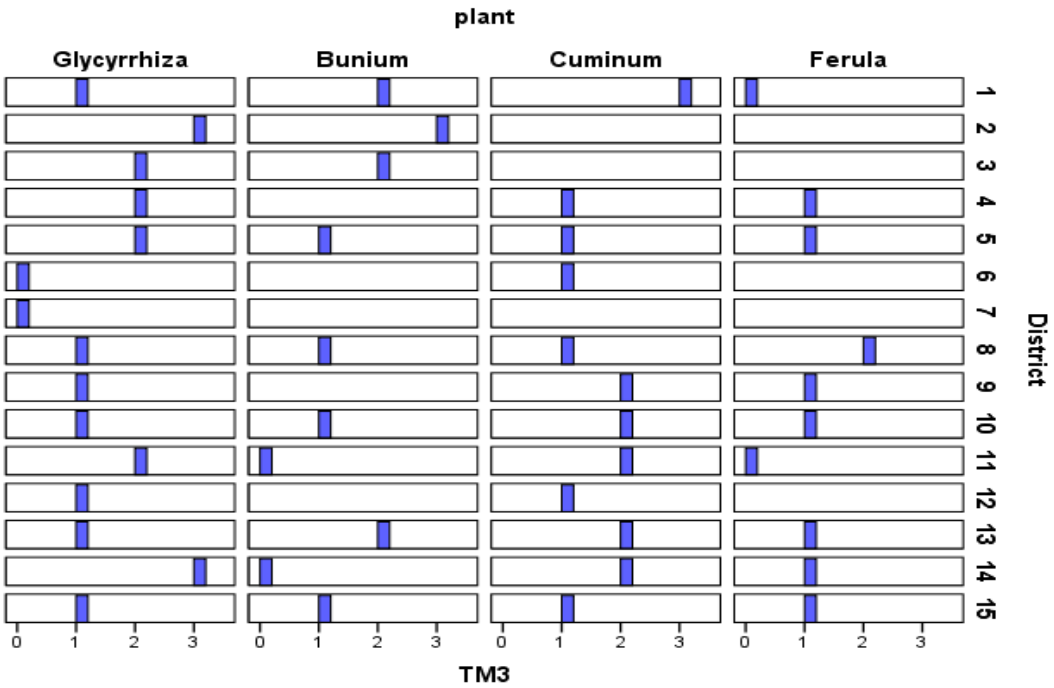


Figure 4.16: Assessment of scale of production (TM3) of studied plants.

The figures reveal that the scale of the production of the studied plants have irregular levels in different districts, but at the same time the production of *Glycyrrhiza* sp. and *Cuminum* sp. has higher levels than the two other plants.

4.8.4. Quality of production

The quality of the MAP products is one of the serious concerns for the market. This criterion is closely related to the collection practices and post-harvest treatment of the plants collected. The results of this assessment are illustrated in the figure below.

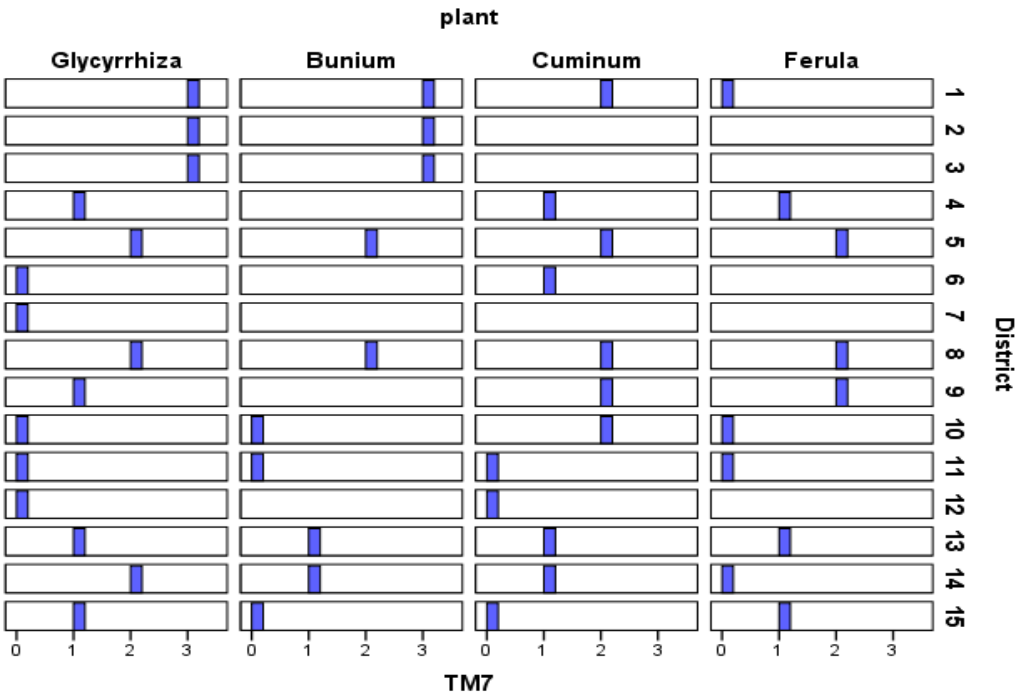


Figure 4.17: Assessment of quality of product (TM7) of studied plants.

The figures reveal that the quality of the product, in spite of having some nurturing conditions and opportunities ascribed below, has not been good even at moderate levels in most of the districts. It is obvious that the required measures for achieving desired quality varies between the products.

4.8.5. Potential for generation of employment

This criteria has a special place in the socioeconomic context of war affected Afghanistan. Realizing that 73% of population is rural with 1.5 million nomadic families (CSO, 2017 a), the values of this assessment demonstrate the vital potential for the improvement of the livelihood of communities. The results of this assessment are demonstrated in the following figure:

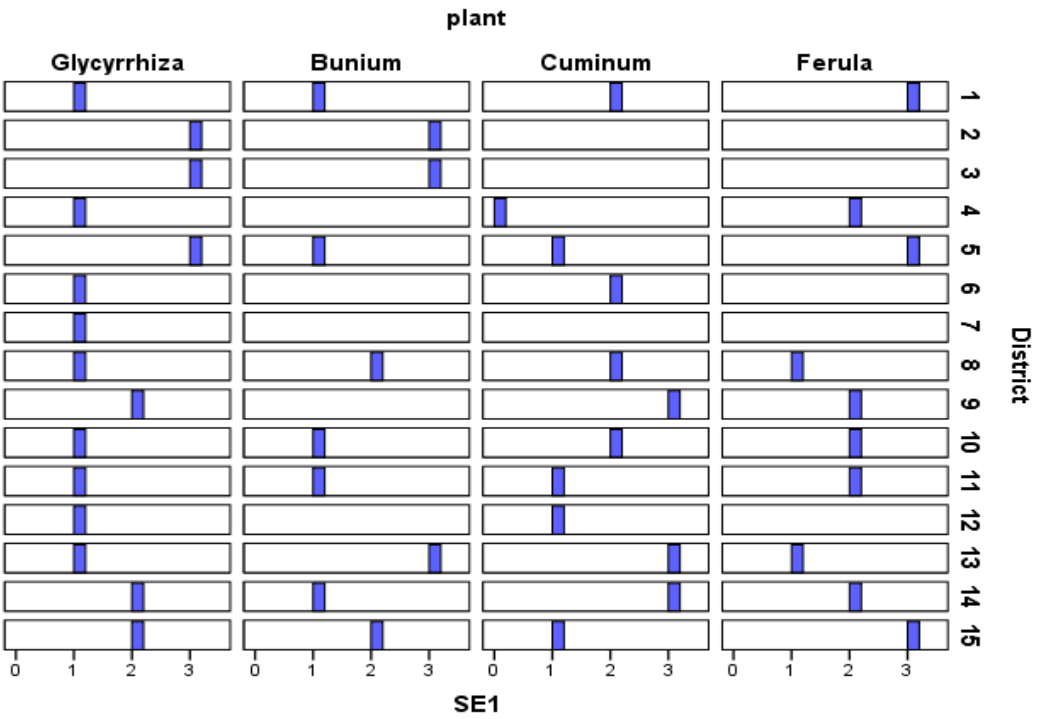


Figure 4.18: Assessment of potential for generation of employment (SE1) of studied plants.

The potential for employment related to the four MAPs are not evenly distributed in all districts, however, it is observable that in most of the provinces this criteria has mild and over mild status.

4.8.6. Suitability of productions for alternative livelihood of the communities

In contemporary Afghanistan alternative livelihoods have a vital importance for the rural population, though in the Herat districts poppy cultivation is not common. This opportunity of wild collection was included in the socioeconomic assessment framework because of the fragile security situation in the country and in this province.

The assessment results of suitability of productions for alternative livelihood (SE3) of studied plants are illustrated in the bellow figure:

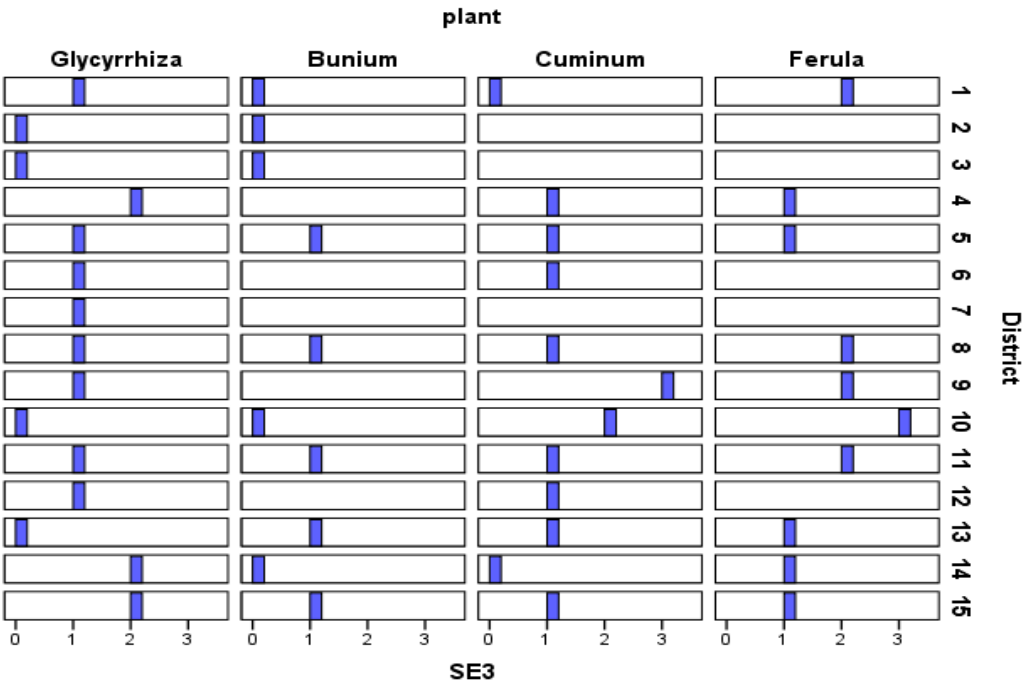


Figure 4.19: Assessment results of suitability of productions for alternative livelihood (SE3).

Generally, the figure indicates the mild level of suitability of these plants for alternative livelihoods, though *Ferula* sp. has better suitability in this regard.

4.8.7. Ability and skill for technological proficiency

This criterion relates to the fundamental opportunity for improving processing and is a basis for the development of a technological infrastructure and eventually to improve the quality of the products to meet quality control requirements. Furthermore, during the last 17 years some international organization and non-governmental organizations (NGOs) working in agriculture and other relevant areas of the country have helped in this area. Therefore, the assessment of this criterion is crucial for further improvement of the situation.

The assessment results regarding the ability and skills for technological proficiency (T1) of the plants studied are illustrated in the figure bellow:

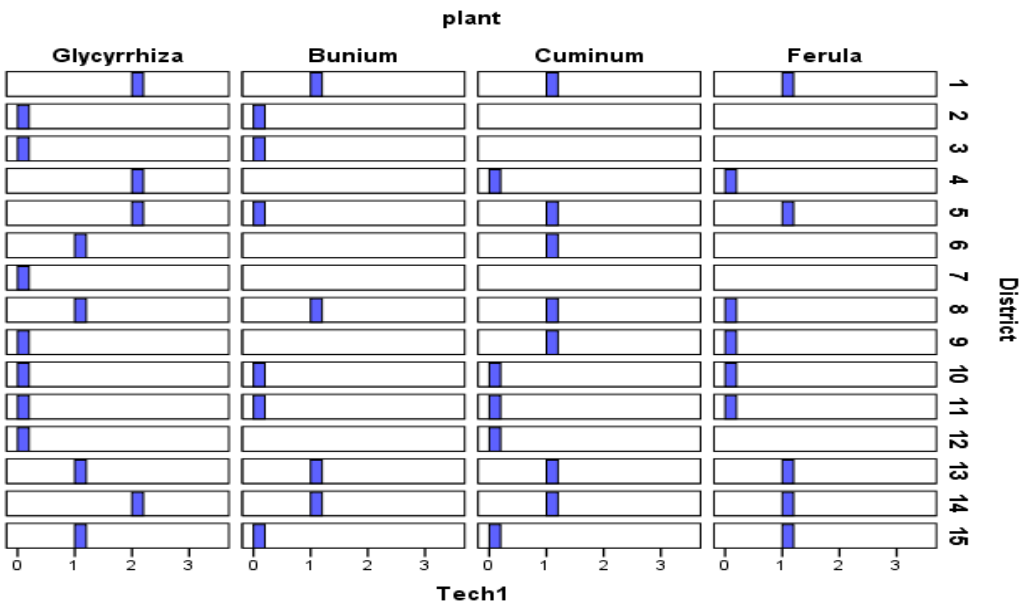


Figure 4.20: Assessment results of ability and skill for technological proficiency (Tech1).

The results of this assessment in the Fig. 4.21 demonstrate that in the most districts and particularly for *Ferula* sp. the ability and skill for technological proficiency of the collectors and labor forces are in critical status.

4.8.8. Availability of technological support

The assessment results of the availability of technical support for the targeted MAPs are demonstrated in the figures bellow:

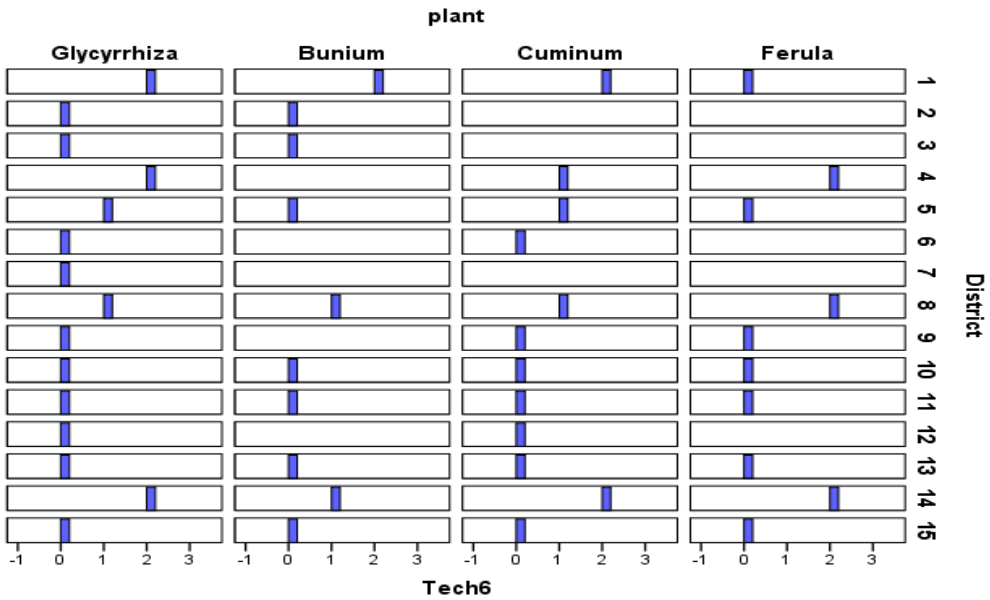


Figure 4.21: Assessment results of availability of technical support (Tech6).

The figure demonstrates a low level of the availability of technical support, though in certain districts (1, 4, 8 and 14) the situation is better and in mid-levels.

4.9. Review of the comparative analysis of means of criteria

The general comparative view of the means of all four aspects demonstrated in the following bar chart:

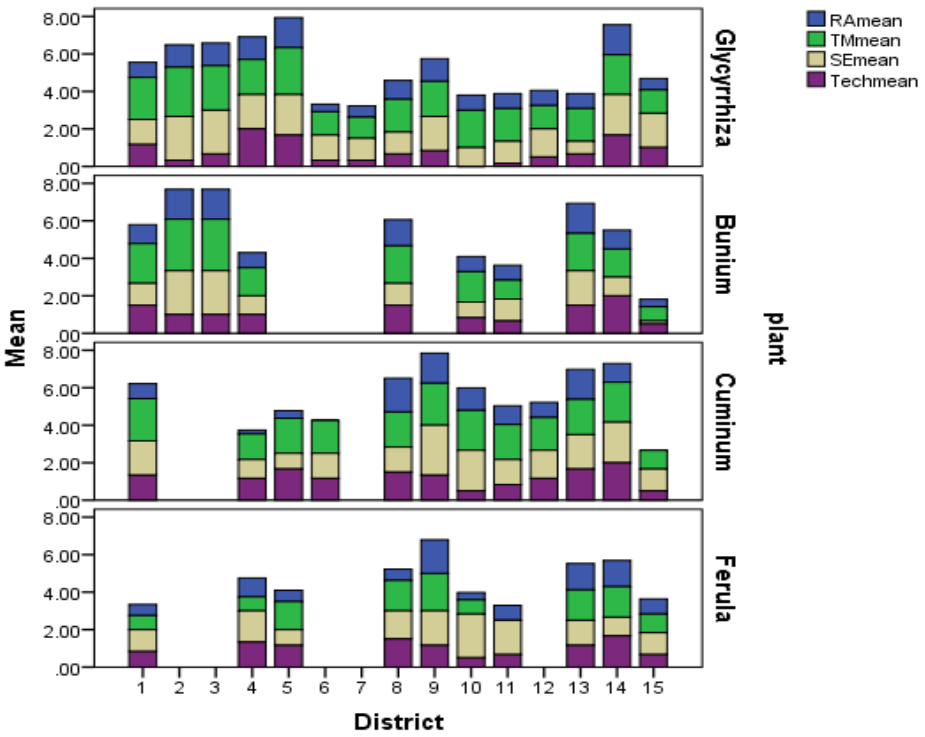


Figure 4.22: Comparison of mean values of criteria.

In this bar chart, the relative proportions of every aspect mean values for every district can be comparatively revealed. As it seen trade and marketing, socioeconomic aspect, resources and conservation status and the last, but not the least the technical proficiencies for the processing respectively have mean values (See Tab. 4.14).

5. Discussion

The following points of the findings of this research will be discussed in accordance with the context of Afghanistan and relevant scientific sources and approaches:

5.1. Need for assessment of medicinal and aromatic natural resources

In spite of limited information and documentation about the vegetation and MAPs in Afghanistan, the available sources (Emadi, 2011; Breckle et al, 2013) emphasize the richness and diversity of the flora of Afghanistan. However, the legacy of war that has plagued Afghanistan and its people for around four decades and has not only damaged the country's society and institutions, but also its environment and ecosystem. The main impacts of these conditions and the unrest are the depletion and overuse of natural resources including wild MAPs, which impair the present socio-economic situation, reduce access to natural resources and fragilise traditional governance systems of natural resources. There is an additional challenge to the environmental context, air and water pollution, and with the added threat of land mines makes land and pastures unsafe to use.

At the same time severe degradation of the rangeland ecosystem continues to be a major cause for concern. Afghanistan is highly susceptible to desertification. It is believed that the process of desertification is advancing in several areas of Afghanistan's arid northern, western and southern regions (MAIL, 2017). Eventually, the manmade pressures, alongside to the impact of climate change on natural resources and the ecosystem of Afghanistan, may led to reduced ecosystem performances and seriously damage the population and habitat of MAPs in Afghanistan.

Furthermore, the ongoing conflict in Afghanistan has made it nearly impossible for researchers to conduct ground fieldwork and resource assessments to find out how species such as the selected medicinal plants have survived in the wild and how they can be saved. The lack of information about wild MAPs available from the national government as well as local communities delays and even hampers the establishment or updating of national policies, strategies, law and regulations for wild collection and the sustainability of resources.

Despite the continuing conflict over the last two decades, the government of Afghanistan, in addition to other priorities in the country, is endeavoring to revive the ecosystem and biodiversity through introducing some strategies and policies as part of rural development and agricultural initiatives.

The Ministry of Rural Rehabilitation and Development (MRRD) was established to develop and implement programs promoting responsible social and financial growth in rural areas, primarily in the non-farm sector. It is working closely with other relevant

ministries and authorities to improve social and economic life in rural areas. Both agriculture and rural development act as an engine of economic growth in the country.

Several other governmental agencies, both within and outside MAIL also work in areas related to natural resource management. The National Environment Protection Agency (NEPA), Ministry of Energy and Water (MEW), Ministry of Rural Rehabilitation and Development (MRRD), Afghanistan Meteorological Authority (AMA) among others, deal with some aspects of natural resource management (MAIL, 2017).

One of the keys to poverty reduction and inclusive growth is the development of agriculture and water resources in Afghanistan. In addition to agriculture serving as an engine of growth for the economy, the development of the sector will contribute to peace and stability in rural areas through increased employment, higher incomes, and more equitable distribution of water resources (ADB, 2017 b). The development of targeted programs and policies to rehabilitate and further develop the agricultural sector, sustainably manage the natural resources and hence reduce poverty and vulnerability, requires reliable information about different pertaining aspects. The provision of better information, short-term emergency assistance, and also longer-term rehabilitation and development needs, will more efficiently and effectively fill requirements, ultimately reducing food insecurity and vulnerability, poverty and sustainability of the natural resources of the country.

To be sustainable, economic growth cannot be achieved at the cost of environmental and natural resource degradation. Establishing a clear environment–poverty relationship in the context of Afghanistan development, improving natural resource management with due consideration for the vulnerable population, preventing further environmental degradation, and improving and maintaining the integrity of ecosystem services, is therefore the key to lasting recovery, human security, and the sustainable development of Afghanistan (Emadi, 2011).

The agriculture sector is the major contributor to the GDP, providing a good prospect of employment opportunities. Moreover, it has the potential for productivity/production increases and exerts a profound and far reaching effect in other sectors, particularly by enhancing economic efficiency and providing more employment opportunities. However, the sector's productivity is low due to frequent droughts, poor infrastructure, limited research and extension services, poor access to input and output markets. The success in the future largely depends upon heavy investment in agriculture, through coordination, advocacy, and increased regulatory and managerial capacity of MAIL (FAO, 2016).

Nevertheless, social and economic development will not be achieved unless the insecurity that prevails in some parts of the country is markedly reduced and the study of different aspects of these resources using a methodology of resource assessment is the substantial basis for the sustainable management of natural resources.

The aim of this research was to assess the resource status of potential MAPs and propose approaches for sustainable resource management of wild medicinal plants. It is thought that this study in its nature is a unique as an attempt towards the sustainable management of MAPs in Afghanistan. It was further designed as a pragmatic approach through frameworks to assess and quantify the four main aspects of MAPs resources: resource assessment, trade and marketing, socioeconomic, and technological proficiencies for the processing and sustainable exploitation of MAP products.

5.2. Export of MAPs

Since the collapse of the Taliban government, the economy has been steadily growing due to the influx of foreign aid and investments. However, security threats and a lack of infrastructure and good governance have been hampering economic activity and growth. Agriculture (23% of GDP) is the most important sector of the economy, as the majority of the population are dependent on agricultural products (Trading Economics, 2018).

Afghanistan, as a war-torn country with a negative trade balance, has a critical need to promote its exports to diversify its economy. While the country relies heavily on imports, amounting to three times the value of exports, some imported goods could be produced for less cost domestically.

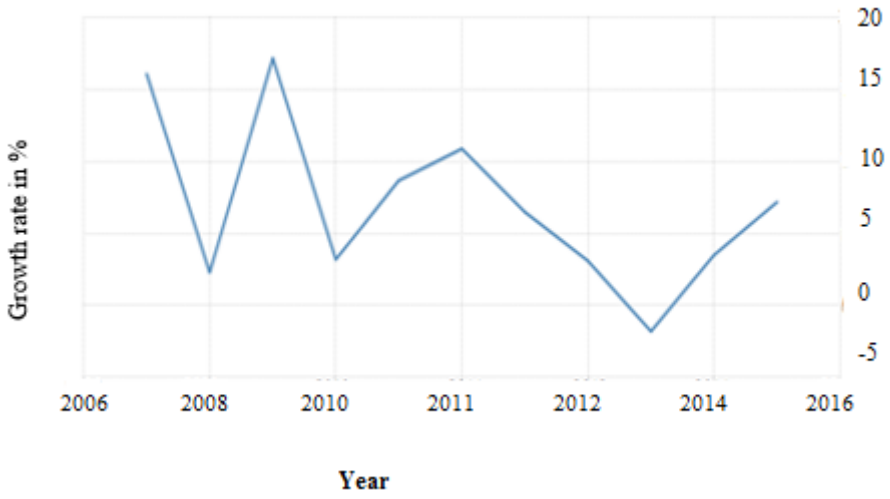


Figure 5.1: Afghanistan GDP annual growth rate during last ten years (Trading Economics, 2018; based on CSO data).

Since 2002 one of the main focus of the government of Afghanistan has been to address the necessity of increasing exports from the country. In spite of all efforts the trade balance in Afghanistan is alarming. In 2016, Afghanistan had a negative trade balance of $ 7.81B (Trading Economics, 2018) which had increased by 2017. Afghanistan recorded a trade deficit of 6960.70 USD Million in 2017.

Since 2006, Afghanistan´s trade deficit has been widening as imports have surged due to the reconstruction effort. Afghanistan main exports are: carpets and rugs; dried fruits and medicinal plants. Main imports are: petroleum; machinery and equipment and food items (Trading Economics, 2018).

Trade enables countries to import ideas and technologies, realize comparative advantages and economies of scale, and foster competition and innovation, which in turn increases productivity and achieves higher sustainable employment and economic growth. Countries open to international trade tend to provide more opportunities to their people, and grow faster (World Bank, 2012).

The Balance of Trade in Afghanistan averaged -4701.91 USD Million from 2003 until 2017, reaching an all-time high of -1660.90 USD Million in 2005 and a record low of -8517.90 USD Million in 2012.

Figure 5.2: The trend of Afghanistan balance of trade (Trading Economics, 2018).

Afghanistan has seen exceptionally high economic growth by 2012, averaging 9% annually. But this has been highly volatile because of the heavy reliance on agriculture and, to a lesser extent, aid flows that have driven demand for services. While the economy is dependent on international trade, on imports of fuel, raw materials and food, trade is not the main driver of growth (World bank, 2012).

Afghanistan economy is mix of formal, informal and illicit elements. It is estimated that the Afghan informal economy roughly accounts for some 80- 90% of the total output (including drugs). It is flexible in responding to shocks and to short-term opportunities, but this is also a reflection of the role of conflict in the economy. While the informal sector provides a vital source of income for the poorest groups, it can become a constraint on long-term growth because informal businesses tend not to expand in size, do not invest in technology, and face difficulties breaking into export markets. Furthermore, the informal economy sidesteps Afghan customs, evades taxation, and poses security and health risks because of the uncontrolled movements of goods. Informal traders take advantage of arbitrage opportunities offered by the widely diverging trade regimes in the region, thereby mitigating the distortionary effects of the more restrictive trade regimes

(World Bank, 2012). For Afghanistan, the important overall part of the informal economy will be a challenge at least in the short term period.

In 2018, Afghanistan's High Economic Council, approved the highly anticipated National Export Strategy (NES). This strategy highlights the importance of exports to increase revenue, create jobs, and support long-term peace and prosperity. The principal outputs of NES Afghanistan design initiative are endorsed, coherent and comprehensive export strategy documents with a five-year detailed plan of action and implementation management framework (MoCI, 2018 b).

Afghanistan's security situation is continuing to deteriorate. The increased conflict appears to be holding back business and consumer confidence from recovering fully from the impact of the security transition in 2014.

After nearly 17 years since the establishment of new democratic government in Afghanistan, and more than decade of strong growth, Afghanistan remain as one of the poor countries. Since 2001 the country has seen improved development outcomes, such as rapid economic growth (with large fluctuations), relatively low inflation (after hyperinflation in the 1990s), better public financial management, and gains in basic health and education. Key social indicators, including life expectancy and maternal mortality have improved markedly (though from an extremely low base).

Most of the Afghan economy's output comes from agriculture. Afghanistan exports many agricultural, mining and handicraft products and among those the most valuable is grapes ($146.2 million), natural gums and resins ($102 million), fresh or dried figs ($101.4 million), coal ($68.8 million), miscellaneous nuts ($60.5 million) and uncombed cotton ($46.3 million). According to MoCI in 2017 Afghanistan exported gums, resins and herbal saps: $102 million which made 11.1% of the total exports after fresh and dried fruits and nuts (43.4%) (Data from directorate of export promotion, MoCI, 2018).

Over the past decade the composition of exports has changed, with dry fruits and seeds becoming the largest official Afghan export. Through fiscal 2006–2010, exports of dry fruits and seeds grew to account for half the total exports, surpassing carpets, which dropped from 60% to 38% of exports (Fig. 5.3). In addition, the export of fresh fruits accounted for just 6% of export trade, reflecting the limited infrastructure (cold storage facilities) available for handling fresh produce. The remaining 10% of exports comprised leather, spices, and medicinal plants (World bank, 2012).

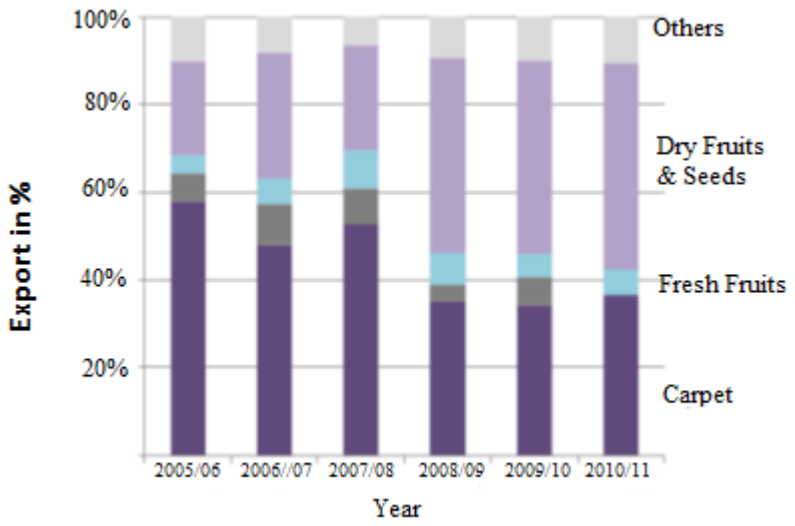


Figure 5.3: Composition of official Afghanistan export during 2005/06-2010/11 (World Bank, 2012; based on CSO data).

There is no reliable information and data about the share of medicinal plants exported from Herat province. Though, the survey of five main Markets of MAPs by researcher in Herat show that these markets make up an important share in export of MAPs and their products (See App. 8.1).

According to information from local traders from MAPs markets in Herat, in 2016 (1395) the province exported a significant volume of MAPs compared to the official data by CSO (See Tab.4.1). The estimated export volume of MAPs from Herat during 2016 (1395) was gathered from chief traders of MAPs in Herat. For the details see App. 8.2.

Table 5.1: Estimated export volume of MAPs by Herat during 2016 (1395), Kg.

#	MAP	Collected area	Export to	Volume
1	*Glycyrrhiza* sp.	Shendand, Adraskan, Golran, Koshk-e -Kohna, Badghis (Ghormach, Qades, Morghab)	Pakistan, India	6,500,000.0
2	*Bunium* sp.	Adraskan, Pashtun Zarghun, Chesht-e-Sharif, Badghis, Ghor, Pashtun Zarghun Kandahar, Helmand	Iran, India, Pakistan	2,300,000.0
3	*Cuminum* sp.	Adraskan, Ghorian, Ghor, Gulran, Karokh, Obe, Shendand	India, Iran, Pakistan	1,200,000.0
4	*Ferula* sp.	Farsi, Ghorian, Karokh, Kohsan, Kushk-e- Robat Sangi, Obe, Shendand	India, Pakistan	400,000.0

Evidently, the volume of exports listed in Tab. 5.1 is not merely from wild collection from Herat, but includes a share of other smaller neighboring provinces (Badghis, Ghor and Farah) which usually trade their products via Herat market as a hub in the region.

A comparison of these exports with the official data from CSO (Tab. 4.1) which represent national exports, explicitly demonstrates a notable difference for all the selected products. It is said that a substantial quantity of MAPs, like other natural products including mining, is exported illegally to neighboring countries and especially to Pakistan. This information has been acknowledged by many traders in Herat markets and even some officials in Herat DAIL, MAIL, MoCI and CSO confirm this fact in informal interviews. It is conservatively thought that around 40% of natural products including MAPs and their various products are exported informally or illicitly and that these exports are not included in data released by CSO.

It is difficult to establish the size of the illicit trade in Afghanistan because there is limited data (World Bank, 2012) and officials are not willing make estimates. However, an efficient way to estimate the scale of informal and illicit exports would be to compare data from the market with officially released data by CSO or other governmental agencies. It should be noted that the information and the data from the market may not be accurate and reliable.

A comparative assessment of average export volume of MAPs during the last 3 years with the estimated export volume of Herat market in 2016 is listed in the table below.

Table 5.2: Comparison of official (national level) and market (Herat province) data on export volumes of MAPs in 2016 (Kg).

#	MAP	Product	Local name	Average exp. volume last 3 years at national level	Estimated export volume in 2016 from Herat
1	*Glycyrrhiza* sp.	Licorice	Sherin booia	19,986,087.9	6,500,000.0
2	*Bunium* sp.	Black wild cumin	Zeera sia	579,190.1	2,300,000.0
3	*Cuminum* sp.	Green wild cumin	Zeera sabz	4,391,344.9	1,200,000.0
4	*Ferula* sp.	Oleo-gum-resin	Anghoza, Heng	585,708.3	400,000.0
5	Total			25,542,331.1	10,400,000.0

The comparison of data demonstrates that export from Herat in 2016 made up 40% of the national average export volume share during last three years of the period of study (2014-2016). In spite of the important role of Herat in the production of the selected MAPs as a hub in the western part of the country, this share overrides the data of CSO which is at the national level. Other provinces are also prominent in the production of the selected plants. For instance, Faryab, Jawzjan, Samangan, Balkh, Baghlan and Takhar make significant share of the oleo-gum-resin of *Ferula* sp. and *Glycyrrhiza* sp. and the Balkh market of natural products is another important focus for the trade of these products in north of Afghanistan.

The data presented in Tab. 5.2 suggest that illicit export of MAPs occur. Smuggling goods into neighboring countries is a significant part of the informal and noxious economy of Afghanistan.

With regard to the information obtained from markets in Herat, the main proportion of MAP products are exported illicitly to Pakistan and even there are some Pakistani companies which are active in different parts of Afghanistan under pseudonyms and are involved in the production and export of *Glycyrrhiza* sp. and *Ferula* sp.

The main destinations of the MAPs formal export in the regional market are Pakistan, India, Iran and Turkey. Most of the products do not undergo the required technological processing to meet international standards and requirements. Traders in Herat emphasizing the need for post-harvest treatment and standardization of MAPs products to enable them to be exported onto the international markets.

The informal export of significant volumes of MAPs to neighboring countries, and especially to Pakistan, enhancing their capacity to be major exporters of MAPs on the global market.

The domestic use of MAPs is limited to its use in traditional and folk medicines and also as a culinary spice in the Afghanistan. ATM is one of the complementary and alternative medicines that has played an important role in preventing and treating diseases at various times during the development of Afghanistan. As it was described earlier (See Afghanistan traditional medicine, pp. 52), of the approximately 5,000 species of flowering plants in Afghanistan, more than 200 species are known to be used as medicinal plants. There is no data about the volume and details of these plants are used domestically. Nevertheless, some information from the markets in Herat and Kabul suggest that the volume percentage varies among different species and products and for the selected species that only 3-7% are used inside the country.

Presently, there are 45 pharmaceutical factories producing pharmaceuticals mainly used inside the country. Unfortunately, in spite of the relatively high volume of MAPs produced in Afghanistan, only one of these factories recently established uses domestic natural products for their productions (API, personal communication, 17.10.2018). Whilst the conflict has undoubtedly been an exogenous factor, lack of an appropriate environment to attract investment in this sector is markedly evident.

5.3. Focus on Herat province

While Afghanistan almost lacks information about its wild medicinal plants, there is a general consensus that the natural resources of Afghanistan are in poor condition. Furthermore, Afghanistan does not have an authority with overall responsibility for the protection of its natural resources. Thus, the need for resource assessment has become essential for overall the country.

Resource assessments should be performed in a selected area or territory. However, as per the flowchart strategy in Fig. 5.4, the definition of the assessment area is considered a point of discussion in this study.

The distribution pattern of the selected species shows that they are distributed in the wild in many parts and climatic zones of the country. Based on the available sources, the distribution maps of the selected plants have been drawn and comparative study of these maps indicate that Herat is the richest province in terms of the number of the species of the selected plants. A preliminary market survey conducted by the researcher also demonstrates that this province plays a substantial role in the export of MAPs to regional and international markets (See Tab. 5.1).

Herat's impressive economic growth over the past decade, as elsewhere in Afghanistan, has slowed in the wake of the postelection political impasse and continued insecurity. The province is a key trading hub, and its recovery is inextricably linked to that of the national economy, which remains fragile. Investment in industry and real estate in Herat, which the press often portrays as the powerhouse of the Afghan economy, has been significant. The potential of the province was set out in an ambitious strategy for economic development prepared by a group of local professionals in 2011. Herat's historic role as a trade hub persists, and a significant proportion of imports destined for elsewhere in the country transits through its customs facilities, generating considerable revenue for the national budget (Leslie, 2015).

Herat Province's annual output in 2011 was estimated at $1.2 billion (some 7% of the national total)—$325 million in agriculture, $465 million in the service sector, and $425 million in industrial enterprises (including mining). According to CSO in terms of value, the most important licit export through Herat are carpets, dried fruits, animal skins, and wool to Iran, though Turkey and the United Arab Emirates are increasingly important (Leslie, 2015).

Nevertheless, during last few years Herat's economy has been like other major cities in Afghanistan affected by insecurity and political uncertainty. Private investment in the city has dropped markedly and the business climate in Herat has been negative since the second half of 2015, with a small uptick in the second quarter of 2016 (EASO, 2017).

Besides the general preferences mentioned above, and particularly the details of the distribution patterns of the selected species, there are certainly other factors contributing to the selection of Herat as a targeted province for conducting the resource analysis of MAPs. Extensive consultations with experts in agriculture, ecology and economics indicted Herat as a preferred province for study. Indeed, the security situation in this province provides a better opportunity for conducting a field study and particularly a study with the aim to get a realistic outlook from all districts on MAPs different dimensions. Furthermore, the motivation of DAIL staff encouraged the researcher to initiate this study.

5.4. Outlook of resource assessment

Wild collection of MAP secures valuable income for many rural households, especially in developing countries, and is an important factor in the source countries' local economies (Schippmann et al. 2006). Wild collection also can provide incentives for conservation and sustainable use of forests and other important plant areas (Leaman, 2008). With 80% of the Afghan economy dependent on the country's natural resource base, long term stability will be directly dependent on sustainable management of natural resources (MAIL, 2017). The collection of medicinal plants as a source of income has a socioeconomic background in Afghanistan. For many decades people in rural areas have collected different wild plants which have traditional uses in the country and are also exported to other countries. Presently, medicinal plants are the main sources of income generation and alternative livelihood for many rural people. According to provincial DAILs reports, people can collect and sell around 70-105 kg of *Glycyrrhiza* sp. everyday which brings in a daily income of 600–800 Afghanis (8.5-11.5 USD) (MAIL, 2017). This source of livelihood is of critical importance in many parts of the country. However, the reliance of the rural population on medicinal plan as a source of livelihood does not seem to be viable in the long run as the wild collection is unplanned and in addition to that degradation and depletion of these resources will additionally result from climate change.

Afghanistan ever-increasing need for land and resources combined with the threat of collapse of the management system due to the long-lasting war in the country and climate change have pushed the assessment of MAPs natural resources and even biodiversity to the top of the list of plant science research priorities.

There is some alarming information about depletion of some wild medicinal plants species in Afghanistan. The establishment of sustainable harvesting practices as part of the management system is a matter of urgency, with a need to document and disseminate case-studies pertaining to species.

There are two types of assessment relating to the supply of a resource. One is a baseline assessment, which is about making an initial estimate of the amount of the resource. The other is monitoring, which is carried out as a part of routine management (Hamilton, 2005). It is of significant importance to conduct a baseline assessment of certain potential species of MAP in Afghanistan. The studied species as the potential products in the country can be appropriate candidate for such assessment.

According to (Leaman, 2008) resource assessment is an essential component of an adaptive management process and it enables collectors and other resource managers to:

- estimate sustainable harvest limits for a specific resource within a particular collection area;

- observe and understand the impact of current harvest protocols (specific methods, often with agreed limits) on the recovery of the target resource; and
- make the needed adjustments in harvest protocols to maintain the target resource at sustainable levels.

In the absence of updated information and data, the ability to undertake sustainable MAP resource management and planning of Afghanistan's natural resources and agricultural sector would be significantly diminished. The initial step toward such a study after decades of war was the development of the land cover atlas of Afghanistan which has been developed through the support of FAO in 2016 by updating the 1990-93 land cover dataset with higher resolution satellite imagery and using modern state-of-the-art tools and techniques.

Currently, the Geographical Information System (GIS) is often cited as the most efficient tool used to perform these studies. This frequently employs species occurrence data from informatics sites like the Global Biodiversity Information Facility (GBIF) and remotely sensed data from satellites to determine the relative species richness of a particular area. Realizing the unique situation of the country and the modalities of implementation of such techniques from one side, and security constraints on access to the given area by the researcher on the other side, it was decided to develop a rational approach to the assessment of MAPs resources.

Resource assessment is an evaluation of some aspects of the resource based on information gathered from a variety of sources. It can include socioeconomic aspects, market issues, or the quantity and quality of the resource.

There are different types of assessment of study that can help the development or management of MAPs resources. For example, to assess non-wood forest products (NWFP), certain approaches have been introduced (Wong et al., 2006). The approaches can focus on either:

1. The NWFP resource itself, including its abundancy or potential for future supply, through resource inventory; or
2. Its use in the market, such as market or product surveys, biodiversity inventories (or species list), and cultural studies.

There are many published studies (Hamilton, 2001; Hamilton, 2005; Wong et al. 2006; Emadi, 2011; Chen et al., 2016) focused on sustainable conservation and resource management of forests, forest product and MAPs. Therefore, establishing appropriate approaches depends on the objectives of the study. In this research, this study focuses on the capacity of the resources and aligned factors incorporating the sustainability of the wild collection and supply of the products.

For every assessment, there is a basic need to identify the resource species and focus on the specific object. In the same time, the supply chain of herbal products and as described

by Botha et al. (2004) the herbal markets of any region are influenced by diverse socio-economic factors, ecological conditions, transportation systems and affirmed policies (Ahmad et al., 2017). Hence, in this study as the first in his nature in Afghanistan and in absence of data, an appropriate methodology for the screening of the MAPs and conservation has been developed as follows:

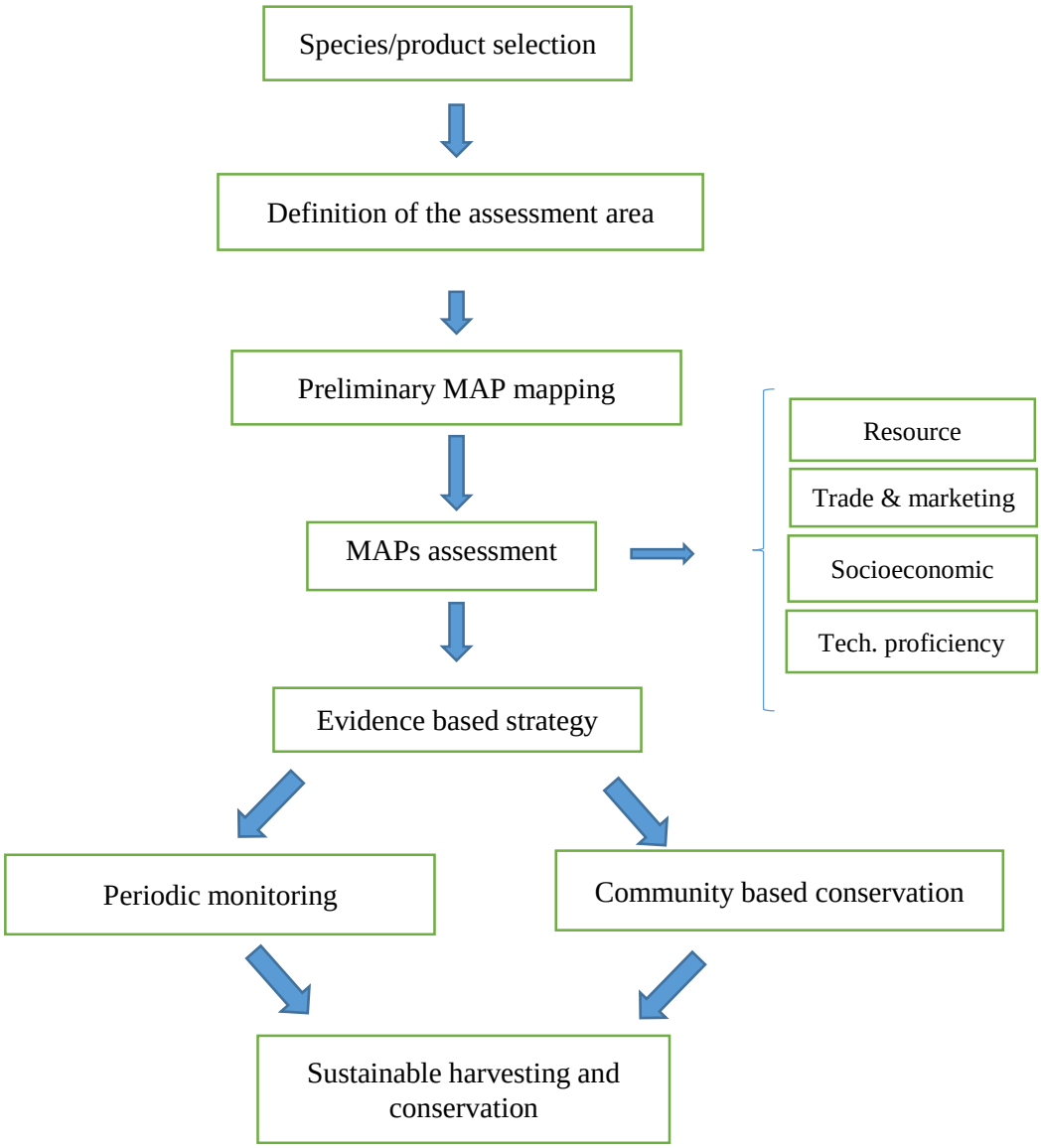


Figure 5.4: Flowchart strategy for resource assessment of MAPs in Afghanistan.

An ideal development process might begin with species/product selection and include resource assessment, trade and marketing, socioeconomic and technological proficiencies for the processing of MAPs products. Of course, if a sustainable conservation approaches is the aim, then the determination of sustainable harvest rate and establishing management planning and monitoring emerge as crucial next steps.

The strategy described above by the flowchart in Fig. 5.4, demonstrates the main elements of resource assessment in this study as seen as appropriate to tackle the most

important factors of MAPs wild resources in Afghanistan. Nevertheless, whichever approach is taken, resource assessment has a key role in the resource management of MAPs.

5.5. Development of frameworks

In order to sustainably manage the resources of MAPs, firstly, it is necessary to establish quantitative values that can be compared; as such, to separate the array of variation that wild resources, we need to distinguish the key elements. The four major aspects of wild resources have been identified according to UNCTAD's BioTrade initiative (United Nations, 2009) and based on the inseparable dimensions of MAPs supply chain, the continuation of war and unrests in the country and ongoing achievements in reviving the governance system in the country during last post-Taliban period. In fact, these four aspects should not be thought of as being distinct from one another, but as being inextricably linked.

Based on these three dimensions the four aspects of MAPs resources have been selected:

1. Resource assessment of MAPs,
2. Assessment of trade and marketing,
3. Socioeconomic assessment, and
4. Assessment of technological proficiencies of processing.

In order to develop practical techniques to achieve desired objectives posed in this study, four frameworks to assessing each aspect have been adapted. The frameworks designed in a pragmatic manner and require basic knowledge for their manipulation.

To achieve maximum reliability and accuracy for the collection of the data the appropriate teams of assessors have been agreed upon and trained. Furthermore, close backup support and monitoring of the oversight of the researcher could ensure higher reliability of the collected data (See pp. 83, 102). Furthermore, as the study is complex and multifaceted and the criteria can be measured with errors, therefore the structural equation modeling (SEM) is used to evaluate the relationship between indirect (mediated) and direct effects of variables on other variables (See sec. 5.9).

The aforementioned approach is considered to be practical and reliable approach in context of contemporary Afghanistan.

5.6. Resource assessment of selected MAPs

5.6.1. Abundance and state of conservation of the species

The abundance of the species is used to assess the capacity and risk of extinction of MAPs and identify the species exposed to the risk of threats and endangered before initiating conservational measures. Given the measures and urgency of sustainability issues, the inventory provides the only realistic means for assessing the population status and harvest

potential of target resource species. Recognizing the fact that an inventory is fundamental to assessments of the conservation status of wild populations, and a prerequisite for addressing harvesting sustainability of target species; there was substantial emphasize in the workshop on achieving this task.

In fact, this assessment was carried out for the first time after a long period of war, draughts and overexploitation of resources. As such, the criteria were assigned to assess the abundance and the state of conservation, which are closely interrelated.

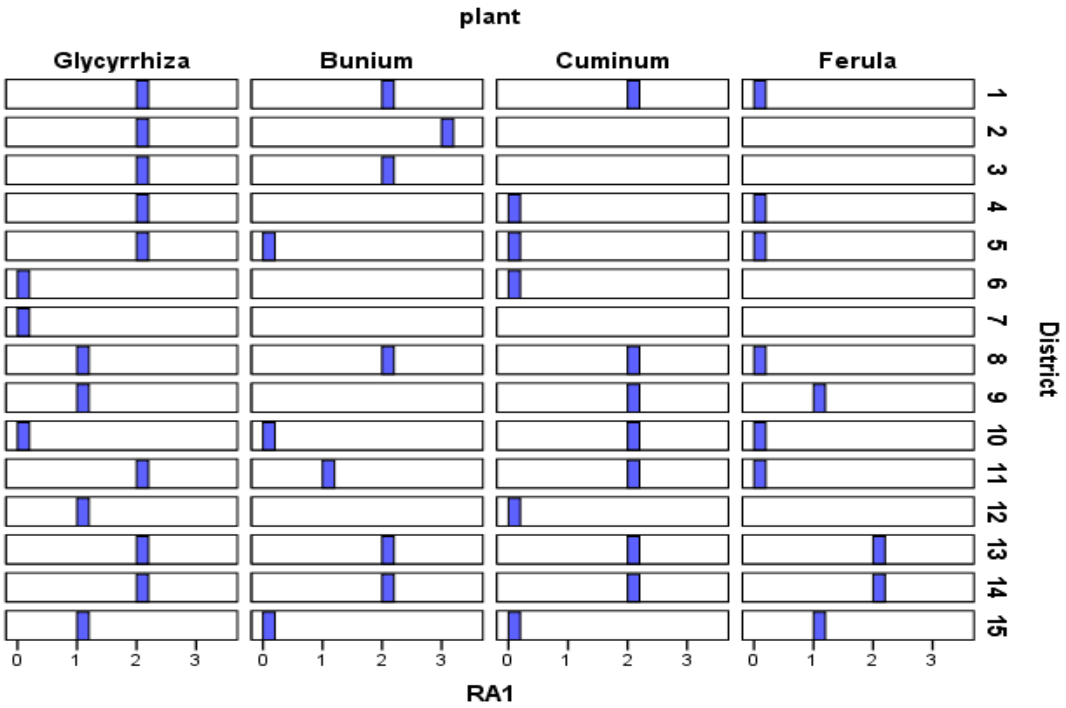


Figure 5.5: The assessment of abundance and state of conservation (RA1) of the studied plants.

Abundance reflects the ample occurrence of the species in a sample plot. In the October workshop in Herat, it was conditionally agreed to score the criteria as the following:

- Abundant - occurrence of 4 or more plants in a plot of 1x1m^2
- Sufficient - 2-3 plants
- Under threat - 1 plant

5.6.1.1. Glycyrrhiza sp.

The result of the assessment for this criterion (RA1) demonstrates that *Glycyrrhiza* sp. is of a sufficient capacity in 8 of the following districts: Adraskan, Chesht-e-Sharif, Farsi, Ghorian, Gulran, Kushk-e-Kohakna, Pashtun Zarghun and Shendand (with respective number1, 2, 3, 4, 5, 11, 13, and 14), however, Injil, Guzara and Kushke-e-Robat Sangi (with respective number 6, 7, and 10) are in a critical status. As mentioned earlier in section 4.1.2 Injil and Guzara do not have resource importance for the province as they surround the city of Herat and during last decades, particularly last 17 years due to

urbanization and extension of the city, they have become less important. For practical reasons, these two districts will be disregarded in the assessment.

Four other districts: Karokh, Kohsan, Obe and Zendajan (8, 9, 12 and 15) demonstrate that some initiatives are under development to improve conservation. In these districts, due to over-collection and other exacerbating factors the resources of the plants have been undermined.

(A) (B)

Figure 5.6: Rhizome and taproot of *Glycyrrhiza* sp. before (A) and after processing (B) (Photo by Ansai, 2018).

The expansion of saffron cultivation counts as one of the exacerbating factors for the reduction of the *Glycyrrhiza* sp. habitat. But, at the same time the moratorium on the collection by DAIL in Herat is also evident in the districts of Kohsan and Zendajan. These two districts initiated the conservation of wild plants by establishing protected areas.

Glycyrrhiza sp. is propagated easily by rhizome and root, and as such the resources of this species are in a better status than other selected species.

Information from the districts indicate the followings:

- Collectors are not trained and are lacking the required technical knowledge about good collection practices.
- Meanwhile, they do not collect the young plants.
- The collected underground parts are cleaned of soil and dried in open air by collectors.

- The collectors sell the dried and unprocessed rhizome and root to local traders (middleman), who normally have a unit in the district.
- The local traders pack the raw material in bags and send them to Herat MAPs market.
- Traders and registered companies, since almost seven years, further process their stock: cleaning, cutting, sorting, bundling and packing with limited facilities, but still there is a crucial need for post-harvesting treatment and standardization of the product.
- In the past, raw products were exported without post-harvesting treatment.
- The preliminary processing by traders and companies is carried out according to the purchaser requirements in regional markets.
- There is not any capacity building and certification by the relevant authorities in Afghanistan. The Afghan Raisin, Fruit, Vegetables and Medicinal Plants Export Promotion Administration (ARFVMPEPA) provides a formal certificate to some exporter companies according to the request of the Customs. Often, this certificate is issued after only physical analysis of the product.
- Although sustainable harvesting is a crucial requisite, the resources of *Glycyrrhiza* sp. are not in a critical status.

Figure 5.7: The stock of processed *Glycyrrhiza* sp. belongs to a trader (Photo by Ansai, 2018).

5.6.1.2. Bunium sp.

The results of the *Bunium* sp. assessment for the abundance and state of conservation of the species (RA1) reveals that the species are in abundance and that the required stage of conservation in Chesht-e-Sharif (2) is of sufficient status as it is in the districts of Adreskan, Farsi, Karokh, Pashtuz Zarghun and Shendand (with respective numbers 1, 3, 8, 13, and 14), but the districts Gulran, Kohsan and Zendajan (with respective numbers

5, 9, and 15) are under the threat. At the same time, it is revealed that the communities in Kushk-e-Kohna (11) took some measures to improve the conservation of the species through protection of hills and rangeland in the district.

Generally, *Bunium* sp. compared to other species does not show a promising picture in terms of the resources in Herat province. According to the information, it had been one of the abundant resources in the 1990's. Overharvesting, overgrazing, droughts and lack of conservation measures are seen as the main reasons for the decline in resources.

The demand for the black cumin is rapidly increasing while its habitat has been decreasing across the province because of the above mentioned factors.

The supply chain of the seed of *Bunium* sp. (Zeera siah) starts with the collection of the seeds by women, children and other collectors. The product is dried at home by collectors in the open air and eventually sold to the local trader (middleman), who transports the product to the provincial MAPs market. The further processing performed by companies, includes drying (if needed), cleaning, sieving and packing in bags of 20-50 Kg.

According to Garval, Rani and Omidbigi in the natural habitat, seeds of *B. persicum* (Boiss.) B. Fedtsch. germinate in three to four months after passing through the winter and consequently produce only a few leaves and a small tuber. Plant growth rate in the first year of cultivation is significantly slow and the maximum diameter of the *B. persicum* (Boiss.) B. Fedtsch. tuber is approximately 4 mm. The reproductive phase (seed production) of *B. persicum* (Boiss.) B. Fedtsch. starts after four years and may be maintained up to 12 years as the tubers continue growing. Generally, economic production of this plant begins after almost four years which is the main reason for low tendency of local farmers to cultivate this valuable plant (Mardani, H., et al., 2015). In spite of this difficulty, the trends for the cultivation of the plant in Herat and some other provinces (Farah, Helmand and Kandahar) is increasing.

(A) (B)

Figure 5.8: *Bunium* sp. in traditional healer shop ("Attarii") (A) and in a stock of middleman in Ghorian district (B) (Photo by Babury, 2018).

Information from the districts indicate the followings:

- Collection of *Bunium* sp. seed is one of the livelihood sources of communities in some districts of Herat,
- Women are engaged in collection of *Bunium* sp. seed.
- Collectors are not trained and lack the required technical knowledge about good collection practices and especially about conservation measures.
- Except for drying, no any post-harvesting treatments are performed by the collectors.
- The collectors sell the product to local traders (middlemen) who sometimes represent certain companies and traders from provincial market.
- Traders and registered companies receive/purchase product in bags with various volumes from middlemen.
- The traders and companies dry (if needed) sieve, clean and package it in bags for the export (Fig. 5.8).
- The traders and companies do not have equipment and standardized stores, but they store the bags of products in the cold with protection from sunlight in store rooms/stocks.
- There is no any facility, capacity building and certification by the relevant authorities in Afghanistan. The Afghan Raisin, Fruit, Vegetables and Medicinal

Plants Export Promotion Administration (ARFVMPEPA) provides a formal certificate to some exporter companies according to request of the Customs. Often, this certificate is issued after only physical analysis of the product.
There are some attempts to cultivate the plant in Farah, Helmand and Kandahar.

5.6.1.3. Cuminum sp.

The results of the *Cuminum* sp. assessment looking at its abundance and the state of conservation of the species (RA1) demonstrates that the species is in a better state and conservation status than *Bunium* sp. The species is present in sufficient quantities in Adresken, Karokh, Kohsan, Kushk-e-Robat Sangi, Kushk-e-Kohna, Pashtun Zarghun and Shendand (with respective number 1, 8, 9, 10, 11, 13, and 14), while it is considered under the threat in Ghorian, Gulran, Guzara, Obe and Zendajan (with respective number 4, 5, 6, 12, and 15)

The product is well known in the trade and marketing of Afghanistan and has been exported for many decades. Therefore, its wild collection has traditional meaning for the livelihood of the communities in districts.

Cuminum sp., due to its seed dormancy, germinates with difficulty (Sharififar et al., 2015). Moreover, some other exacerbated climatic factors and over-collection have affected the resources of this species in the Herat districts during the last decades.

The findings from the districts reveal the following information:

- The resources of *Cuminum* sp. were abundant two decades ago.
- Wild collection of *Cuminum* sp. is one of the means supporting the communities and providing a livelihood.
- Women are engaged in wild collection of cumin.
- Collectors are not trained and are lacking the required technical knowledge about good collection practices and especially about conservation measures.
- Except for drying, no post-harvesting treatments are performed by the collectors.
- The collectors sell the cumin to local traders (middlemen), who sometimes represent certain companies and traders form the provincial markets.
- Traders and registered companies receive/purchase product in bags with various volumes from middlemen.
- The traders and companies dry (if it is needed), sieve, clean and package it in bags for export.
- The traders and companies do not have equipped or standardized stores, but they store the bags of products in rooms/stocks that are cold and protected from light.
- There is not any facility, capacity building or certification by the relevant authorities in Afghanistan. The Afghan Raisin, Fruit, Vegetables and Medicinal Plants Export Promotion Administration (ARFVMPEPA) provides a formal certificate to some exporter companies according to request of the Customs. Often, this certificate is issued after some physical analysis of the product.

Figure 5.9: Cleaning and sieving of *Cuminum* sp. in a company's processing unit in Herat (Photo by Babury, 2005).

Seed dormancy is a very important mechanism to ensure that sufficient factors are available to support the young seedlings, particularly for rangeland seeds. Dormancy can be regulated by the environment or by the seed itself. Seed dormancy is defined as ways of hindering germination for an intact viable seed.

5.6.1.4. Ferula sp.

The resource assessment of *Ferula* sp. demonstrates the critical status of the species in most districts of the province. While, Herat had been one of the important places in the production of oleo-gum-resin in the past, the assessment reveals that the situation is alarming. Only two districts of Pashtun Zarghun and Shendand have sufficient populations of the species and in Kohasan and Zendajan some measures are under development to improve the conservation through banning the collection of oleo-gum-resin. In the rest of the districts, the species is reported as being under threat. Information indicates that even in those districts where the collection of the species is banned through protection of rangelands, the moratorium has not been respected by collectors. Due to the increasing need for the product, the collection is considered an important source of revenue for the communities and DAIL offices in provinces.

The collection of oleo-gum-resin from the taproot of the *Ferula sp.* require some knowledge and experience in resection of the taproot for collection of the product. However, the knowledge and experience of the collectors lacks any conservational basis.

Asa foetida is extracted from the *Ferula* sp. which has massive taproots or carrot-shaped roots, around 15 cm in diameter at the crown when they are four to five years old. Before

the plants flower, the upper part of the living rhizome root is laid bare and the stem cut off close to the crown. A dome-shaped structure made of twigs and earth covers the exposed surface. A milky juice exudes from the cut surface. The exudate is scraped off and a fresh slice of the root cut when more latex exudes. Sometimes the resin is removed along with the slice. The collection of resin and slicing of the root are repeated until exudation ceases (Amalraj & Gopi, 2017).

Figure 5.10: The milky exudate (oleo-gum-resin) of *Ferula* sp. from transverse surface section of taproot (Photo by Duerbeck, 2005).

In most provinces including Herat, individuals apply for the formal agreement (authorization) to collect the product in a certain area based on renting *"Ejara"* (tenance). The terms of the contract require these tenants to respect some basic measures in the conservation of the plant, but in reality this has never been monitored by DAIL or any other organization.

Nowadays the harvesting of the product is performed in two ways.

Tenants hire some labors on a daily basis to collect the product. Usually, the amount of payment depends on the volume of the collected product. In a second way, the tenant gives permission for the harvesting of the product to community inhabitants and populations of the district/area. Women and children also contribute to the collection, however, the product should be sold only to the tenant at a price set by the tenant and usually at unfair rates.

Both these ways put destructive pressure on resources of the plant. Moreover, the manner in which the resection of the taproot of the species is performed by the collectors in the vast majority of cases ends the lifecycle of the plant.

Subsequently, due to the increasing demand for the product in the market, inadequate knowledge of collectors, absence of monitoring and other conservational measures, and declining levels of communities economics, the resources have become more scarce and threatened.

Figure 5.11: The harvested samples of Asa foetida (Heng) by a tenant in Baghlan (Photo by Babury, 2005).

The findings from districts reveal the following information:

- Resources of *Ferula* sp. are under intense threat.
- There is an increasing market demand for the oleo-gum-resin of Asa foetida.
- the trade of the product is unfair, however, it plays an important role in the livelihood of the collectors and communities,
- Women and children are engaged in the wild collection of the product.
- Collectors are not trained and lack the required technical knowledge about good collection practices and conservation.
- The post-harvesting treatment is limited only to packaging of the oleo-gum-resin in MAPs markets in Herat.
- The illicit export of the product to Pakistan is evident. Even some tenants belong to illicit networks of the supply chain for getting this product to Pakistan.
- Traders and registered companies receive/purchase the product in cans with various volumes from middlemen.

- The traders and companies do not have equipment or standardized stores for stocking the product. The oleo-gum-resin has a strong, tenacious sulphur odour and it should be stored in the cold and protected from light rooms/stocks.
- There is not any capacity building or certification by the relevant authorities in Afghanistan. The ARFVMPEPA provides a formal certificate to some exporter companies according to the Customs. Often, this certificate is issued after some physical analysis of the product.

In summary, the resource assessment data show that certain districts have high potential in resources, conservation and sustainable management, the species have a suitable socioeconomic role in the livelihood and there are better trade and marketing and opportunities for the improvement of the supply chain and quality of the products. The summary of the district ranking based on the grand total score of the resource assessment listed in below table:

Table 5.3: Ranking of districts based on the grand total results calculated for an individual species.

#	District	*Glycyrrhiza* sp.	*Bunium* sp.	*Cuminum* sp.	*Ferula* sp.
1	Adraskan	6	5	4	7
2	Chesht-e-Sharif	2	1		
3	Farsi	2	2		
4	Ghorian	4		11	5
5	Gulran	1	7	9	5
6	Guzara	11		10	
7	Injil	12			
8	Karokh	7	4	6	4
9	Kohsan	5		1	1
10	Kushk-e-Robat Sangi	9	8	5	7
11	Kushk-e-Kohna	8	9	8	8
12	Obe	10		7	
13	Pashtun Zarghun	8	3	2	3
14	Shendand	3	6	3	2
15	Zendajan	7	10	12	6

Note: The gray cells indicate that the district does not produce the production.

The table reveals that Chesht-e-Sharif, Kohsan and Pashtun Zarghun have the most potential among Herat districts in resources, conservation and sustainable management, and that the species have a suitable socioeconomic role in livelihoods. There are better trade and marketing and opportunities for the improvement of the supply chain and quality of the products. Meanwhile, Obe, Zandajan, Kushk-e-Kohna, Kushk-e-Robat

Sangi and Adraskan are the poorer districts, respectively. As indicated earlier, Guzara and Injil should be almost disregarded in this list, because they don't play a tangible role in the wild collection and production of natural ingredients in Herat and there is no perspective for them in future (See pp. 130).

Information from the districts reveals that resources of *Ferula* sp. in Adraskan reduced drastically during the last two decades, while two decades ago, population of the species was satisfactory. In two other districts, Chesht-e-Sharif and Obe are almost deficient in this species and the collection of the product has happened previously.

5.7. Conservation and sustainable use of MAPs

Overexploitation, indiscriminate collection, uncontrolled deforestation, and habitat destruction all affect species rarity, but are insufficient to explain individual species susceptibility or resilience to harvest pressure. Multiple biological characters correlate with extinction risk, such as habitat specificity, distribution range, population size, species diversity, growth rate, and reproductive system (Chen et al., 2016).

In order to develop a mechanism to achieve conservation and sustainable management, the knowledge of genetics, ecology, geography, taxonomy, socioeconomics and other disciplines must be used to understand and manage the MAPs. Plant conservation is a complex process involving the mixture of a multitude of scientific disciplines and practical techniques. In the same time an essential element of conservation is the protection afforded by legal instruments, such as international treaties and national legislation. As such, the role of security, stability and rule of law in context of Afghanistan should be highlighted.

Most of the literature reviewed is concerned about the availability of natural resources of MAPs in many countries pointing to harvesting pressures and other man-made and environmental factors. The results of this research show that there are certain exacerbating factors associated with specific contexts of Afghanistan as a war-affected country. These included lack of any monitoring, illicit and informal export of the natural products, the vulnerability of the population in rural areas, control of the areas by warlords and lack of stable trade chain for MAPs products among them. Nevertheless, it is important to evaluate the opportunities available for the conservation of the MAPs and therefore focusing on the criterion "potential for the sustainable management" (RA2) which shows that the selected plants have variable status in this regard.

The data analysis of RA2 shows that in different districts there are various socioeconomic contexts in communities, different ecological conditions, and different value given to the opportunities provided by this criterion. An attempt was made to evaluate this criterion uniformly.

It is central to scrutinize the different aspects of the conservation of the selected plants.

The SPSS analysis of the criterion “potential for the sustainable management” (RA2) in histograms illustrated in the Fig. 5.12.

The figure depicts that *Glycyrrhiza* sp. has the highest potential for sustainable management compared to other species, while *Cuminum* sp. has the lowest such potential. The benchmarks indicated for this criterion show that along with the relationship between resource capacity and harvesting rate, community understanding and engagement and also the relevant authorities’ activity for the conservation were the focus of evaluation for this criterion. The information revealed that communities are not always aware of the long-term prospects of the critical status of resources, while they are willing to participate in resource management initiatives. Some other factors like poverty, market demands and unemployment also considered intensifying factors.

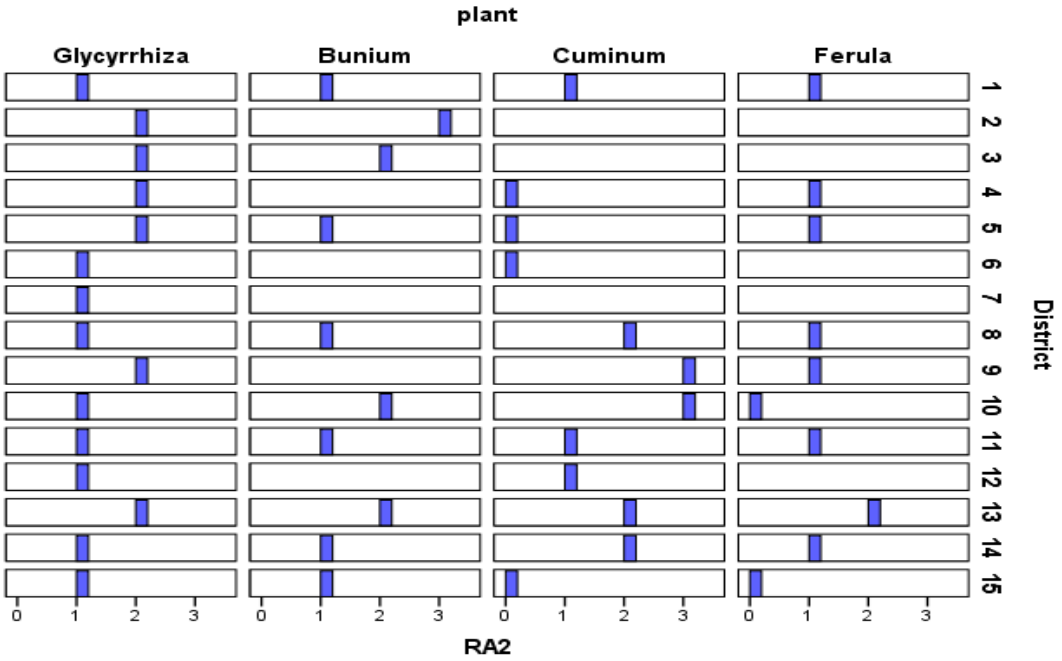


Figure5.12: Assessment of potential for sustainable management (RA1) of the studied plants.

The resource assessment of the selected plants demonstrates the following three major trends:

1. Overwhelming wild collection of the species without regulatory and observational measures**.**
2. Rarity of the resources and the risk of the threat of the selected species is at high in the following order:

Ferula sp.> *Bunium* sp. > *Cuminum* sp.> *Glycyrrhiza* sp.

3. The potential for sustainable management for the species varies among districts, however, based on the data, the following order can be established:

Glycyrrhiza sp. > *Bunium* sp. > *Ferula* sp.> *Cuminum* sp.

The market demands, unemployment and poverty are the basic factors for this increase. These factors are common in the larger picture for other countries as well, as Bentley (2010) and Ross (2005) which indicate that the demand for wild resources has increased by 8–15 % per year in Europe, North America, and Asia in recent decades (Chen et al., 2016). This rate cannot be determined for Afghanistan accurately. Although the annual average growth rate (AAGR) for the export of MAPs is 16.2% compared to 2.4% in volumes of export in global trade during 2001 to 2014 (Vasisht et al., 2016) which is a distinct increase. This figure does not include the domestic use of and informal export of these products.

The second exacerbating factor for this increase is the lack of regulatory and monitoring measures by the relevant authority. Government agencies have had a limited role in conservation work over the last 20 years, with most of the work being undertaken by NGOs. The NGOs have worked directly with local communities and "*shuras*" (council of elders), with the focus of activities being livelihood sustenance based on horticulture and agroforestry interventions. While the NGO contribution has been large, there has been little coordination of the program and limited evaluation (ADB, 2003). The only two developed relevant documents by MAIL are: the Procedure for Conservation and Collection of Wild Medicinal and Aromatic Plants (PCCW-MAP) and the National Natural Resource Management Strategy (NNRMS).

The procedure for conservation and collection of wild MAPs issued in 2002 and made of four following parts:

1. General rules
2. Duties and measures
3. Access and harvesting
4. Miscellaneous

The document defines the terms for the conservation, sustainability and monitoring of natural resources and wild collection. In part 3, it sets out some basic principles for wild collection, but there are no defined conservation measures and good collection practices (GCP) and particularly it does not encourage or support the sustainable cultivation and collection of medicinal plants of good quality in ways that respect and support the conservation of medicinal plants and the environment in general. The last is one of the objectives of the WHO Guideline on Good Agricultural and Collection Practices (GACP) for medicinal plants (WHO, 2003).

This procedure has been officially put in place; however, it is not applied in practice in the wild collection. Despite such guidelines, there is still considerable disparity between existence and implementation. There is no any initiative to train collectors, farmers and other relevant persons such as middleman, processors of medicinal plant products and labor forces. The training of collectors and other relevant people in the production of

MAPs product is therefore one of many important measures to be taken to conserve the resources and MAPs products of high quality.

The absence of monitoring opportunities and measures by DAIL in provinces and absence of required awareness of the communities about the importance of conservation of resources are among other factors. The results of the related criterion assessment "availability guidelines for the implementation of good collection practices" (RA4) in this study demonstrate different pictures for the species studied. The basic idea behind sustainable harvesting is that a biological resource should be harvested within the limits of its capacity for self-renewal and that the manner of its harvest should be such as to not degrade the environment (Hamilton, 2005).

The criterion can be discussed from two points of view: availability (awareness of the existence of such a document) and application in practice. As Figure 5.13 reveals in most of the districts and for three species of *Glycyrrhiza sp.*, *Bunium sp*. and *Cuminum sp.*, the situation is similar and it indicates an absence of awareness about this document, while for the *Ferula sp*. in most districts they are aware of the some requirements by the district agriculture office.

Information shows that the document has not been introduced as a general framework for the wild collection of MAPs and there is not enough information about it even among district agricultural officers. However, for *Ferula* sp. most of the engaged people and collectors know that there is an official document requiring permission for collection and the tenant is the individual who has this right to harvest the oleo-gum-resin (heng). As was noted earlier, there is no information about conservation and appropriate collection requirements.

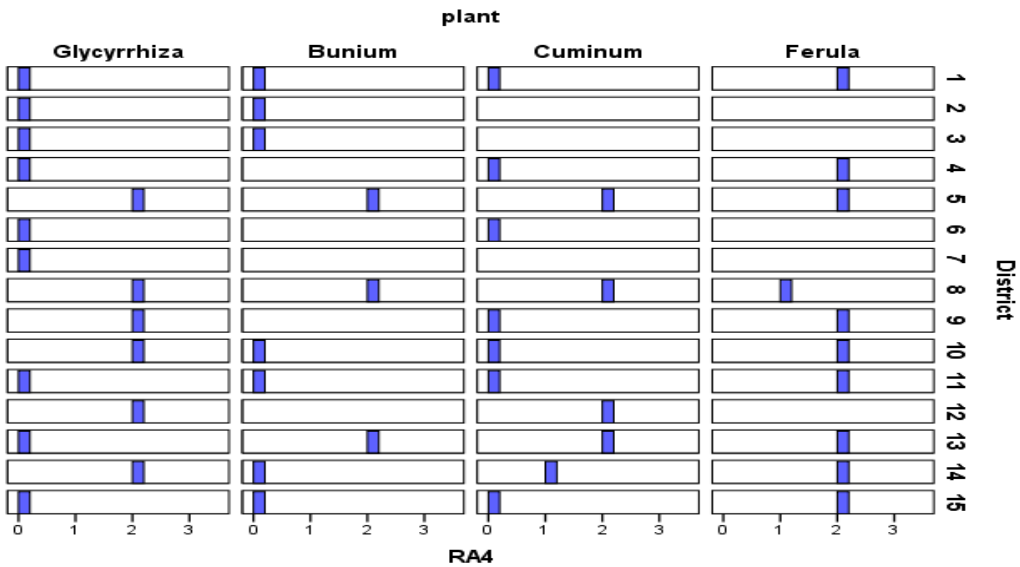


Figure 5.13: Assessment of the guideline availability and its implication for the implementation of good collection practices (RA4).

Another document developed by MAIL is the National Natural Resource Management Strategy (NNRMS) in 2017. As it is indicated in the forward of this document, the NNRMS 2017-2021 has been prepared to provide a strategic framework for MAIL and its development partners to focus on supporting the sustainable economic development of communities which depend on natural resources, create a sustainable environment, conserve soil, water, and protect biodiversity. The NNRMS also recognizes climate change as a serious threat to natural resources and its effect on agriculture and livelihoods of the country and points to the need for addressing the adverse effects of climate change through awareness-raising and by assisting local communities to adapt to climate change (MAIL, 2017).

The NNRMS, in its strategic objectives claims that: "over the next five years a variegated approach of short and long term measures will be undertaken in the areas of natural resource management. In addition, links will also be developed between rural and peri-urban communities to build social awareness of the value of urban ecosystems and the provision of greenery for major cities to reduce environmental pollution levels. This strategy will be underpinned by a concerted capacity development that places MAIL in a facilitative and implementing positions over the next five years as it shifts custodianship of common assets into the community, identifies key areas of medium to long-term income generation for communities wholly reliant on natural resources. Investment in these sectors will allow for rapid growth of products that will contribute directly to the economic growth of the country in a substantive manner (MAIL, 2017).

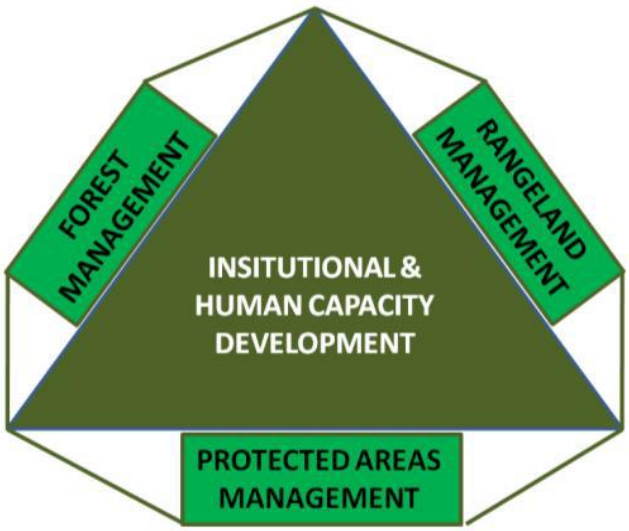


Figure 5.14: Natural resource triangle (MAIL, 2017)

The MAIL through NNRMS committed to achieving the following targets in four major areas in the management of natural resources:

1. **Forest:**

Baseline (2016):

- 1,781,045 ha Natural forests, 2.766% by the country land area.
- 7,235 ha natural forests conserved and improved, 0.047% of total forest areas.

Targets until 2021

- 50,000 ha Conservation/improvement (Natural Forests)
- 34,500 ha Reforestation (Pistachio and Pine nut forests)
- 22,500 ha Urban Greenbelts
- 16,000 ha Agro-forestry (industrial/fast growing forests)

- Total Expansion by the country land area till 2021:
- 1,854,045 ha forests, 2.879% by the country land area.

2. **Rangeland and Medicinal Plan Management:**

Baseline (2016):

- 30,243,985 ha rangelands and medicinal plants, 46.97% by the country land area.

Targets until 2021:

- Conservation/improvement: 493,870 ha (Natural Rangelands and Medicinal Plants)
- Restoration of Medicinal Plants: 2,500 ha (*Glycyrrhiza* sp., *Ferula* sp., *Cuminum* sp.,
  Alkanna tinctoria (L.) Tausch)
- Watershed Management (Check dams): 10,000 ha
- Desertification Control/Sand-dune fixation: 20,000 ha

3. **Protected Area Management:**

- Baseline (2016):
- 1,196,330 ha Protected Areas coverage, 1.858% by the country land area.

Targets until 2021:

- Expansion of Protected Areas to 1,432,551 ha, 2.22 ha by the country land area.
- 7 new Protected Areas listed based on the IUCN Categories.

4. **Institutional and Human Capacity Development:**

Baseline (2016):

- Forests and Rangelands' Policy and Strategy.
- Forest Management Law.
- Forestry Associations Establishment by-law.

- Rangelands Law.
- NRM Stakeholders Coordination Committee/Working Group Platform.

Targets until 2021:

- Structural reforms and realignments in national and sub national levels
- Afghanistan's forestry policy Revised
- New rangeland law Amended and approved
- Social forestry regulations exist
- Green Afghanistan regulations Approved.
- Regulation for project implementation by social organizations
- Regulation for sustainable use of rangelands is developed based on the rangeland law
- Existence of procedure for establishment of RMAs
- Wild medicinal plants procedure by participation of local communities
- Approved medicinal plants law
- Existence of protected area policy.
- Existence of procedure for establishment of protected area committees.
- Approved wildlife conservation and hunting management law.
- Universities and educational institutions engaged in scientific based natural resources

The NNRMS in its strategic objectives states "community based management of rangeland and medicinal plants through strengthening community-based interventions, introducing good practices, and up-scaling indigenous knowledge, for a better livelihood of local and herder communities, desertification control and subsequently combat negative impacts of climate change" (MAIL,2017).

It foresees that the ultimate result of this objective is to promote engagement of local communities in community-based practices in rangeland management. As such, community-based sustainable management conservation, restoration and improvement in natural resources will be used as mechanisms to manage sustainable utilization of rangelands and wild medicinal plants in order to support and develop sustainable livelihoods of local communities.

The NNRMS considers that sustainable management conservation will require indigenous knowledge management and up-scaling of good practices, and local communities to actively conserve and maintain 210,000 ha of rangeland by introducing rotational grazing practices over 5 years. This will be done by establishing community-based organizations such as rangeland management associations to undertake community-based rangeland assessment and developing rangeland management plans. Innovative approaches to engaging communities in watershed management, and the establishment of local producer groups and associations will be undertaken through mobilization and capacity building. Local communities will have their capacity enhanced

to take into account local knowledge and to know how to adapt to climate change and combat desertification (MAIL, 2017).

Generally, the NNRMS foresees ambitious achievements until 2021. Having recognized the realities in remote areas like the Herat districts, the limitations and low potential of DAIL and district offices of agriculture, increasing market demands for natural products and the poverty of the population, any strategy in favour of natural resource management requires pragmatic approaches and action plans. It is important to find mechanisms for the community-based approaches to the sustainability of the resources and their conservation. Moreover, the NNRMS is deficient in scientific details and pieces of evidence regarding natural resources and especially MAPs. The budget calculation in this document is lacking any action plan based estimates.

The NNRMS does not focus on any conservation approaches such as in situ, ex situ and other agricultural and cultivation practices. Different groups of recommendations concerning the conservation of medicinal plants have been developed, such as providing both in situ and ex situ conservation. According to Sheikh et. al. (2002) and Coley et. al. (2003) natural reserves and wild nurseries are typical examples for retaining the medical efficacy of plants in their natural habitats, while botanic gardens and seed banks are important paradigms for ex situ conservation and future replanting (Chen et al., 2016). At the same time, it is important to know about the geographic distribution and biological characteristics (biogenesis of the bioactive compounds) of medicinal plants to guide conservation activities, e.g. to assess whether species conservation should take place in nature or in a nursery.

In situ conservation of wild MAPs in Afghanistan has a long history in reforestation of pistachio in the past and this can be considered an effective conservational measure for other species. It allows the protection of indigenous plants and maintains natural communities, along with their intricate network of relationships. Additionally, in situ conservation increases the amount of diversity that can be conserved, and strengthens the link between resource conservation and sustainable use (Chen et al., 2016).

In Afghanistan the success of any kind of conservation and particularly in situ conservation depends on a sound mechanism for the implementation and follow up through rules, regulations, and potential engagement of communities.

One of the common methods of conservation in Afghanistan is designation as protected areas. However, it is impossible to designate every natural wild plant habitat as a protected area, owing to cost considerations and competing land uses. Some authors have suggested that a wild nursery can be established for species-oriented cultivating and the domesticating of endangered medicinal plants in a protected area, natural habitat, or a place that is only a short distance from where the plants naturally grow (Chen et al., 2016). Liu et. al. (2011) suggest that although the populations of many wild species are under heavy pressure because of overexploitation, habitat degradation and invasive

species, wild nurseries can provide an effective approach for in situ conservation of medicinal plants that are endemic, endangered, and in-demand (Chen et al., 2016).

Ex situ conservation acts as a back-up for certain types of diversity that might otherwise be lost in nature and in human-dominated ecosystems, generally through the maintenance of colonial crops in field gene banks and in vitro banks, certain trees in conservation stands, and many seed-bearing species in botanical gardens and/or in seed banks (conventional and cryogenic) (Li and Pritchard, 2009).

During last two decades in spite of natural resource difficulties in Afghanistan, some valuable species have been conserved through ex situ conservation by communities. *Carum caraway* L., *Bunium* sp., and *Cuminum* sp. are among these species. Ex situ conservation aims to cultivate threatened species to ensure their continued existence and sometimes to enhance the productivity of the natural products and planting material, and it is often an immediate and easier action to sustain MAPs resources.

Ex situ conservation is not always sharply separated from in situ conservation, but it is an effective complement to it, especially for those overexploited and endangered medicinal plants with slow growth, low abundance, and high susceptibility to replanting diseases. Many species of previously wild medicinal plants can not only retain high potency when grown in gardens far away from the habitats where they naturally occur, but can have their reproductive materials selected and stored in seed banks for future replanting (Chen et al., 2016). It is important to understand the different aspects of the species conservation. As Bodeker et al. (1997) highlights the relationship between in-situ and ex-situ conservation of species is an interesting topic with implications for local communities, public and private land owners and managers, entire industries and, of course, wild species. Identifying the conservation benefits and cost of the different production systems for MAP should help guide policies as to whether species conservation should take place in nature or the nursery, or both (Shippmann, 2002).

The establishment of botanical gardens also plays an important role in ex situ conservation as they can maintain the ecosystems which enhance the survival of rare and endangered plant species. Moreover, by collecting systematically diverse plants, botanical gardens can play a further role in medicinal plant conservation through the development of propagation and cultivation protocols, as well as undertaking programs of domestication and variety breeding (Chen et al., 2016). In the nineteen sixties, Kabul University had a small botanic garden which was destroyed during the nineteen nineties war and presently, there are no botanical gardens in their full meaning in Afghanistan. The NNRMS does not foresee any target for establishing botanical gardens during forthcoming period.

Seed banks are another way to preserve the genetic diversity of the threatened and endangered MAPs. Seed banks represent genetic reservoirs of adaptive traits. According to Templeton and Levin (1979), the seed bank of a plant community represents the "memory" of previous conditions, and it is an important component of the potential of

the community to respond to conditions in the present and future (Coffin and Lauenroth, 1989).

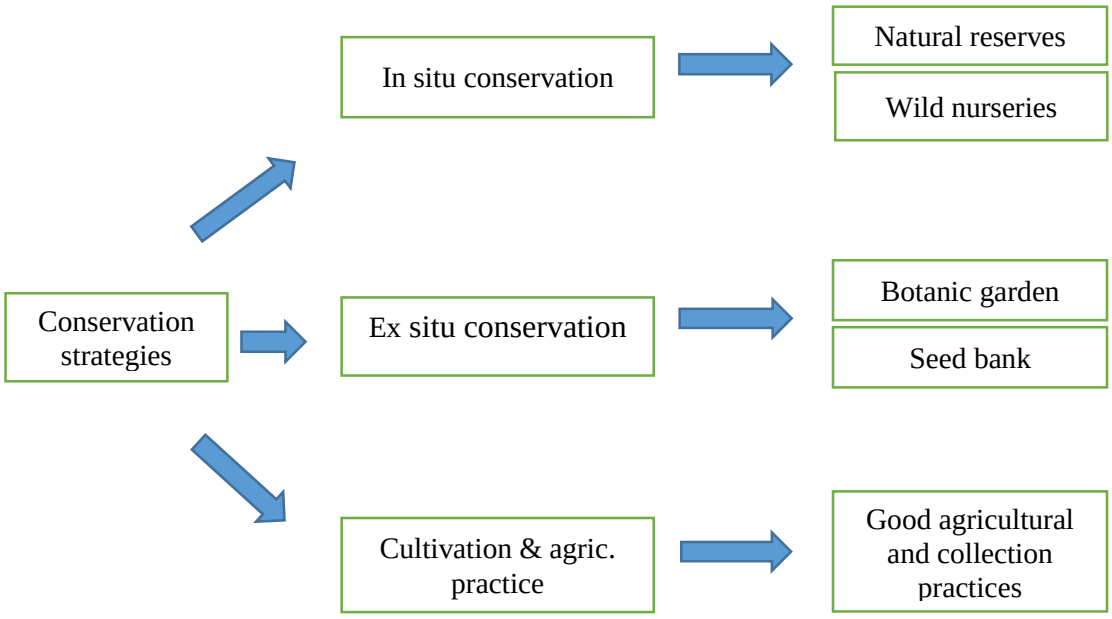


Figure 5.15: Diagram of methodological systems involved in the conservation of medicinal plants (modified from Chen et al., 2016).

According to Li and Pritchard (2009) and Schoen and Brown (2001) "seed banks offer a better way of storing the genetic diversity of many medicinal plants ex situ than through botanical gardens, and are recommended to help preserve the biological and genetic diversity of wild plant species. Seed banks allow relatively rapid access to plant samples for the evaluation of their properties, providing helpful information for conserving the remaining natural populations. The challenging tasks of seed banking are how to reintroduce the plant species back into the wild and how to actively assist in the restoration of wild populations" (Chen et al., 2016).

Another reason for establishing seed banks for MAPs in Afghanistan could be the need for selecting adaptive cultivars to climate changes or developing new ones by crossing varieties in the future.

The seed bank issue is another important conservational measure that has not been targeted as an important attempt in conservation of wild MAPs in Afghanistan in NNRMS by MAIL.

Wild harvesting has led to biodiversity decline and such loss is detrimental to the ecosystems and services on which humans ultimately depend. It is now estimated that of the 1500 species of plants that are listed as threatened, 33 are extinct, 157 are endangered, 114 are vulnerable and 246 are rare (Raina et al. 2011). As Mudappa and

Oommen (1998) reports more than 70% of the threatened medicinal plants are actively traded (Raina et al. 2011).

One of the main preferences of wild collection is the appropriate efficacy of the collected products compared to the cultivated species. Nevertheless, due to certain reasons the cultivation of MAPs also play an important role in supply of the market demand.

Cultivation is one of the efficient ways to overcome such drawbacks. Cultivation provides the opportunity to use new techniques to solve problems encountered in the production of medicinal plants, such as toxic components, pesticide contamination, low contents of active ingredients, and the misidentification of botanical origin (Raina et al. 2011). Through cultivation the yields of pharmacologically active compounds, which are almost invariably secondary metabolites, can be enhanced. The advantages and disadvantages of both wild resources and cultivated species are listed in Tab. 5.3.

Table 5.4: The advantages and disadvantages of wild resource versus cultivated medicinal plant species

Characteristics	Wild resource	Cultivated species
Advantages	It is open access resource without investment It is natural resource and free from pesticides Wild resource is supposed to be more efficacious	It relieves harvesting pressure on rare and threatened species It can keep genotypes being standardized or improved It guarantees continuing supply of raw medicinal materials Production volume and price can be stable for longer periods
Disadvantages	Wild resource is becoming scarce and threatened by over-harvesting There exists a risk of adulterations and resource exhaustion Uncontrolled harvesting leads to the extinction of ecotype and species There is a lack of resource inventories and related management practices	It needs substantial investment before and during production It narrows genetic diversity in gene pool of wild populations Reintroduced plants can cause genetic pollution of wild resource Cultivated species may have negative impacts on ecosystems There is a lack of successful cultivation techniques for some species

The table prepared based on the information from Hamilton (2004), Schippmann et al. (2005), Liu et al. (2011), and Raina et al. (2011) (Chen et al., 2016).

Hamilton (2004), Larsen & Olsen (2009) and Schipmann et al. (2005) highlight that increased cultivation contributes to decreases in the harvest volume of medicinal plants, benefits the recovery of their wild resources, and decreases their prices to a more reasonable level (Chen et al., 2016). However, in practice this trend does not apply to Afghanistan because of the high regional demand for the products, relatively low market price of products and illicit and informal export of MAPs. The relation between price

and harvest volume in wild harvesting, cultivation and the transition period from wild harvesting to cultivation are demonstrated in Fig. 5.16.

On a time scale of sometimes many decades, the transition from wild harvesting to cultivation goes through different phases:

Discovery Phase: At this point, the demand can be met by wild harvest. The collection is done for local use or for trade.

Expansion Phase: Normally, the product is potentially useful and that demand is likely to increase. Harvest is done for local, regional, and ultimately for international markets. Species with naturally low densities are unlikely to become important sources of commercially large quantities.

Stabilization Phase: The species is unlikely to be attractive to growers unless prices are high enough and wild-harvested resources are scarce enough. However, desirable species may be grown on farmland and planted around settlements.

Decline Phase: Prices increase with scarcity due to transport costs, search time and the long-distance trade. Wild populations will have to decline further before cultivation is a viable option.

Extinction phase: The species become extinct (termination of the species) and therefore the prices of the products in the market increase and the harvest volume approaches null.

Recovery phase: Prices decrease with an increase in abundance and harvest volume.

Cultivation Phase: The species are domesticated and incorporated in the required agricultural system. If the demand is high and international market opportunities exist, commercial plantations are formed with applying genetic measures like selection, cloning, breeding, and other biotechnological applications.

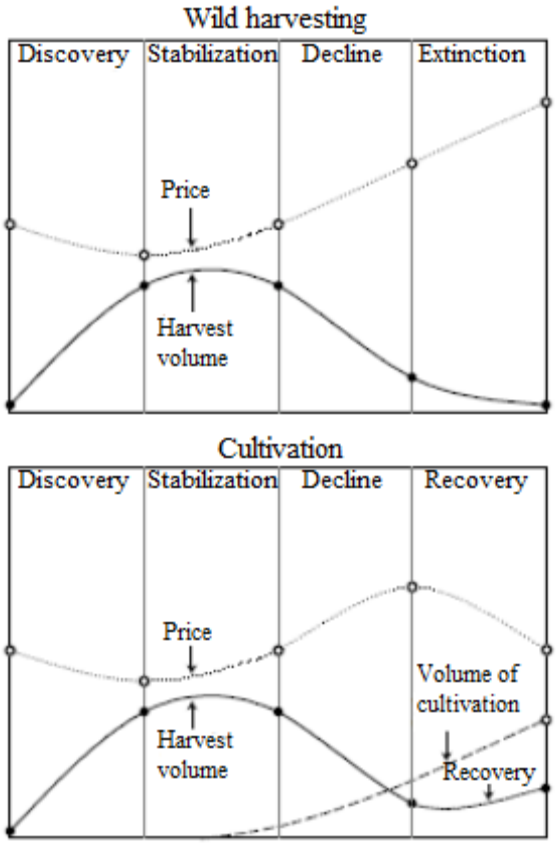


Figure 5.16: Price and harvest volume variation in the transition from wild-harvesting to cultivation of medicinal plants. Data sources from Hamilton (2004), Larsen and Olsen (2007), Schippmann et al. (2005), Chan et al. (2012) (Chan et al., 2016).

As wild resources decline with overharvesting, the price of raw material increases accordingly. Therefore, cultivation becomes economically feasible for price stabilization and resource recovery of medicinal plants.

One of the critical issues in the collection, processing, quality and standardization of wild collection is the guidelines and instructions which can provide technical guidance about harvesting and procurement of MAPs materials of appropriate quality for the sustainable production of MAPs and their products for medicinal and aromatic uses. Many countries have developed national or specific guidelines which apply to the cultivation and collection of medicinal plants, including certain post-harvest operations. The WHO guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants are primarily intended to provide general technical guidance for obtaining medicinal plant materials of good quality for the sustainable production of herbal products classified as medicines (WHO, 2003).

This document should be used as a basis for the establishment of appropriate guidelines at the national level. Raw medicinal plant materials should meet all applicable national and/or regional quality standards. The guidelines therefore, may need to be adapted according to each country's conditions and situation. Afghanistan is lacking any such

document providing technical guidance and instruction on cultivation, harvesting, conservation and facilitating standardization MAPs products. Therefore, it is essential for the authorities and specially MAIL in Afghanistan to develop such guidelines to provide technical instructions, guidance to obtain required MAPs products, conserve the resources and improve the knowledge and experience of the communities and collectors.

The main objectives of these guidelines (WHO, 2003) are to:

- contribute to the quality assurance of medicinal plant materials used as the source for herbal medicines, which aims to improve the quality, safety and efficacy of finished herbal products;
- guide the formulation of national and/or regional GACP guidelines and GACP monographs for medicinal plants and related standard operating procedures; and
- encourage and support the sustainable cultivation and collection of medicinal plants of good quality in ways that respect and support the conservation of medicinal plants and the environment in general.

The guidelines along with a general introduction include good agricultural practices for medicinal plants and good collection practices for medicinal plants, respectively. They also outline common technical aspects of good agricultural practices for medicinal plants and good collection practices for medicinal plants.

The section "good agricultural practices" describes general principles and provides technical details for the cultivation of medicinal plants. It also describes quality control measures, where applicable. However, the section "Good collection practices for medicinal plants" describes permission to collect, technical planning, selection of medicinal plants for collection, collection and issues relevant to capacity and knowledge of the personnel engaged in the collection practice.

The guidelines in "common technical aspects of good agricultural practices for medicinal plants and good collection practices for medicinal plants" guide the post-harvest processing through inspection and sorting, primary processing, drying and specific processing, processing facilities, packaging and labelling, storage and transportation, equipment and personnel.

The International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) is an initiative of the International Expert Workshop on CITES Non-Detriment Findings, Perennial Plant Working Group (Ornamentals, Medicinal and Aromatic Plants) to meet the needs of industry, governments, certifiers, resource managers, and collectors to understand whether wild collection activities for MAP are sustainable, and how to improve collection and resource management operations that are detrimental to the long-term survival of these resources. Implementation of the ecological elements of ISSC-MAP in the Convention on International Trade in

Endangered Species of Wild Fauna and Flora (CITES) is one of the priority implementation scenarios identified for ISSC-MAP.

The focus of the ISSC-MAP is on the ecological sustainability of wild plant populations and species in their natural habitat, but it also addresses the social and economic context of sustainable use. The ISSC-MAP provides a practical interface between the general recommendations set out in these Guidelines, and management plans that must be developed for particular species and specific situations (Leaman, 2008).

The purpose of the ISSC-MAP is to ensure the continued use and long-term survival of MAP species and populations in their habitats, while respecting the traditions, cultures and livelihoods of all stakeholders (Leaman, 2008). The ISSC-MAP focuses on best ecological practices but also aims to support responsible social standards and business practices that affect collectors and collection operations, because these elements in turn affect the management of collected species and collection areas (Leaman, 2008). The objectives and content of the standard in many cases are compatible with the conditions of Afghanistan. Furthermore, the methodology of this study is envisioned in this document.

Based on the finding of this study, realities of Afghanistan natural and socioeconomic context and the purpose of the ISSC-MAP, the resource management of MAPs in Herat can be outlined in the following parts:

- Wild collection and conservation requirements,
- Regulatory and ethical requirements
- Resource management and trading requirements

The structure and proposed principles and criteria for resource management of MAP natural resources in Herat based on the ISSC-MAP guideline are outlined in the Tab.

Table 5.5: Proposed principles and criteria for management of MAP natural resources in Herat based on ISSC-MAP guideline.

Section 1: Wild collection and conservation requirements
Principle 1: Maintaining MAP natural resources Wild collection of MAP resources shall be conducted at a scale and rate and in a manner that maintains the populations and species over the long term.
1.1 Conservation status of MAP The conservation status of target MAP species and populations is assessed and regularly reviewed. **1.2 Knowledge-based and skilled collection practices** MAP collection and management practices are based on identification, inventory, assessment, and monitoring of the target species and collection impacts.

1.3 Collection intensity and species regeneration The rate (intensity and frequency) of MAP collection does not exceed the target species' ability to regenerate over the long term. **1.4. Establishing *"local council of natural resources"*** District governmental offices (district offices of agriculture) with the support of Community Development Councils establish *"local council of natural resources*".
Principle 2: Preventing Negative Environmental Impacts Negative impacts caused by MAP collection activities on other wild species, the collection area, and neighboring areas shall be prevented.
2.1 Sensitive taxa and habitats Rare, threatened, and endangered species and habitats that are likely to be affected by MAP collection and management are identified and protected. **2.2 Habitat (landscape level) management** Management activities supporting wild MAP collection do not adversely affect ecosystem diversity, processes, and functions.
Section II: Legal and ethical requirements
Principle 3: Complying with Laws, Regulations, and Agreements MAP collection and management activities shall be carried out under legitimate tenure arrangements, and comply with PCCW-MAP, relevant regulations, and agreements with collectors and communities through Community Development Councils / "*local council of natural resources*".
3.1 Tenure, management authority, and use rights Collectors, managers and community have a clear right and authority to use and manage the target MAP resources, especially for *Glycyrrhiza* sp. and *Ferula* sp. **3.2 Laws, regulations, and administrative requirements** Collection and management of MAP resources comply with all international agreements and with national laws, regulations, and local administrative requirements, including those related to protected species and areas. **3.3 Worker safety, gender equity and child protection** MAP collection management provides adequate work-related health, safety, and financial compensation to collectors and other workers, protects females and children from exploitation in the collection and post-harvesting treatment.
Principle 4: Respecting Customary Rights Local communities' customary rights to use and manage rangelands and collection areas and wild collected MAP resources shall be recognized and respected.
4.1 Traditional use, access rights, and cultural heritage

Local communities with legal or customary tenure or use rights maintain control, to the extent necessary to protect their rights or resources, over MAP collection operations.

4.2 Benefit sharing

Agreements with local communities, Community Development Councils / *"local council of natural resources*" are based on appropriate and adequate knowledge of MAP resource tenure, regulatory requirements, and resource value.

4.3 Tax payment

Agreement with collectors, local communities and Community Development Councils / *"local council of natural resources*" for paying the taxes according to the PCCW-MAP" by MAIL.

Section III: Management and trade and marketing requirements

Principle 5: Applying Responsible Management Practices

Wild collection of MAP species shall be based on adaptive, practical, participatory, and transparent management practices.

5.1 Species / area management plan

A species /area management plan defines adaptive, practical management processes and good collection practices.

5.2 Inventory, assessment, and monitoring

Management of MAP wild collection is supported by adequate and practical resource inventory, assessment, and monitoring of collection impacts by relevant bodies indicated in this standard.

5.3 Transparency and participation

MAP collection activities are carried out in a transparent manner with respect to management planning and implementation, recording and sharing information, and involving stakeholders.

5.4 Documentation

Procedures for collecting, managing, and sharing information required for effective collection management are established / rationalized (PCCW-MAP) and carried out.

5.5 Monitoring

District offices of agriculture and "*local councils of natural resources"* systematically monitor the application of regulations, procedures including PCCW-MAP to ensure the effectiveness of measures and standards.

Principle 6: Applying Responsible Business Practices

Wild collection of MAP resources shall be undertaken to support quality, financial, and labor requirements of the market without sacrificing sustainability of the resource.

6.1 Market / buyer specifications
The sustainable collection and handling of MAP resources is managed and planned according to market requirements in order to prevent or minimize the collection of products unlikely to be sold.

6.2 Traceability
Storage and handling of MAP resources is managed to support traceability to the collection area.

6.3 Financial viability
Mechanisms are encouraged to ensure the financial viability of systems of sustainable wild collection of MAP resources.

6.4 Training and capacity building
District agricultural officers and collectors have adequate skills and knowledge to implement the provisions of the management plan, and to comply with the regulatory requirements or any introduced standards.

The proposed principles and criteria for management of MAP natural resources in Herat can be applicable to whole country.

Like any other area of the development in Afghanistan, the key point in the resource management of MAPs is sustainability. Information from districts in Herat shows that limited activities have been initiated by DAIL (introducing PCCW-MAP, regulating the wild collection of *Ferula* sp. oleo-gum-resin by contracting to tenants) and communities; however, they have not been sustained. Sustainability is important because it insures that progress in the conservation of wild MAPs is lasting, rather than fleeting and it will provide the basis for reviving the resources and the basis for improved livelihoods, especially for the vulnerable population. There are seven main reasons for the lack of sustainability of conservation initiatives in Afghanistan as follows:

1. Information about MAPs natural resources has not been accumulated, systematized or made available in a manner suitable to the communities.
2. The community is not engaged in conservation which may further enlarge this body of knowledge or become active promoters and disseminators of information regarding conservation.
3. There is not an appropriate administrative or organizational structure by or within which the conservation activities may be established and conducted.
4. There is no adequate legislative or other official mandate which prescribes or enables the conservation measures or GACP to occur.
5. No training or knowledge transformation has been offered for the collectors and communities.
6. District offices of agriculture are lacking adequate soft and hard potentials for extension activity and support to collectors, small-scale farmers and communities.

7. Security deterioration in some areas hindering effective interventions by the district offices of agriculture, therefore sometimes the issue of conservation in a war zone raising.

Practically, in view to sustain the conservational activities in Afghanistan it is crucial to focus to the main seven abovementioned reasons. Based on the reasons, and finding from the study, essential features of sustainable resource management in Afghanistan should include:

1. Integrity and close collaboration between different stakeholders in the area of biodiversity, environmental protection, and natural resources. The realization of the developed NBSAP as an important hub for the other relevant initiatives in conservation requires strong commitment and collaboration of the implementing government organizations. As a signatory member, it is of importance for Afghanistan to cooperate effectively with potential organization functioning in conservation and protection of nature and biodiversity (CITES, WCS, WWF, etc.).
2. Engagement of community in sustainable resource management. It is of crucial importance to find a pragmatic mechanism for the community-based approaches to the sustainability of the resources and their conservation. Establishing "local councils of natural resources" at the level of every district and eventual expansion to the village level as a part of the 'Community Development Council" through Citizen's Charter National Priority Program by the MRRD can be a vital initiative in this regard.
3. Training and capacity enhancement of communities, collectors, available technical staff, district agricultural officers and governmental institutions in conservation and effective management of MAPs natural resources and biodiversity. The concepts of sustainable management, conservation and good collection practices should be well defined and applied in practice.
4. Increasing public awareness of biodiversity and its value to the people.
5. Generation of evidence-based information about MAPs, through baseline and monitoring assessments. Any managerial and conservational approach requires systematized information and pieces of evidence, therefore it is of vital importance to conduct resource assessments and generate the required information. Presently, the GIS as the efficient tool used in resource assessment and determination of species population makes this task easier. Afghanistan still lacking published and documented flora of the country. Although there are some valuable works recently published (See pp. 35) which could be an essential basis for the flora, it requires compassioned multi-stakeholder strides.
6. MAIL through general directorate of natural resource management should take practical evidence based initiatives for conservation of wild resources of MAPs. Its activity should not be limited to development of strategy or paperwork. It was one of the request of the most agricultural officers in Herat districts.

7. The government commitment for the conservation of the resources and its sustainable management is a vital importance. However, formally there are some achievements in establishing new authorities (Directorate of natural resources at MAIL, NEPA), but this commitment should be featured in some practical stride in the conservation of natural resources.
8. Allocation of financial means for the sector is essential. The MAIL and government should not be lagging far behind the needs. There are certain opportunities at the global arena for the funding, cooperation and collaboration in the conservation of biodiversity and MAPs and they should be efficiently attracted to this subject.
9. Develop a protected areas plan for Afghanistan in order to protect representative areas of high biodiversity in all major eco-regions.

Certainly, the important elements of management systems for the sustainable use of medicinal plant resources should include: (1) efficient community involvement, (2) effective and dutiful presence of district office of agriculture/responsible organization, (3) management plan which should be reviewed periodically, (4) defined management area, (5) strong tenure and (6) defined procedures for monitoring harvested species, good quality products and setting management mechanism for them.

The harvesting of the studied species in Afghanistan offers some opportunities:

- The regional and global market conditions and economic environment for the business are favorable. There are exponential trends in market demand for these products and especially for the wild collection.
- The wild collection has good suitability for the livelihood of the communities.
- Basically, communities realize the critical status of natural resources and are willing to support appropriate initiatives by responsible organizations and authorities.
- Awareness of the need for conservation is increasing among officials and stakeholders.

5.8. Prospect of certification system for MAPs in Afghanistan

International agricultural trade has expanded rapidly in recent decades and requirements for the quality of the products and services have increasingly becoming important. According to Byerlee & Rueda (2015), as sources of agricultural products multiply in ever more complex supply chain systems, a growing set of new standards and regulations has come to affect the way agricultural commodities are produced, traded and consumed (Oya, Schaefer and Skalidou, 2018). The majority of agricultural products traded from low and middle-income countries are lacking any certification, however, exports from these countries in particular are increasingly covered by private voluntary standards that claim to certify the social and environmental sustainability of production conditions. This expansion of agricultural trade and associated standards

may benefit producers and workers incorporated into global value chains, insofar as new conventions help empower these groups and improve control over the social and environmental effects of agricultural production (Oya et al., 2018). In Afghanistan, low levels of industrial and manufacturing activity coupled with the sluggish (and sometimes negative) pace of agriculture have adversely affected value addition, innovation and livelihoods (MoCI, 2018 b). At the same time it is becoming essential to protect public health and ensure the ability of the market to supply safe, required quality and effective products to the market.

In fact, a combination of market, industry, relational and civic conventions increasingly shape the governance of value chains and the distribution of value therein (Auld, Renckens, & Cashore, 2015).

As Raynolds (2017) notes "certification systems are often multi-stakeholder initiatives with multiple drivers and shifting priorities. Historically, they frequently originated from, and were driven by, NGOs, as in the case of Fairtrade, a pioneering standards system that remains one of the most famous today" (Oya et al., 2018). The main priorities for MAPs product certification in Afghanistan can be sustainable resource management, environmental sustainability, Fairtrade of products, quality enhancement through post-harvesting treatment and packaging. The main function of CS in agriculture, especially in the form of third-party certification, is to set voluntary standards with specific requirements for producers or suppliers, monitor their compliance (through independent auditors) and support producers to meet them, with the goal of making agricultural production more economically, socially and environmentally sustainable and agricultural trade fairer to direct producers, i.e. farmers, and workers (Oya et al., 2018).

Certification may be defined as a process whereby an unobservable quality level of some product is made known to the consumer through some labeling or stamping system, usually issued by a third independent party. In other words, certification is a process for transforming a credence attribute into a search attribute (Auriol & Schilizzi, 2015).

Certification systems try to achieve their goals through a combination of standard-setting actions, compliance, capacity building and training for farmers and producers' organisations, as well as different types of market interventions such as guaranteed market outlets, price premiums and credit facilities (Podhorsky, 2015).

There are certain essential factors requiring Afghanistan to adopt rapid and effective certification systems for the natural products including MAPs ingredients. International agricultural trade is expanding in recent decades rapidly and Afghanistan as a country with agricultural based economy needs to become an effective part of this trade. At the same time, it is of vital importance for Afghanistan to promote its export and diversify its economy.

In Afghanistan there is no external and internal standards for the collected products in the country and usually the middleman, local and regional traders perform certain processing procedures according to the requirements of the local and regional markets. As there is not any standard requirement and monitoring over the process by any other source, therefore the interest and effort for the quality enhancement of the product depends only on price in the market. There is not any information about the development of a certification system in the reviewed references and interviewed official peoples and figures.

The assessment of the variable "potential for certification in the market" as an included criterion in the trade and marketing assessment of this study demonstrates that there are good potentials for this initiative in the studied districts of Herat province.

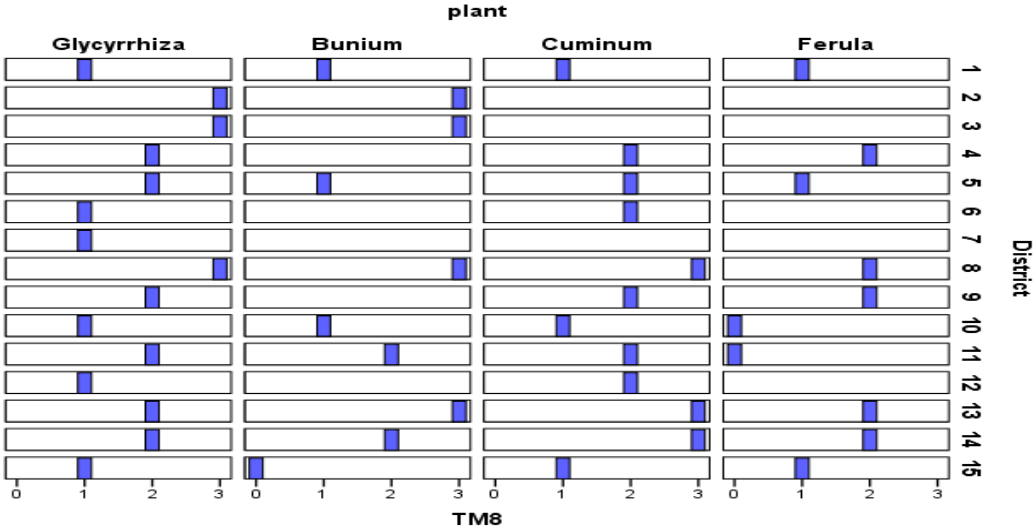


Figure 5.17: Assessment of the potential for the certification in the market.

As the graph shows, the demand and capacity for creating a certification system for each of the four products in each district of Herat have a good status. In view to assess the opportunities and challenges of this question, it is necessary to scrutinize the process from different aspects.

Along with the opportunities, the quality of the products of the natural ingredients of Afghanistan can be cited. A number of these products, especially the four products studied, occasionally appear on the international market. This means that these products, although not directly purchased by international companies, come from the markets of neighboring countries after additional processing, and especially better packaging. Obviously, the penetration of Afghan natural products has two main reasons, one that the volume of production is relatively significant and can be surplus in the countries of the region, and secondly the decent quality of these products has attracted the food and pharmaceutical companies in the international markets it goes.

Unfortunately, this pathway for products through regional markets in neighboring countries to international markets that are mostly applicants for certification can be cited

as an obstacle, because, as previously mentioned, a significant portion of these products (around 40%) are exported unofficially to neighboring countries and then reach the international market. Trading of Afghani products through regional markets in the neighboring countries is easier and has less barriers to overcome than global ones as they tend to be less consolidated and demand less rigorous certification and at the same time they enjoy the low prices of the Afghan products. This should be leveraged as these regional economies offer more complementarities than competition, given that they are actively seeking suppliers and links for sourcing (MoCI, 2018 b). On the other hand, even on the part of products exported through formal trade, the share of neighboring countries, especially Pakistan, India, Iran and Turkey, is the largest. Demand for certification of this part of the export is also not strong. As it was ascribed earlier, the main destinations of the MAPs formal export in the regional market are Pakistan, India, Iran and Turkey. Most of the products exported to these countries do not undergo the required technological processing to meet international standards and requirements.

There is a general consensus that the impact of certification is context specific, but this mixed-method review provides insights into key contextual factors affecting particular causal chains, such as certified farm income, workers' wages and total household income (Oya et al., 2018). Realizing the traditional supply chain of the MAPs in Herat and whole of the country, the impact of the systems and their associated interventions on the socio-economic wellbeing of those who are supposed to be the ultimate beneficiaries of certification like direct producers and hired workers, rural communities and other middleman can be assessed through a causal chain illustrated below.

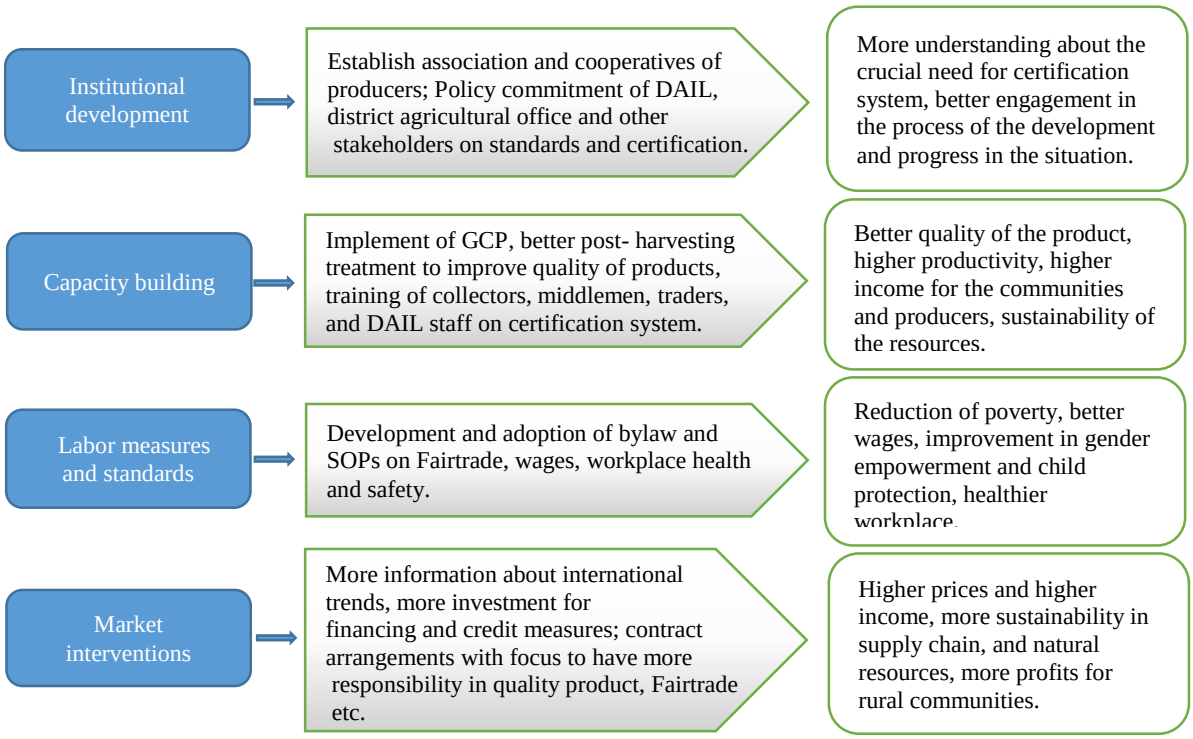


Fig. 5.18 The causal chain of the intervention for establishing certification system of MAPs in Herat (modified from Oya et al., 2018).

One limitation of the evidence base is that the effectiveness results can only be interpreted in terms of whether certifications as bundles of interventions, have any impact. These results also call into question the effectiveness of agricultural certification in helping the poorest of poor. The implication is that CS need to manage expectations and carefully frame their claims about impact, especially when positive effects are only marginal or even non-existent. The difficulty faced by certification systems is the latent tension between the market imperative to promote a particular certification, which may lead to bold claims about sustainability, and the operational imperative to improve the evidence base on impact through more rigorous and more frequent impact evaluations (Oya et al., 2018).

Generally, there are certain challenges and opportunities in Afghanistan for establishing CS. The main challenges facing MAPs products and other natural ingredients certification in Afghanistan are:

- The low level of information about certification in general
- Financing limitations
- Poor capacity of local agricultural offices, traders, collectors, and other involved organization about current trend in resources, sustainable resource management, and monitoring measures.
- Political instability
- High cost associated with the certification of MAPs products.
- Lack of certification organization with experience in natural products, ecology and supply chain of MAPs products in Afghanistan.
- Lack of trend for certification of MAPs product of Afghanistan by regional market.

At the same time there are certain opportunities for establishing certification system for MAPs products and other natural ingredients in Afghanistan. The main opportunities are:

- Potential market demand for certain Afghani MAPs and other agricultural products at international market.
- Sustainability in harvesting of many MAPs product,
- Awareness and concerns about low price of MAPs product in regional market,
- Potential role of MAPs and other natural ingredients in the livelihood of rural communities and in alternative livelihood of provinces producing opium.
- Ability of certified MAPs products in markets to command a price premium.
- Crucial need for Fairtrade initiative in supply chain of MAPs products in Afghanistan as a way to improve the rural communities' livelihood.
- Opportunities for private property ownership based on the Constitution, which has established legal protection for private sector and for development of market economy and economic development.
- For certain items like *Glycyrrhiza* sp., *Ferula* sp., saffron etc. conditions in domestic market ranging from purchasing power of consumers to the inadequate demand/size are impediment which negate the opportunity to position the

domestic market as a stepping stone. For such items international market is a necessary growth medium.

- Strong strategic commitment of the government to improve agriculture sector and rural development.

Regarding workers specifically, a wide range of CS in the past two decades have focused on the application of adequate labour standards relating to wages and non-wage working conditions, particularly with regards to health & safety. This is a result of two main trends. First is the growing awareness among consumers about the importance of labour standards, decent work and the prevention of the worst forms of exploitation in the production of widely traded commodities. Second, seeking to expand their reach, certification systems initially focused on small producers, have been extending their certification to large-scale plantations (Raynolds, 2017). As a result, most CS, even those focused on other dimensions of sustainability such as environmental protection, also include basic labour standards in their requirements. This point has an essential importance in Afghanistan where gender equity and child labour became a social challenge due to the continuous unrest conditions in the country. At least a quarter of Afghan children between ages 5 and 14 work for a living or to help their families (CSO, 2016). Many are employed in jobs that can result in illness, injury, or even death due to hazardous working conditions and poor enforcement of safety and health standards (US Department of Labor, 2008). Work induces many children to leave school prematurely. Only half of Afghanistan's child laborers attend school (CSO, 2016).

On the other hand, while the economic participation of women in traditional sectors, such as agriculture, is significant, Afghan women remain among the most marginalized. Their limited access to support services, such as training and access to credit, hinders their potential to contribute to economic growth and trade development (MoCI, 2018 b).

There are some strategic commitments to improve the conditions of child-labor by the MoCI. The National Export Strategy employs an approach of bring weaving communities out of isolation into weaving workshops/centers, with better working conditions. It states, that efforts will also be made to increase the presence of "child labor free" certifications in the country (MoCI, 2018 b).

The sanitary measures in processing and production of MAPs and other natural ingredients are another challenging question in CS in Afghanistan. According to the study in Herat province, there is limited awareness among collectors, traders and sector enterprises on the sanitary and phytosanitary measures that must be taken for their products to satisfy food safety requirements in target markets. In short term, this challenge needs to overcome by training and capacity building of producers, but for the key solution it is important to improve the quality certification process and upgrade the relevant governmental body ability to enforce quality standards.

The efforts so far to establish the key elements of the quality and sanitary and phytosanitary infrastructure, including standardization, metrology and conformity

assessment (testing, inspection, certification and accreditation), have not received strategically oriented and adequate support from the Government, the donor community and the private sector in terms of human and financial resources and, most importantly, political will and support (MoCI, 2018 b). Some specific areas in the quality and SPS framework fare slightly better, such as: development of national standards with the adoption of 580 national standards; participation in regional standardization efforts (e.g. membership of the South Asian Regional Standardization Organization and Metrology Institute of Islamic Countries); strengthening of testing capacity such as at the Animal Health Department of MAIL; and establishment of petroleum products testing laboratories and construction laboratories by the private sector (MoCI, 2018 b). Nevertheless, shortages in the fields of metrology, certification, and inspection as a result of insufficient human resources, technical skills, equipment and financial resources are evident.

One of the crucial question in marketing of MAPs in Herat and whole country is the equitable functioning of different segments of the marketing. As a result, there is no opportunity for vulnerable communities engaged in wild collection to get interest in many ethical aspects of the production process and sustainability of the natural resources. Fairtrade as a salient and growing phenomenon in marketing of natural products in many developing countries can be an appropriate solution for this rigid situation in Afghanistan. "Fairtrade is a way of trading that seeks to reduce poverty and empower producers who are disadvantaged by the structures of conventional trade. Those involved in Fairtrade seek to empower producers by adhering to certain principles and standards of behavior in their trading relationships and also campaign to challenge mainstream trade structures." (El Nasri, 2018). Although certified products currently comprise a small proportion of the world market, the absolute quantity of Fairtrade sales is large. According to Fairtrade Labelling Organization (FLO) annual report 2013/14 in 2013, consumers spent 5.5 billion euros on Fairtrade products worldwide, a 15% growth rate over the previous year, and the Fairtrade system worked with 1.4 million farmers and workers across 74 developing countries (Podhorsky, 2015). Hence, Fairtrade certification program can transfer income to rural communities and collectors by establishing a guaranteed price and ultimately enhance the interest and responsibility of these communities to sustainability of natural resources and any initiative taken in this regard.

The aims of Fairtrade for studied products and holistically for some other potential products of Afghanistan can be to improve the livelihoods of all segments of the supply chain and especially wild collectors, ensure sustainable management of MAPs natural resources, protect female and children from exploitation in the collection and post-harvesting treatment of products and improve access to international market. As it depicted by another source (El Nasri, 2018). Fairtrade also aim to set an example of partnership in trade through dialogue, transparency and respect, challenging the rules

and practice of conventional trade, and promoting social justice, sound environmental practices, and economic security.

Certification foresees recovery of depleted natural resources of the studies species production and the opening of new market opportunities outside the country, since it can assess the degree of natural resources, trading, post-harvesting treatment, socio-economical, and environmental management aspects of the products from natural resource origins against certain international sets of quality standard. As has been highlighted by Fall Brook Center, the assessment for establishing CS extends across management plans, monitoring and rating, ecological harvesting activity, biodiversity conservation, soil and water conservation, protection of high conservation value areas, regulation of chemical substances, integrated pest management, tenure and customary use rights, air returns and adequate benefits, safe and healthy working environments, impact on local and indigenous communities, and economic viability (El Nasri, 2018).

It is assumed that in the development of certification system in process of MAPs products there is a wide range of players (stakeholders) with their own attributes and characters. The players are:

1. The community: These are people who live in rural areas and beside agriculture and husbandry they are benefiting rangelands and other types of the lands for the livelihood through livestock grazing and collection of wild medicinal plants.

In spite of many progresses during last 17 years mainly through various ministries including the ministry of rural rehabilitation and development (MRRD), the livelihood of the population in many areas remains challenging. The infrastructure is undeveloped and rural development efforts in the areas are aimed at improving the life of the communities. The MRRD through Citizen's Charter National Priority Program foresees important role in rural development for Community Development Councils. By channeling resources and support, the Government is committed to ensure the means to develop villages and cities as the Community Development Councils will lead the development process and make sure that all men, women, and children are included in development initiatives and activities (MRRD, 2015). According to this program, communities will participate in planning building/rehabilitating the projects, monitoring progress and the Government's provision of the minimum services.

The study in all districts in Herat province revealed that in spite of the lack of adequate information there is a significant desire in the community in certification, because it will bring more benefit and commerce to the community. The creation of "*local councils of natural resources*" in villages can be an effective approach. This experience is considered to work in some parts of the country (Paktia, Panjshir and Badghis).

2. The elders (*arbab, malik*): These elders have a significant influence in rural communities. They administer many issues in the communities and occasionally, natural resources in different ways. Normally, the elders can play leading and constructive role

in many initiatives for the development of the communities and improvement of the livelihood of the community including in the development of certification system.

3. Local government: The local government system is represented by the district administration and made up of representatives of almost all state governments. There are departments of agriculture service, rural development, education, communication, labor, and social affairs among other arms of the governments, who can be effectively involved in the certification system. Their goal is the provision of services to the local communities in their areas of jurisdiction.

4. Department of Agriculture Service: The department is the DAIL district branch and its task is to manage and supervise the usage of the natural resources and rangelands, promote agriculture and livestock, supervise the implementation of related regulations and bylaws. The discussion with the district's directors of agriculture service during a workshop (See Appendix II) showed that generally they are lacking enough knowledge about the certification in the value chain of natural products, its importance, and impact, but they are willing to support such initiative.

5. Donors and NGOs: During the last four decades of war and unrests, NGOs played major role through running many programs in different areas. Formally, some NGOs were involved in improving agriculture and livestock in rural areas. However, there is a general consensus that the impact of these activities is not noticeable and sustainable in the development of the rural communities, and many of these initiatives were incompatible with the state strategies and policies. Nevertheless, in certain cases, their input was vital during the last four decades of unrest and war in the country. In spite of their engagement in many agricultural programs, no NGO and donor has worked in the area of standardization and certification of MAPs products in Afghanistan.

6. Traders and local companies: There is a range of traders working in the trade on MAPs and natural ingredients in Herat. Some of those are functioning as registered companies in export, while others trading at the district, and provincial (local) market. While these are in business for profits bodies, some of them have processing facilities and units, where the products undergo certain processing and standardization measures. Most of the interviewed companies and traders aware of the importance and role of standardization and only a few are aware of certification in the value chain of natural ingredients (See app.8.1).

Considering the above points, while the necessity and capacity with regard to the importance of certification for Afghan plant products is crucial, this does not seem to be so imperative through the traditional supply chain for markets in neighboring countries (see above). At the same time, a number of natural products in Afghanistan, and in particular saffron, *Glycyrrhiza* sp. and *Cuminum* sp. can be regarded as attractive items for international markets and Europe, and, of course, the more urgent need for their certification is felt.

On a medium- and long-term basis, the best approach for the European market is to increase the sales volume of high-quality Afghan saffron to the most dominant re-exporting countries, namely Spain, Italy and France. After an initial period focusing on bulk shipments, Afghan saffron enterprises can focus on moving up the value chain by establishing relationships with local distributors and national supermarket chains. Success in this area will require a significant improvement in Afghan packaging standards, along with credible quality certification (MoCI, 2018 a). As a result, export of MAPs products can be divided into two groups, which for the first one include products with a robust potential in the international market and certification should be developed in the first phase of the system. Another group that has been used most in the regional and neighboring countries and is not urgent need to certify them in the short term. In doing this stepwise certification, relevant bodies in the country can benefit experiences and practices of the certification for the wider range of MAPs and other natural products.

According to the traders one of the basic factors pertaining to weak attraction of international companies in MAPs products of Afghanistan is the lack of sustainability in supply chain of the these products. Absence of certification is considered to be a critical factors causing fluctuations of supply and prices of MAPs products in regional and international markets. This concern calls for exerting more effort to establish certification system for potential MAPs products.

One of the manufacturers concern in western countries is the challenge of proving the authenticity and purity of herbal products by suppliers during commercialization. This challenge may raise in case of supplying Afghani products to such manufacturers. Marker based standards are becoming popular for the identification/authentication of herbal drug components. However, as herbal drugs are plant extracts based the need for adoption of multi-marker system and effect of storage conditions are important points to be considered (Sahoo, Manchikanti, & Dey, 2010). National academic institutions and particularly the faculty of pharmacy at Kabul University and its academic partners like the faculty of pharmacy at Phillips Marburg University can play supportive role in the application of such system in the country.

Given the current situation in Afghanistan and the security challenges, it is suggested that the certification system for medicinal plants can be divided into two stapes. One is the development of standards, in which most NGOs, MAIL, MoCI and private companies can take the initiative. This action calls for an initiative that should be part of the bigger initiative to create a Fairtrade in Afghanistan. In addition to improving the quality of products and increasing the price, this will have an important impact on the income of the community population and collectors wage. Furthermore, there are some other potential bodies like Afghanistan National Standard Authority (ANSA), Afghan Raisin, Fruits, and Vegetables Export Promotion Administration (ARFVEPA), MAIL,

MoCI, and some potential production companies, who could contribute to the development of standards and certifications.

It should be recalled that the development of these standards provides both a technical and mentally sound basis for establishing a certification system. The second step is to create a certification system that will be started by third parties for certain potential products. Undoubtedly, this step is an important stride for the Afghan products to reach international markets, and, on the other hand, Fairtrade areas will strengthen the foundations of sustainable management of natural resources, environmental protection and livelihoods of rural communities. The involvement of communities and collectors of medicinal plants in this key process is very important.

As previously mentioned (See Tab. 5.6), the creation of "*local councils of natural resources"* at least at the level of every district can be an important axis for engagement in sustainable resource management, capacity building for rational collection and good collection practices, and monitoring over the application of standards and requirements for the certification.

As defined by the International Organization for Standardization (ISO), there are different types of standards, which can be categorized as being either external or internal to the local producers of MAPs. External standards are those set by third-party independent bodies. These are usually international or national bodies, and all stakeholders usually participate in the standard-setting process. Internal standards are those developed by local bodies and companies to describe the level of performance that their activities must reach. A vital part of the certification process is an assessment of this interpretation by the certification body (El Nasri, 2018). Formally, there are no internal standards for MAPs in Afghanistan, though there are certain attempts to adjust the quality of exported products to the certain requirements of the regional market. Even in the case of saffron, there are some attempts to shift to organic farming, for example saffron farmers in Afghanistan have been advised to use fertilizers as an input in the first year of planting. Following the initial planting stage, though, chemical inputs such as fertilizers and pesticides are kept to a minimum (if used at all) (MoCI, 2018 a).

5.9. Structural equation modeling (SEM) in potential for sustainable management

The sustainable resource management of wild resources is a complex process involving many biological, social, political, economic, and other factors, which vary according to region and culture. Therefore, the assessment also includes four different aspects noted earlier. To analyze the relationship between certain specific criteria, the structural equation modeling (SEM) has been used.

Structural equation modeling is a collection of statistical techniques that allows a set of relationships between one or more independent variables (IVs), either continuous or discrete, and one or more dependent variables (DVs), either continuous or discrete, to

be examined. Both IVs and DVs can be either factors or measured variables (Ullman & Bentler, 2013). “Structural equation modeling is also referred to as causal modeling, causal analysis, simultaneous equation modeling, analysis of covariance structures, path analysis, or confirmatory factor analysis. The latter two are actually special types of SEM” (Ullman & Bentler, 2013).

The partial regression coefficient is also called regression coefficient, regression weight, and partial regression weight. Multiple linear regression analysis has been used and quantifies the DV increases when one IV is increased by one unit and all the other independent variables are held constant. This coefficient is called partial because its value depends, in general, upon the other independent variables. Specifically, the value of the partial coefficient for one independent variable will vary, in general, depending upon the other independent variables included in the regression equation (Lewis-Beck, et al., 2003).

SEM permits multiple regression analyses of different factors. In this study there are 25 independent variables classified in four different aspects of MAPs resources: resource analysis, trade and marketing, socio-economic aspect, and technological proficiencies for the processing of MAPs. The districts and four selected medicinal plants are the dependent variables. The relationship between a single measured variable and other measured variables will be studied in this model. The SEM of this relationship is the regression of the selected factors which can be measured by Partial Regression Coefficient. The calculation carried out by programming language R, which is for statistical computing.

The relationship between factors influencing the “potential for sustainable management” (RA2) was assessed. The calculation made is based on the means of the data for these variables for all four studied species.

The following independent factors can affect the criterion “potential for sustainable management” (RA2):

1. Abundance and state of the conservation of the species (RA1),
2. Abilities and skills for the technological processing of the product (Tech1),
3. Human resources for the technological processing of the product (Tech2),
4. Technological requirements for improving processes (Tech3), and
5. Existence of guideline for the implementation of good collection practices (RA4).

The SEM of the means value for all four studied species is illustrated in the following figure. This figure demonstrates the general effects of above-mentioned five factors on sustainable management in this multiple regression of analyses based on mean values of resource assessment of the studied species.

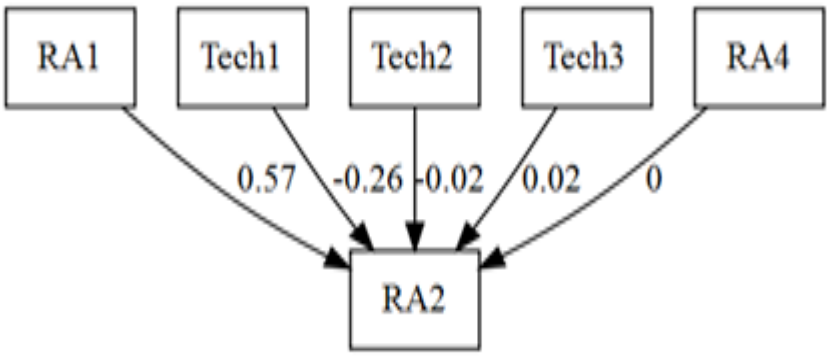


Figure 5.19: SEM of relevant dependent variables (RA1, Tech1, Tech2, Tech3, RA4) affecting the potential for sustainable management (RA2) for all studied species.

As the SEM in Fig. 5.19 demonstrates "abundance and state of the conservation of the species" (RA1) has the highest effect on "potential for sustainable management" (RA2), while "the technological requirements for improving processes (Tech3) has the lowest (0,02) "the availability of guideline for the implementation of good collection practices (RA4) does not have any effect and two other factors "abilities and skills for the technological processing of the product" (Tech1) and "Human resources for the technological processing of the product" (Tech2) are affected by potential for sustainable management" (RA2).

In view to estimate the effect of the factors influencing the "potential for sustainable management" (RA2) for individual species, the effect of relevant five IVs on RA2 within resource assessment of every species has been studied separately. The details are depicted in the following figures.

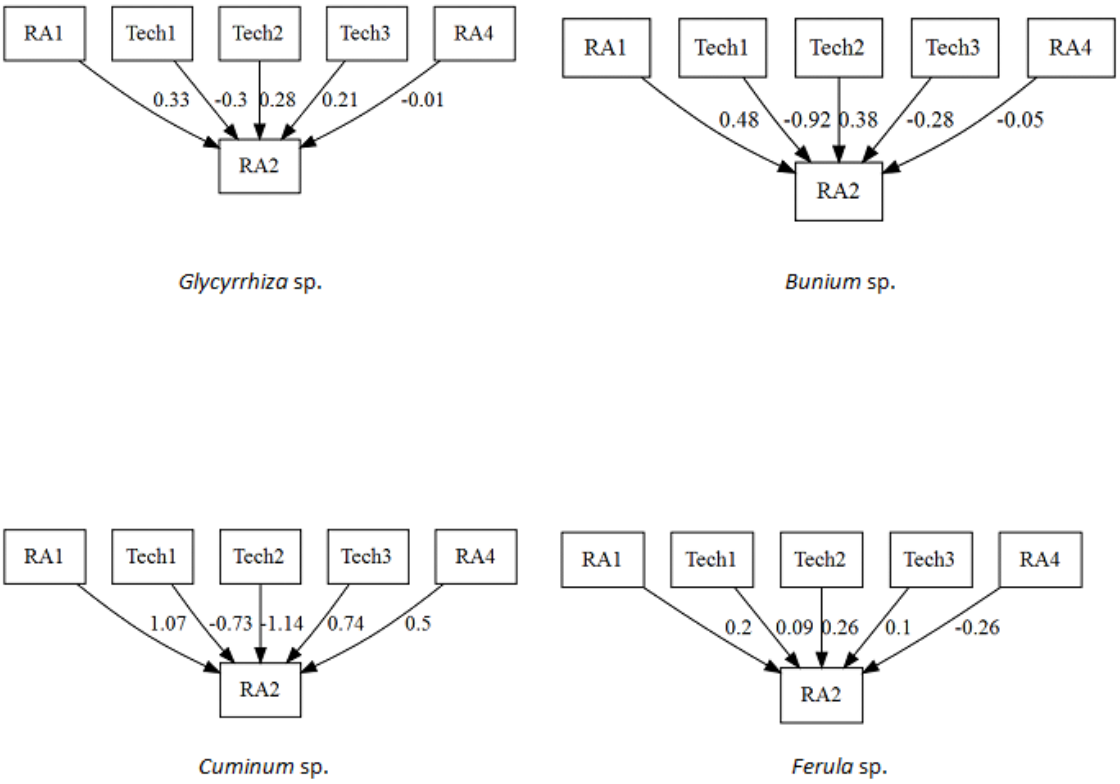


Figure 5.20: SEM between direct dependent variables (RA1, Tech1, Tech2, Tech3, RA4) affecting the RA2 in resource assessment of studied species.

The SEMs in Fig. 5.20 reveal that the degree of relevant IVs effects in this multiple regression of analyses factors, varies among different species, while "abundance and state of conservation of the species" (RA1) in all cases have significant partial regression coefficients on "potential for sustainable management". This signifies that the physical capacities of resources cause the attraction of more soft and hard investments by the different stakeholders in different segments of the supply chain of the products for "sustainable management" (RA2). Meanwhile, "abilities and skills for technological proficiencies (Tech1) have a negative regression coefficient on RA2. This suggests that there is an insignificant abilities and skills for sustainable management of the resources.

A comparative study of SEMs in Fig. 5.18 reveals that the degree of relevant variables effects in this multiple regression of analyses factors among different species varies significantly. *Glycyrrhiza* sp. has a better profile of effects of the variables on "sustainable management" (RA2). It occupies the highest sum of partial regression coefficient (0.51) compared to other three species (the partial regression coefficient of this relationship for *Bunium* sp., *Cuminum* sp. and *Ferula* sp. are respectively -0.39; 0.44 and 0.39). This can be explained by the long lasting collection and supply of the product through rich resources, easier technological requirements for improving processes and a mild number of skilled collectors who have the experience needed to reach production objectives. This situation differs for other species, especially *Bunium* sp. where the abilities and skills of the collectors are insufficient, there is a great need for the training

of the collectors and the technology required for the processing of the product which is not available locally.

It can be concluded that the development a realistic mechanism of accreditation, allowing to claim that products originating from certain areas can be sustainably harvested is important for the studied species.

5.10. Structural equation modeling (SEM) of relevant factors on quality of production

The quality of natural production is an important challenge in the trade and marketing of these products in Afghanistan and other related markets. While original products in most of the cases have required and in certain cases matchless properties and respectively quality, unfortunately, due to reasons brought up earlier, the final products often do not meet the requirements of the market and subsequently the market price of the products are lower. Therefore, since almost four decades of value-adding take place in neighboring countries and creates unfair trade in these products mainly for the rural inhabitants and collectors. Government agencies have had a limited role in standardization, development of certification, value adding and capacity enhancement of the entrepreneurs and traders.

The results of the quality of production assessment reveal that *Glycyrrhiza* sp. has comparatively better status, while *Ferula* sp. has critical status.

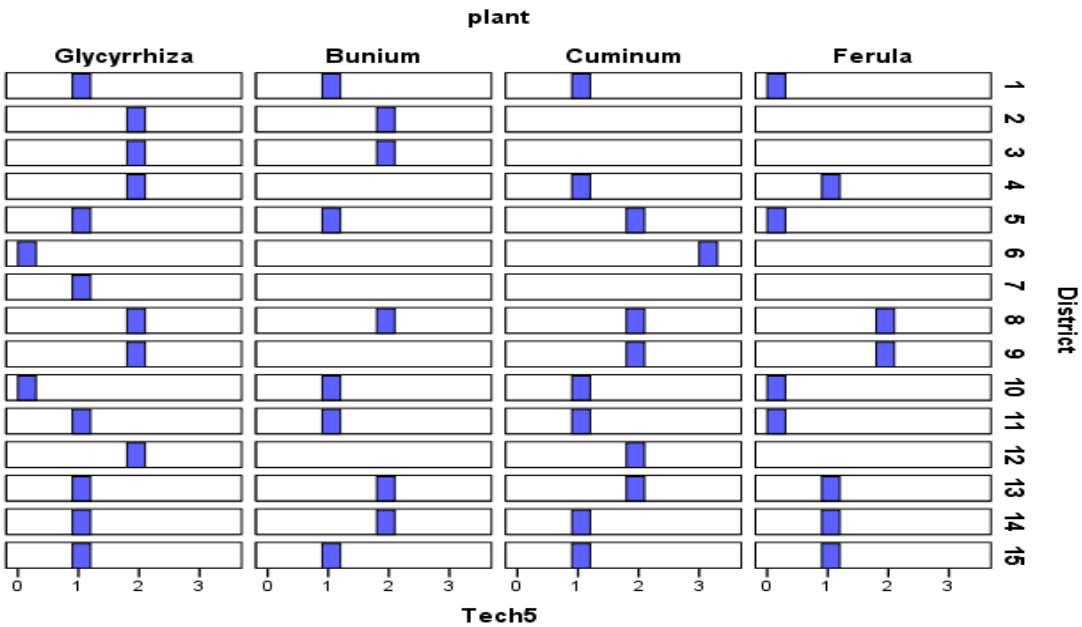


Figure 5.21: Assessment of the quality of production of the studied species.

There are certain variables that can affect the quality of production (Tech5) in direct ways. The abilities and skills of the entrepreneurs (Tech1), technological requirements for improving processes (Tech3), quality control requirements (Tech5) and experience

of local communities with the product (SE5) are the most effective factors. At the same time the state of conservation potentially impacts the quality of production directly and indirectly through the experience of local communities with the product (SE5). The SEM of this relationship based on mean values of all studied species is represented in the following figure:

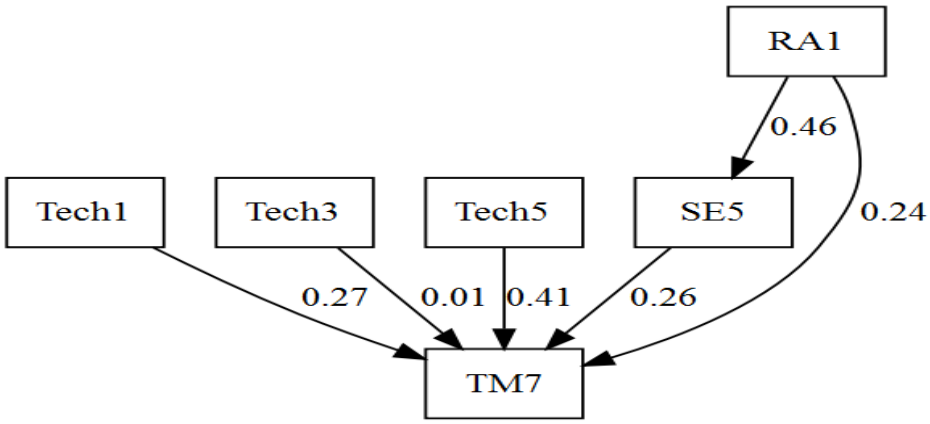


Figure 5.22: SEM of direct variables (Tech1, Tech3, Tech5, and SE5), indirect variable (RA1) and quality of production (TM7).

Fig. 5.22 illustrates that all the dependent variables have an impact on the quality of production and the quality control requirements (Tech5), abilities and skills of the entrepreneurs (Tech1), experience of the local communities with the product (SE5) and the direct effect of abundance and state of conservation of the species (RA1) have respectively high regression effect on the quality of production. Meanwhile, the effect of quality control requirements is significant (0.41) and it can be assumed that improving the quality of production is achievable mainly because the quality control requirements for the studied products can easily be met; abilities and skills of collectors are moderate or some initiatives are under process to develop the skills of collectors; and the experience of local communities with the products in most of the districts are moderate and even in some (four districts) are considerable. In the same time, this SEM shows that technological requirements for improving processes to reach the standards in most of the districts (9 districts) are hard to attain. However, there are some other districts where the situation differs and these requirements are easier to reach. Apparently, the last variation depends on the differences of socioeconomic status of the communities.

It is interesting to see that indirect effect of abundance and state of the conservation of the species (RA1) through the experience of the local communities with the product (SE5) is significant. To produce high-quality herbal products, attention must be paid to, among other things, phytochemical variations due to plant breed, organ specificity, and stages of growth, cultivation parameters, contamination by microbial and chemical

agents, substitution, adulteration with synthetic drugs, heavy metal contamination, storage and extraction (Tanko, Carrier, Duan, & Clausen, 2005). Undoubtedly, in the absence of required training and knowledge transformation offered for the collectors and communities and other factors brought up earlier, the importance of "experience of local communities with the product" (SE5) emerges vividly in this relationship.

Information from the districts and MAPs markets in Herat confirms the SEM value of the relationship, i.e. the trends in improvement of the quality of the product during the last decade.

The development of targeted programs and policies to rehabilitate and sustainably manage the natural resources and hence reduce poverty and vulnerability require reliable information. Through the provision of better information, short-term emergency assistance needs, and also longer-term rehabilitation and development needs, will be fulfilled more efficiently and effectively, ultimately reducing food insecurity and vulnerability, and poverty and sustain the natural resources of the country.

5.11. Structural equation modeling (SEM) of relevant factors on scale of production

The scale of the production has been set in this study as an IV in the trade and marketing aspect of resource assessment of the studied species. This variable is an important factor for the sustainable supply chain of the relevant products in the national and regional markets in the country. In the case of Afghanistan context, where the wild harvesting plays an important role in the livelihood of the communities, the role of the abundance of resources and the state of conservation on the scale of production is undoubtable. But, the effect of this factor on scale of the production can be illustrated by certain other variables, especially socio-economic factors. To study the SEM of affecting factors on scale of production, the species following IVs have been identified:

1. Potential for generation of the employment,
2. Suitability of production for the livelihood of the communities (SE2),
3. Suitability of production for alternative livelihood of the communities (SE3), and
4. Suitability of production for local communities or small entrepreneurs.

The SEM of this relationship based on the mean values of all studied species demonstrated in the following figure:

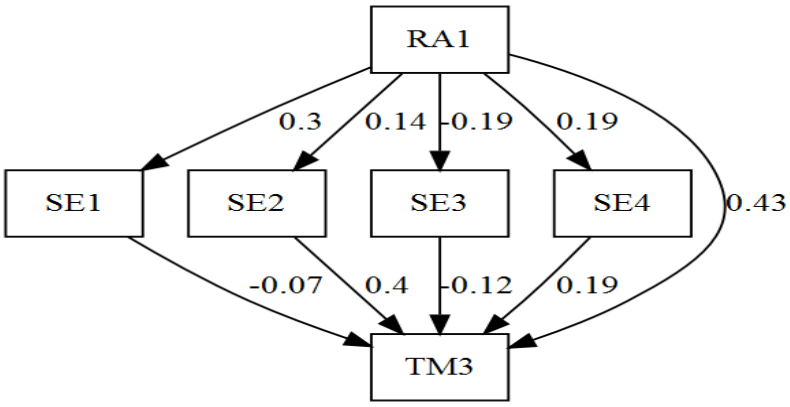


Figure 5.23: SEM of direct dependent variables (SE1, SE2, SE3 and SE4), indirect dependent variable RA1 and scale of production (TM3).

Fig. 5.23 demonstrates that the suitability of production for the livelihood (SE2) and for local communities or small entrepreneurs (SE4) has a positive regression coefficient on the scale of production (TM3). It suggests that communities rely on the production of the species for their livelihood significantly, however, due to the eradication of poppy production in Herat during last years, the production of the species has negative regression coefficient for alternative livelihood on the scale of the production. In the same time, the abundance of resources directly and indirectly through other IVs has a significant regression coefficient. It can be therefore concluded that the optimal scale of the production of the studied products in view of the sustainability of the resources and sustainable resource management of MAPs are crucial for the province and whole country.

Certainly, the demand for wild species is increasing with the growth in human needs, population numbers and commercial trade. With the increased realization that these wild species are being over-exploited, it is recommended that these wild species be brought into cultivation. But, at the same time the conservation impacts, for example, the environmental degradation and loss of genetic diversity as well as loss of incentives to conserve wild populations, should be considered.

6. Summary

Afghanistan is an ancient country with rich nature and rich traditional medicine. The history of using plants for treating illnesses and traditional medicines among populations of the country goes back many millenniums. The country is known as a resource base for many wild-collected medicinal and aromatic plants that are well-recognized in regional and international markets. Medicinal and aromatic plants (MAPs) in Afghanistan represent important health and economic components of the country's biodiversity. The country has a high floristic diversity; flowering plants are estimated to be about 5,000 species with many of them endemic.

Although the country is rich in great natural history; recent human history has not been so kind. A coup in 1978 and the Soviet invasion in 1979 with nine years of war against the Soviet occupation was followed by a chaotic and tragic civil war between Mujahedeen, and then the rampage of the Taliban militia; the fighting has never completely stopped. The long conflict and its extensive violence have torn apart Afghanistan society and its natural resources and assets.

The extent of destruction of the country's physical, institutional, human and social capital in 2001 left Afghanistan with a monumental task to rebuild the country in all aspects.

Agriculture has traditionally driven the Afghan economy, accounting for approximately 50% of Gross Domestic Product (GDP) before the Soviet invasion in 1979 and 28% in 2017. About 80 percent of Afghans live in rural areas

Afghanistan is a landlocked country and situated in the subtropical, dry zones of Southwest Asia that have continental types of climate characterized by desert, steppe, and highland temperature and precipitation regimes. The physical geography of Afghanistan is characteristically fairly spectacular, from the rather huge area around 7 km of relief from lowest altitudes in the northwest Amu Darya (258 m) region to the highest at Naushaq (7,492 m) mountains in the northeast. The Hindu Kush Mountains are an important factor with an impact on the land and climate of Afghanistan and divides the country into northern and southern pages of two geographic regions and created various mountainous branches in different valleys with distinct climates.

Afghanistan is a mostly rather arid country with extreme minimum of perhaps <50 mm of precipitation in the Seistan Basin of the southwest, and around 1,100–1,400 mm in the mountains of the central Hindu Kush to the Wakhan Corridor to the northeast. Average annual precipitation is commonly less than 210 mm in many areas, declining to less than 110 mm in the southwestern deserts, and increasing to more than 1,000 mm in the high mountains.

The main part of the land cover of Afghanistan, 30,243,985 ha is made up of rangeland (47%). Irrigated agricultural land makes up 5.6% and rainfed agricultural lands make up almost the same percentage of the land cover (5.8%). Barren land occupies a considerable portion of the total land cover of Afghanistan (27%), and 2.8% are occupied by forest.

The sharp climatic seasonality gives rise to the extensive development in Afghanistan of peculiar desert types of vegetation, consisting principally of groups of half-shrubs and small shrubs scattered over the whole profile of the mountains from their bases to the high-mountain regions. The wild vegetation of the most part of Afghanistan is rangeland, woodland and forest, and this is strongly influenced by Afghanistan's topography and geology. Afghanistan is one of the most significant centers of the origin of domestic plants and animals.

Wild collection of MAPs has a long history in the country and it contributes to traditional medicine and local economies of the populations. Afghanistan is an important exporter of medicinal plants; each year more than 45 different species are being exported to different countries. During 2016 about 25 different medicinal plants (78,440 tons), with a total value of USD 167,631,003 have been exported. The domestic use of MAPs is limited to its use in traditional and folk medicines and also as a culinary spice in Afghanistan.

Analysis of the records on export of MAP products from Afghanistan shows that over the years, the extent of Afghanistan exports of MAPs has increased sharply from 2008 to 2016. In 2016, the total export of the main MAP products of 25 items earned USD 167,631,003. However, this growth on an annual basis shows some deviations and did not grow steadily. In the data for the last three years, 2014-2016, stability was observed.

For the study period 2008-2016, an annual average growth rate (AAGR) of 16.2% in comparison to 2.4% in the volumes of export in global trade earlier was observed.

A comparison of the export data of the selected products from the market in Herat with the official data from CSO, which represent official national export volume and value, explicitly demonstrates a notable difference for all the selected products. It shows that a substantial quantity of MAPs is exported illegally to neighboring countries – especially to Pakistan.

Increased consumption of medicinal plants, through expansion of the local and regional markets, has increased pressure on resources that are largely harvested from the depleted wild population. At the same time, the long lasting war, poverty, increases in the collection of MAP, the breakdown of the governmental and local system of monitoring, and the impact of climate change and the susceptibility of Afghanistan to desertification are the main threats to natural MAP resources.

Much of the wild flora of the country is experiencing a significant decline on account of habitat loss and degradation. Most of the country's valuable forests have been degraded

during the years of war and social unrest. It is estimated that between 1978 and 2002 the area under conifer forests in the eastern part of the country was reduced by 50%. At the same time, scarcity of data and information about natural resources of MAPs available from the national government, as well as local communities, hampers the establishment or updating of national policies, strategies, law, and the regulations for wild collection and the sustainability of resources.

Widespread poverty, insecurity which impedes service delivery, climate change and repeated droughts, weak governance and corruption, a poor environment for private sector investment as well as the corrosive effects of a growing narcotics industry are the major problems. Afghanistan faces a complex and interrelated set of ecological, environmental, economic, administrative and political challenges.

This study has been conducted with the objectives for resource analysis of potential species of MAPs, and approaches for sustainable resource management of wild medicinal plants.

With a view to rank the main species of MAPs, the criteria such as source of supply, export volume, sustainability and socioeconomic factors have been set. The calculation of these criteria has been performed based on the information and data available in the literatures.

Based on the said criteria the following species have been identified as the potentially viable products among the wild collections in the country:

1. *Glycyrrhiza* sp. (Licorice)
2. *Ferula* sp. (Asa foetida, Hing)
3. *Cuminum* sp. (wild green cumin)
4. *Bunium* sp. (wild black cumin)

In this study, four aspects of natural resources were evaluated. These are:

1. Resource assessment of MAPs,
2. Socioeconomic aspects of wild collection,
3. Trade and marketing of medicinal plants and their products, and
4. Technological proficiencies for the processing and standardization of natural products.

The implementation of every framework is based on scoring certain criteria. Every criterion is weighted (scored) by 0 (lowest value) to 3 (highest value) according to their relative significance through focusing on defined benchmarks. Totally, 25 independent variables have been studied for every species of MAPs.

Based on the available literature and documents about the vegetation of the country, the distribution pattern of selected MAPs was studied. Comparative study of the distribution maps reveals that Herat province has bigger and richer numbers of the MAPs focused in this study. Therefore, in this study, the resource assessment targets Herat districts.

The results of the resource assessment of the selected species in this province show that unlike other selected MAPs, *Glycyrrhiza* sp. is distributed and produced in all districts of the province. It reveals that districts Gulran (8), Kohsan (7) and Shendand (7) have respectively the highest and Guzara (2), Injil (3) and Zendajan (3) have the lowest values (from the highest composite score of 15) in the status of the resources.

The results of the four assessment frameworks of *Glycyrrhiza* sp. demonstrate that from the highest composite score of 75, districts of Gulran occupies the first (50), Chesht-e-Sharif (44) and Frasi (44) the second and Shendand (43) the third place in overall aspects of the assessment. The districts of Obe (26) and Kushk-e-Robat Sangi (27) occupy the lowest places respectively. The two districts of Guzara and Ingil should be disregarded from this assessment because of the expansion of Herat city and urbanization in these areas.

In ten producing districts of *Bunium* sp. in Herat, from the highest composite score of 75 Chesht-e-Sharif (50), Farsi (46) and Pashtun Zarghun (42) take respectively the first, second and third positions in this assessment. In contrast Zendajan (19), Kushk-e-Kohna (24) and Kushke-e-Robat Sangi (27) take the lowest positions.

In the list of districts producing cumin in Herat, from the highest composite score of 75, districts of Kohsan (49), Pashtun Zarghoon (43), and Shendand (43) take respectively the first and second positions in this assessment, while Ghorian (25), and Gulran (9) have the lowest rank in the assessment.

In ten producing districts of *Ferula* sp., Kohhsan (38), Shendand (36), and Pashtun Zarghun (33) take the highest rank in this assessment respectively. In contrast, Adraskan (24), and Kushk-e-Kohna (20) have the lowest rank from the highest composite score of 75.

The study reveals that Chesht-e-Sharif, Kohsan, and Pashtun Zarghun have the highest potentials among Herat districts in resources, conservation and sustainable management and species with a suitable socioeconomic role in livelihood. They have better trade, marketing, and opportunities for the improvement of the supply chain and quality of the products. In contrast, Obe, Zandajan, Kushk-e-Kohna, Kushk-e-Robat Sangi and Adraskan are the poorer districts, respectively.

The dataset has been analyzed with the Statistical Package of Social Sciences (SPSS). The comparison of the mean values for all four aspects of the resources of the studied species demonstrate that trade and marketing have the highest mean values which are followed by socio-economic, resources and technological proficiencies respectively (1.6915, 1.5638, 0.9532 and 0.9255). Certain variables in different aspects of the resource assessment have been studied individually.

The study suggests, that the production and selling of these products support the livelihood of the communities, while the resources become more under the pressure and

the quality requirements and standardization of the produced products has less importance in this province.

The histograms produced by SPSS demonstrate that the abundance and state of conservation of *Glycyrrhiza* sp. and *Cuminum* sp. are in relatively better condition compared to the two other plants, though the status of *Ferula* sp. is critical. The impact of harvesting on the viability of studied species reveals that obviously the resources of *Glycyrrhiza* sp. haven't been affected by the impact of wild collection but in some ways *Bunium* sp., *Cuminum* sp, and particularly *Ferula* sp. suffer significantly from harvesting. The last species suffers from destructive harvesting of oleo-gum-resin from the taproot and consequently has been seriously depleted and came under threat in six districts (Adraskan, Ghorian, Golran, Karukh, Kushk-e-Robat Sangi and Pashtun Zarghun). The two districts of Ghorian and Shendand called a moratorium on the harvesting of the product in 2017.

Based on the study, certain districts have been identified as potential districts in certain aspects of this assessment, i.e. the status of the districts in recourse management, conservation, trade and marketing, and technological proficiency for the standardization and improvement of the quality of the products varies, while the role of the studied species in socioeconomic aspect varies tremendously.

The study revealed certain exacerbating factors associated with specific contexts of Afghanistan as a war-affected country: lack of any monitoring, illicit and informal export of natural products, the vulnerability of the population in rural areas, control of the areas by warlords and lack of a stable trade chain for MAPs products.

The resource assessment of the selected plants demonstrates the following three major trends:

1. The overwhelming effect of wild collection of the species without regulatory and observational measures**.**
2. The rarity of the resources and the risk of the threat to the selected species is high in the following order:
   Ferula sp.> *Bunium* sp. > *Cuminum* sp.> *Glycyrrhiza* sp.
3. The potential for sustainable management for the species varies among districts; however, based on the data, the following order can be established:
   Glycyrrhiza sp. > *Bunium* sp. > *Ferula* sp.> *Cuminum* sp.

The potential for employment related to the collection, processing and trading of the studied MAPs are not evenly distributed in all districts. However, it is observable that in most of the provinces this criterion has low status. The study indicates the low level of suitability of these plants for alternative livelihoods, though *Ferula* sp. has better suitability in this regard.

The results of the assessment of the ability and skill for technological proficiency demonstrated that in most districts and particularly for *Ferula* sp. the ability and skill for technological proficiency of the collectors and labor forces are in critical state (mean

value is 0.5957). At the same time the results show a low level of the availability of technical support, though in certain districts (Adraskan, Ghorian, Karokh, and Shendand) the situation is better and in mid-levels.

There is a clear scarcity of realistic and updated policy, regulatory works and instructive efforts on MAPs in Afghanistan. The two main documents developed by MAIL are: the National Natural Resource Management Strategy (NNRMS) and the Procedure for Conservation and Collection of wild MAPs. These documents are deficient in scientific details and evidence regarding natural resources and especially MAPs. These documents are good initiative; however, they should be enriched by evidence, conservation measures and pragmatic approaches for the sustainable management of the wild resources.

Based on the results of the assessment, the main reasons for the lack of sustainability in conservation initiatives in Afghanistan have been identified. Lack of systematic and reliable information about the resources, lack of community engagement in the management, low capacity of the local agricultural offices, and security deterioration in certain areas hinder the sustainability of conservation initiatives.

To analyze the relationship between certain specific criteria, structural equation modeling (SEM) has been used as a statistical technique that allows an examination of a set of relationships between one or more independent or dependent variables. This method can quantify the degree of the relationship between different criteria and the effect that it may have on other criteria.

As the SEM demonstrates, “abundance and state of the conservation of the species” has the highest effect on the “potential for sustainable management” (0.57), while “the technological requirements for improving processes” has the lowest (0.02). “The availability of guidelines for the implementation of good collection practices” does not have any effect and two other factors “abilities and skills for the technological processing of the product” (-0.26) and “human resources for the technological processing of the product” (-0.02) are affected by “the potential for sustainable management”.

The SEMs reveals the degree of relevant independent variables effects in this multiple regression of factor analyses, varies among different species, while “abundance and state of conservation of the species” in all cases have significant partial regression coefficients on “potential for sustainable management” (0.33, 0.48, 1.07, 0.2, respectively). This signifies that the physical capacities of resources enhances the attraction of more soft and hard investments by the different stakeholders in different segments of the supply chain of the products for “sustainable management”. Meanwhile, “abilities and skills for technological proficiencies” have a negative regression coefficient effect on “potential for sustainable management”. This suggests that there is insignificant abilities and skills for sustainable management of the resources.

The significant variation of the sum degree of the effect of relevant variables in a comparative study of SEMs among four studied species (0.51, -0.39, 0.44, and 0.39) can explain that the long lasting collection and supply of the product through rich resources, easier technological requirements for improving processes and a number of skilled collectors who have the experience needed to reach production objectives. This relationship differs for *Bunium* sp. where the abilities and skills of the collectors are insufficient. There is a great need for the training of the collectors and the acquisition of technology required for the processing of the product which is not available locally.

It can be concluded that the development of a realistic mechanism of accreditation, allowing people to claim that products originate from certain areas, can be sustainably harvested, is important for the studied species.

Some other SEM of the relationship between different criteria with the aim of the quantification of different factors effects has been studied.

Based on the finding of the study, the main features of sustainable resource management in Afghanistan have been identified. Among them are revising and updating strategies about natural resources, biodiversity, and wild collection of MAPs, close collaboration between different stakeholders in the area of biodiversity and natural resources, engagement of the community in sustainable resource management, generation of evidence-based information about MAPs, training and capacity enhancement of communities, collectors and other relevant technical staff, in conservation. The government's commitment to the conservation of the resources and their sustainable management is of vital importance.

7. References

Abdukadir A et al. (2015). The origins of Uyghur medicine: Debates and perspectives. *Journal of Traditional Chinese Medical Sciences*, 2, 218-224. Retrieved March 15, 2018, from www.sciencedirect.com

Asian Development Bank (ADB). (2018). *Basic Statistics 2018 Statistics*, Economic Research and Regional Cooperation Department, Development Economics and Indicators Division, Retrieved June 11, 2018, from https://www.adb.org/sites/default/files/publication/419891/basic-statistics-2018.pdf

Asian Development Bank (ADB). (2017 a). *GDP Growth in Asia and the Pacific*, Asian Development Outlook (ADO), ADB Data Library, Retrieved January 21, 2018, from https://data.adb.org/dataset/gdp-growth-asia-and-pacific-asian-development-outlook-ado

Asian Development Bank (ADB). (2017 b). *Country Partnership Strategy, Afghanistan, 2017–2021—Achieving Inclusive Growth in a Fragile and Conflict – Affected Situation*. Manila, 3-4, Retrieved May 11, 2018, from https://www.adb.org/sites/default/files/institutional-document/371531/cps-afg-2017-2021.pdf

Asian Development Bank (ADB) (2003). *Rebuilding Afghanistan's Agriculture Sector*. Asian Development Bank, South Asia Department, Manila, 5-6, Retrieved February, 2018, from https://www.adb.org/sites/default/files/publication/27936/rebuilding-agriculture-sector-afg.pdf

Afghanistan National Development Strategy (ANDS) (2008). *Environment Sector Strategy 2007/08 - 2012/13*. Good Governance, Government of Afghanistan, Kabul, 5-6.

Agakhanjanz. O., Breckle S-W. (2002). Plant diversity and endemism in high mountains of Central Asia, the Caucasus and Siberia. *Mountain Biodiversity- a global assessment*, by Korner, Ch. Spehn, E. (eds.), New York: Parthenon Publ. Group, Boca Raton, 117-119.

Ahmad, M. et al. (2017). Ethnobotanical importance of medicinal plants traded in Herbal markets of Rawalpindi- Pakistan. *Journal of Herbal Medicine*, Elsevier, 1-3. Retrieved May 16, 2018, from http://dx.doi.org/10.1016/j.hermed.2017.10.001

Amalraj, A., Gopi, S. (2017). Biological activities and medicinal properties of Asa foetida: A review. *Journal of Traditional and Complimentary medicines*, 7(2017), Elsevier, 347-359.

Amin Sharififar, A, Nazari, M.,Asghari H.R. (2015). Effect of ultrasonic waves on seed germination of Atriplex lentiformis, Cuminum cyminum, and Zygophyllum eurypterum. *Journal of Applied Research on Medicinal and Aromatic Plants, 2*, 102-104.

Arez, Gh. J. (2007). *Jughraphiae Tabei Afghanistan* [Natural Geography of Afghanistan]. (in Dari), Kabul University, Kabul, Maiwand Press, 39-167.

Arkkelin, D. (2014). Using SPSS to Understand Research and Data Analysis, *Psychology Curricular Materials*. Retrieved January 19, 2019, from http://scholar.valpo.edu/psych_oer/1

Auriol, E., Schilizzi, S.G.M. (2015) *Quality signaling through certification in developing countries.* Journal of Development Economics, Elsevier, *116*, 105-121.

Coffin, D.P., Lauenroth, W.K. (1989). Spatial and Temporal Variation in the Seed Bank of a Semiarid Grassland. *American Journal of Botany*, Botanical Society of America, Inc. 76 (1), 53-58.

Babury, M.O., & Hayward, M. F. (2017). Challenges for Higher Education in Afghanistan in nurturing economic development. In Stiasny, M. and Gore, T. (eds.), *Going Global: Building nations, connecting cultures*. London: British Council and UCL Institute of Education Press, 106-117.

Babury, M.O. (2015) *Phytotherapi* [Phytotherapy]. Tehran, The Organization for Researching and Composing University Textbooks in the Humanities (SAMT), Center for Research and Development in the Humanities, Tehran, 33-81.

Babury, M. O. (2012). *Geiahane Tebbi Mustaamela dar Tadawi Amraze Qalbi-waai* [Medicinal Plants Used in the Treatment of Cardiovascular Diseases]. Kabul University, Afghanic, 18-26.

Babury, M. O., Seddiqui M. N. (2010). Identification of *Glycyrrhiza urlensis Fisch*. in Paktia province. "*Darmal", Scientific Journal of the Faculty of Pharmacy, 2*, Kabul University, 15-21.

Bayramov, A. (2017). Review: Dubious nexus between natural resources and conflict. *Journal of Eurasian Studies*, 2, doi: 10.1016/j.euras.2017.12.006

Breckle, S.-W., Hedge, I.C., Rafiqpoor M. D. (2013). *Vascular plants of Afghanistan: an augmented checklist.* Ed. by Dittmann A, Bonn: Scientia Bonnensis, 31-72, 127-134, 320-321.

Breckle, S. -W., Rafiqpoor, M. D. (2010). *Field Guide Afghanistan, Flora and Vegetation.* Scientia Bonnensis, Ed. by Breckle S.-W, Dittmann A. & Rafiqpoor M.D., Bonn, Manama, New York, Florianopolis, 79-128.

Breckle, S. -W., Frey, W. & Hedge I. C. (1969). Botanical Literature of Afghanistan, *Notes from the Royal Botanic Garden Edinburgh*, *29*, N. 3.

Bosworth, C. E. (2007). *Historic Cities of the Islamic World*. BRILL, Leiden-Boston. Retrieved 17 November 17, 2017, from http://nessia.org/files/original/7fb5287183e94fb6ea34e8c74d7f9de9.pdf

Central Statistics Organization (CSO), Ministry of Public Health (MoPH), and ICF (2017a) *Afghanistan Demographic and Health Survey 2015*. Kabul, Afghanistan: Central Statistics Organization, 9-10.

Central Statistics Organization (CSO). (2017b). *Socio-demographic and economic survey 2016, Hera*t, Islamic Republic of Afghanistan, UNFPA, Kabul, 3-46.

Central Statistics Organization (CSO). (2016). *Afghanistan Multiple Indicator Cluster Survey*, Islamic Republic of Afghanistan, 125, Retrieved April 22, 2019, from, http://cso.gov.af/Content/files/AMICS.pdf

Chaudhury, R.R., Rafei U.M. (2001). *Traditional Medicine in Asia.* World Health Organization, Regional Office for South-East Asia, New Delhi: SEARO Regional Publications, 31-45.

Chen, Sh.L. et al. (2016). Conservation and sustainability use of medicinal plants: problems, progress and prospects. *Chinese Medicine Journal*, 1-9. Retrieved January 22, 2018, from https://cmjournal.biomedcentral.com/articles/10.1186/s13020-016-0108-7

Dietl, G. (2004). War, Peace and the Warlords: The Case of Ismail Khan of Herat in Afghanistan. *Turkish Journal of International Relations*, Vol. 3(2 & 3), 45-51. Retrieved September 19, 2018, from http://alternatives.yalova.edu.tr/article/view/5000159555/5000143968

Dhandapani, S., Subramanian, V.R.,Rajagopal, S., Namasivayam et al. (2002). Hypolipidemic effect of Cuminum cyminum L. on alloxan-induced diabetic rats. *Pharmacological Research*, 46(3). Retrieved October 1, 2018, from http://www.idealibrary.com

Dittman, A. (eds.) (2014). *National Atlas of Afghanistan*, Department of geography, Justus –Liebig-University. Bonn: Scientia Bonnensis, 4-8.

El Nasri M.H.M. (2018). Gum Arabic: Certification and Assessment of Marketing Opportunities. In: H.M. Elnasri M., *Gum Arabic: Structure, Properties, Application and Economics*, Academic Press, 45-64, Retrieved March 17, 2109, from https://doi.org/10.1016/B978-0-12-812002-6.00005-1

Emadi, M. H. (2011). Natural resource management and poverty in post-Taliban Afghanistan, *International Journal of Environmental Studies*. 8(3), 267-276.

European Asylum Support Office (EASO), (2018). EASO Country of Origin Information Report, *Afghanistan Security Situation Update*. Luxembourg: Publications Office of the European Union, 19-44.

European Asylum Support Office (EASO) (2017). EASO Country of Origin Information Report, *Afghanistan, Key socio-economic indicators, state protection, and mobility in Kabul City, Mazar-e Sharif, and Herat City*. Luxembourg: Publications Office of the European Union, 77-81.

Evans, A., Manning, N., Osmani, Y., Tully, A. and Wilder, A. (2004). *A Guide to Government in Afghanistan.* World Bank, AREU, 3-7.

Food and Agriculture Organization (FAO). (2016). *Land Cover Atlas of Islamic Republic of Afghanistan*. Food and Agriculture Organization of the United Nations, Rome, Italy, 15-48.

Food and Agriculture Organization (FAO). (2006). *Afghanistan National Livestock Census 2002-2003*. Food and Agriculture Organization, Rome, Italy.

Food and Agriculture Organization (FAO). (2004). *Trade in Medicinal Plants, Raw Materials, Tropical and Horticultural Products,* Service Commodities and Trade Division Economic and Social Department, Food and Agriculture Organization of the United Nations, Rome.

Favre, R.; Kamal, G.M. (2004). *Watershed Atlas of Afghanistan.* 1st Ed., Working Document for Planners, Kabul, Afghanistan, 183.

Habibi, A. (1984). *Jonbesh-e-mashrotiat dar Afghanistan.* [Constitutional movement in Afghanistan]. (in Dari), Kabul,

Hamilton, A. (2005*). Resource assessment for sustainable harvesting of medicinal plants*. Presented at side-event at the International Botanical Congress on Source to Shelf: Sustainable Supply Chain Management of Medicinal and Aromatic Plants, Vienna, 1-4. Retrieved July 7, 2018, from https://www.researchgate.net/publication/238599387

Herat Provincial Office (HPO) (2015). *Herat, Historical Background,*.Herat provincial office. Retrieved February 2, 2018, from http://herat.gov.af/fa/page/5843

Iranshahy, M., Iranshahi M. (2011). Traditional uses, phytochemistry and pharmacology of asa foetida (Ferula assa-foetidaoleo-gum-resin). A review. *Journal of Ethnopharmacology*, 134, Elsevier, 1-8. Retrieved October1, 2018, from https://www.sciencedirect.com/science/article/pii/S0378874110008524

Islamic Republic of Afghanistan (2008). Environment Sector Strategy 1387-1391 (2007/08-2012/13), *Afghanistan National Development Strategy*, Gulkhana Palace, Sedarat.

Jamshidi-Kia F., Lorigooini Z., Amini-Khoei H. (2018). Medicinal plants: Past history and future perspective. *Journal of Herbmed Pharmacology*, 2-4. Retrieved June 6, 2018, from http://www.herbmedpharmacol.com/

Johnson, T.H., Mason, M. C. (2007). *Understanding the Taliban and Insurgency in Afghanistan.* Orbis, *51*(1), 71-89, Elsevier. Retrieved September 9, 2018, from https://www.sciencedirect.com/science/article/pii/S0030438706001104#7s8d6f87

Kassam, K.-A., Baumflek, M., Morgan, R., Karamkhudoeva, M. (2013). Nurturing Knowledge: Medicinal Plants in the Pamir Mountains of Afghanistan and Tajikistan. *Conservation Bridge*, Case Study No. 17, 3-5. Retrieved April 18, 2018, from http://www.conservationbridge.org/casestudy/nurturing-knowledge/

Kelly, A. et al. (2002). *Afghanistan Natural Resources and Agriculture Sector Cprehensive Needs Assessment*. Final Report, By a mission conducted by the Asian Development Bank (ADB), Kabul, AREU, 4-15.

Lawrence, A., Hawthorne W. (2006). *Plant Identification, Creating User-Friendly Field Guides for Biodiversity Management*. World Wild Fund for Nature, Earthscan.

Leaman, D. J. (2008). *The international standard for sustainable wild collection of medicinal and aromatic plants (ISSC-MAP), Elements of the Standard Relevant to CITES NDF*, IUCN-SSC Medicinal Plant Specialist Group, International Expert Workshop on CITES Non-Detriment Findings, Perennial Plant Working Group (Ornamentals, Medicinal and Aromatic Plants), Cancun, Mexico.

Leslie, J. (2015). *Political and economic dynamics of Herat*, Peaceworks, United State institute of Peace, Washington. Retrieved October 6, 2018, from www.usip.org

Lewis-Beck M., Bryman, A., Futing T. (Eds.) (2003). *Encyclopedia of Social Sciences Research Methods.* Thousand Oaks (CA): Sage (Herve, A. Partial regression Coefficients)

Li, D.Z., Pritchard, H.W. (2009). The science and economics of ex situ plant conservation. *Trends Plant Sci., 14*, 614–21.

Linchevsky, I. A., Prozorovsky, A. V (1949). *The Basic Principles of the Distribution of the Vegetation of Afghanistan*. Translated by H. K. Airy Shaw Kew, Bulletin, Vol. *4* (2), 179-214, Springer on behalf of Springe Royal Botanic Gardens, Kew, Retrieved June 7, 2018, from http://www.jstor.org/stable/4113678

Malekiar, Gh.M. (2017 a). *Economic development strategies for conservation of environment in Afghanistan*. NEPA, Kabul.

Malekiar, Gh.M. (2017 b). *The Environment of Afghanistan (2010 - 2017), Pressures, Progress and Challenges/Gap.* NEPA, Kabul, 9-126.

Mardani, H., Ziaratnia, S.M.,Azizi, M., Aung, H.P., Appiah, K.S. and Fujii, Y. (2015). In vitro microtuberization of Black Zira (Bunium persicum Boiss.). *African Journal of Biotechnology*, *14*(25), 2080-2087. Retrieved October 11, 2018, from http://www.academicjournals.org/AJB

Ministry of Agriculture, Irrigation and Livestock (MAIL). (2017). *National Natural Resource Management Strategy (2017-2021)*. Islamic Republic of Afghanistan, MAIL, 14-43.

Ministry of Agriculture, Irrigation and Livestock (MAIL). (2016). *National Comprehensive Agriculture Development Priority Program 2016 – 2021, a strategic framework for agriculture sector development and reform*. Islamic Republic of Afghanistan, MAIL, 4-24.

Ministry of Commerce & Industries (MoCI). (2018 a). *Afghanistan Saffron Sector Export Strategy, Blossoms for Prosperity*. Islamic Republic of Afghanistan, Ministry of Commerce & Industries, 4-41.

Ministry of Commerce & Industries (MoCI). (2018 b). *National Export Strategy of Afghanistan*, Islamic Republic of Afghanistan, Ministry of Commerce & Industries, 14, 21.

Ministry of Rural Rehabilitation and Development (MoRRD). (2015). *Citizen's Charter National Priority Program*, Islamic republic of Afghanistan, Retrieved April 22, 2019, from https://mrrd.gov.af/node/401

Ministry of Rural Rehabilitation and Development (MoRRD). (2007). *Provincial Profile for Herat Province*. Regional Rural Economic Regeneration Strategies (RRERS), Islamic Republic of Afghanistan, 1-9.

Moheb, Z., Paley, R. (2016). Central Asia: Afghanistan, In: *Snow Leopard: Biodiversity of the World - Conservation from Genes to Landscapes*. by McCarthy & Mallon (eds.). Afghanistan Program, Wildlife Conservation Society, Elsevier. 409-410.

Mujtabavi, Gh. H. (2010). *Herat dar Ahde Temurian* [Herat during the Timurid period]. (in Persian), Marandez and Islamic Azad University, Nishabur Branch, Tehran: Misaq, 19-35.

National Environmental Protection Agency of Afghanistan (NEPAA). (2014). *National Biodiversity Strategy and Action Plan of Afghanistan 2014-201*. PCDMB, UNEP, 13-44.

Oya C., Schaefer, F., Skalidou, D. (2018). *The effectiveness of agricultural certification in developing countries: A systematic review.* World Development. Elsevier.112, 282-295. Retrieved March 04, 2019 from https://doi.org/10.1016/j.worlddev.2018.08.001

Parto, S., Mihran, R. (2014). *Climate Change and Food Security in Afghanistan: Evidence from Balkh, Herat, and Nangarhar*. Afghanistan Public Policy Research Organisation (APPRO), 8-14.

Podhorsky, A. (2015). *A Positive Analysis of Fairtrade Certification.* Journal of Development Economics, Elsevier, *116*, 169-170. Retrieved March 24, 2019 from https://www.sciencedirect.com/science/article/pii/S0304387815000449

Raina, R., Chand, R., Sharma, Y.P. (2011). Conservation strategies of some important medicinal plants. Department of Forest Products, Dr. YS Parmar University of Horticulture & Forestry, *Int. J. Med. Arom. Plants*, *1*(3), 342-347.

Rasul, G. (2014). Food, water, and energy security in South Asia: A nexus perspective from the Hindu Kush Himalayan region. *Environmental Science and Policy*, Elsevier, 39, Science Direct, 41.

Ritchie, H. (2010). *Afghanistan Wild and Medicinal Plant Value Chain Analysis (Blackcurrant, Asa foetida, Liquorice, Mushroom, Rhubarb, Sour Cherry).* FAO, The Hague.

Robinett, D., Miller, D., Bedunah, D. (2008). *Central Afghanistan Rangelands, A History of Tribal Rule, Grazing, War, and Rebuilding*. Society for Range Management, SRM. 2-10. Retrieved July 12, from https://journals.uair.arizona.edu/index.php/rangelands/article/download/.../15858

Ruess, P. (2015). *Mapping of Water Stress Indicators*. Term Paper, 3-4. Retrieved June 5, 2018, from https://oemmndcbldboiebfnladdacbdfmadadm/https://www.caee.utexas.edu/prof/maidment/giswr2015/TermProject/Ruess.pdf

Sahoo, N., Manchikanti, P., Dey, S. (2010) *Herbal drugs: Standards and regulation*, Fitoterapia, Elsevier, 81, 462–471

Savage, M., Dougherty, B., Hamza, M., Butterfield, R., Bharwani, S. (2009). *Socio-Economic Impacts of Climate Change in Afghanistan.* A Report to the Department for International Development, Project report, Stockholm Environment Institute (SEI), 2-26.

Schippmann U., Leaman D. J. and Cunningham A. B. (2002). *Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues*. FAO, Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. Satellite event on the occasion of the Ninth Regular Session of the Commission on Genetic Resources for Food and Agriculture. Inter-Departmental Working Group on Biological Diversity for Food and Agriculture. Rome, 1-7.

Seikine, T., Sugano, M., Azizi, M. and Fujii, Y. (2007). Antifungal Effects of Volatile Compounds from Black Zira (*Bunium persicum*) and Other Spices and Herbs, *Journal of Chemical Ecology*. *33*(11), 2123–2132. Retrieved October 10, 2018, from https://link.springer.com/article/10.1007/s10886-007-9374-2

Shank, Ch., Kanderian, N., Johnson, Mc., Rahmani, H. (2009) *The Ecoregional Approach to Identifying Afghanistan's Protected Area Network.* Convention on Biological Diversity (CBD) Programme of Work for Protected Areas, National Environmental Protection Agency (NEPA), Islamic Republic of Afghanistan, Wildlife Conservation Society (WCS), 10-16.

Shroder, J.F., Ahamdzai, Sh.J. (2016). *Trans-boundary Water Resource in Afghanistan, Climate Change and land-Use Implications*. Center for Afghanistan Studies, University of Nebraska at Omaha, Omaha, NE, Elsevier, 10-247.

Shroder, J. (2014). *Natural Resources in Afghanistan.* 1st Ed., Geographic and Geologic Perspectives on Centuries of Conflict, Elsevier. 258-266, 479-485, 514-517.

Tanko, H., Carrier, D., Duan, L. & Clausen, E. (2005). Pre- and post-harvest processing medicinal plants. *Plant Genetic Resources*, Cambridge University Press, *3*(2), 304-311. Retrieved October 10, 2018, from https://doi.org/10.1079/PGR200569

Thomas, V., Eqrar, N. (2011). Managing Water Resources, Scarcity and Climate Shock. In: Afghanistan Human development Report (2011), *The Forgotten Front: Water Security and the Crisis in Sanitation*, Centre for Policy and Human Development, Kabul University, 49-51.

Trading Economics. (2018). *Afghanistan Balance of Trade 2003-2018*. Retrieved September 09, 2018, from https://tradingeconomics.com/afghanistan/balance-of-trade

Trucker, S.C. (Ed.) (2005). *World War I, Encyclopedia*. Volume I: A-D, ABC.CLIO. 583-584. Retrieved May 23, 2018, from, https://books.google.com.af/books?id=2YqjfHLyyj8C&pg=PA583&lpg=PA583&dq=afghan+German+relations+1915&source=bl&ots=BTd9QdZHXM&sig=4jajCa_tfd5FmZfEx8_tauCQicg&hl=en&sa=X&ved=2ahUKEwjmv6qhyJvbAhUIWhQKHYDUCxAQ6AEwDHoFCAEQhgE#v=onepage&q=afghan%20German%20relations%201915&f=false}

Ullman, J.B. & Bentler P., M. (2013) *Structural Equation Modelling.* In I. B. Weiner, (Eds.), Handbook of Psychology, (2nd ed.), John Wiley & Sons, Inc.

United Nations (2009*). Guidelines for a Methodology to Support Value Chains for BioTrade Products*, From the Selection of Products to the Development of Sector Strategies, UNCTAD, New York and Geneva,

United Nations Development Programme (2016). *Human Development Reports.* UNDP Retrieved April 04, 2018, from http://hdr.undp.org/en/countries

United Nations Environment Programme (2008). *Biodiversity Profile of Afghanistan, an output of the national capacity needs self-assessment for global environment management for Afghanistan.* United Nations Environment Programme, Post-Conflict and Disaster Management Branch, Kabul, 49-52.

United Nations Office on Drugs and Crime/ Ministry of Counter Narcotics (2018 a). *Afghanistan opium survey 2017, Challenges to sustainable development, peace and security*. UNODC Research, MCN/NSD. 4-25.

United Nations Office on Drugs and Crime/ Ministry of Counter Narcotics (2018 b). *Afghanistan Opium Survey 2017, Cultivation and Production*. UNODC Research, MCN/NSD. 13-14.

United States Agency for International Development. (2008). *Herat Province Agricultural Profile*, Accelerating sustainable agricultural program, National Agricultural Information System (NAIS/AgNet) for the MAIL. 3-18., Retrieved from https://afghanag.ucdavis.edu/country-info/province/files/profile-Herat.pdf

US Department of Labor. (2008). *Child Labor in Afghanistan: A Four-Province Study in Kabul, Kandahar, Nangarhar, and Balkh.* 9-11, Retrieved on April 25. 2019, http://www.dol.gov/ilab/ICLRE/Downloads/Research/Report/Afghanistan_Research_Report.pdf

Vasisht, K., Sharma, N., Karan, M. (2016). Current Perspective in the International Trade of Medicinal Plants Material: An Update. *Current Pharmaceutical Design*, 22, 4333-4336. Retrieved July 22, 2018 from https://www.ingentaconnect.com/contentone/ben/cpd/2016/00000022/00000027/art00014?crawler=true&mimetype=application/pdf

Waak Gh.A. (2005). *A new history of Afghanistan*, University of Helsinki, Aleksanteri-instituutti, Helsinki, 5. Retrieved February 12, 2018 from http://www.helsinki.fi/aleksanteri/english/publications/presentations/papers/ap_5-2005.pdf

Wong, Jennifer LG, Thornber Ch., Baker N. (2001). *Resource Assessment of non-wood forest products, experience and biometric principles*. Food and Agriculture Organization (FAO) of the United Nations, Rome

World Bank. (2017 a). *Afghanistan Development Update*. November 2017. World Bank, Washington, D. C., World Bank. Retrieved August 08, 2018, from https:// penknowledge.worldbank.org/handle/10986/28928

World Bank. (2017 b). *Afghanistan Unlocking the Potential of Horticulture*. Discussion Note and Input to Agribusiness Jobs Charter, 5-6. June 11, 2018, from http://documents.worldbank.org/curated/en/696611501212586551/pdf/117202-PUBLIC-Output-P158552-final-clean.pdf

World Bank. (2016). *Climate Change Knowledge Portal for Development Practitioners and Policy Makers.* The World Bank. Retrieved February 14, 2018, from http://sdwebx.worldbank.org/climateportal/index.cfm?page=downscaled_data_download&menu=historical

World Bank. (2012). *Afghanistan Diagnostics Trade Integration Study (DTIS).* Poverty Reduction and Economic Management Unit, South Asia Region, The World Bank, 9-28. Retrieved October 09, 2018, from https://oemmndcbldboiebfnladdacbdfmadadm/http://documents.worldbank.org/curated/en/373301467992809220/pdf/706450ESW0P11700Report0final0Feb12.pdf

World Health Organization (WHO). (2013). WHO Traditional Medicine Strategy 2014-2023. WHO, Hong Kong SAR. 15-41. Retrieved from www.who.int

World Health Organization (WHO). (2003). *WHO Guideline on Good Agricultural and Collection Practices (GACP) for medicinal plants.* WHO. Geneva. 2-29.

Wyeth, P., Malik, N. (2007). *A Strategy for Promoting Afghan Saffron Export*. Research in Alternative Livelihoods Fund (RALF), Aleppo: ICARDA. 12-13.

YOU Qing-Long et al. (2017). An overview of studies of observed climate change in the Hindu Kush Himalayan (HKH) region, *Advances in Climate Change Research. 8*(2017), 141-147, Retrieved April 04, 2018, from http://www.keaipublishing.com/en/journals/accr/

Younus, C. et. al. (1987). Repertory of Drugs and Medicinal Plants Used in Traditional Medicine of Afghanistan. *Journal of Ethnopharmacology*, Elsevier Scientific Publishers Ireland Ltd., 20, 245-284.

Yousufi, A. (2016). Horticulture in Afghanistan: Challenges and Opportunities. *Journal of Developments in Sustainable Agriculture. 11*, 37-39.

Zakharova, EA, Degtjareva, G.V., Kljuykov, E.V., Tilney, P.M. (2014). The taxonomic affinity of *Carum piovanii* Chiov. and some *Bunium* species (Apiaceae). *South African Journal of Botany*, Elsevier, *94*, 122-128.

8. Appendix

8.1. Report on the expedition for resource assessment of MAPs to Herat, 25 Oct. to 01 Nov. 2017

Date: 25.10.2017

Visit to Herat Directorate of Agriculture, Irrigation and Livestock (DAIL)

Place: Directorate office, DAIL, Herat

- Attendees:
    - Herat Director of Agriculture, Irrigation and Livestock: Eng A. Saboor Rahmani
    - Mr. Bashir Ahmad Ahmadi, Deputy Director of Agriculture, Irrigation, and Livestock
    - Mr. Amini, Head Natural Resource
    - Prof. Sekandari, Head Natural resources, Faculty of Agriculture, HU
    - Eng Paiman, a graduate of agronomy, Faculty of Agriculture, HU
    - M. Ehsan, assistant field expedition
    - MO Babury, FoPh, KU

Agenda:

1. Introduction
2. Objectives of the visit (briefing on planned study, receive comments, the status of MAPs natural resources)
3. Overview on MAP natural resources
4. Approaches for resource analysis, drafted approaches
5. Views, comments and recommendations

Summary report:
Babury presented information about the research work, objectives and the importance of the study. He gives details about the concerns on natural resources (NR) of medicinal and aromatic plants (MAPs) in Afghanistan, and the current standing and works of Ministry of Agriculture, Irrigation and Livestock (MAIL) and other potential stakeholders (FAO, JAICA, WB, GIZ, and USAID…) in conservation of MAP resources. He also explained the opportunities and limitations for conducting this research. He proposed to conduct a provincial workshop with the participation of all district officers of agriculture and other relevant figures from DAIL, Faculty of Agriculture at Herat University and Herat Institute of Agriculture.

Mr. Amini explained the extensive and intensive harvesting of “Heng” (Gum resin of Asa foetida) and “Kondal” (gum-resin of Dorema) from Ghorian, Kohsan, Golran (especially Kakari area which is located between Golran and Kohsan), Zandajan by

communities and mainly by a team of collectors from other provinces. He also elaborated about the value chain and post-harvesting treatment (PHT) of natural ingredients, especially “Heng” and “Kondal”. The chain is not fair and there is no achievements in PHT cycles. Practically, there is no any initiatives by MAIL except some workshops with generic objectives”- added Mr. Amini.

According to Mr. Amini, Herat Directorate of agriculture, irrigation and livestock (DAIL) has started to conserve certain plants which seem to be under the thread in districts of this province. He reiterated on the needs for some capacity building and technical support specifically about MAPs resources in Herat from MAIL.

He emphasized on the need for resource assessment and the crucial need for the sustainable resource management of MAPs. The proposed approaches seem to be realistic and his department will cooperate in this regard, added Mr. Amini.

Eng. Rahmani, director of AIL endorses the proposed approach (frameworks) for the RA. He explained, that in all 15 districts they have operating offices and in certain districts like Ghorian, Golran, Kohsan, and Shendand they have larger teams of the agriculturist. For example, in Ghorian there are 7 colleagues.

He added:

- There is no accurate and reliable information about MAPs,
- Security is a challenge for efficient monitoring,
- “Heng” and “Kondal” were harvested up to 2015; however, we extended a moratorium on the collection of these natural products for two years,
- We initiated the propagation of “Heng” in two districts of Ghorian and Zandajan, but it was not successful. The land was barren and dry.
- We are implementing the official procedures of MAIL on wild collection of MAPs; however, this procedure requires critical changes, especially the tax of the collected raw materials to be transferred to treasury (1:12) by leaseholders. It is unfair!
- Directorate of NR in MAIL have not taken required action in this regard.
- Rangeland is a challenging question in the country. Land ownership requires serious attention and hard working. It should be brought up ASAP; otherwise, the territory of rangeland is under pressure, especially in provinces where the security is challenging.
- The draft of the rangeland’s law has been prepared last year and it was introduced in a national workshop in Kabul. We gave our comments and hope that it will be approved.
- Herat has its own complexity in this regard; however, we try to save rangeland and save it.

Conclusion:

1. The developed frameworks for analysis of different aspects of MAPS resources is a pragmatic approach.

2. There is a crucial need for capacity enhancement of the technical teams at MAIL and all DAIL at the provincial level in NR of MAPs.
3. It is important to revive the chain between research via academies with fields and AILs.
4. The proposed workshop "Resource Assessment of Medicinal and Aromatic Plants in Herat" will be organized and conducted by Prof. Babury on October 28, 2017. This workshop will have two main objectives:
    a. Introducing the concept of Natural Resource Management of MAPs and Good Collection Practices,
    b. Introducing new frameworks for resource analysis of MAPs
5. All heads of AILs/ officers of NR, from all 15 provinces and relevant faculty members from the faculty of agriculture will be invited jointly by Herat DAIL and Babury in the said workshop.

26.10.2017

Visit to Faculty of Agriculture, Herat University

Meeting with Dr. Faez, chancellor of university and Professor of agronomy

Summary:

- Needs for capacity enhancement of NR Dep. at agriculture faculty
- Farm of the university is progressing,
- There are some joint research activities with the Directorate of AIL,
- Cultivation of the wild and rare medicinal plants is a neglected issue,
- Resource assessment of MAPs will give basis and clue for the management of these resources,
- USWDP (Purdue University) support in food technology can be expanded to NR.

Meeting with the faculty of agriculture

Attendees:

- Dean Faculty of Agriculture, Prof. Jami
- Head of natural resource department, N. Sekandari
- Vice Chancellor HU, Sekandari
- Prof. Dr. Ghoryar
- Head of agronomy department
- Representative of USWDP (University Support and Workforce Development)
- M. Ehsan, assistant in conducting workshop
- M.O. Babury

Summary:
The aims of this meeting were to discuss:

- status of the natural resources in the country and particularly in Herat,
- any activity conducted by the faculty on NR and MAPs,

- the proposed approaches for the RA of MAPs.

Key points:

- Resource assessment of MAPs are neglected issue in the country,
- The Natural Resource Department (NR Dep.) at HU is young and needs to be grown,
- MAPs are not the focus of MAIL,
- In many cases, rangelands are in critical status,
- We are working to collaborate with DAIL, which will ensure better management of resources and progress,
- The proposed approaches by M.O. Babury for RA of MAPs is a pragmatic,
- Training of district's officers of agriculture/NR officer is needed.
- Prof. Sekandari, head NR Dep. will contribute to the workshop.

28.10.2017

Workshop on resource analysis of MAPs in Herat

Objectives:

- To introduce the concept of sustainable resource management of MAPs,
- To discuss and finalize the screening methodology for the selection of potential MAPs,
- To finalize the drafted criteria and frameworks for the resource assessment of MAPs, and
- To get consensus on methodology and timeline of the study.

Venue: Conference Hall, DAIL, Herat

Program and list of participants: See App. 8.2

Summary:

The workshop was inaugurated after registration of participants, by verses of Holy Quran and national anthem, following by keynote speeches delivered by Eng. Rahmani, Director of Herat DAIL and Dr. Faez chancellor of Herat University. Prof. Babury presented the objectives and goals of the workshop. The workshop was conducted according to the outlined program. "An overview of Medicinal and Aromatic Plants and "Wild collection of MAPs in Afghanistan, impact on resources" were the introductory presentations in the workshop followed by detailed discussions after every presentation. Attendees were enthusiastic, responsive and active. The presentation on the rational collection and good agricultural and collection practices (GACP) attracted the attention of participants to different aspects of NR. In the second half of the workshop, the following frameworks were presented and elaborated:

Figure 8.1: Herat workshop “resource assessment of medicinal and aromatic plants in Herat” on 28.10.2017 (Photo by M. Ehsan).

- Framework for resource analysis
- Framework for socio-economic assessment
- Framework for technological assessment
- Framework for marketing

In another part of the workshop, the drafted methodology for the screening of the main medicinal plants and natural product of Afghanistan has been discussed and elaborated. There were productive discussions on selected criteria and some points were modified and rationalized.

Key findings from discussions:

- Herat has rich natural resources of MAPs; however, there are some concerns about resources of the certain species,
- Over-collection is a critical challenge for these resources,
- Poor knowledge about agronomy, harvesting and post-harvesting process of MAPs,
- MAIL doesn’t play an efficient role in the conservation of NR of MAPs,
- There is no any information about strategies of MAIL (NNRMS) and others (National Biodiversity Strategy) among authority and district officers,
- Resources of MAPs require serious measures for sustainable management,
- Wild collection of MAPs plays an important role in the livelihood of the rural communities,

Figure 8.2: Herat workshop “resource assessment of medicinal and aromatic plants in Herat” on 28.10.2017 (Photo by M. Ehsan).

- MAPs conservation must be included in the curriculum of Heart Institute of Agriculture and faculty of agronomy at HU,
- In certain spots, species like “Heng” (Ghorian, Karokh, and Kohsan) became threatened and endangered,
- In Golran there are some areas under the poppy cultivations, therefore MAPs can be an appropriate alternative livelihood for the community. In practice, 26 species of MAPs are cultivated in this district. Two species (*Colchicum* sp. and “qook”) are endangered,
- In a few, cases communities took initiatives to revive the resources (Shendand, Ghorian),
- Overharvesting of *Glycyrrhiza* sp. resulted in degradation of lands in many places,
- It is important to estimate the resources of MAPs in every district and make a mapping of MAPs,
- Introduced frameworks for resource assessment have been discussed, modified and agreed,
- If there will be an initiative for the resource management, they will be willing to support it,
- Standards for some potential MAPs should be developed. Although there is no adequate knowledge about certification system; nevertheless, participants believe that establishing the certification system is an essential attempt to increase the

marketing of MAPs and support the livelihood of the communities. Participants are eager to learn more and support such an initiative.

Conclusions:

- The methodology for the screening of the main MAPs including criteria has been finalized,
- The details of frameworks were discussed and after some modifications agreed,
- The knowledge on GACP and importance of conservation of natural resources were useful and constructive,
- Frameworks will be assessed and scored by a team of three technical people and led by the district officer of agriculture,
- These frameworks will be completed during 4-6 coming weeks,
- The two focal points (head of natural resource department of Herat DAIL and the head of agronomy department at Herat Institute of Agriculture) will serve as the focal points for any clarification, guidance, and instruction. The Terms of reference have been agreed, and
- The main findings from this assessment will be shared with the participants of the workshop.

29-30.10.2017

Visit to markets of MAPs products in Herat

Visited markets:

1. Sarai (Market) "Darakhte Toot", Darbe Khush
2. Sarai (Market) Haji Hussain, Darbe Khush
3. Salimi Market, Darbe Malik,
4. Nesari Market, Jadae Khuja Amini,
5. Markete "Dukhtare Wazir", Darbe Kandahar,
6. Haji Aslam Market, Darbe Kandahar

1. Visit to Sarai (Market) "Darakhte Toot"; Nesari Market

Interviewed: Haji Ghulam Hazrat Khan, Gh. Hazrat Co., Shogufa Co.

Findings:

- Working experience around 20 years,
- Exporting more than 25 natural herbal products,
- Exporting to India, Iran, UAE, and Pakistan,
- Procuring from traders and owns suppliers from Herat districts, and other provinces (Badghis, Ghor, Farah, and Kandahar),
- Haven't receive any support from government and any other institutions,

- Post-harvest treatment performed according to the requirements of the costumer, and
- Grading and packaging made by the company.

The details of the products, prices, resources, etc. are illustrated in the following table.

Table 8.1: Details of MAPs and natural products exported by Gh. Hazrat Co. and Shogufa Co.

#	Item	Part of plant	Source (district, province)	Local price, Af/Kg	Exported to	Comments
1	*Stipa capensis* Thunb. Bahmane Sorkh (Gushte Adam)	stem and root	Ghor, Golran, Obe, Karokh	40	India	1 MT* exported by the Co. last year
2	*Orchis mascula* (L.) L. (Saalab Mesri)	bulb	Karokh, Obe, Farse, Golran, Ghor	4500	India	Plant requires water
3	*Colchium* sp. (Sorenjan)	bulb	Golran, Adreskan, Pashtun Zarghun, Karokh, Obe	400	India, Pakistan	Collected in mid of spring
4	*Eremurus* sp. (Seresh)	herb	Karokh, Ghorian, Golran	35	Iran, Pakistan	The collection banned this year by district office of agriculture
5	*Saponaria* sp. (Flar)	Root and rhizome	Badghis, Ghor, Herat	60	India, Pakistan	2 MT eported to Pakistan
6	*Eremurus* sp. (Seresh Zard)	roots	All districts	60	India, Pakistan	Strong demand by market
7	*Allium* sp. (Piaz Kohi, Salangita)	bulb	Ghor, Farse, Obe, Koshk, Ghorian	600	Pakistan	700 Kg exported to India
8	*Glycyrrhiza* sp. (Sherin Buia, Makh)	root and rhizome	All districts, (Koshk, Golran, Shendand) Badghis (Qades, Morghab, Ghormach)	55	Pakistan Two years to Europe	Grading made by my company

9	*Bunium* sp. (Black Cumin)	seed	Mainly Ghor and Badghis, partialy Karokh, Golran, Obe, Koshk	500	Mainly Iran, also India and Pakistan	17 MT* exported
10	*Alkania* sp. (Rodang)	root	Ghorian, Zindajan, Golran	63	India, Pakistan	High demand by market
11	*Marrubium* sp. / *Nepeta* sp. (Chai Kohi) (Jupa in India)	herb	Herat, Ghorian, Karokh, Obe, Chesht, Farse and Ghor	200	India	High demand by Indian market
12	*Stipa* sp. (Bahman Safed, Zardak Kohi)	Root	All districts	125	India	

* MT –metric ton

2. Sarai Haji Hussain

Interviewed: Mirza Abdul Razaq Arghawan

Findings:

- Working experience around 25 years as wholesaler and trader of natural ingredients in Herat,
- Exporting to Iran, Egypt, and Libya,
- Natural ingredients procured from different districts of Herat and other provinces, Ghor, Badghis…,
- Partially engaged in export of *Glycyrrhiza* sp.,
- In 2015 five containers of *Glycyrrhiza* sp. exported to Iran and Egypt,

- Heng traded mainly through Mazar-e-Sharif,
- The company performing some grading and packaging for export,
- Important part of trading made by selling to local and provincial retailers and wholesalers,
- *Bunium* sp. is supplied to this company from Adreskan, Pashtun Zarghun, Obe, Chesht-e-Sharif, and also from Baghran district in Helmand. It is mainly exported to Iran,
- *Cuminum* sp. are collected mainly from Kandahar and nowadays it is cultivated there. This product is exported to India,
- Caraway is cultivated in many districts of Herat and exported to Dubai, India and Pakistan,
- We did not receive any support from any sources including governmental authority, and there is no promotion,

- Most of our ingredients are exported through private markets, to Iran and Pakistan illegally, and
- We can improve the quality of the products, but no access to western markets.

The details of the items traded by this company are included in below table.

Table 8.2: Details of MAPs and natural products exported by Arghawan Co.

#	Item	Contents	Source	Local price, Af/Kg	Exported to	Comments
1	Oleo-gum-resin *Dorema* sp. (Kandal)	Gum resin	Ghorian, Karokh, Zindajan, Koshk, Golran, Shindand	1500	Libya, India, Pakistan	12 metric ton exported to Pakistan
2	Oleo-gum-resin *Dorema* sp. (Stagh)	Yellow Gum resin	Golestan Farah, Zindajan Ghorian, Shendand	1300	India, Iran	Product of Dorema
3	*Orchis mascula* (L.) L. (Saalab Mesri)	Bulb	Karokh, Obe, Ghor, Adareskan, Shahrak	4500	India	Plant requires water
4	Gole par	Flowers	Karokh, Shendand, Pashtoon Zargoon, Obe, Golran	40	Iran	For preparing pickles
5	Gum resin *Ferula* sp. (Asa foetida, Heng)	Gum resin	Kohsan, Ghorian, Karokh, Adraskan, Shendand, Ghor	7000	India	Mainly traded through Mazar-e-Sharif
6	*Glycyrrhiza* sp.	Root and Rhizome	All districts, Badghis (Koshk, Golran, Shendand)	60	Pakistan Two years sent to Europe	Grading made by the company, 40 MT exported to Pakistan

31.10.2017

3. Salimi Market, Darbe Malik

Interviewed: Haji Mir Hamza

Findings:

- Working experience around 10 years,
- Exporting to Iran, India, UAE, and Pakistan,
- Procurements: from Badghisat, Kandahar, Farah, and Herat districts of Karokh, Golran, Ghor, Kohsan, Ghorian,
- As there is no procedure and standards for the processing of natural ingredients, the quality is not good. There are some cases of adulteration in *Bunium* sp.,
- However, there are some companies who are performing good grading, cleaning, and packaging of the raw products,
- He is exporting harmal, sesame, watermelon seed to Iran, Caraway to Dubai, Iran and Pakistan,
- Black and green cumin are exported to Iran, and
- The export of black cumin is reduced during the last 10 years.

Details of trading, whole selling, and export of natural ingredients by this company are included in below table.

Table 8.3: Details of MAPs and natural products exported by Hamza Co.

#	Item	Contents	Source	Local Price, Af/Kg	Exported to	Comments
1	Caraway	fruit	Golran, Badghes, Ghorian, Zindajan, Shindand	250	Dubai, Iran Pakistan	Rain-fed cultivation
2	*Peganum harmala* L.	harmal seed	Zindajan, Ghorian, Shendand, Adareskan	25	India, Pakistan	
3	Sesame	Seed	Karokh, Obe, Ghorian, Adareskan,	100	India, Iran, Pakistan	
4	Watermelon Seed	Seed	Ghorian, Koshk,	70	Iran	Rain-fed cultivation

			Shendand, Badghis			
5	*Bunium* sp. (Zeera siah)	Seed	Chest-e-Sharif, Karokh, Oashtun Zarghun	580	Iran	Production is decreased during the last 10 years
6	*Cuminum* sp. Zeera Sabz	Seed	Karokh, Kohsan and Kandahar	420	India, Pakistan	Main source is cultivated

4. Haji Nader Khan Company, Faiz Market, trader of *Glycyrrhiza* sp.

Findings:

- Working as a follower of his father business during the last 4 decades.
- Exporting to Pakistan during the last years,
- The company does some sorting and grading of the product,
- Cleaning, cutting (40 cm), and sorting are the main post-harvesting treatment by the company,
- No any procedure and standard for collection and processing of the product is available,
- No any instructions, guidance, and technical support received from government or any other organization.
- There is a decrease in the amount of production of *Glycyrrhiza* sp. during last five years,
- In last year, more than 6000 metric tons have been produced in Herat,
- According to information from purchasing companies, this product is partially consumed in Pakistan and mainly exported to China following some further post-harvesting treatment.

The total estimated export of MAPs collected from chief traders of MAPs in Herat (H Nader Khan, Haji A. Rauf, H. Gh. Hazrat, H. Shahzada and H. Shah Aadel) listed in the following table.

Table 8.4: Estimated export volume of MAPs by Herat during 2016 (1395), Kg.

#	Item	Collected area	Export to	Volume (Kg)
1	*Glycyrrhiza* sp.	Shendand, Adraskan, Golran, Koshke Kohna, Badghis (Ghormach, Qades, Morghab), Chesht-e-Sharif, Farse	Pakistan, India	6,500,000.0

2	*Bunium* sp.	Adraskan, Pashtonzarghon, Chesht-e-Sharif, Badghis, Ghor, Farse, Pashtun Zarghun Kandahar, Helmand	Iran, India, Pakistan	2,300,000.0
3	*Cuminum* sp.	Kohsan, Adraskan, Kushk-e-Robat Sangi, Ghor, Karokh, Obe, Shendand, Pashtun Zarghun	Iran, India, Pakistan	1,200,000.0
4	*Ferula* sp.	Ghorian, Karokh, Kohsan, Kushke Rubat Sangi, Obe, Shendand, Pashtun Zarghun	India, Pakistan	400,000.0

01. 11. 2017 - 01. 11. 2017

Expedition to Nuqra valley, Injil district; Pole Hshimi, Zendajan district

This valley is well-known in wild collection and cultivation of MAPs in Herat.

Finding:

- Natural ingredients are an important part of the health, traditional medicine and livelihood of the communities in this valley in Herat,
- Inhabitants are enthusiastic to cultivate and propagate threatened plants; however, they need some technical support,
- Saffron cultivation is getting overwhelming expansion in this and other surrounding valleys.

8.2. Workshop agenda, "Resource Assessment of MAPs in Herat"

Date: 28.10.2017 (6 Aqrab 1396)
Venue: conference hall, directorate of agriculture, irrigation and livestock, Jadae Walaiat, Herat.

Table 8.5: Workshop agenda, October 28, 2017.

#	Topic	Facilitator	Time
1	Registration	Eng. M. Ehsan	9:00-9:15
2	Recitation of Holy Quran	Qari Azizi	9:15-9:20
3	Keynote speech	Eng. A. Saboor Rahmani, Director Agriculture, Irrigation and livestock, Herat	9:20-9:30
4	Keynote speech	Prof. Dr. Faez Chancellor of Herat University	9:30-9:40
5	Objectives & goals	Babury M.O.	9:40-10:00
6	An overview of Medicinal and Aromatic Plants and their resources in Afghanistan.	Babury M.O.	10:00-10:30
7	Discussion	Participants & facilitator	10:30-11:00
8	Tea break		11:00-11:20
9	Wild collection of MAPs in Afghanistan, impact on resource	Babury M.O.	11:20-11:40
10	Discussions	Participants & facilitator	11:40-12:40
11	Lunch break and pray		12:40-14:00
12	Rational collection of MAPs, good agricultural and collection practices (GACP)	Babury M.O.	14:00- 14:30
13	Discussions on screening of Afghanistan main medicinal plants	Participants & facilitator	14:30-15:30
14	Introducing of resource analysis frameworks for medicinal and aromatic plants: • Framework for resource analysis • Framework for socio-economic assessment	Babury M.O.	15:30-16:30

	• Framework for technological proficiencies • Framework for marketing		
15	Discussions on objectives content and structure of frameworks	Participants & facilitator	16:30-17:30
16	Conclusions	Eng. A. S. Rahmani, DAIL; Babury	17:30-18:00

Table 8.6: List of participants in Herat workshop October, 28, 2017.

#	**Name**	**Position**	**District/Institution**
1	Eng. A. Saboor Rahmani	Director	Herat DAIL
2	Alhaj Bashir A. Ahmadi	Deputy Director	Herat DAIL
3	Prof. Dr. Faez	Chancellor	Herat University
4	Mr. Sekandari	Vice Chancellor	Herat University
5	M. Paiman	Member of rural development	Pashtun Zarghun
6	Hamidullah Mohammadi	Director of Agric. Service	Ghorian
7	Abdullah Nawini	Director of Agric. Service	Gozarah
8	Fraidoon Jamshidi	Director of Agric. Service	Kohsan
9	M. Nader Hamidi	Director of Agric. Service	Injil
10	M. Ibrahim Rahmani	Director of Agric. Service	Kushk-e-Kohna & Rabat Sangi
11	Abdul Ali Naseri	Director of Agric. Service	Obe
12	Sayed Abdul Qayum Qaderi	Director of Agric. Service	Pashtun Zarghun
13	Abdul Jalil Paiman	Director of Agric. Service	Zendajan
14	Abdul Samad Habibi	Director of Agric. Service	Adraskan
15	Abdul Ghafur Afzali	Director of Agric. Service	Shendand
16	Abdullah Masumi	Director of Agric. Service	Chesht-e-Sharif
17	Abdul Aziz Saadat	Director of Agric. Service	Golran
18	Shukrullah	Head Horticulture Dep.	Herat DAIL
19	Wali Ahmad	Director of Saffron Cultivation	Herat DAIL

20	Zia Jan Jamshidi	Director of Agric. Service	Karokh
21	Eng. Nesar Ahmad Amini	Head NR. Dep., Herat DAIL	Herat DAIL
22	Gh. Qader Baburi	Head of agronomy department	Herat Institute of Agriculture
23	Eng. Mahmood Shah Haidarian	President	Herat Institute of Agriculture
24	Eng. Basir Ahmad Sherzad	Specialist in Saffron agriculture	Herat DAIL
25	M. Ehasn	Assistant expedition	Hired assistant
26	Prof M Nazim Sekandari	Head NR Dep., HU	Fac. of Agriculture, HU
27	Mohammad Maisam	MAPs trader	Herat Drakhte Tut Market
28	Mohammad Sulaiman	MAPs trader	Herat Drakhte Tut Market
29	Babury M. O.	Researcher (PhD candidate)	Kabul University

8.3. Terms of reference (ToR) for focal points (N. Ahmad Amini & Gh. Qader Baburi)

This collaboration will engage in an open and transparent process where a detail of research and its objectives is shared, and where the roles and expectations of team members are clearly understood.

This work will be a collaborative activity to conduct research in resource analysis of medicinal and aromatic plants in Herat where to focal pints will support district teams of assessment as per the details of this ToR by support of Prof. Babury toward the program objective.

This research will provide opportunities for capacity building through "learning exchanges" where team members can learn about research skills, community development, and community work.

This ToR recognizes that roles and responsibilities of focal points are based on principles of ethics, honesty, and support to natural resources of Afghanistan and reviving the critical situation for the benefit of the people of the country.

The focal points will support the assigned district teams in resource assessment of medicinal and aromatic plants (MAPs) according to agreed forms and frameworks in all 15 districts of Herat with the main support from the researcher (M. O. Babury). These are:

- overseeing the process of information gathering,
- coordinating assessment team activities,
- reporting the questions and unclear points to researcher,
- supervising the process of data collection, and
- ensuring the dissemination of research findings.

Other relevant responsibility:

- Liaise between the district's teams of assessment and researcher in any question related to the research.

8.4. Workshop II agenda (follow up workshop on progress of the work)

Date: 05.04.2018 (13 Saur 1397)
Venue: Senate hall, Herat University

Table 8.7: Workshop agenda, May 04, 2017.

#	Topic	Facilitator	Time
1	Registration	Eng. Mohammad Ehsan	9:30-9:45
2	Recitation of Holy Quran	Qari Rahimi	9:45-9:50
3	Keynote speech	Babury M.O.	9:50-10:00
4	Keynote speech	Mr. Amin Head Natural Resources, Herat DAIL	10:00-10:10
6	Overview of the reports from districts	Babury M. O.	10:10-10:40
7	Discussion	Participants & facilitator	10:40-11:10
8	Tea break		11:10-11:30
9	Discussions on provided reports, identified questions and points in frameworks	Participants & Babury Representative of CRS	11:30-12:00
10	Discussions on reports from 7 remained districts (Farsi, Chesht-e- Sharif., Shindand, Kohsan, Kushk-e-Kohna, Kushk-e-Robat sangi, Zendajan)	Participants & Babury and Representative of CRS	12:00-12:30
13	Conclusions	Participants, Mr. Amin, Eng. Qader and Babury	12:30-13:00

8.5. Results of different aspects of assessment

Table 8.8: Results of resource assessment of *Bunium* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abundance and state of conservation of the species	Abundant of conservation	3		3		does not grow		does not grow	does not grow		does not grow			does not grow			
		Sufficient/uncertain state of conservation	2	2		2					2					2	2	
		Some initiatives are under development to improve conservation	1											1				
		Under threat	0					0					0					0
2	Potential for sustainable management	High	3		3													
		Moderate	2			2							2			2		
		Mild	1	1				1			1			1			1	1
		Low	0															
3	Impact of production for harvesting on the species and its habitats	Positive	3															
		Neutral	2	2	2	2					2		2	2		2	2	
		Negative	1					1										1
		Critical	0															

4	There are guidelines for the implementation of good collection (management) practices	Guidelines exist and they are being used.	3															
		Guidelines exist, but they need improving.	2					2			2					2		
		Development of guideline is under process	1															
		No guidelines exist	0	0	0	0							0	0			0	0
5	Availability of a suitable environmental or any other certification mechanism	There is a mechanism and it is being used.	3															
		There is a mechanism, but it is not being used, or it needs improvements.	2															
		Some initiatives have been taken to introduce certification.	1								1							
		There is no mechanism.	0	0	0	0		0					0	0		0	0	0
6	SUBTOTAL			5	8	6	-	4	-	-	8	-	4	4	-	8	5	2

Table 8.9: Results of trade and marketing assessment of *Bunium* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Quantity and quality of the information about the existing market	Sufficient/ reliable	3		3		does not grow		does not grow	does not grow		does not grow			does not grow			

		Inadequate/ imprecise	2	2		2							2					
		Is being developed	1					1			1			1		1	1	
		Non-existent/ unreliable	0															0
2	Potential market demand	High	3	3	3	3							3			3	3	
		Moderate	2								2			2				2
		Mild	1					1										
		Limited	0															
3	Scale of production	High	3		3													
		Moderate	2	2		2										2		
		Mild	1					1			1		1					1
		Low	0											0			0	
4	Experience of the product in the market	Already on the market	3	3	3	3												
		In development	2					2			2		2				2	
		There are opportunities to be on the market	1											1		1		

		No development currently taking place	0															0
5	Competition (as a threat to maintaining the market place)	Weak	3		3	3							3					3
		Mild	2	2				2			2					2		
		Moderate	1															
		Strong	0											0			0	
6	Evaluation of financial feasibility (analysis of economic viability of investment)	Good profitability	3								3					3	3	
		Moderate profitability	2					2						2				
		Mild profitability	1	1	1	1							1					
		Low profitability	0															0
7	Quality of production	Good	3	3	3	3												
		Moderate	2					2			2							
		Mild	1													1	1	
		Low	0										0	0				0
8	Potential for certification in the market	High	3		3	3					3					3		
		Moderate	2											2			2	
		Mild	1	1				1					1					
		Low	0															0

9	SUBTOTAL			17	22	20	-	12	-	-	16	-	13	8	-	16	12	6

Table 8.10: Results of socioeconomic assessment of *Bunium* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Potential for generation of employment	High	3		3	3	does not grow		does not grow	does not grow		does not grow			does not grow	3		
		Moderate	2								2							2
		Mild	1	1				1					1	1			1	
		Low	0															
2	Suitability of production for the livelihood of the communities (Natural Capital)	High	3		3	3												
		Moderate	2					2								2		2
		Mild	1	1							1		1					
		Low	0											0			0	
3	Suitability of production for alternative livelihood of the communities	High	3															
		Moderate	2															
		Mild	1					1			1			1		1		1
		Low	0	0	0	0							0				0	
4		Very suitable	3															

	Suitability of production for local communities or small entrepreneurs	Moderately suitable	2	2	2	2					0		2	2		2	2	
		Mildly suitable	1					1										1
		Unsuitable	0															
5	Experience of local communities with the product	Considerable	3		3	3												
		Moderate	2	2							2			2			2	
		Mild	1															1
		Little	0					0					0			0		
6	Additional benefits to small businesses	Many	3		3	3										3		
		Moderate	2															
		Mild	1	1				1			1		1	1			1	1
		Few	0															
7	SUBTOTAL			7	14	14	-	6	-	-	7	-	5	7	-	11	6	8

Table 8.11: Results of technological proficiencies assessment of *Bunium* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abilities and skills	High	3				does not grow		does not grow	does not grow		does not grow			does not grow			
		Moderate	2															
		Mild	1	1							1					1	1	
		Low	0		0	0		0					0	0				0
2	Human resources	Available	3															
		Moderate	2		2	2		2			2		2	2		2	2	
		Mild	1	1														1
		Limited	0															
3	Technological requirements for improving processes	Low	3															
		Mild	2	2	2	2		2					2	2			2	
		Moderate	1								1					1		1
		High	0															
4	State of infrastructure	High	3															
		Moderate	2														2	
		Mild	1	1				1								1		
		Low	0		0	0					0		0	0				0

5	Quality control requirements	Low	3																
		Mild	2		2	2					2					2	2		
		Moderate	1	1				1					1	1				1	
		High	0																
6	Availability of technical support	Available	3																
		Moderate	2	2															
		Mild	1								1						1		
		Limited	0		0	0		0					0	0		0		0	
7	SUBTOTAL			**8**	**6**	**6**		**6**			**7**		**5**	**5**		**7**	**10**	**3**	
8	Grand Total			**37**	**50**	**46**		**28**			**38**		**27**	**24**		**42**	**33**	**19**	
9	Ranks			**5**	**1**	**2**		**7**			**4**		**8**	**9**		**3**	**6**	**10**	

Table 8.12: Results of resource assessment of *Cuminum* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abundance and state of conservation of the species	Abundant of conservation	3		does not grow	does not grow				does not grow								

		Sufficient/uncertain state of conservation	2	2							2	2	2	2		2	2	
		Some initiatives are under development to improve conservation	1															
		Under threat	0				0	0	0						0			0
2	Potential for sustainable management	High	3									3	3					
		Moderate	2								2					2	2	
		Mild	1	1										1	1			
		Low	0				0	0	0									0
3	Impact of production for harvesting on the species and its habitats	Positive	3															
		Neutral	2								2	2		2		2		
		Negative	1	1									1		1			
		Critical	0				0	0	0								0	0
4	There are guidelines for the implementation of good collection practices	Guidelines exist and they are being used.	3															
		Guidelines exist, but they need improving.	2					2			2				2	2		
		Development of guideline is under process	1														1	
		No guidelines exist	0	0			0		0			0	0	0				0

5	Availability of a suitable environmental or any other certification mechanism	There is a mechanism and it is being used.	3																
		There is a mechanism, but it is not being used, or it needs improvements.	2																
		Some initiatives have been taken to introduce certification.	1				1				1	1				1			
		There is no mechanism.	0	0				0	0				0	0	0		0	0
	SUBTOTAL			4	-	-	1	2	0	-	9	8	6	5	4	9	5	0

Table 8.13: Results of trade and marketing assessment of *Cuminum* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Quantity and quality of the information about the existing market	Sufficient/ reliable	3		does not grow	does not grow				does not grow			3					
		Inadequate/ imprecise	2	2				2	2			2		2			2	
		Is being developed	1				1				1				1	1		
		Non-existent/ unreliable	0															0
2	Potential market demand	High	3	3			3		3				3	3	3		3	
		Moderate	2					2			2	2				2		2

		Mild	1															
		Limited	0															
3	Scale of production	High	3	3														
		Moderate	2									2	2	2		2	2	
		Mild	1				1	1	1		1				1			1
		Low	0															
4	Experience of the product in the market	Already on the market	3	3											3		3	
		In development	2						2		2	2	2	2				
		There are opportunities to be on the market	1				1	1								1		1
		No development currently taking place	0															
5	Competition (as a threat to maintaining the market place)	Weak	3									3			3			3
		Mild	2	2				2			2		2	2		2		
		Moderate	1				1		1									
		Strong	0														0	
6	Evaluation of financial feasibility (analysis of economic viability of investment)	Good profitability	3					3				3				3	3	
		Moderate profitability	2	2					2		2		2	2				
		Mild profitability	1				1								1			
		Low profitability	0															0

7	Quality of production	Good	3															
		Moderate	2	2				2			2	2	2					
		Mild	1				1		1							1	1	
		Low	0											0	0			0
8	Potential for certification in the market	High	3								3					3	3	
		Moderate	2				2	2	2			2		2	2			
		Mild	1	1									1					1
		Low	0															
	SUBTOTAL			18			11	15	14		15	18	17	15	14	15	17	8

Table 8.14: Results of socioeconomic assessment of *Cuminum* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Potential for generation of employment	High	3		does not grow	does not grow				does not grow		3				3	3	
		Moderate	2	2					2		2		2					
		Mild	1					1						1	1			1
		Low	0				0											
2	Suitability of production for the livelihood of the communities (Natural Capital)	High	3															
		Moderate	2	2							2	2	2			2	2	2
		Mild	1					1	1					1	1			
		Low	0				0											
3	Suitability of production for alternative livelihood of the communities	High	3									3						
		Moderate	2										2					
		Mild	1				1	1	1		1			1	1	1		1
		Low	0	0													0	
4	Suitability of production for local communities or small entrepreneurs	Very suitable	3									3					3	
		Moderately suitable	2	2			2		2				2	2	2	2		
		Mildly suitable	1															1
		Unsuitable	0					0			0							

5	Experience of local communities with the product	Considerable	3	3								3					3	
		Moderate	2				2				2		2	2	2			
		Mild	1					1	1									1
		Little	0													0		
6	Additional benefits to small businesses	Many	3										3			3		
		Moderate	2	2								2			2		2	
		Mild	1				1	1	1		1			1				1
		Few	0															
7	SUBTOTAL			11	-	-	6	5	8	-	8	16	13	8	9	11	13	7

Table 8.15: Results of technological proficiencies assessment of *Cuminum* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abilities and skills	High	3		does not grow	does not grow				does not grow								
		Moderate	2															
		Mild	1	1				1	1		1	1				1	1	
		Low	0				0						0	0	0			0
2	Human resources	Available	3															

		Moderate	2				2	2						2	2	2		
		Mild	1	1					1		1	1	1				1	1
		Limited	0															
3	Technological requirements for improving processes	Low	3															
		Mild	2				2	2	2			2		2	2	2		2
		Moderate	1	1							1		1				1	
		High	0															
4	State of infrastructure	High	3															
		Moderate	2					2									2	
		Mild	1	1			1					1			1	1		
		Low	0						0		0		0	0				0
5	Quality control requirements	Low	3						3									
		Mild	2					2			2	2			2	2		
		Moderate	1	1			1						1	1			1	1
		High	0															
6	Availability of technical support	Available	3															
		Moderate	2	2													2	
		Mild	1				1	1			1							
		Limited	0						0			0	0	0	0	0		0
	SUBTOTAL			**7**	**-**	**-**	**7**	**10**	**7**	**-**	**6**	**7**	**3**	**5**	**7**	**8**	**8**	**4**

	Grand Total			**40**	**-**	**-**	**25**	**32**	**29**	**-**	**38**	**49**	**39**	**33**	**34**	**43**	**43**	**19**
	Ranks			**4**	**-**	**-**	**11**	**9**	**10**	**-**	**6**	**1**	**5**	**8**	**7**	**2**	**3**	**12**

Table 8.16: Results of resource assessment of *Ferula* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abundance and state of conservation of the species	Abundant of conservation	3		does not grow	does not grow			does not grow	does not grow					does not grow			
		Sufficient/uncertain state of conservation	2													2	2	
		Some initiatives are under development to improve conservation	1									1						1
		Under threat	0	0			0	0			0		0	0				
2	Potential for sustainable management	High	3															
		Moderate	2													2		
		Mild	1	1			1	1			1	1		1			1	
		Low	0										0					0

3	Impact of harvesting for production on the species and its habitats	Positive	3																
		Neutral	2															2	
		Negative	1									1		1					1
		Critical	0	0			0	0			0		0			0			
4	There are guidelines for the implementation of good collection practices	Guidelines exist and they are being used.	3																
		Guidelines exist, but they need improving.	2	2			2	2				2	2	2		2	2	2
		Development of guideline is under process	1								1								
		No guidelines exist	0																
5	Availability of a suitable environmental or any other certification mechanism	There is a mechanism and it is being used.	3																
		There is a mechanism, but it is not being used, or it needs improvements.	2																
		Some initiatives have been taken to introduce certification.	1				1				1	1							
		There is no mechanism.	0	0				0					0	0		1	0	0
	SUBTOTAL		-	3	-	-	4	3	-	-	3	6	2	4	-	7	7	4

Table 8.17: Results of trade and marketing assessment of *Ferula* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Quantity and quality of the information about the existing market	Sufficient/ reliable	3		does not grow	does not grow			does not grow	does not grow					does not grow			
		Inadequate/ imprecise	2								2	2				2	2	
		Is being developed	1					1					1					
		Non-existent/ unreliable	0	0			0							0				0
2	Potential market demand	High	3										3				3	
		Moderate	2									2				2		
		Mild	1	1			1	1			1			1				1
		Limited	0															
3	Scale of production	High	3															
		Moderate	2								2							

		Mild	1				1	1				1	1			1	1	1
		Low	0	0										0				
4	Experience of the product in the market	Already on the market	3															
		In development	2					2									2	
		There are opportunities to be on the market	1				1				1	1				1		1
		No development currently taking place	0	0									0	0				
5	Competition (as a threat to maintaining the market place)	Weak	3	3								3						3
		Mild	2					2			2					2		
		Moderate	1										1				1	
		Strong	0				0							0				
6	Evaluation of financial feasibility (analysis of economic viability of investment)	Good profitability	3									3						
		Moderate profitability	2	2				2								2	2	
		Mild profitability	1								1							

		Low profitability	0				0						0	0				0
7	Quality of production	Good	3															
		Moderate	2					2			2	2						
		Mild	1				1									1		1
		Low	0	0									0	0			0	
8	Potential for certification in the market	High	3															
		Moderate	2				2				2	2				2	2	
		Mild	1	1				1										1
		Low	0										0	0				
	SUBTOTAL		48	7	-	-	6	12	-	-	13	16	6	1	-	13	13	8

Table 8.18: Results of socioeconomic assessment of *Ferula* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Potential for generation of employment	High	3	3	does not grow	does not grow		3	does not grow	does not grow					does not grow	1		3
		Moderate	2				2					2	2	2			2	
		Mild	1								1							
		Low	0															
2	Suitability of production for the livelihood of the communities (Natural Capital)	High	3	3									3	3				
		Moderate	2				2				2					2		
		Mild	1					1				1					1	1
		Low	0															
3	Suitability of production for alternative livelihood of the communities	High	3										3					
		Moderate	2	2							2	2		2				
		Mild	1				1	1								1	1	1
		Low	0															
4		Very suitable	3									3						

	Suitability of production for local communities or small entrepreneur	Moderately suitable	2				2						2	2				2
		Mildly suitable	1	1				1								1	1	
		Unsuitable	0								0							
5	Experience of local communities with the product	Considerable	3															
		Moderate	2				2				2			2		2		
		Mild	1	1								1	1				1	1
		Little	0					0										
6	Additional benefits to small businesses	Many	3										3					
		Moderate	2				2				2	2		2				
		Mild	1	1				1								1	1	1
		Few	0															
	SUBTOTAL			11	-	-	11	7	-	-	9	11	14	13	-	8	7	9

Table 8.19: Results of technological proficiencies assessment of *Ferula* sp.

#	Criteria	Scale	Score	District														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Abilities and skills	High	3		does not grow	does not grow			does not grow	does not grow					does not grow			
		Moderate	2															
		Mild	1	1				1								1	1	1
		Low	0				0				0	0	0	0				
2	Human resources	Available	3															
		Moderate	2															
		Mild	1					1			1	1	1	1		1	1	
		Limited	0	0			0											0
3	Technological requirements for improving processes	Low	3														3	
		Mild	2	2			2	2										
		Moderate	1								1	1	1	1		1		1
		High	0															
4	State of infrastructure	High	3															

		Moderate	2															
		Mild	1				1	1			1	1				1	1	1
		Low	0	0									0	0				
5	Quality control requirements	Low	3															
		Mild	2								2	2						
		Moderate	1				1									1	1	1
		High	0	0				0					0	0				
6	Availability of technical support	Available	3															
		Moderate	2				2				2						2	
		Mild	1															
		Limited	0	0				0				0	0	0		0		0
	SUBTOTAL			**3**	**-**	**-**	**6**	**5**	**-**	**-**	**7**	**5**	**2**	**2**	**-**	**5**	**9**	**4**
	Grand Total			**24**	**-**	**-**	**27**	**27**	**-**	**-**	**32**	**38**	**24**	**20**	**-**	**33**	**36**	**25**
	Ranks			**9**	**-**	**-**	**6**	**5**	**-**	**-**	**4**	**1**	**8**	**10**	**-**	**1**	**2**	**7**

ERKLÄRUNG

Ich versichere, dass ich meine Dissertation

„Sustainable Resource Management of Medicinal and Aromatic Plants of Afghanistan“

selbständig ohne unerlaubte Hilfe angefertigt und mich dabei keiner anderen als der von mir ausdrücklich bezeichneten Quellen bedient habe. Alle vollständig oder sinngemäß übernommenen Zitate sind als solche gekennzeichnet.

Die Dissertation wurde in der jetzigen oder einer ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg, den 24.07.2019

Mohammad Osman Babury

(Unterschrift mit Vor- und Zuname)

Curriculum Vitae

This part has been deleted from the electronic version.