Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

Natural Resources: Case Study of North Africa

Author: **Ali Elbouz**

Supervisor**: prof. Ing. Mansoor Maitah, Ph.D. et Ph.D.**

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Ali Elbouz

Economics Policy and Administration
Business Administration

Thesis title

Natural resources in North Africa

Objectives of thesis

This thesis portrays Africa's natural resources in two parts theoretical and practical, mentioning different types of natural resources and their available reserve. describing the effect on economy.

Methodology

Comparative and descriptive methods are used in the thesis focusing on renewable and non-renewable resources in africa, analyzing the magnitude of the minerals, especially main important ones as soil, timber and natural gas

The proposed extent of the thesis

35 – 40 pages

Keywords

Africa, natural resources, minerals

Recommended information sources

Mansoor MAITAH, MACROECONOMICS Issues and Exercises. 2017, ČZU, Praha, ISBN 9788021327481
M.Malloch Brown, N. Desai, G. Doucet, Energy and the challenge of sustainability. 2003, NY 10017, ISBN 9211261260
Roger Perman, Yue Ma, James McGrilvary, Michael Common, Natural Resource and Environmental Economics. 3rd edition, 2003. ISBN 0273655590

Expected date of thesis defence

2020/21 SS – FEM

The Bachelor Thesis Supervisor

prof. Ing. Mansoor Maitah, Ph.D. et Ph.D.

Supervising department

Department of Economics

Electronic approval: 27. 1. 2021

prof. Ing. Miroslav Svatoš, CSc.

Head of department

Electronic approval: 2. 2. 2021

Ing. Martin Pelikán, Ph.D.

Dean

Prague on 03. 03. 2022

Declaration

I declare that I have worked on my bachelor thesis titled "Natural resources: Case Study of North Africa" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 3rd of March 2022

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Ali Elbouz

Acknowledgement

I would like to thank and appreciate prof. Ing. Mansoor Maitah, Ph.D. et Ph.D., for the guidance and encouragement in finishing this thesis. Faculty of Economics and Management, for the instructions and guidance through the period of my work on this thesis.

Natural Resources: Case Study of North Africa

Abstract

Natural resources are dispersed throughout North Africa. This thesis describes the many forms of natural resources and discusses the economic impact of natural resources in emerging and developed countries, as well as the impact of oil countries on the region. The consequences and aspects of natural resources in North Africa will be highlighted in this case study.

First, a quick survey of natural resource literature. Its definition, characteristics, and the types of natural resources that are extracted in a sustainable manner are all discussed. In addition, the first section will discuss the many forms of natural resource categorizations and criteria used around the world. Natural resource scarcity, depletion, and sustainability are all highlighted. Examples of natural resource classifications from throughout the world will be included in this section.

The function of natural resources in North Africa will be the focus of the practical section. Describes the economic impact of North Africa's developing and developed countries. Economic indicators are used to show information on natural resource production and consumption in North Africa. Following that, highlighting the issues that North Africa faces as a region. Finally, a summary of natural resource impacts across the region.

Keywords: Africa, Soil, Timber, Natural gas

Přírodní zdroje: Případová studie severní Afriky

Abstrakt

Přírodní zdroje jsou rozptýleny po celé severní Africe. Tato práce popisuje mnoho forem přírodních zdrojů a diskutuje o ekonomickém dopadu přírodních zdrojů v rozvíjejících se a rozvinutých zemích, jakož i dopadu ropných zemí v regionu. Důsledky a aspekty přírodních zdrojů v severní Africe budou zdůrazněny v této případové studii.

Za prvé, rychlý průzkum literatury přírodních zdrojů. Jeho definice, charakteristika a typy přírodních zdrojů, které jsou extrahovány udržitelným způsobem, jsou diskutovány. Kromě toho bude první část diskutovat o mnoha formách kategorií přírodních zdrojů a kritérií používaných po celém světě. Všechny zvýrazněné nedostatky přírodního zdroje, vyčerpání a udržitelnost. Příklady klasifikací přírodních zdrojů z celého světa budou zahrnuty do této sekce.

Funkce přírodních zdrojů v severní Africe bude zaměřením praktické sekce. Popisuje ekonomický dopad rozvojových a rozvinutých zemí severní Afriky. Ekonomické ukazatele slouží k zobrazení informací o produkci přírodních zdrojů a spotřeby v severní Africe. Následovat, zdůraznit otázky, které Severní Afrika čelí jako oblast bohatá na zdroje. Konečně, souhrn dopadů přírodních zdrojů v celém regionu.

Klíčová slova: afrika, půda, dřevo, zemní plyn.

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1 Introduction

Humans have been consuming the planet's resources since the beginning of time. Human people learnt how to grow more necessary natural resources from the surrounding environment and biosphere with the appearance of earliest civilizations. Throughout history, natural resources have been the essence and driving force behind human activity. On the one hand, kingdoms and civilizations grew out of a shared desire for natural resources. Wars and treaties, on the other hand, are used to acquire and defend natural resources.

This thesis begins by concluding the definitions and classifications of natural resources. This contains the various sorts of natural resources as well as some of their drawbacks. In summary, the first part demonstrates the importance of natural resources to humans, other living organisms, and the ecosystem. Natural environmental resources are resources that humans do not mess with, yet they are influenced and affected by them due to their vital value and human need on them.

Finally, there's North Africa an area recognized for its oil and natural gas. When discovered, there is an abundance of resources and a rapidly rising economy. For example, in the early twentieth century, Libya and Algeria were the first to discover oil. Later in the century, neighboring countries such as Egypt and Tunisia began exploring oil reserves. As a result, economies began to prosper, and labor demand decreased, resulting in a fall in employment. Furthermore, the North African area has problems that will be covered in the practical section, including the fact that achieving a sustainable economy may be a difficult path for several countries and subregions.

2 Objectives and Methodology

2.1 Objectives

This thesis portrays Africa's natural resources in two parts theoretical and practical, mentioning different types of natural resources and their available reserve. describing the effect on economy.

2.2 Methodology

Comparative and descriptive methods are used in the thesis focusing on renewable and non-renewable resources in Africa, analyzing the magnitude of the minerals, especially main important ones as soil, timber, and natural gas.

3 Literature Review

3.1 Natural Resources

Natural resources are the kind of resources that occur in nature without any action of humankind, that exists everywhere on our planet and some we use on our daily basis. Anything that comes from nature; that could be used to fill human’s needs are considered to be a natural resource. Natural resources are fundamental for the economy and well-being, provide raw materials that society needs in daily activities. Many consequences affecting future generations environmentally, economically, and socially, in individual countries or regions depending on the related products and the consumption processes of the material.

Despite the Simplicity of the meaning of the word ‘’ Natural resources ‘’, a resource that has occurred or created without human intervention. For instance, Agricultural goods cannot be considered as natural resources, although through the process of production, the goods need land and water to grow and produce. Furthermore, Forestry products and Fish, not considered Natural resources these products can be cultivated from nature and can be produced & Harvested in Farms managed by humans, using other resources like Oxygen, water, land, and food. Hard Statistically to be clear how are the population of Fish in the world and its varieties to be shown in a standard deviation, which makes it harder to consider it as a ‘’ Natural resource ‘’.

Furthermore, Air is a natural resource, it can be used freely by breathing, is available anywhere does not get through any procedure to be extracted or used, but it’s possible to be treated as a commodity for trading, although it does not have an economic impact on the market. Safe and sustainable use of natural resources and materials from an environmental perspective is important for the economy, as well as from the viewpoint of economics and trade. It is vital to ensure that Sufficient availability of materials for economic operations, management of the environment Impacts of extraction, refining, transport, use and disposal of them, preservation of vital environmental resources.

(OECD, 2007a)**,**(World Trade Organization, 2010)

3.2 Classifications of Natural resources

By the time, Natural resources showed a huge growth of economies and importance for societies, where people need certain types of resources in their daily life activities. Like water, gas, and energy. The usage of natural resources amounts, quantities should be strictly managed, as overuse can cause depleting of the resources.

Many different factors classify a natural resource, these factors, source of origin, the state of development, and the renewability of the resource. Although, depends on the way of extraction and the processes it goes through to be ready for trading. Some resources come from living and organic material, some recourses come from non-living and non-organic materials. Also, Natural resource could be categorized based on their stage of development, technology has a huge role in this step categorizing a resource and developing it. A resource’s renewability is so important to Discriminate it.

3.2.1 Renewable and Nonrenewable Resources

This category describes the two different types of natural resources depending on their time of replenishment.

- **Renewable resources** are resources that can be renewed and regenerated, available continuously and human consumption does not affect their quantity.

    - Solar energy
    - Biomass (animals, plants…).
    - Wind

    - Water
    - Geothermal

- **Non-renewable resources** are resources that are limited in quantity, do not have the ability to replenish after exploitation unless by natural cycle could help to renew, and that would take million years compared to human scale (e.g., Fossil fuels).

    - Nuclear energy
    - Oil
    - Natural gas
    - Minerals (iron, copper…)

Within this classification a subdivision should be mentioned, Inexhaustibility resource at which a resource being exploited to offer an infinite supply to cover societies demands, however,

the quantity used has to be less than the quantity reserved (exploitation rate has to be lower than replenishment rate), although the resource can get overexploited, that could turn an inexhaustibility resource into exhaustibility resource.

3.2.2 Biotic and Abiotic Classification

Environmental researchers have divided natural resources into two specific kinds. That explains their difference in their structures.

- **Biotic resources** come from living and organic material, including living organisms such as Animals, Plants, and Bacteria. Besides, Fossil fuels are biotic resources such as Coal, Petroleum which was formed from organic matter that has decayed a long time ago.
- **Abiotic resources** come from non-living and non-organic material, including non-living organisms such as Land, Water, Radioactive minerals, Wind, and Minerals (gold, silver, copper, etc.).

3.2.3 Types of resources development

In this category, listed four types of forms each of them, explains the situation of each resource, describes the way of use, Extraction duration, and tracks the resource's development stage.

- **Potential resources** are resources that exist in a region, can be used in the future. For instance, if a country has a big number of sedimentary rocks that have petroleum inside, located beneath the earth's surface would take (long) time to drill out of rocks so it can be used.

- **Actual resources** are resources that have been observed, their quantity and quality have been decided and they are being used in the present time.

- **Reserve resources** are parts of the actual resources, that have been already discovered and valued but can be developed profitably in the future. (e.g.) The USA has a massive amount of oil and gas in reserves and instead of relying on it, the USA imports oil and gas to keep the reserve amount for future use.[1]

- **Stock resources** are resources that have been discovered and observed but cannot be utilized due to the lack of technology. [2]

3.3 Water Resources

One of the most important and valuable subsentences on earth, water's origin dates to many million years. One of the fundamental resources that human beings have been gifted by mother nature. We use it daily for drinking, cooking, cleaning, agricultural activities, transportation, and food. And there are many sources for water, like Stored water resources building a dam to save water from rains, floats and generating electricity to provide some source of energy. Groundwater resources are found beneath the Earth's surface.

The Earth has Ninety-seven percent of water, about 1,386 billion cubic kilometers of water. It is separated into 4 categories.

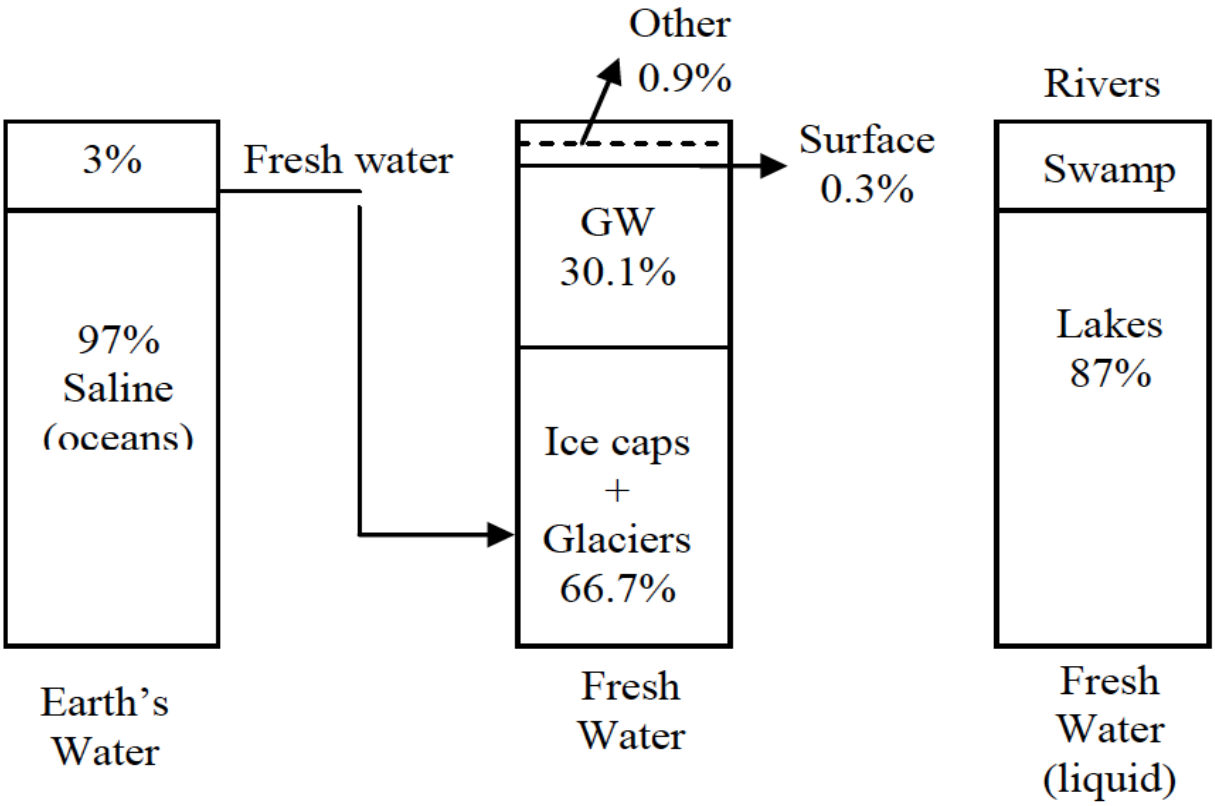
Oceans & seas, which is about 96.5% of the total of the water on earth containing salt, approximately 1370 million cubic kilometers of water with a reproduction rate of 452 cubic kilometers per year. Ice caps & Glaciers represent 1.74% of the earth's water which is about 24 million cubic kilometers, with a reproduction rate of 3 cubic kilometers per year and if it is compared to the distribution of freshwater alone it would represent almost 66.7% of the freshwater available on earth. Groundwater has about 1,74% of the total water on earth, which is about 60 million cubic kilometers of water, at a reproduction rate of 12 cubic kilometers per year. Rivers & Lakes & Swamps have a small amount that is 0.2812 million cubic kilometers of water,

[1] https://www.eia.gov/naturalgas/crudeoilreserves/

[2] https://courses.lumenlearning.com/boundless-economics/chapter/introduction-to-natural-resource-economics/#:~:text=Key%20Points-,Natural%20resource%20economics%20focuses%20on%20the%20supply%2C%20demand%2C%20and%20allocation,on%20their%20stage%20of%20development. (Suarez & Tsutsui, 2004)

which's equivalent to 0,0132% and with a reproduction rate of 39 cubic kilometers per year. Earth's surface is 71% covered by water.

Figure 1: Distribution of water



Source: (A. Balasubramanian, 2015)

Water is a scarce natural resource that services about 7.8 billion human beings on earth as was estimated in January 2021 by (Worldmeters). Not only serving human needs like drinking, bathing, cooking, transporting, and providing food. But also, globally Water has a huge impact on Agricultural systems as it provides services for the system's needs of irrigation to be sufficiently able to go through procedures of production. Although, Water services the Ecosystem by the maintenance of wetland, support of wildlife. [3](Suarez & Tsutsui, 2004)

Water for irrigation, there are three main ways of irrigation systems, but of course, it depends on the location of the land and if there is a good supply of water available to decide

[3] https://www.worldometers.info/world-population/#:~:text=The%20current%20world%20population%20is,currently%20living

which system is more applicable. Climate plays a big role in whether the crop's growing conditions are matching the region's condition. To be clear which one is a better more suitable system of these; (surface, overhead, drip). [4]

Also, one of the most important things about Water is how to use it for beneficiary purposes for farming use or domestic use, or industrial use, then it should be managed in a way that satisfies Society equally without affecting the Environment. A reason why Government's issue policies and rules for the permanently sustainable use of water proportions depending on the significant statistical results and the way of distribution. Valuing the water at a price per cubic meter, that's the next step after realizing the amount of supply and trying to modify the amount of demand to make it reduce with a provision for covering other needs for societies. (Kay et al., 2002)

3.4 Energy resources

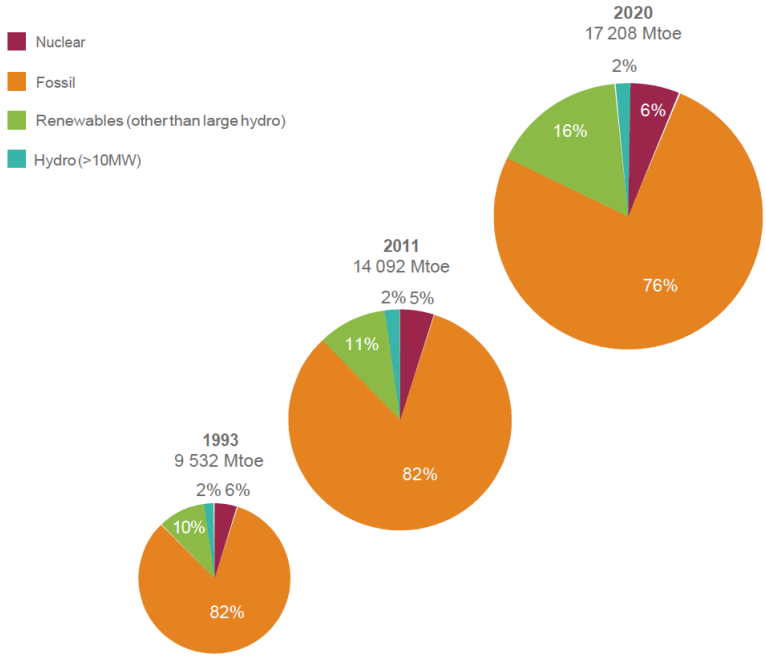
Energy is separated into two types of resources, which are renewable and non-renewable energies. Energy is essential for everyday activities. Renewable energy is the use of natural resources to generate clean energy, even some types of renewable energy resources might be considered polluting the earth but less compared to nonrenewable energy resources pollution it causes. Also, renewable energy could be considered as an inexhaustible resource, as it replenishes constantly in a short human timescale although some resources require time and weather. Now there are innovative and less expensive ways to capture and retain wind and solar energy for example.

On the other side, there are nonrenewable energy resources, there is nuclear energy generated from the splitting of uranium atoms this process is called fission, which generates heat to produce steam that passes through turbines to generate electricity. Also, there is another source of energy that has been known for a long time ago, fossil fuels, such as oil, gas, and coal. These kinds of energy resources cannot replenish again or do not replenish at a reasonable rate of human timescale. As proof that this kind of resource can cause air pollution, earthquakes caused by the exploitation of resources, and fracking inside the earth's layer beneath the surface to

[4] https://www.farmersweekly.co.za/farm-basics/how-to-crop/main-types-irrigation/

exploit natural gas debatably causes water pollution, these activities contribute to global warming.[5]

Figure 2: Total Primary Energy Supply by resource 1993, 2011 and 2020



Source: (World Energy Council, 2013)

In figure 2 above, estimation of how by the time the world is shifting to depend on renewable energies little by little, as it is estimated that the reserves of non-renewable energy resources would run out sometime between 2050 and 2150 that's due to the high rate of consumption that is more than that of newly discovered resources. Coal reserves are estimated to last for about 300 years if the consequences of pollution are managed well.[6]

3.4.1 Fossil fuels

The resource that has been created millions of years ago, due to the remains of plants and animals that were buried a long time ago, having a high carbon content. Crude oil is a liquid fossil fuel mostly made up of hydrocarbons, found deep under the earth's surface, extracted, and

[5] https://www.nrdc.org/stories/renewable-energy-clean-facts
[6] https://www.tulane.edu/~sanelson/eens1110/energy.htm

transported for supplies to consumers. [7]Used as a transportation fuel, gasoline, and diesel for vehicles and jet fuel for aeroplanes, it is used also for electricity generators and heating.

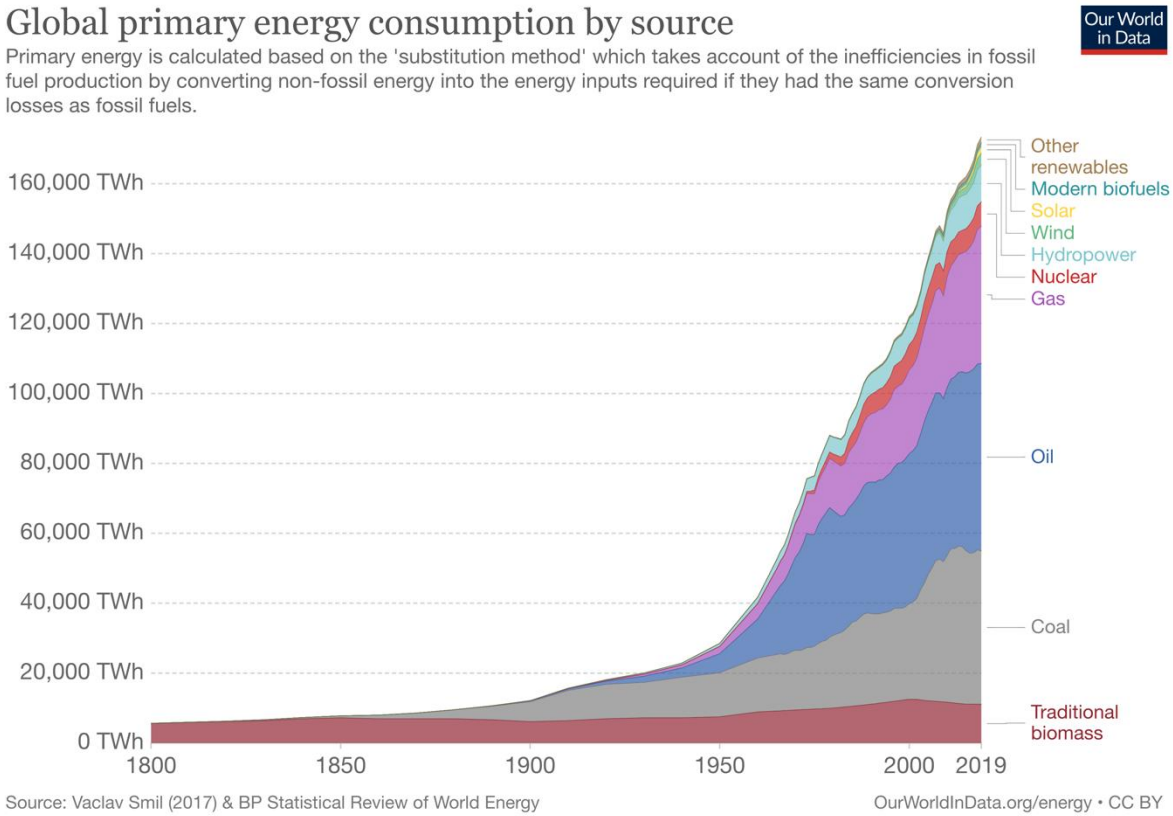
Natural gas found in two conditions, whether it is found underground on land or in the sea, Conventional natural gas is to extract it traditionally and unconventional natural gas can be hard and cost a lot of money to extract with a probability to find a deposit of crude oil in the same area. It is used in households through pipelines for heating, cooking and generating electricity, and propelling vehicles. Coal extracted from underground, used since long time ago in heating, cooking, propelling trains, generating electricity, etc. It is a resource that causes pollution to the environment. [8]

Developed countries almost use the highest consumption of energy compared to the consumption of developing countries, some developing countries have energy insecurity due to the lack of energy production and the reason can be a small amount of production whereby cannot satisfy the countries need for energy and which leads to solutions such as importing. Countries like Russia and Canada, having a high rate of energy production with a surplus, can sell their surplus to demanding neighboring countries or keep it as a reserve. There is a connection between GDP and energy consumption. [9]

[7] https://www.nrdc.org/stories/fossil-fuels-dirty-facts#:~:text=clean%20energy%20future.-,What%20Are%20Fossil%20Fuels%3F,have%20a%20high%20carbon%20content.
[8] https://www.nrdc.org/stories/fossil-fuels-dirty-facts#:~:text=clean%20energy%20future.-,What%20Are%20Fossil%20Fuels%3F,have%20a%20high%20carbon%20content.
[9] https://www.bbc.co.uk/bitesize/guides/z3pppv4/revision/2

In Figure 3, the Consumption results of Fossil fuels; Oil, Natural gas, and Coal represented 78.89% of all the energy consumed in the year 2019.

Figure 3: Global Primary Energy consumption by source



Source: https://ourworldindata.org/energy-production-consumption

3.4.2 Hydropower

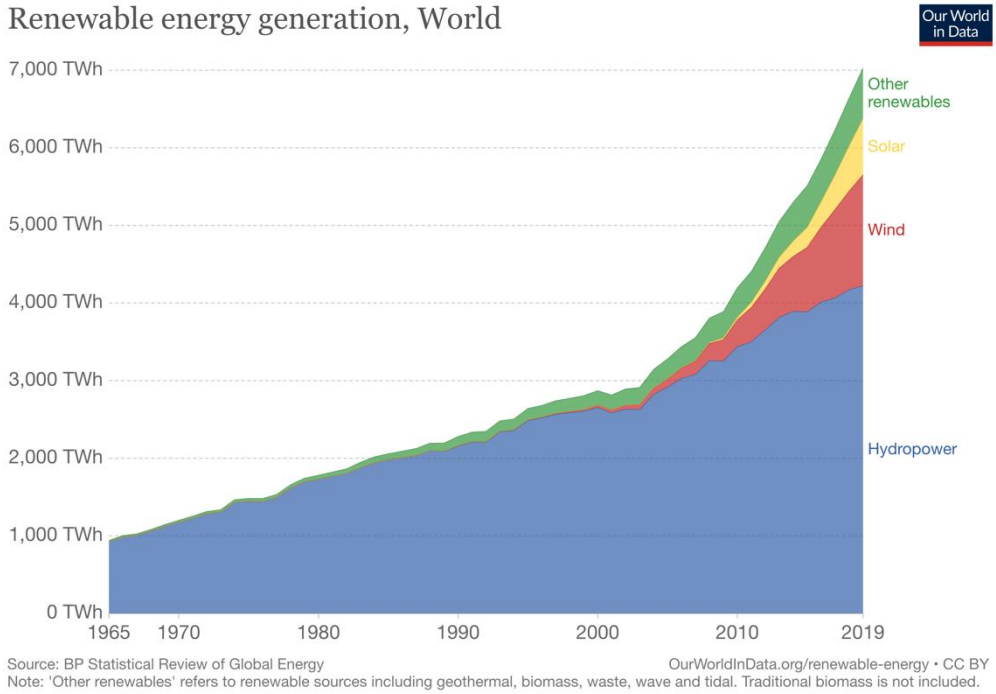
Hydropower is renewable energy, is considered as one of the renewable energy sources which provide production of clean energy, using water to generate electricity through the power of water flowing from a reservoir located at a higher elevation to a reservoir at a lower elevation, although there are many ways to produce electricity by the movement of water. It is covering a small percentage which is about 6.03% of the energy consumed globally in 2019 as mentioned above in figure 3.

Run of river hydropower relies on the power of flowing water through electromechanical turbines helping the turbines to spin and generate electricity. Storage hydropower requires creating a large dam blocking the pass of water in a river or storing a reservoir for a long time for

controlling and managing water reservoir and generating electricity from water flows through the electromechanical turbines.

For hydropower to be successful, it should cover the economy's need for energy at a certain point to help the country's energy security case. To approach this target considering main factors, location is particularly important, geology to study and understand the potential of the land as reservoirs or basins should be lands that is not soft and can absorb the water to the underground and the hydrology, is important as the study of water's movement and its conditions, deciding whether or not a particular region could be suitable for constructing a hydropower plant. Unlike non-renewable energy sources which caused massive impacts, when focusing on the consequences of the environment due to the air pollution of using them and the wastes of producing them. (GiZ, 2014)

Figure 4: World renewable energy generation 2019



Source: https://ourworldindata.org/renewable-energy

Figure 4 globally shows the amount of energy generated by renewable energies, with hydropower generating around 4,222.21 of terawatt-hours in 2019.

3.4.3 Solar and wind energy

In the ancient world, many ancient cultures esteemed the sun as the most powerful element in their world, not only for worshiping the god of Ra (God of the sun) in ancient Egypt but also for building their houses and temples in positions with the sun that can absorb the heat for the longest periods possible. Moreover, the wind was a source of power for sailing boats, windmills, and wind turbines in the 18th century in the USA[10]. The pollution non-renewable energy causing to the global environment, showing the necessity of acknowledging the importance of renewable energy and the positive sides of using it.

Solar energy is a way from a solar panel material absorbing the sunlight to generate electricity. Nevertheless, Solar energy plants require suitable locations having the potential amount of sunlight like the sub-Saharan desert in Africa to help generate a large amount of electricity. However, wind energy is renewable energy that is depending on the movement of wind, considered to be useful for rural regions far from cities as the generating capacity of wind turbines is not easily predictable[11].

As technology is developing each year, solar energy's costs of production are getting cheaper more than the costs of non-renewable energy's production, at the same time the installing, manufacturing, and maintenance require strict managing. Nonetheless, some materials used for production are considered to be limited for future growth. On the other side, the possibility of improving economies. Besides, offering more opportunities in developing countries. The low cost of investment in a sustainable energy source more efficient and with

Figure 6: Installed global renewable energy capacity, Solar

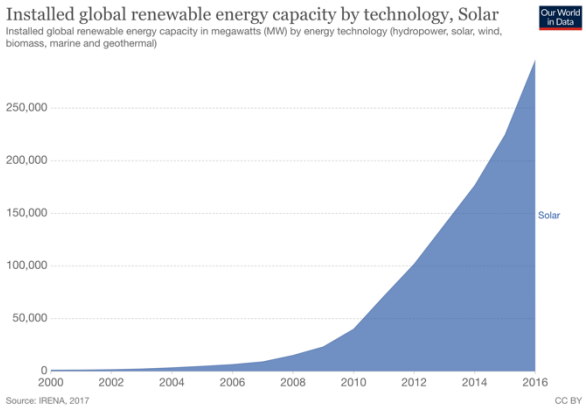
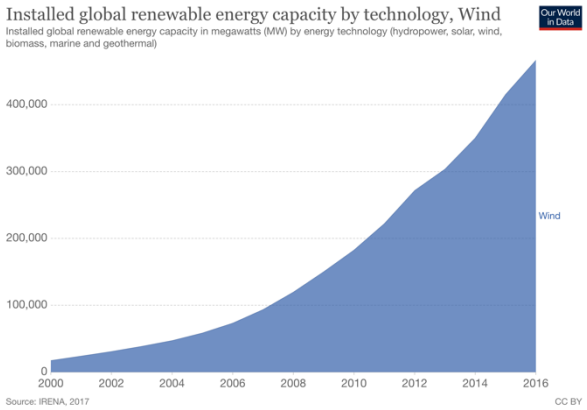


Figure 5: Installed global renewable energy capacity, Wind



Source: https://ourworldindata.org/grapher/installed-global-renewable-energy-capacity-by-technology?time=earliest..latest&country=~Bioenergy[10] https://cleanchoiceenergy.com/news/Ancient_Solar
[11] https://elemental.green/wind-vs-solar-which-power-source-is-better/

fewer carbon emissions and helps secure a percentage for the national security need for energy (Ferroukhi et al., 2016). During the first six months of 2020, solar and wind-generated

about 9.8% of global electricity.[12]In Czechia, an increase in the percentage of solar and wind electricity production from 1.21% to 3.53% (2010-2019).[13]

In figure 5 above, shows the increased percentage of installed energy capacity

of solar from the year 2000 to 2016 was 241.1%.

In figure 6 above, shows the increased percentage of the installed energy capacity of wind from the year 2000 to 2016 was 26.9%.

3.4.4 Nuclear energy

Nuclear energy is considered to be one of the main energy sources which help to reduce carbon emissions, generating a huge amount of electricity. From a chemical element called uranium ore, extracted from the earth in most cases to be found through deep underground shafts or shallow open pits. Then mining and processing nuclear fuels, uranium's radiation affects the element's supply of energy makes one pound of sufficiently concentrated uranium has as much more energy as that of three million pounds of coal.

The process of a nuclear power plant, is the splitting of neutrons collides with uranium atoms, called fission. This split causes a chain reaction within which is controlled with control rods that absorb neutrons. The fission of the uranium atoms releases energy that heats water turning into steam to spin turbines that are linked to generators to produce electricity. There are two types of nuclear reactors used in the USA & Canada, pressurized water reactors and boiling water reactors.[14] The reason why countries could decide to switch to alternative sources of energy instead of non-renewable energy sources is to try to reduce the negative impact of fossil fuels on the environment and climate change, after opening the way for a renewable energy source to gain trust from investors and civilians, seeking for a pollution-free environment.

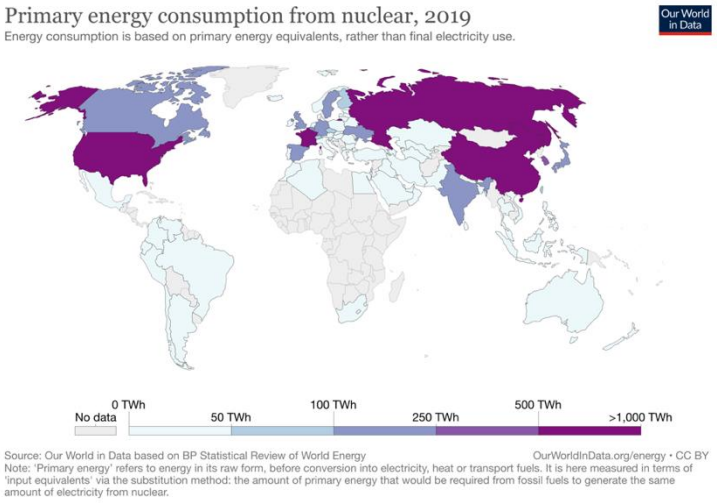
[12] https://www.pv-tech.org/news/solar-and-wind-produce-record-10-of-global-electricity-says-think-tank#:~:text=Solar%20and%20wind%20have%20doubled,a%20new%20report%20has%20said.
[13] https://yearbook.enerdata.net/renewables/wind-solar-share-electricity-production.html
[14] https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html

Nuclear energy's waste is an important matter whether or not, the waste of nuclear power plants is called fuel, when the fuel is expired is called 'spent fuel' containing radiations, thereby storing the waste in large stainless-steel casks and burying it in special locations away from cities and groundwater, preventing any impact on the environment.

There are two types of nuclear waste, whether High-level waste primarily is U element's fuel that is being used in nuclear power reactors, spent fuel cannot be reprocessed again for reuse or low-level waste, the waste of reactors operations, and also from industrial, medical materials, academic and other commercial uses of radioactive materials.[15] (OECD, 2007b)

In the economic aspect, the nuclear energy industry plays an important role in job creation and economic growth, affecting directly all workers in the industry, indirectly other economic activities, and induce the local markets. (Working Group for Sustainable Biomass Unitisation Vision in East Asia, 2008), in the 1950s, was the first establishment of a commercial nuclear power station operation, now about 440 power reactors of nuclear energy from all around the world provide 10% of the world's electricity.[16]The USA's nuclear electricity supplied in 2018 was approximately 807,078 Gigawatt hours that represented 19.3% of all the electricity

Figure 7: Primary energy consumption from Nuclear 2019



Source: https://ourworldindata.org/grapher/installed-global-renewable-energy-capacity-by-technology?time=earliest..latest&country=~Wind

[15] https://www.ucsusa.org/resources/how-nuclear-power-works#:~:text=In%20nuclear%20power%20plants%2C%20neutrons,with%20uranium%20atoms%2C%20splitting%20them.&text=In%20the%20core%20of%20nuclear,connected%20to%20generators%2C%20producing%20electricity.

[16] https://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx#:~:text=Around%2010%25%20of%20the%20world's,from%202563%20TWh%20in%202018.

generated. Czechia's nuclear electricity supplied from nuclear generation was 28,256 Gigawatt hours, about 34.5% of the country's total electricity generated in 2018.[17]

3.4.5 Biomass energy

Biomass is any (biotic) organic material that comes from living organisms, such as plants and animals. For centuries, people have had been using wood fires for keeping warm in homes and for cooking. This type of energy relies on agricultural waste like rice straw, animal waste, trees, plants, forestry areas, and human waste.

Providing advantages, for instance, can reduce the amount of waste that goes to the landfill, relatively cheap, and the carbon in biomass is an essential part of the earth's carbon cycle. In contrast to biomass, fossil fuel's carbon cannot be exchanged in the carbon cycle, although biomass should be used wisely. Although, some disadvantages should be considered as cutting trees and using land and water to grow crops only for the use of biomass energy.[18]

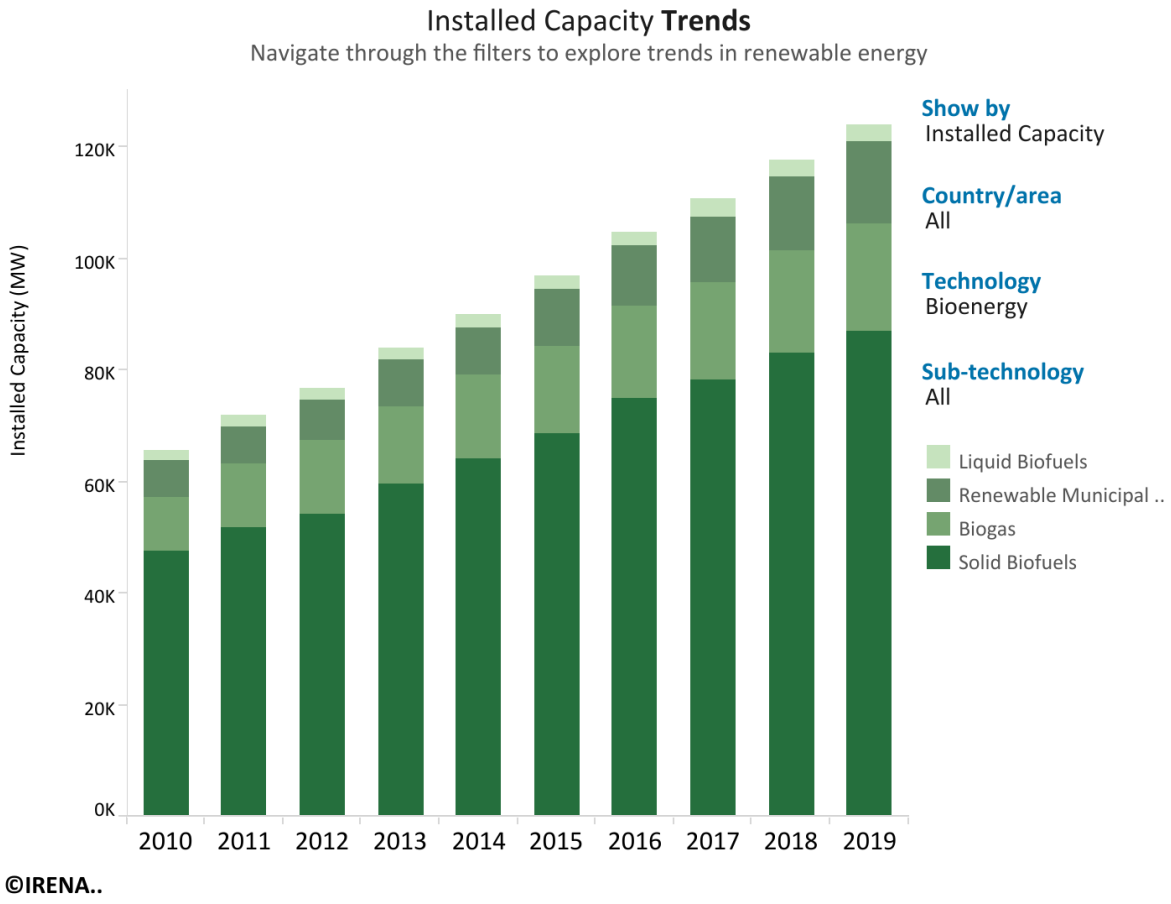
Biomass could be renewable energy and nonrenewable energy depending on the types of biomasses. Biomass feedstock provides three types of energy heat, electricity, and biofuels. There are different types of process, first one burning feedstocks, in (combined heat and power) plants to produce steam that can be used as heating or used to spin turbines to generate electricity, called direct combustion. The second type is biofuel is a fuel that is made from biomass using wheat, corn, and other crops to convert them into liquid fuels like ethanol and methanol. Biofuel does not work as efficiently as gasoline. However, both can be mixed to propel a vehicle.[19]

In the economic aspect, biomass is a cheap source of energy compared to fossil fuels, countries could reduce the amount of money spend on fossil fuels. In contrast to biomass energy, which is labor-intensive, fossil fuels are more capital intensive. The dependence on producing, harvesting and processing biomass fuel can help increase job creation, also creating new local

[17] https://www.nei.org/resources/statistics/top-15-nuclear-generating-countries
[18] https://www.nationalgeographic.org/encyclopedia/biomass-energy/#:~:text=Biomass%20energy%20is%20energy%20generated,heat%20or%20converted%20into%20electricity.
[19] http://lsa.colorado.edu/essence/texts/biomass.html#:~:text=We%20use%20four%20types%20of,%3B%20and%204)%20alcohol%20fuels.&text=biomass%20energy.,-Other%20biomass%20sources

markets opportunities. (Working Group for Sustainable Biomass Unitisation Vision in Esat Asia, 2008) in 2017, bioenergy accounted for all renewable energy supply in Africa around 96%, 59% in the Americas, 65% in Asia, and 59% in Europe. (WBA, 2019)

Figure 8: Global installed capacity of Bioenergy



Source: https://www.irena.org/bioenergy#:~:text=About%20three%2Dquarters%20of%20the,global%20power%20generation%20in%202015.

Figure 8 shows the increase in installed capacity of bioenergy. In 2015, bioenergy globally had contributed 10% of total energy consumption. [20]

20 https://www.irena.org/bioenergy#:~:text=About%20three%2Dquarters%20of%20the,global%20power%20generation%20in%202015.

3.5 Mineral resources

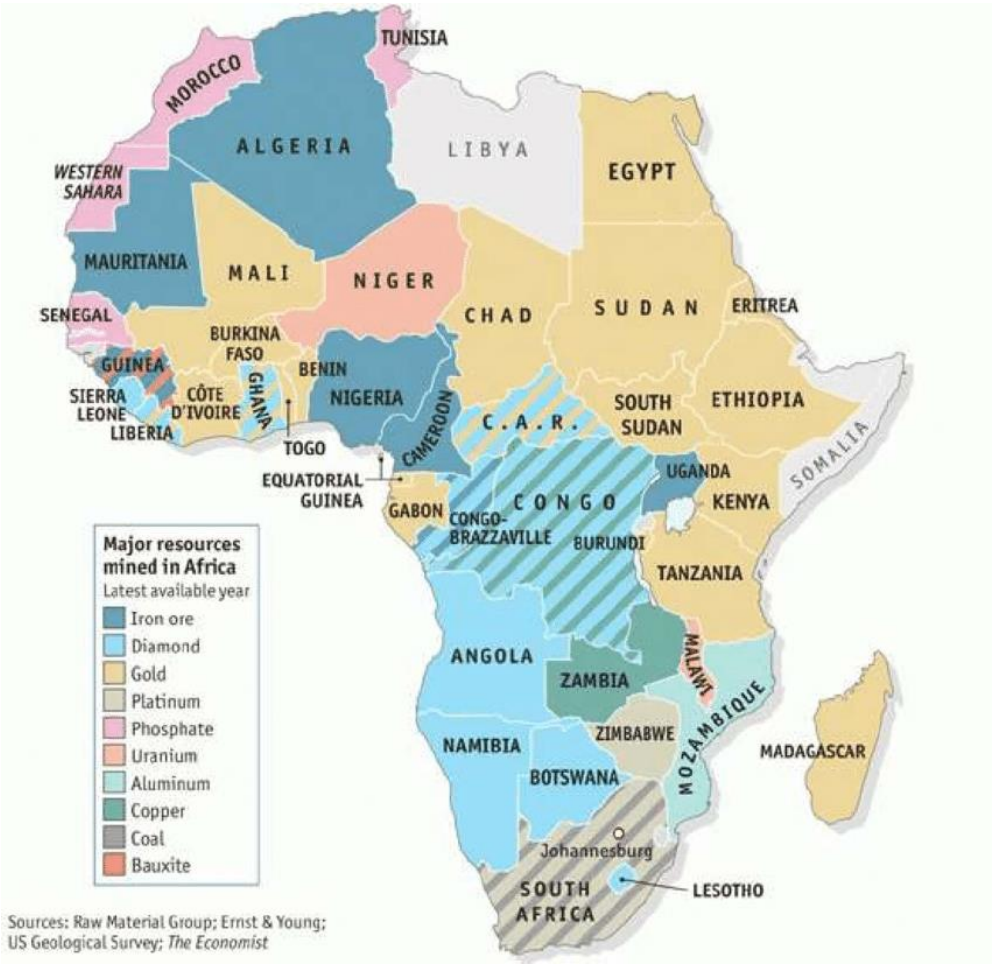
Mineral resources are inorganic substances created by natural geological processes. Minerals can be found under the Earth's crust which is called subsurface mining or on top of the earth's surface that is called surface mining or placer mining or undersea mining, extracting minerals depend on the level of concentration, although it differs from one to the other since economics controls the level of concentration of each substance, which means that some substances may require a high level of concentration to be economically profitable to be mined and some substances may not require these levels of concentration.

This process is called Ore deposit and Ore is a natural rock or sediment that has one or more valuable minerals could be extracted. In addition, the level of concentration of minerals mined could change as a reflect to the economic conditions such as demand for the substance and the cost of extraction.

For an instance, gold prices are different everyday as gold increases in price old unused mines reopen, when the prices decrease gold mines reclose again. Basically, there could be a big number of mines in a particular country, if it is a developed country then the labor cost would be high in comparison with a third world country's labor cost, which would be cheaper obviously. So, the time and location does matter to determine the extraction cost, labor costs, and energy costs.[21]

Figure 9: Major mineral resources mined in Africa 2020

[21] https://www.tulane.edu/~sanelson/eens1110/minresources.htm.



Source: https://www.researchgate.net/figure/Africa-Mineral-Resource-Map_fig1_346971661.

There are many products we as human beings use daily, these products somehow contain or made up of components that are considered as mineral resources. Mobile phones cannot work without resources, while toothpaste contains chalk and silicate, newspaper made of ground limestone. Even kitchen equipment such as plates made of mineral resources processed into stainless steel or ceramics, energy resources like coal, and with the concentration of carbon and hydrogen we get petroleum...etc.[22] Minerals are categorized into 3 classes which are fuel, metallic, and non-metallic. Fuel minerals form nearly 87% of the global mineral production whereas metallic and non-metallic forms around 7%.[23]

[22] https://www.eumicon.com/en/topics/the-role-of-mineral-resources-in-today-s-world/.
[23] https://www.yourarticlelibrary.com/environment/minerals/mineral-resources-definition-types-use-and-exploitation-with-statistics-and-diagram/28169.

- Metallic Mineral:
    - Ferrous: (iron, manganese, titanium, etc.)
    - Non-Ferrous: (copper, bauxite, aluminum, gold, silver, tin, etc.)
- Non-Metallic Mineral:
    - Fuel Mineral: (coal, petroleum, natural gas, etc.)
    - Other non-metallics: (mica, limestone, graphite, etc.)[24]
- Radioactive metals:
    - (Radium, uranium, potassium)[25]

[24] https://ncert.nic.in/textbook/pdf/legy207.pdf.
[25] https://www.geologypage.com/2017/06/top-radioactive-minerals.html.

4 Practical Part

4.1 An overview of North Africa

Africa, the birthplace of humankind, second largest continent on Earth bounded by the Mediterranean Sea, the red sea, the Indian ocean, and the Atlantic Ocean. There are 54 countries in Africa, languages being spoken there can be around 2,000 languages which are more than that of any other continent. Arabic is the language of northern African countries, from Egypt and Sudan in the east to Mauritania in the west with a population of 258 million approximately. Arabic is the official language, however, not the only language being used there as for instance, Amazigh people have their own language with different dialects, depending on where they are. Nubian language, spoken by the Nubians, is used in upper Egypt from Aswan to Darfur also in Sudan.[26]

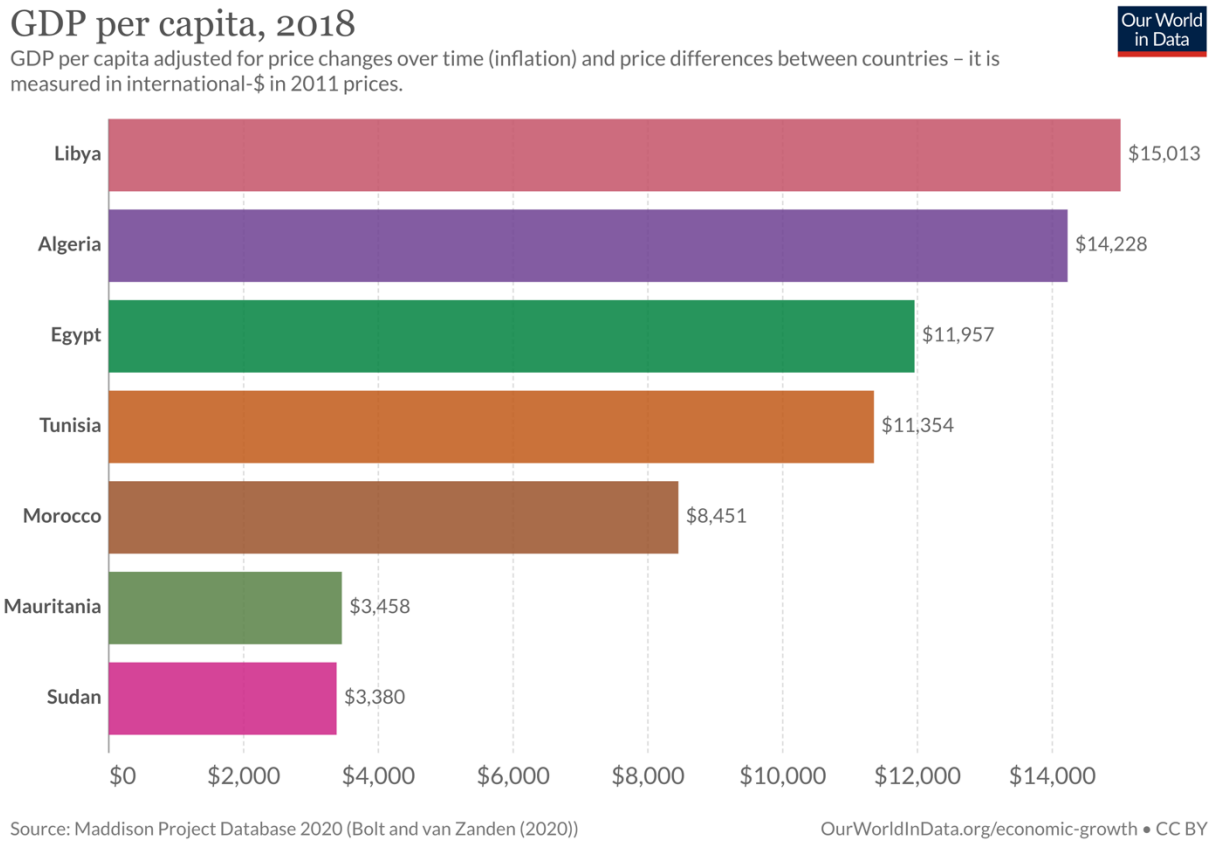
Focusing on, North Africa countries with relation to its natural resources. First and foremost, Northern African Countries are Egypt, Sudan, Libya, Tunisia, Algeria, Morocco, Western Sahara, and Mauritania.[27] Basically, there are many natural resources to be mentioned, all the northern African countries have a coast except for Sudan, mountains, deserts, and water. Although all these countries are recognized to be water rich resources, in Libya, Egypt, and Algeria are considering oil and gas reserves as one of their factors for economic growth. There is a huge potential in this region to expand usage and utilization of natural resources as for instance,

[26] https://www.britannica.com/topic/Eastern-Sudanic-languages.
[27] https://www.britannica.com/place/North-Africa.

Solar energy needs this kind of weather to generate and cover citizens need so it is an optimal solution, but the price of implementation must be figured. [28]

4.1.1 Economical Aspects of North Africa

Figure 10: GDP per capita 2018



Source: https://ourworldindata.org/grapher/gdp-per-capita-maddison-2020?time=2018..latest&country=DZA~EGY~LBY~MAR~SDN~TUN~MRT.

[28] https://www.britannica.com/summary/Africa#:~:text=Africa%2C%20Second%20largest%20continent%20on,almost%20equally%20by%20the%20Equator.&text=Africa%20is%20composed%20largely%20of,plateau%20regions%20in%20the%20interior.

First and foremost, Political situation has an impact on economy, and it is important to take into consideration that it causes economic changeability. Moving to the natural resources and how countries in North Africa are categorized according to their natural resources they have. Among other countries as North African countries known to be a part with the Middle Eastern countries that will be mentioned below.

MENA countries are categorized into three groups according to the three-grouping classification, Arab Republic of Egypt, Jordan, Lebanon, Morocco, and Tunisia are resource-poor labor-abundant (RPLA); Algeria, Islamic Republic of Iran, Iraq, Libya, Syrian Arab Republic, and Republic of Yemen are resource-rich labor-abundant (RRLA); and Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates are resource-rich labor-importing (RRLI). as the Gulf Cooperation Council (GCC) countries are represented in this last group. (Marotta, 2012) The GCC owns over 40% of the world's oil reserves. While Libya's GDP annual growth decreased 12.5% in 2019 and around 26.5% in 2020 due to the political situation in Libya and not to forget the reflection of corruption and bad management.[29] Although, Libya is the 9th largest country of oil reserves in the world, with 48 billion and around 363 million barrels in reserve.[30]

4.2 Role of Natural resources in North Africa.

Africa continues to be a vital part of the global landscape. The continent, which is rich in oil and natural resources, occupies a key position. North African countries are different for many aspects whether it's a resource rich or a resource poor country, the population makes it more complex to compare between countries' income levels. Moreover, the natural resources play an important role in North Africa's region. (Marotta, 2012)

[29] https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=LY.
[30] https://www.worldometers.info/oil/libya-oil/.

MENA countries represent 60% of World's Oil reserves which is undoubtably a huge percent of share. North Africa alone has about 70 billion and 385 million barrels in reserve which is almost 20.5% of Oil's global share.[31] After the discovery of oil in 1859, there was a natural resource race in North Africa. The wave of exploration in North Africa began in 1950s, when the first big oil discovery was made in the Sahara Desert province of North Africa. By way of a Palaeozoic system. Libya was the next country to discover oil reserves in 1959, nevertheless, prospecting began in 1952.[32]

However, North Africa is not only rich of oil and natural gas, but mineral resources also abound It is mostly found in North Africa. Furthermore, the water resources of this region will be described in this section, with a focus on strategic places, potential crises, and hydropower. Looking at the water supply. In addition, the north African's land resources and land use. Showing the activities that take place on the land of the region. Finally, after outlining and contrasting the north African's resources. The challenges and issues that North Africa is currently dealing with in terms of natural resources.

4.2.1 Oil and Natural Gas

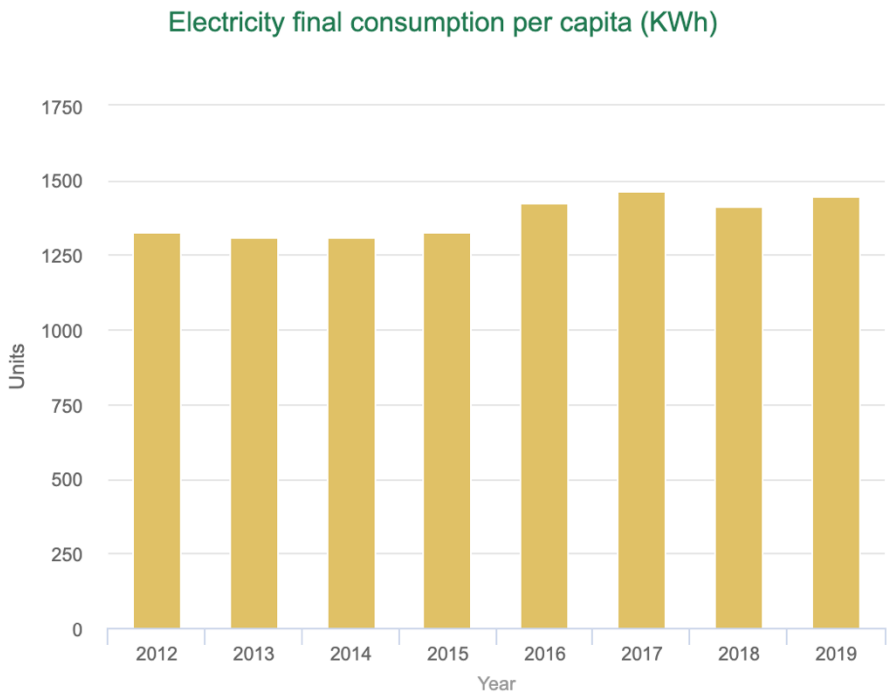
For energy supply and domestic consumption, North African countries rely significantly on fossil fuels. The region's countries are quickly increasing energy consumers, owing to rising GDP, population, and urbanization pressures. Energy demands are expected to grow at a rate of more than 5% each year in the future. According to estimates, fossil fuel energy consumption accounted for 95.08 percent of total regional energy consumption in 1971, peaking at 98.71 percent in 2008. In 2015, fossil fuel energy accounted for 97.38 percent of overall energy consumption, demonstrating the low adoption of alternative fuels. A series of distinct regional elements characterize the political economics of energy in the North Africa.

[31] https://www.worldometers.info/oil/.

[32] https://sp.lyellcollection.org/content/132/1/69#:~:text=Subsurface%20exploration%20of%20the%20Palaeozoic,drilled%20in%20Algeria%20in%201952.

Increasing demand in the North African region is projected to put more burden on fossil fuel usage, as net energy exporters are likely to utilize their fuel resources inefficiently, putting government finances under strain. Net energy importers are also becoming more aware of the volatile nature of energy costs, which poses a danger to energy security. Since the early 2000s, rising oil prices on global markets have increased the cost of imported oil and oil products for MENA net energy importing countries, while many oil and gas producers (net energy exporting countries) divert increasing amounts of production away from international markets to meet domestic demand. (Avis, 2020)

Figure 11: Electricity final consumption per capita (KWh)



Source: https://africa-energy-portal.org/region/north-africa.

For most of its recent history, the Middle East, and North Africa (MENA) region has been known for its abundant energy resources. The region has emerged as a worldwide energy source, with more than half of the world's crude oil reserves and a third of its natural gas reserves.

According to estimates, the region produced 16 percent of the world's total energy in 2014. (Half of which was exported). Between 1990 and 2014, energy production climbed by 2.4

percent annually on average, with the region accounting for 37 percent of global crude oil production and 22 percent of global gas supply in 2016.

However, not only in terms of economic and political frameworks, but also in terms of energy resources and infrastructure, the MENA area is highly diversified. Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates, and Yemen are the countries and territories that most usually fall under the MENA term. The countries in the region are further divided into two groups. This categorization has significant implications for both the use of fossil fuels and the possibility of a renewable energy transition.

Net energy exporters such as Gulf Cooperation Council Countries (GCC), Iran, Iraq, Algeria and Libya, those countries are which considered to have a large oil and gas resources.

Net energy importers are except for Algeria and Libya, all countries on the Mediterranean's southern and eastern coasts rely on energy imports. (Avis, 2020)

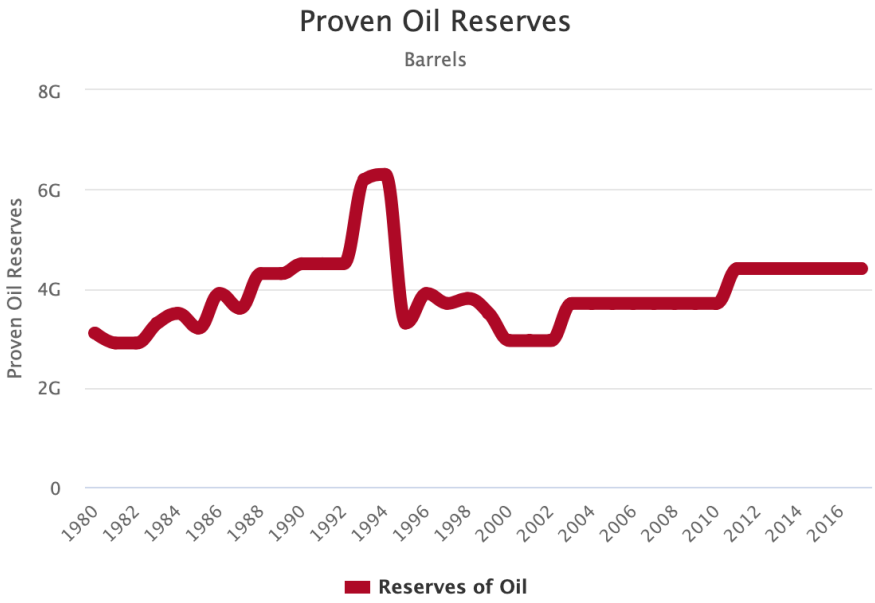
In all its energy-related activities, Egypt has been known to rely on three major sources: oil, natural gas, and hydroelectric electricity provided by the Nile's massive dam projects: the High Dam, Aswan I, and Aswan II.

As shown in figure 12 below, despite being a large oil producer and net exporter, particularly during the 1990s, when output peaked at over 900000 barrels per day, Egypt became a net oil importer about 2009/2010. Thus, both economic and population accelerated growth coincided with the start of the new millennium, resulting in an increase in consumption of about 3% per year, resulting in rising demand and falling production, which could only meet consumption requirements, resulting in a significant drop in the country's oil refinery output since 2009.

During the late 1990s and early 2000s, Egypt saw a surge in the discovery and extraction of vast natural gas deposits around the country, propelling the country to become a prominent player in the region as a natural gas producer and exporter. During the first decade of the 2000s, consumption of natural gas increased by about 7% per year, while production decreased by around 3% per year between 2009 and 2013, limiting the country's natural gas exporting capacity

to only 5% of total production by 2013, and eventually driving the country to begin signing importing agreements in the following years of 2014 and 2015. (Avis, 2020)

Figure 12: History of Oil Reserves in Egypt



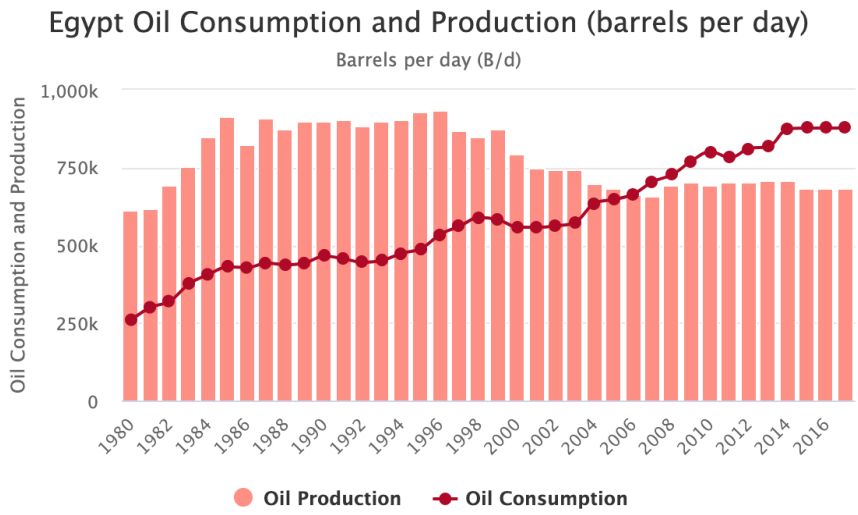
Source: https://www.worldometers.info/oil/egypt-oil/#oil-reserves.

Egypt ranks 27th in the world in terms of oil production, with 682,904.14 barrels per day produced in 2016. Every year, Egypt produces enough oil to equal 5.7 percent of its entire proven reserves (as of 2016). As of 2016, Egypt consumed 877,000 barrels of oil per day. Egypt is the world's 25th largest oil consumer, consuming around 0.9 percent of the world's total of 97,103,871 barrels per day. Egypt utilizes 0.39 gallons of oil per capita per day, or 142 gallons per year (based on the 2016 population of 94,447,073 people) (3 barrels).

In figure 13, it is clear and easy to analyze that oil production in Egypt's 1980s was around 600,000 barrels per day being produced, although the consumption number of barrels per

day was around approximately 252,000 barrels per day, which indicated that Egypt's production surplus left was about more than 350,000 barrels of its production amount per day. Due to Egypt's dynamic population demand on oil increased causing the production rate to decrease on the long-term avoiding depletion of oil country's reserve and instead of exporting oil, now the country imports oil to fulfill its domestic needs. As the consumption of oil was counted around 877,000 barrels per day 25th in the world if not more in 2016. Even with a production rate of almost 682,904 barrels per day in 2016 with a deficit of approximately 194,096 barrels per day. As now Egypt considered as a Net import country.[33]

Figure 13: Egypt Oil Consumption and Production (barrels per day)



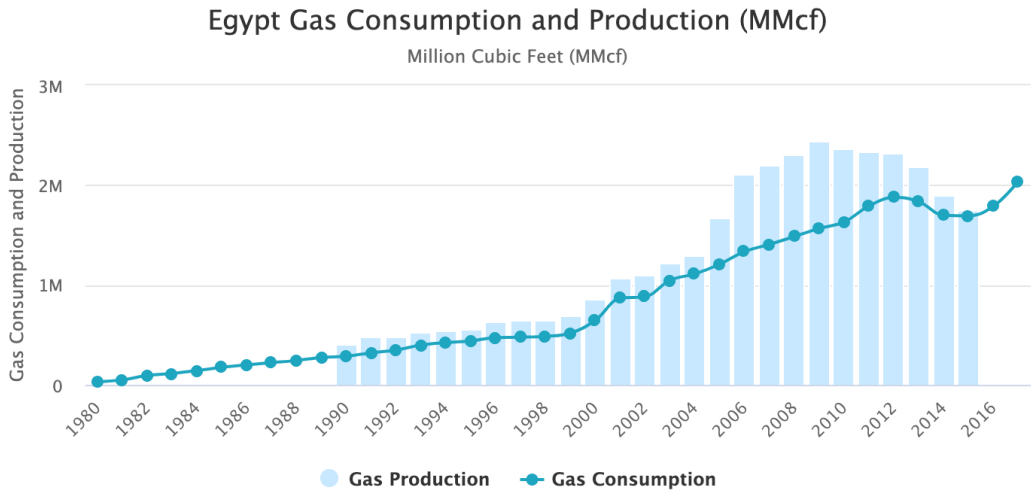
Source: https://www.worldometers.info/oil/egypt-oil/#oil-reserves.

During the fiscal year 2019/2020, Egypt's oil and gas sector contributed 24 percent to GDP, with $74 billion invested in the first four years of 2014/2015 to 2019/2020. Egypt's Energy consumption is 96% depending on fossil fuels (non-renewable energy), and with 4% dependance on Renewable and Nuclear energy.

[33] https://www.worldometers.info/energy/egypt-energy/.

Egypt's share of World's Gas is about 1.12%, ranked 16th in the world with gas reserves of 77,200,000 MMcf. With more discoveries since 1980. Egypt has proved reserves of 37.9% of its annual consumption. This means it will run out of gas in around 38 years (at current consumption levels and excluding unproven reserves).

Figure 14: Egypt Gas Consumption and Production (MMcf)



Source: https://www.worldometers.info/gas/egypt-natural-gas/.

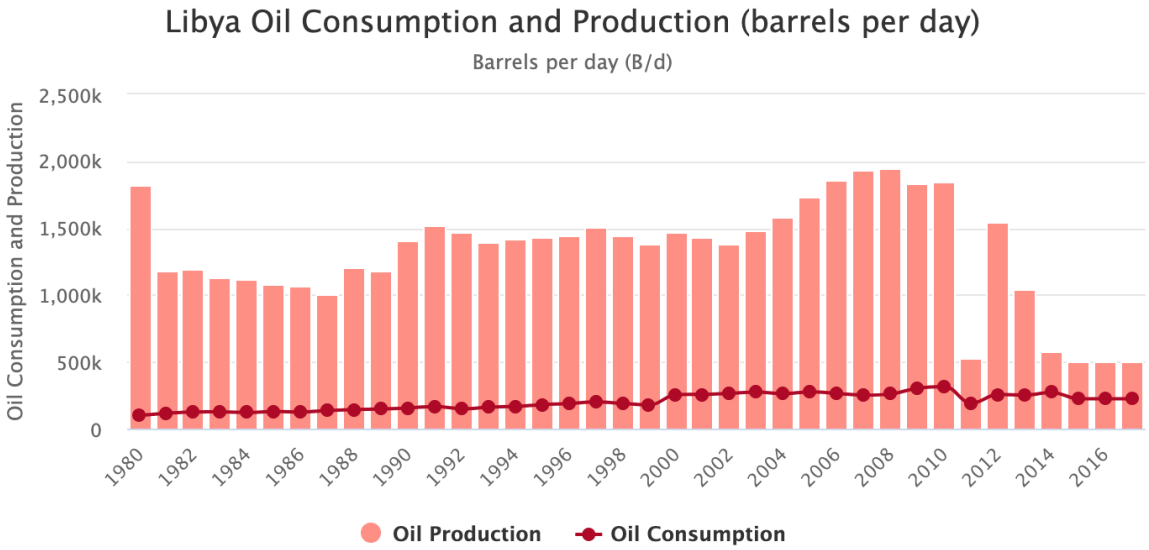
In figure 14 above, the numbers show the increase of consumption from 1980 to 2016. Egypt's production of gas is around 1,742,018 MMcf and its counted rate of consumption was around 1,692,930 MMcf, which leaves the country with a yearly surplus of 49,088 MMcf. Egypt is the world's 17th largest consumer of natural gas, accounting for around 1.5 percent of global consumption of 132,290,211 MMcf. Egypt uses 21,134 cubic feet of natural gas per person per year (based on a population of 96,442,591 persons in 2017), or 58 cubic feet per day.[34] According to a statement attributed to Egypt's Minister of Petroleum Tarek el-Mulla, released Feb. 2 the minister of Petroleum said, Egypt's natural and liquefied gas exports increased by 550 percent in 2021 to $3.9 billion, up from $600 million the year before.[35]

[34] https://www.worldometers.info/gas/egypt-natural-gas/.
[35] https://www.al-monitor.com/originals/2022/02/egypt-breaks-lng-export-records-eye-europe#:~:text=Egypt's%20exports%20of%20natural%20and,on%20the%20ministry's%20Facebook%20page.

In the figure below, Libya produces 499,396.79 barrels of oil per day, ranking 30th in the world in 2016. Every year, Libya produces an amount equal to 0.4 percent of its entire proven reserves in 2016. Although 48% of Libya's oil production is being exported which is about 238,501 barrels per day. As of 2016, Libya consumed 223,000 barrels of oil per day.

Libya consumes roughly 0.2 percent of the total world oil consumption of 97,103,871 barrels per day, placing it 53rd in the world. Libya consumes 1.44 gallons of oil per capita per day, or 527 gallons per year (based on a population of 6,492,162 people in 2016). (13 barrels).[36]

Figure 15: Libya's Oil Consumption and Production



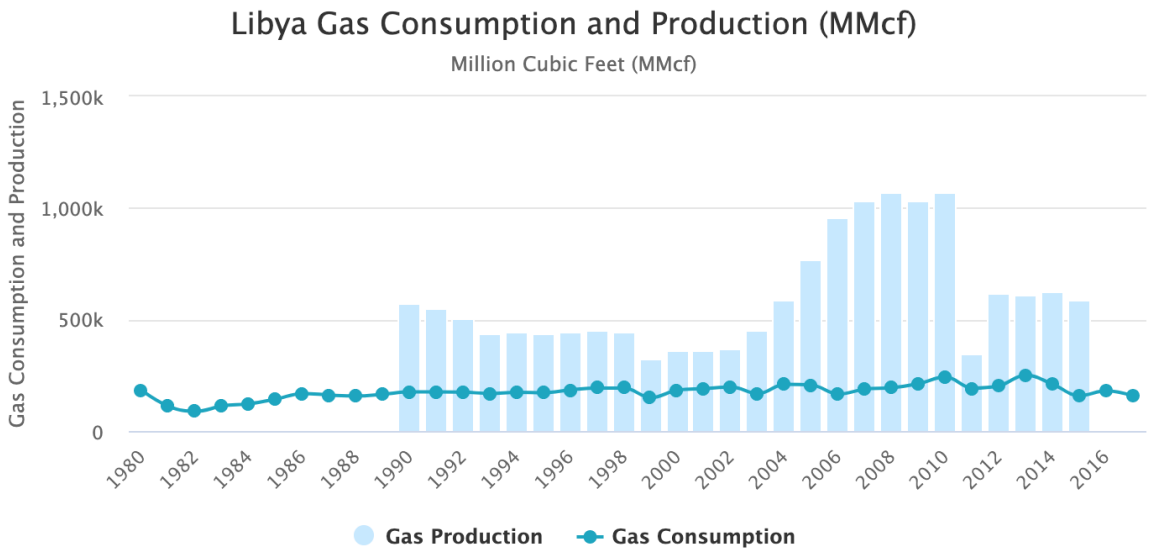
Libya has proved oil reserves of 48,363,000,000 barrels, ranking ninth in the world and accounting for around 2.9 percent of the world's total oil reserves of 1,650,585,140,000 barrels. Libya has proven reserves of 594.2 times its annual consumption rate. This suggests that if Net Exports were not in place, there would only be roughly 594 years of oil left.

In the figure below, data indicates that Libya ranks 40th in the world, producing 591,526.25 million cubic feet (MMcf) of natural gas per year in 2015. As of 2017, Libya consumed 157,147 million cubic feet (MMcf) of natural gas per year. Consumes around 0.1 percent of the world's total natural gas consumption of 132,290,211 MMcf, placing it 60th in the world. Uses 23,880 cubic feet of natural gas per person per year (based on a population of

[36] https://www.worldometers.info/oil/libya-oil/.

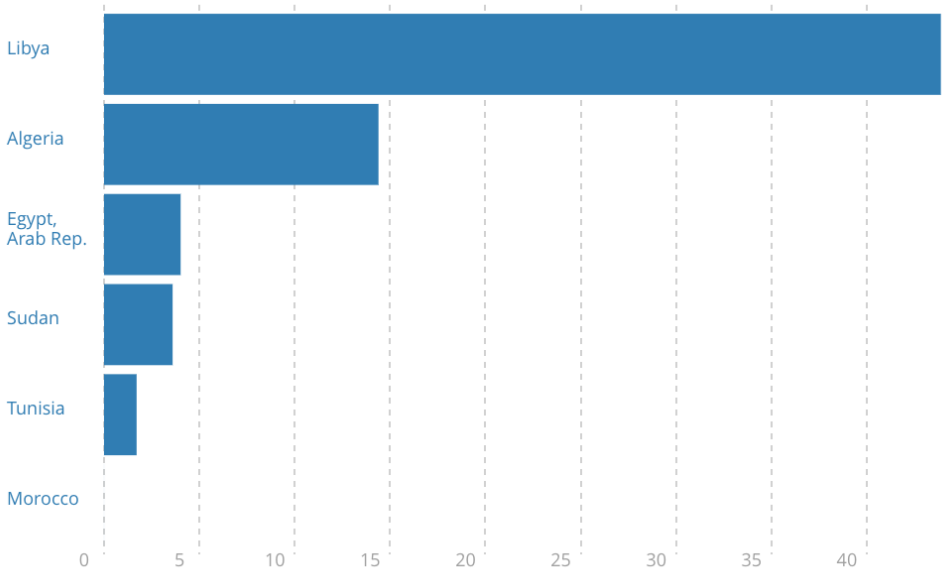
6,580,724 people in 2017), or 65 cubic feet per day. Libya's natural gas exports account for 42% of the country's total output (251,090 MMcf in 2015).[37]

Figure 16: Libya's Gas Consumption and Production



Source: https://www.worldometers.info/gas/libya-natural-gas/.

Figure 17: Oil rents (% of GDP) - Egypt, Algeria, Libya, Tunisia, Sudan, Morocco



Source:https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS?end=2019&locations=EG-DZ-LY-TN-SD-MA&start=2019&view=bar.

[37] https://www.worldometers.info/gas/libya-natural-gas/.

In the figure above, the data shows Libya's oil represents 43.9% of its GDP in 2019 that's after an increase in the previous years as in 2017 oil's share of the country's GDP was 36.7%. While Algeria's oil's share of GDP in 2019 was 14.4% which had an increase about 2.1% from 2017. Egypt's Oil rents decreased from 2017 as it was 4.2% then to 4% in 2019. Sudan's increased by 1% as in 2017 oil rents counted about 2.6% and then in 2019 it was 3.6%. Tunisia's Oil rents share of GDP increased by 0.3% from 2017 till 2019.[38]

4.2.2 Renewable Energy resources

Renewable energy is a newcomer to the North African energy scene, it has the potential to lower fuel costs, reduce carbon emissions, conserve water, and create jobs. Against the backdrop of rapidly rising domestic energy demand and a need to secure future hydrocarbon export profits, GCC countries have taken attempts to diversify their economies. The domestic energy situation in the North African region has shifted dramatically in recent years. arguing that there are two major elements that have influenced regional energy preferences. The increase in regional energy demand among North African countries economies, and its impact on the region's export capacity.

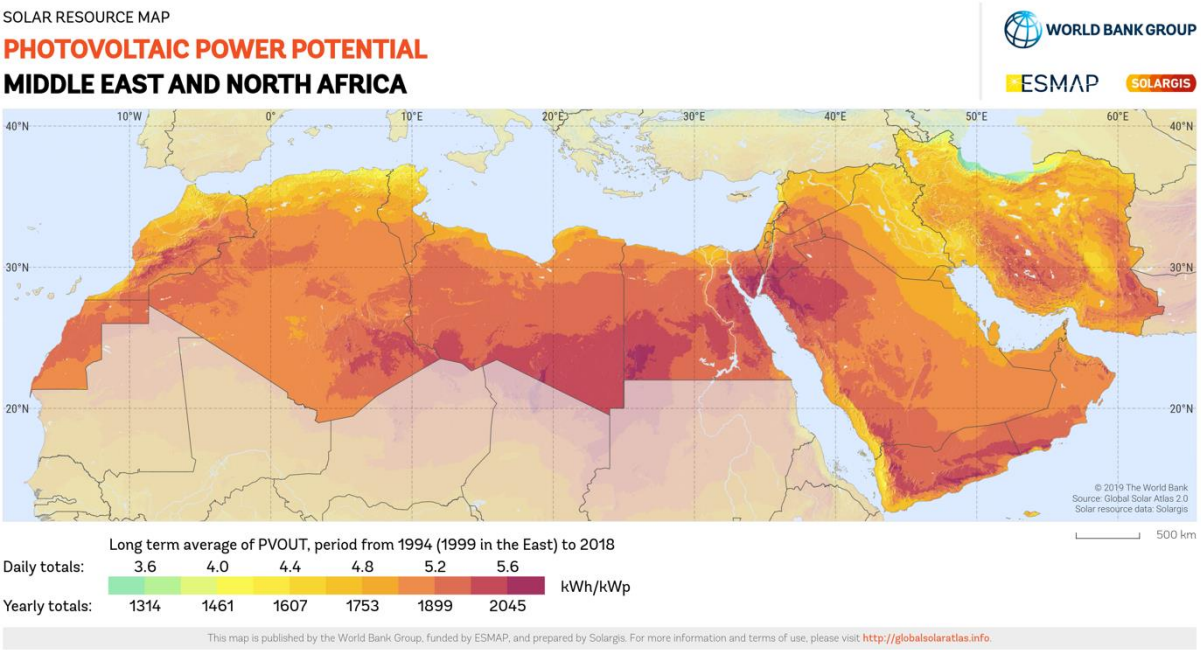
In addition to, as a result of increased oil prices during the early 2000s and the region's persistent reliance on oil for a substantial share of its domestic energy supply, the rising economic cost of surging domestic energy demand in both net energy exporting and net energy importing countries. Moreover, the environmental effects of continuing to rely on fossil fuels for almost all of the region's energy requirements. Because of its historically low levels of industrialization, small population, and small domestic market, the North African area has long been a peripheral demand market for energy. However, the energy consumption of North African economies has increased faster than that of most other countries, particularly during the 1970s. (Avis, 2020)

[38] https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS?end=2017&locations=LY-DZ-EG-SD-TN-MA&start=2017&view=bar.

Energy demand in the region is expected to rise as a result of continued industrialization, urbanization, and growing living standards. According to OECD figures, North Africa's aggregate energy demand would grow at a rate far above the global average, at over 3% per year from 2010 to 2030, with electricity demand expanding at around 6% per year. Civil strife (Libya), flatlining production (Egypt), and the long-term decrease of resources have all disrupted supply in producing countries (Tunisia). This has impacted net importing countries, as traditional partners' supply has fallen below previous levels and is no longer sufficient to meet demand. The reliance on favorable long-term contracts with a few important suppliers is a source of vulnerability for these governments.

Renewable energy has been highlighted as a potential possibility in this context. It is seen as a strategy to diversify energy supply away from fossil fuels while also reducing the effects of supply disruptions. It also benefits both exporting and importing countries in terms of revenue: exporting countries can increase earnings by reducing the portion of production that serves domestic demand and increasing the proportion that goes to export, while importing countries can reduce expenditure on fossil-fuel imports and the volatility associated with this expenditure. (Avis, 2020)

Figure 18: GIS Solar Radiation in North Africa 2020



Source: https://solargis.com/maps-and-gis-data/download/middle-east-and-north-africa.

In figure 18, the map shows how the potential is huge for north African countries to generate energy using the sun light.

Egypt has had some interesting adventures. Between 2015 and 2019, the country transitioned from severe power shortages to a 25% surplus in electricity supply by adding 25.5 GW of new generating capacity. There was 1 GW of solar photovoltaic system and almost 840 MW of new wind power added to the mix. This transition demonstrates a key point: it is perfectly possible to manage urgent energy concerns while still planning for a more sustainable future. Although Renewable energy represents 4% only from Egypt's energy production. By 2035, Egypt plans to increase the percentage of electricity generated from renewable sources to 20% by 2022 and 42% by 2035, with wind accounting for 14%, hydropower 1.98 percent, photovoltaic (PV) 21.3 percent, wind 14 percent, concentrating solar power (CSP) 5.52 percent, and oil and gas accounting for 57.33 percent. This plan is now being amended and awaits approval by the supreme council for energy, with the goal of generating 33% of energy from renewable sources by 2025, 48% by 2030, 55% by 2035, and 61% by 2040.

Morocco accounted for three-quarters of the increase in renewable electricity production in the area. Impressive successes in the energy transition process have been backed up by determined government policy in this area as well. Morocco said in 2009 that by 2030, it would supply 42 percent of its electricity from renewable sources. That objective was raised to 52 percent in 2015, and it is now expected to be met five years ahead of schedule. In reality, the government is on target to raise renewable energy's contribution of electricity generation to 60-65 percent by 2030.[39]

North Africa has increased its renewable energy production by 40% in the last decade, thanks to the addition of 4.5 GW of wind, solar PV, and solar thermal capacity to its renewable energy power fleet. Renewable generation capacity has increased by 80% in the last 10 years, and by about 560 percent when hydropower is excluded. Despite major recent social and political

[39] https://www.trade.gov/country-commercial-guides/egypt-electricity-and-renewable-energy#:~:text=Egypt%20is%20working%20on%20increasing,conventional%20energy%20sources%2057.33%20percent.

change in four nations in the region, this progress has been made. As technology has progressed and costs have decreased, countries have begun to develop their own policies to encourage energy transitions.[40]

4.2.3 Water Resource

Morocco and Tunisia rely on internally generated surface freshwater runoff from rainfall as their primary source of supplies, with groundwater being used to a lesser extent. These countries are among the most vulnerable to the effects of climate change in the Mediterranean, where a decrease in rainfall is expected with high confidence. Due to their susceptibility to major primary and indirect impacts as well as uncertainties related with climate change, Egypt and Sudan face a complicated risk. The direct physical implications of climate change in the North African expected to enhance aridity in both countries. Unregulated transboundary uses upstream in the Nile River basin could jeopardize these two countries' freshwater security.

The Mediterranean region's water constraint has been worsened by rapid population development. While natural factors such as intermittent droughts and limited freshwater sources can contribute to scarcity, rapid population increase adds to the burden. Water availability is measured by experts in terms of the amount of annual renewable fresh water per person. When a country's total renewable freshwater resources are between 1,000 and 1,700 cubic meters per person per year, it is deemed "water strained." "Water-scarce" countries have an average annual sustainable fresh water supply of less than 1,000 cubic meters per person, such as Egypt, Morocco, Algeria, Tunisia, and Libya.[41]

[40] https://www.iea.org/commentaries/north-africa-s-pathways-to-clean-energy-transitions.
[41] https://www.prb.org/resources/finding-the-balance-population-and-water-scarcity-in-the-middle-east-and-north-africa/#:~:text=The%20Middle%20East%20and%20North%20Africa%20(MENA)*%20is%20the,demand%20for%20water%20resources%20rises.

Water Use in a Sequential Order Water that has been utilized in one area is captured and treated so that it can be directed to other users in a sequential manner. Domestic use necessitates

Figure 19: MENA freshwater Usage; key figures

EUROPEAN COUNCIL ON FOREIGN RELATIONS ecfr.eu

	Freshwater withdrawals 2015			Percentage of GDP (%) 2017			Source: World Bank
	% for agriculture	% for industry	% of domestic	Agriculture	Industry	Manufacturing	Services
Algeria	59	5	36	12	36	5	44.1
Bahrain	..	..	..	0	41	19	57
Egypt	86	3	12	11	34	16	-
Iran	..	..	..	10	21	12	65.4
Iraq	..	..	..	5	42	2	-
Israel	..	..	..	1	19	12	69.8
Jordan	52	3	44	4	25	16	58.8
Kuwait	..	..	..	1	52	7	61.4
Lebanon	..	..	..	4	12	5	76
Libya	83	5	12	..	..	..	-
Morocco	88	2	10	13	26	16	49.5
Oman	..	..	..	2	47	8	43.7
Qatar	..	..	..	0	52	9	47.9
Saudi Arabia	8	3	9	3	45	13	52.5
Syria	..	..	..	..	..	..	-
Tunisia	80	5	15	9	24	15	-
Turkey	81	..	..	6	29	18	53.3
United Arab Emirates	..	..	..	1	44	9	46.9
West Bank and Gaza	..	..	..	3	20	11	63.4
Yemen	..	..	..	16	91	18	9.5
World	65	21	14	4	25	16	65.1
Middle East and North Africa	52	3	44	6	35	11	54.2

Percentages may total to 101% due to rounding

the cleanest water; thus, water should be used first in the home, next in industry, and finally in agriculture. Brown water, or urban wastewater, can be cleansed and routed from towns and cities onto surrounding fields, boosting agricultural yields, and reducing the need for chemical fertilizers. Tunisian wastewater is utilized to irrigate orange and olive groves, as well as golf courses, hotel gardens, and certain crops, near the city.

Source:https://ecfr.eu/publication/how_water_scarcity_could_destabilise_the_middle_east_and_north_africa/.

As shown in the figure above, North African countries usage of freshwater for agriculture, industry, and domestic consumption. Algeria's domestic usage of freshwater was 36% while 59% goes for agriculture. Egypt in 2015 had 86% of its freshwater being used for agriculture and only 12% for its domestic use. Libya with 12% of domestic use and 83% for agriculture. Morocco

with 88% of freshwater for agriculture beside 10% domestic use. Tunisia with 80% for agriculture and 15% for domestic use. Algeria is the highest north African country of the domestic use of freshwater and the lowest usage of freshwater for agriculture.

Egypt uses more than 85% of its freshwater withdrawal for agricultural, compared to a global average of roughly 65%. It has a well-developed irrigation and drainage system.

Only around half of Egypt's population has access to piped sewage systems with wastewater treatment. In rural areas, this figure reduces to 12%. The country should work to cut down on home usage and reduce the effects of water scarcity. The same problem for Morocco. The growth rate is in increase in the North African countries and that leads to an impact on the consumption of water which is unsustainable, not to forget the climate change and its effect on rainfalls in the region.[42]

4.2.4 Land Use in Northern Africa

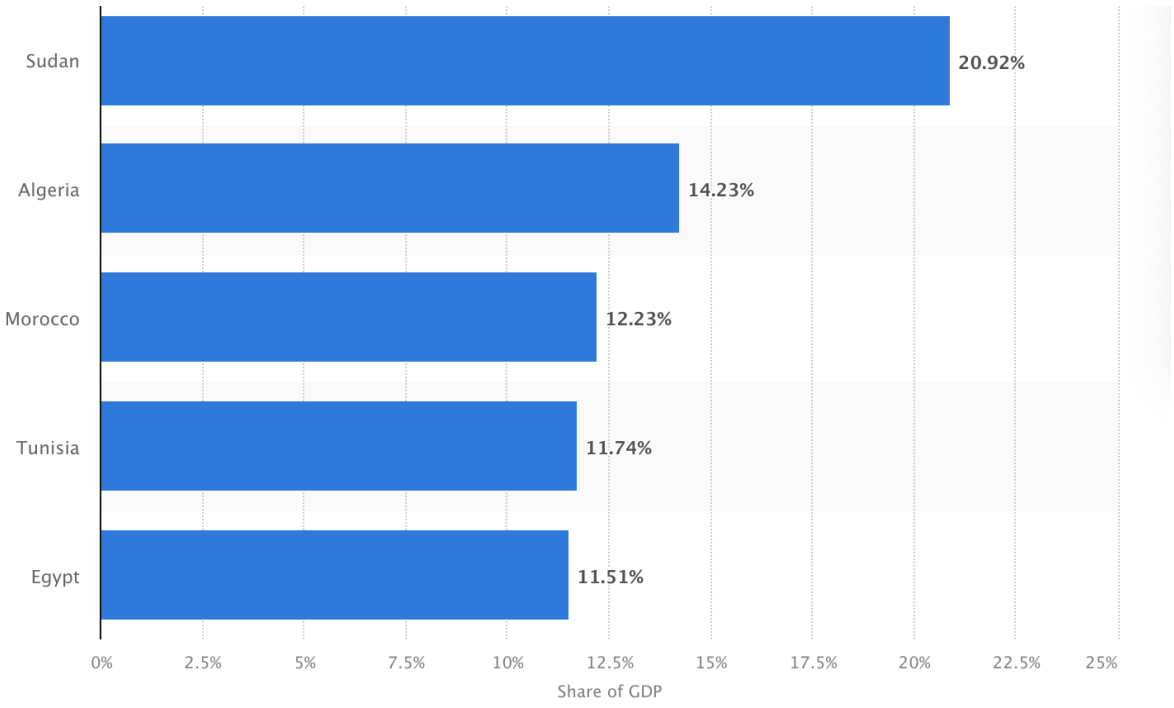
Due to increased temperature, precipitation fluctuation, and population growth, Northern Africa, and the Sahel in particular, are extremely vulnerable to climate change. Land usage and accompanying land cover change, particularly where subsistence farming is practiced, are a crucial relationship between climate and humans in this region.

As arable land and water become scarcer, the North African region's high and growing reliance on overseas markets for critical staple food goods is a major source of concern. The region's policies encourage grain production and consumption, resulting in 65 percent of cropland being planted with water-hungry cereals, particularly wheat, which accounts for a major portion of calorie consumption. The MENA region's future predicts moderate growth in food consumption, incremental changes in diet to incorporate more animal intake, continued unsustainable water use, and more reliance on global markets.

[42] https://ecfr.eu/publication/how_water_scarcity_could_destabilise_the_middle_east_and_north_africa/.

A different approach to food security would refocus policy on rural development, poverty alleviation, and support for higher-value horticulture product production. Such a shift would result in more diverse and healthier diets, but it would necessitate farmers improving their ability to manage risk while growing higher-value crops.

Figure 20: Contribution of share of agriculture, fishing to the GDP in North Africa, By country (2020)



Source: https://www.statista.com/statistics/1193834/agriculture-as-a-share-of-gdp-in-north-africa-by-country/.

These recent occurrences demonstrate the region's major development concerns. Many North African countries' economies are fully reliant on oil exports, putting them sensitive to price changes. Unemployment remains highly high, the region's population is rapidly increasing, and rural poverty endures, with 70% of MENA's poor living in rural regions.

By addressing these issues, we can boost economic growth, enhance people's lives, and increase stability. Agriculture has a critical role in the region's economy, even if it only accounts

for 13% of the region's GDP. Water is already scarce in the region, and climate change is making it even more difficult to meet the region's agricultural needs.[43]

In the figure above, data presents the contribution of agriculture to the gross domestic product of the North African countries in order, as Sudan has the highest rate of share 20.92% of its GDP, Algeria is the second highest country with 14.32%, Morocco with 12.23% in the fourth place, Tunisia 11.74%, and Egypt comes in the bottom with 11.51%.

4.3 Challenges Facing Countries in North Africa.

The North African countries are confronted with issues, whether they be political, economic, or social. However, in this part, the focus is on the issues faced by resource-rich countries that import labor. The reason for this is that the majority of resource-poor and resource-rich labor abundant populations are confronted with a variety of obstacles that have led to their economic insecurity and unstable growth. Resource-rich labor-importing countries, on the other hand, have experienced consistent economic growth in recent years. Nonetheless, other countries, such as Libya, still reliant on natural resources (specially oil) for general income. The country with the largest reliance on natural resources in the region. Finally, this section discusses the political and economic obstacles, as well as the attempts made to address them.

4.3.1 Resource Cures and Regionalism.

Much of the Middle East and North Africa (MENA) has seen rallies, labor unrest, localized development demands, and aspirations for autonomy or even independence in recent decades. While those occurrences have exposed a wide range of grievances, a closer examination of the nature of the requests reveals several repeating themes in different parts of the region. This is especially true in areas with abundant natural resources. Despite the fact that resource revenues are generated within their regions, Barca in Libya, Gafsa in Tunisia, the Eastern Province of

[43] https://www.ifpri.org/blog/unlocking-potential-agricultural-development-middle-east-and-north-africa.

Saudi Arabia, Hasakah and el-Zour in Syria, and Hadramawt and Sheba in Yemen have all expressed dissatisfaction with their lagging development in comparison to other areas within their countries.

In the MENA area, "resource regionalism" refers to a growing desire in resource-rich regions to keep more of the income generated inside their borders. The authors situate those demands within a larger context of spatial inequities and social fragmentation caused by colonial legacies, centralized states, resource dependence, and a lack of political rights.

They look at how resource distribution is uneven across the globe, and they warn that resource regionalism might extend conflicts in the event of political shocks like civil war, regime change, popular uprisings, partition, or foreign invasion. Highlight spatial inequities as a reoccurring challenge within such regions, and investigate strategies for governments to better allocate resource revenue. They examine a range of tactics, such as resource profit sharing methods, regional development funds, regional state-owned enterprises, and resource dividends, briefly highlighting their advantages and disadvantages. They end their analytical paper with a case study on Iraq to show how resource regionalism can have negative consequences.

Looking ahead, it will be critical to keep an eye on the region's potential incendiary environment and how it interacts with more typical economic shocks such as energy and food prices, as well as finance. Oil prices have appeared to be on the verge of returning to their historic highs of 2008, aided by changes in the region. In the last year, food prices have also risen dramatically. As money flees to safety and prospective sovereign risk premiums rise, growing concerns about political risk in the region may put pressure on financial risk premiums in the region.

The uncertainty surrounding Libya has, at least temporarily, improved the terms of trade of net oil exporters by driving up international oil and gas prices. Because most MENA countries have low retail fuel prices, many less well-off countries (such as Egypt, and Syria) are facing scissor effects from rising worldwide prices on the one hand, but low absolute domestic prices on the other. While this may benefit oil producers in terms of terms of trade, it will also increase

liabilities in terms of subsidies. This could exacerbate the difficulties associated with more common economic shocks, such as delicate subsidy reform pressures.[44]

4.3.2 Diversification and Sustainable Growth

The Persian Gulf holds a third of the world's natural gas reserves, while the Middle East holds a large amount of the world's oil. North Africa has a unique set of challenges due to the abundance of such precious resources and its strategic location. For example, the Middle East has a lot of issues, particularly in countries with abundant natural resources. To begin with, employment in North Africa is primarily in the public sector, accounting for 39% of total employment, indicating a drop in other sectors, particularly agriculture. As a result, people express a desire to work in the natural resource sector in order to earn money.

This indicates a high importance towards diversification of exports to expand other sectors rather than a decline in employment. Countries with abundant resources tend to experience growth volatility due to reliance of one source for income while the price of oil or natural gas is volatile in the market. Generally, the volatile revenue effects long term financing and future planning. In addition, uncertainty might lead to repel investments internally and externally due to the absence of diversification. However, countries, like Egypt and Algeria, should apply constant changes in the infrastructure and projects to raise investment and create jobs for the growing population. Achieved diversification in exports results in sustainable growth.

Fortunately, several resource-rich countries have begun to diversify their income streams in order to keep their economies from overheating. In some situations, these efforts are directed toward the energy industry, while in others, they are directed toward investment. Only 411 megawatts of renewable energy are produced in Algeria. Officials anticipate that the new plan would re-energize efforts to bring more than 1 gigawatt of solar energy online by the end of the

[44] https://www.researchgate.net/publication/241642681_Theresource_cursein_MENA_political_transitions_resource_wealth_economic_shocks_and_conflict_risk.

year and another 13 gigawatts by 2030. For example, Egypt aims to diversify its clean energy resources by 2025, and to generate 40% of its electricity from solar and wind by 2030. The Egyptian plan to establish the East Mediterranean Gas Forum (EMGF) as a platform for efficient cooperation among the region's countries to maximize the economic benefits from natural gas resources was mentioned by the minister[45], which intends to diversify exports. Invest in renewable energy to expand the energy sector.

5 Conclusion

Natural resources, generally, may be widely available in one sort of place but scarce in another. Regardless, natural resources abound in various forms and stages. Natural resource classification can be difficult. Manual and heavy machinery are used for discovery and extraction. However, as the world's population grows, so does its consumption. Natural resource replenishment is also used to determine a resource's long-term viability. Fossil fuels, for example, require millions of years to produce in the earth's crust. Regardless, with high depletion of natural resources, all natural resources, save renewables, must be replaced at some point or in some fashion. To keep resources for longer periods of time.

Natural resources, according to this study, could be a double-edged sword. In truth, natural resources help some countries achieve progress and stability. Some may have more resources than others. Despite this, it is unable to attain stability, let alone certainty. The Middle East was depicted in this thesis. Because of the abundance of oil, natural gas and minerals in this region, numerous resource-related classifications emerged. More than half of the world's reserves are found in the Middle East, which is home to 5% of the world's population. A region primarily focused on oil and natural gas.

As a result, the Middle East, with its unevenly distributed overabundance of resources, comes out on top. Many problems have been faced, and diversification is the key to reviving and prospering this region. By implementing structural reforms for economic diversification and sustainable and inclusive growth, building resilience in post conflict situation, enhancing youth

[45] https://egyptoil-gas.com/news/egypt-plans-to-achieve-diversity-in-clean-energy-resources-by-2025-el-molla/.

skills, employability, and inclusion, tackling gender inequality, and encouraging regional development, increasing agricultural productivity and food security.

Diversification may result in the creation of jobs in previously underserved areas. Other nations in the area should follow Qatar lead in decreasing oil and gas GDP rents. And, after being reliant on phosphate, most of the MENA area, including Morocco, has invested in renewable energy. Therefore, nations will prosper, and employment rates will rise because of sustained growth and a high-quality lifestyle. To decrease the impact of variable resource commodity prices, the economy is shifting from a single-sector to a varied one.

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