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Overall sustainability impact of population trend: comparison between developed and developing countries.

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Abstract

The impact of population growth on living beings and the planet is a topic that has been widely debated. This paper aims to examine the effects of population trends on sustainability in developed and developing countries using the three spheres of sustainability approach, including economic, environmental, and social sustainability. The United Kingdom and Australia were chosen as the developed countries, while Various statistics from Nepal and the Philippines were considered for developing countries. For the Social factor, the unemployment rate was considered; for the economic factor, the Industrial and Service sectors were chosen. For Environmental analysis, greenhouse emission and energy uses/demand in the prior mentioned countries was studied. The time period taken into consideration was 1990 to 2022. The study analyses the impact of population trends in each of the three spheres. The tools used for this project include Jupyter Notebook and the programming language Python/Pandas for data cleaning/transformation and Tableau for visualisation. The dataset was collected from worldbank.org, an online database website with various datasets on various topics. The research shows that population growth does not necessarily directly influence the socio-economic aspect of sustainability. Instead, it is driven mainly by sustainability policy and implementation in developed and developing nations. Furthermore, no correlation was found between population and the discussed economic and social sectors, and other social and economic aspects could be correlated to the research. In the case of emissions, it was found that emissions were primarily affected by population growth as the growth rate of the population was like the emission increase rate. However, a contradicting scenario was observed in the developed nations as their emissions were not highly affected by population. This was primarily due to developed countries changing the energy mix by decreasing the reliance on fossil fuels and increasing the development of renewable and eco-friendly energy sources. It was also found that the improved efficiency of the machinery across different sectors also allowed the UK and Australia to significantly lower energy demand per capita. Overall, it was deduced that Environmental impacts caused by increasing population can be negated and even dampened if competent policies and reforms are in place.

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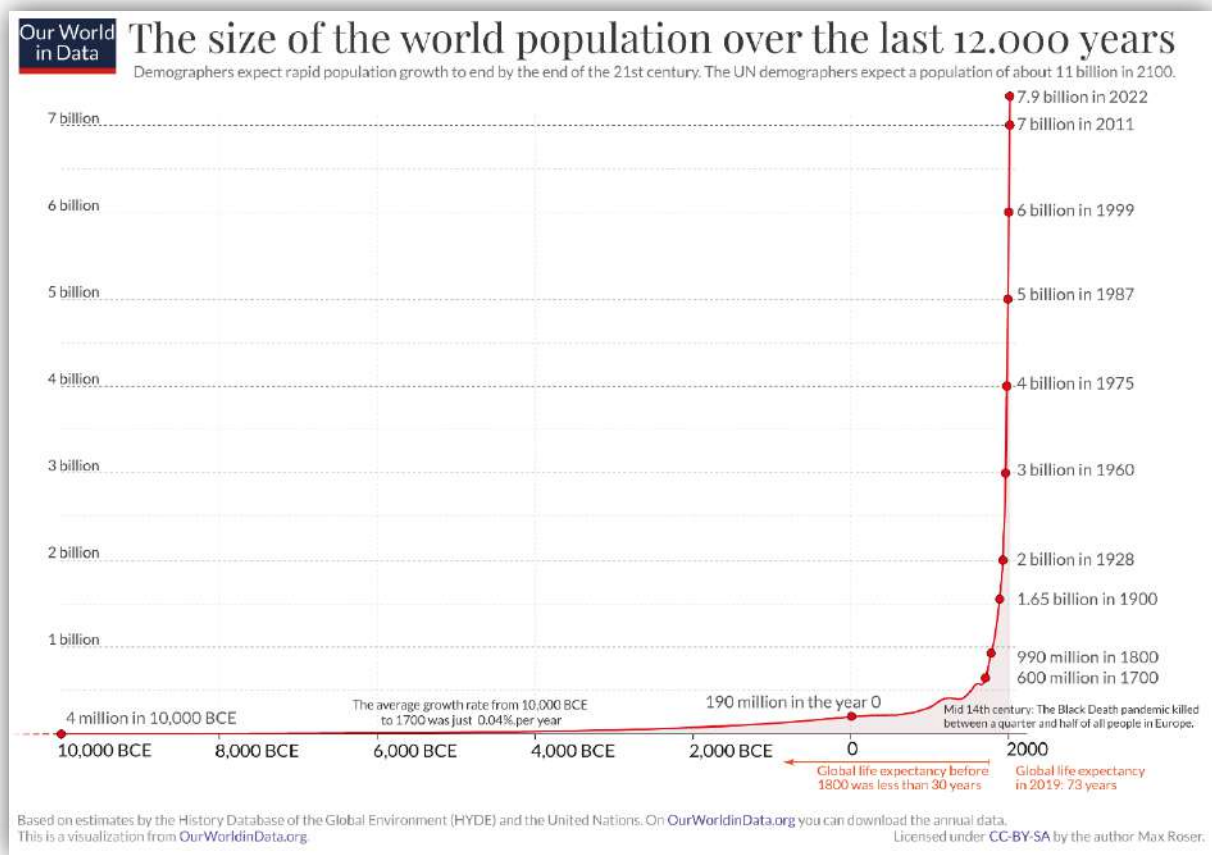
1 Introduction

1.1 Background, current situation, and significance.

Population trend is a tool used to measure a population's overall increase or decrease globally and in individual countries.

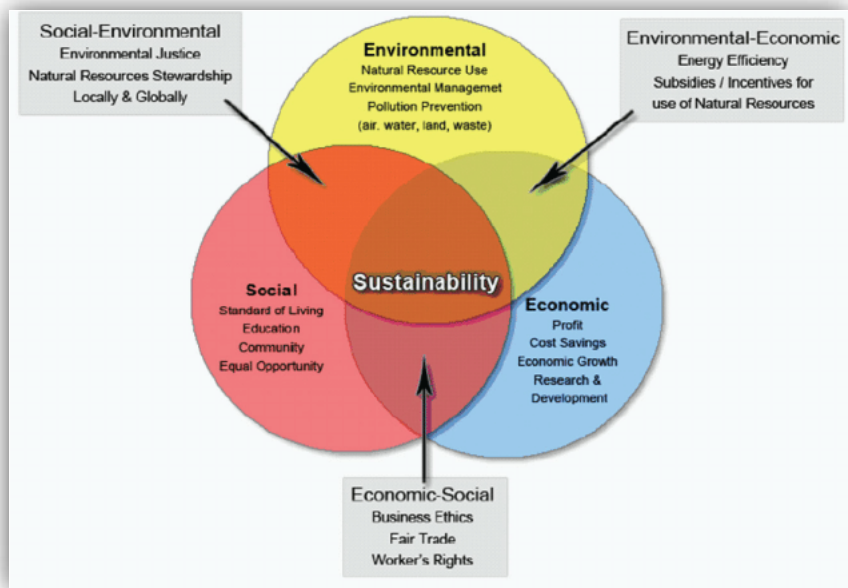


Population Trend from Past to Present I(Ritchie & Roser, 2023)

For the first time in 1800, the global population reached one billion (Ritchie et al., 2023). It's worth noting that the population has undergone a significant change, especially when compared to the average growth rate of 0.04% between 10,000 BCE and 1700. According to a research study on world population growth, the global population was a mere 4 million in 10,000 BCE, but that number skyrocketed to 190 million by the year 0 CE or AD. (Ritchie & Roser, 2023), which then rose to 600 million in the 1700s and 1 billion in the 1800sThe world's population has seen a significant increase in recent years. In 1804, it was one billion, and by 1927, it had already doubled to two billion. The trend continued with three billion in 1960, four billion in 1974, five billion in 1987, and six billion in 1999. Finally, in 2011, the world's population hit seven billion; as of November 15, 2022, it stands at a staggering eight billion (Timeline, 2023). It is fascinating that the world population took 123 years to escalate from 1 billion in 1804 to 2 billion in 1927. After that, there was a 33-year gap until 1960, when the population reached 3 billion. The people then grew exponentially, taking only 14 years to reach 4 billion in 1974, followed by 13 years to reach 5 billion in 1987, and another 12 years to reach 6 billion in 1999. Finally, it took another 12 years to get 7 billion in 2011. As of 2022, the world population stands at 8 billion, attained after 11 years from 2011. (Timeline, 2023). The growth of the world's population has been unprecedented in recent centuries. The global population lasted almost a millennium from 0 AD 1800 to 1 billion. However, in the present day, this milestone has been achieved in a little over a decade. This exponential growth trend is a cause for concern as it indicates potential future population growth. The current alarming rate of population growth sees a billion increase in the world population each decade, which could lead to sustainability issues and negatively impact the overall well-being of the global population.

1.1.1 Concept of sustainability.

Ensuring that current and future economic and environmental needs are met is the core principle of sustainability (United Nations, *Sustainability* 2023). Achieving sustainability is crucial for creating a functional ecosystem that can efficiently support the economy and meet the needs of the people. To fully understand sustainability, the concept of the three spheres of sustainable development has been introduced, wherein each sphere intersects with the others to ultimately achieve the core of sustainability.



3 spheres of sustainability I(Nawawi, 2015).

It's important to remember that sustainability encompasses three key spheres: environmental, economic, and social. Each of these spheres is critical in promoting sustainable practices and ensuring a better future for all. Focusing on all three spheres can create a more balanced and equitable world for future generations. (Aminuddin & Nawawi, 2015). Within the environmental sphere, the primary goal is to promote eco-friendly practices in the operations of individuals, companies, and organisations, both locally and globally. Such methods include the reduction of carbon dioxide emissions, which is currently one of the significant contributors to global climate change (Safdieand, 2023); to support sustainability, it is imperative to reduce any waste generated during daily operations, transition to renewable energy sources rather than relying on fossil fuels, minimise water usage, choose sustainable suppliers, repurpose and recycle resources, and encourage the use of environmentally-friendly modes of transportation such as electric vehicles or London's TFL buses that are powered by hydrogen fuels (*Causes of climate change* 2023), aiming to decrease water consumption and assess the overall advancement achieved. The economic sector strives for sustainable stability, enhancing our planet's social and environmental welfare (*Hydrogen benefits and considerations* 2023). We must adopt alternative energy sources like wind, solar, and hydropower to achieve financial sustainability. Relying solely on fossil fuels is no longer viable. This should be a mandatory part of everyone's daily activities, including individuals and companies. Sustainable farming is equally crucial, and organic and regenerative farming practices should be embraced without hesitation. These practices avoid harmful pesticides, maintain soil health, and improve crop rotation. Furthermore, reducing the consumption of animal products is a necessary step that can help lower carbon dioxide emissions and reduce the cost of food. We must act now to secure a sustainable future for ourselves and our planet (*Economic Sustainability*, 2019); the strategy of developing or embracing a socio-economic enterprise centred on advancing society rather than exclusively pursuing profits for the organisation or shareholders (*Social Enterprises,* 2022). These are some viable ways in which economic sustainability can be achieved. Social sustainability cannot be achieved without prioritising employee rights, promoting a healthy work-life balance, ensuring equal access to natural resources, implementing a fair employment system, providing educational opportunities, and offering free healthcare. However, CO2 emissions and greenhouse gases remain major obstacles towards reaching sustainability as they result from social and economic activities that harm the environment. To combat this issue, countries like the United Kingdom have launched Mission Zero, a carbon-neutral initiative to eliminate all greenhouse gas emissions by 2050 (Department for Business, 2019). The UK has taken a significant step towards global sustainability by becoming the first major world economy to halt its contribution to climate change. If other major economic countries follow suit, the goals of sustainability can be achieved at a faster rate.

1.1.2 Importance of population study.

A population study is a scientific research study that utilises various statistical methods to analyse, predict, and comprehend the overall trend or situation of the world's human demographic (Mihan, 2022). Analysing population data is crucial in understanding the factors that impact the quality of life in various countries. A thorough examination of data from both developed and developing countries enables us to identify their strengths and weaknesses and pinpoint similarities and differences. Such analysis is essential in evaluating economic, environmental, and social factors and promoting sustainable development.

1.1.3 Importance of data analysis in a population study.

Performing statistical and visual data analysis is a crucial method in population studies. It calculates various social, environmental, and economic situations of populations worldwide. Data visualisation represents this data through pie charts, histograms, linear graphs, and cartography (IBM, 2023). It is essential to analyse demographic data better to understand the people of certain countries or the world. This involves transforming raw datasets found in databases to obtain more accurate results. Data analytic tools such as Google Collab, Jupyter Notebook, R Studio, and Microsoft Excel can be utilised. Data cleaning involves removing irrelevant values from the dataset, while data transformation involves selecting the most efficient format for analysis (Tableau, 2023). The third crucial component in data analysis is programming languages such as Python and R. These are used to create models for visualisation and data transformation. By employing these tools, datasets can be transformed and visualised effectively, leading to better analysis of population studies.

1.2 Research aim

This research study aims to analyse the impact of population growth on the sustainability of developed and developing nations. The research uses the concept of three spheres of sustainability as a base to examine the impact of population trends on three different types of sustainability, which are economic, environmental, and social. The effect of population growth on 2 developed and two developing countries based on 3 spheres of sustainability are researched and analysed using a visualisation tool called Tableau, a programming software called Jupyter Notebook and through review of literature mainly through Google Scholar, Research Gate and Science Direct.

2 Literature review

Studying population trends' impact on sustainability involves examining demographics. This study is beneficial in various fields, including business, as it reveals how population affects sustainability. Research on Egypt's population and environment's impact on sustainable development found that a 1% population increase caused a 2.4% increase in CO2 emissions, leading to a 2.5% rise in air pollution-related deaths due to respiratory and cardiovascular diseases (Ghanem, 2016). Studies have shown that population growth in developing nations, particularly Egypt, has harmed sustainable development. Research indicates that the rise in air pollution has decreased labour productivity by 1.58%. Moreover, a case study of eight cities in northeast China has demonstrated the correlation between population decline and urban development sustainability from 2002 to 2035. Cities that have implemented smart shrinking policies are expected to maintain their current level of sustainability. In contrast, those that support growth-oriented development, such as anti-shrinkage policies, are projected to have better sustainability in the future (Yang, 2019). Effective policies were implemented in China to address the decreasing population in urban areas. The anti-shrinkage and smart shrinking policies were particularly successful in the long run. In a separate study, the impact of population growth on water quality in the Kelani River of Sri Lanka was assessed through the Bayesian network model. The study revealed that a population density of less than 2375 is necessary for safe bathing and drinking purposes, while a population density of less than 2672 is required to thrive aquatic life and fish to maintain healthy water quality (Liyanage & Yamada, 2017). This research study underscores the detrimental effects of population growth on water quality in watersheds. To maintain a harmonious balance between lifestyle and the environment, it is crucial to have an appropriate number of individuals residing within a given land area. This can be determined by computing the population density, which is obtained by dividing the total population by the total area (Cohen, 2021), and it measures the number of people living in an area (*What is population density?*, 2022). A comprehensive investigation was carried out to scrutinise the food sustainability practices of Spanish adults. A total of 2052 respondents, consisting of 57% women and 43% men who were 18 years or older, were randomly chosen for the study (García-González et al., 2020). The study revealed that 40% of the population comprehended a sustainable diet. It is alarming to note that a staggering 70% of the population remained oblivious to the concepts of carbon footprint and blue water. Furthermore, 70% of the population demonstrated a lack of clarity in understanding the impact of fish and dairy products on sustainability. Half of the population had insufficient knowledge regarding the effects of meat and processed products on sustainability. Despite a positive attitude towards food sustainability, the participants showcased several misconceptions about food products and production (García-González et al., 2020). Research into sustainable development goals (SDG) suggests that utilising a multidimensional population dynamics model could lead to a global population size ranging from 8.2 to 8.7 billion in the year 2100 (Abel et al., 2016), which is lower than the current world population. By 2030, the SDG aims to empower girls using a multidimensional population dynamics model. This model categorises the national population by factors such as education, fertility, and mortality rates, considering age, sex, and education level (Abel et al., 2016). Investing in female education and reproductive health can effectively reduce the global population and foster long-term sustainability, as demonstrated by this study. The analysis of sustainability spheres during the COVID-19 pandemic underscores the hazards viral diseases pose to environmental, social, and economic sustainability (Ranjbari et al., 2021). The pandemic had both positive and negative effects on environmental sustainability. On the negative side, there was an increase in biomedical waste generation, a rise in mixed CO2 emissions, and water waste outbreaks in poor countries. However, on a positive note, the pandemic resulted in improved surface water quality, better air quality, increased awareness and actions in waste management and disposal, and greater access to renewable and cleaner energy sources (Ranjbari et al., 2021). To promote social sustainability, a plan has been established to offer free, high-quality education to all boys and girls worldwide by 2030. The United Nations has reported that 617 million children lack basic literacy and math skills, which is expected to result in 200 million young people dropping out of school. (Ranjbari et al., 2021). To achieve economic sustainability, a goal has been set to eliminate world hunger and improve food accessibility, particularly in poor countries, by 2030. This is because approximately 8.9% of the global population, or roughly 690 million people, are currently experiencing hunger (Ranjbari et al., 2021). A study was conducted on the fishery to evaluate the three pillars of sustainability - social, economic, and environmental. This study used 121 distinct fishery systems from around the world to measure their scores for performance in these areas. (Asche et al., 2018). The sustainability of the global fishery is a pressing issue. Research has shown that a strong social management system is necessary for the fishery to thrive economically and environmentally (Asche et al., 2018). The United Nations has devised a plan to eradicate inequality among countries on a global scale, as revealed by a recent study on mapping sustainable development goals to promote social sustainability. To achieve this, they have developed a cartographic indicator that identifies injustices occurring in countries based on the sustainability development goals (SDGs) established by the United Nations. It's worth noting that the SDGs vary for each country worldwide (Kraak et al., 2018). Cartography is a technique used to create maps that aid in comprehending the geography of locations. (National Geographic, *Map* 2023). The cartographic visualisation will show the disparities related to SDG indicators and the problems that must be addressed. Map makers can assist in creating solutions specific to local areas, enhancing SDG, and reducing inequality (Kraak et al., 2018). According to a research article, the sustainability models and goals created by leading countries globally are ineffective due to a failure to recognise the ethics of unsustainability and how to address it. The article specifically focuses on the impact of unsustainability on victims (Kopnina, 2015). The ongoing economic and population growth is the root cause of environmental problems, hindering economic prosperity and social equality (Kopnina, 2015). It also argues that the lack of action of consumers to counteract hegemonic tendencies made by politicians and corporations to carry on economic growth, which might not be ethically sustainable, is the reason for unsustainability. A research study has determined that our current policies are insufficient to achieve the sustainable development goals (SDGs) by 2030. The study found that only 53% of the target goal will be reached by then (Moyer & Hedden , 2019); the SDGs aim to achieve safe sanitation, reduce underweight children, and increase upper secondary school completion. However, 28 of the most vulnerable countries (MVCs) are predicted to fall short of achieving any SDG targets and will require international assistance. The population in these countries is projected to grow from 751 million in 2015 to 1721 million in 2050. By 2030, it is expected that only 1 out of every four youths in these countries will survive (Moyer & Hedden , 2019). A research article carried out in the evolution of sustainability models finds that over the last few decades of study and review, the three spheres of a sustainability framework when engaged at its core, can turn challenging sustainability problems into solutions that can be followed by communities and stakeholders (Clune & Zehnder, 2020).

3 Methodology

3.1 Data Collection

An online website called the World Bank org (World Bank Group - International Development, Poverty, & Sustainability, 2023) was used for data collection. The organisation has 189 member countries, a staff representing over 170 countries, and offices in various locations (Getting to Know the World Bank, 2012). From 130 locations, the World Bank Group is an unparalleled global partnership (Getting to Know the World Bank, 2012). Its five institutions work towards sustainable solutions to reduce poverty and foster shared prosperity in the developing world (Getting to Know the World Bank, 2012). It has a vast collection of datasets, known as World Bank open data, that is free to access. The collection of datasets has numerous topics in fields such as agriculture, climate change, the financial sector, health, etc. Still, more importantly, it has various sustainability-related datasets that were downloaded and used for this dissertation project.

The dissertation utilised the three spheres of sustainability method to evaluate the overall sustainability impact of population trends. This method assesses social, environmental, and economic aspects of sustainability, and accordingly, datasets relevant to each of these categories were collected.

3.1.1 Quantitative analysis

For the dissertation project, all my datasets have a numerical value, which has been gathered from the World Bank organisation. Since this paper aims to evaluate and analyse the impact of population trends on the overall sustainability of developing and developed countries, quantitative data is needed for the numerical assessment of sustainability factors.
The Examples of qualitative data collected through existing data from the World Bank are industry, agriculture, and services datasets to assess economic sustainability, total greenhouse gas emissions data to determine environmental sustainability, unemployment dataset to assess social sustainability, etc., with various more data sets associated with economic, ecological, and social sustainability were used.

3.1.2 Qualitative analysis

Regarding qualitative analysis, Google Scholar, Science Direct, and Research Gate were used for results and discussions when analysing the charts and for literature review. Other official websites like worldbank.org were used to reference the datasets used in this study, and the line charts were used for comparison. World atlas was used to source maps of the four countries used.

3.2 Data analysis

- Data type- secondary as the datasets were collected online from the World Bank organisation.
- Software used to analyse the data: tableau for visualisation, which comprises mainly line chart comparison.
- The software used to analyse the data is Jupiter Notebook for data processing and cleaning. The gathered Excel datasets from the World Bank were processed and cleaned in Jupyter Notebook to be visualised in Tableau.
- Statistical methods used- line charts and histograms.

- Programming library/language used- Pandas, a Python library, was used for data processing and cleaning. Matplotlib is a Python plotting library used to plot histograms in jupyter notebook.

3.3 Limitations

The research was conducted in only four developed and two underdeveloped countries. However, a more comprehensive study can be done on population trends and sustainability. The topics covered in economic, environmental, and social sustainability were limited to only seven aspects, including industry and services for economic sustainability, greenhouse gas emissions and energy use per capita for environmental sustainability, and unemployment for social sustainability. Other areas could be explored further. The selected topic for this paper is broad, and if the word count is unrestricted, it can be researched more in-depth.

4 Chapter Analysis

4.1 Tools used.

Use of tableau for visualising graphs. The datasets of total population growth, annual population growth, Agriculture, forestry, fishing, Industry, services, total greenhouse gas emissions, energy use per capita, and unemployment were gathered from worldbank.org. And then was uploaded into Jupyter Notebook. Once the dataset was uploaded, it was then further processed & cleaned using Python, especially using the Pandas library, which uses Python as a language. The functions mainly used in Jupyter Notebook were import pandas as Pd to use the library pandas for data processing, pd.read_excel to read the Excel files which were extracted from worldbank.org that were saved in a data frame named DF, list & range function was used to pinpoint the rows and columns that needed to dropped, then drop function was used to remove the unwanted rows, display function, fillna and reset index were also used which are clarified more on figure 1 to figure 14 in depth. Then, the cleaned data from jupyter notebook was saved in a CSV file and was loaded into Tableau. Since the topic of this paper is to determine whether population trend impacts economic, social, and environmental sustainability, a comparison between the population trend with these three factors would be ideal. Hence, a line chart was created in Tableau using each cleaned CSV file downloaded from jupyter notebook.

Tableau was used to ease visualisation; it has a smooth user interface, multiple chart design options and overall comfort to implement. Line chart comparison between population trends and the three spheres of sustainability consisting of economic, environmental, and social factors were created, which can be referred to in figures 16 to 41 in the results and discussion chapter. Jupyter Notebook was used to clean and transform datasets as the commands coded are read fast and executed smoothly, the datasets are loaded quickly, and it's easy to create and save Python files. It doesn't lag like other coding platforms like Pycharm or Google Collab. All the datasets were cleaned using jupyter notebook. Jupyter notebook was used again to create histograms in the data analysis chapter. All cleaned datasets and charts are kept in the appendix section, which is the last chapter of this paper.

5 Data cleaning

5.1 Using Jupyter notebook

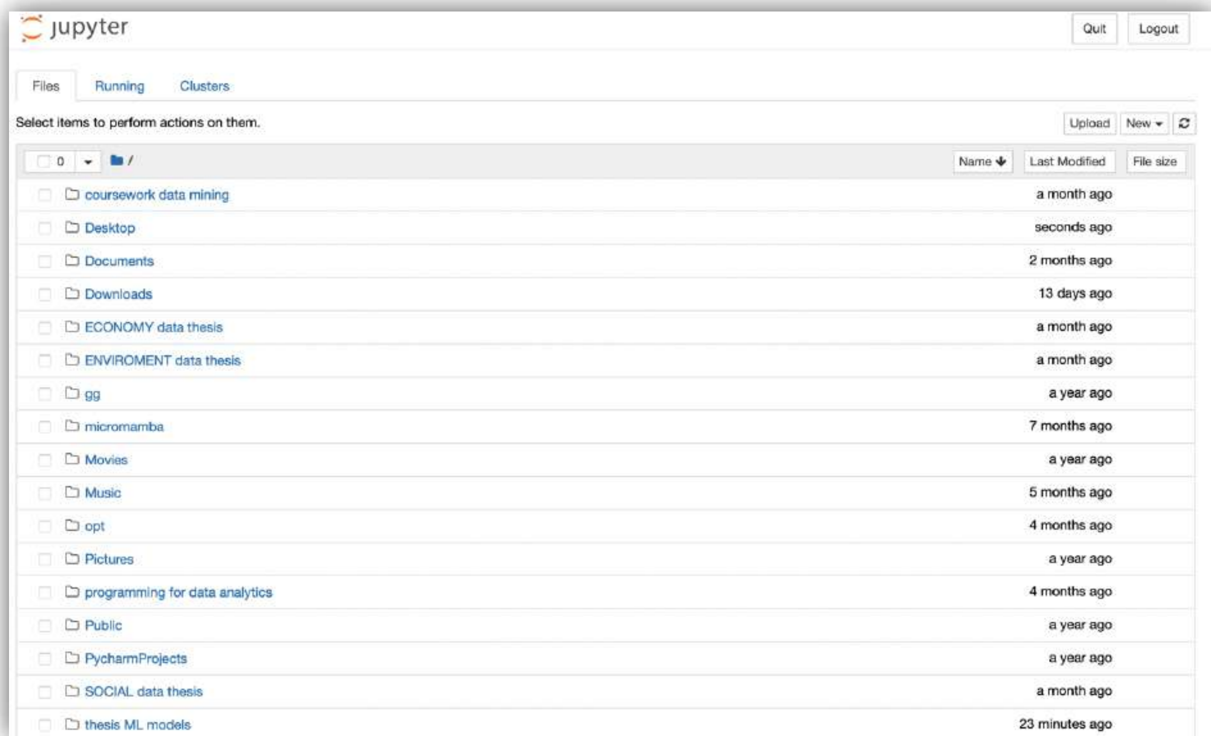


Figure 1, The home screen of Jupyter Notebook.

As you can see, multiple folders can be created, and inside multiple python files can be saved. For this paper, a total of 4 folders were designed.

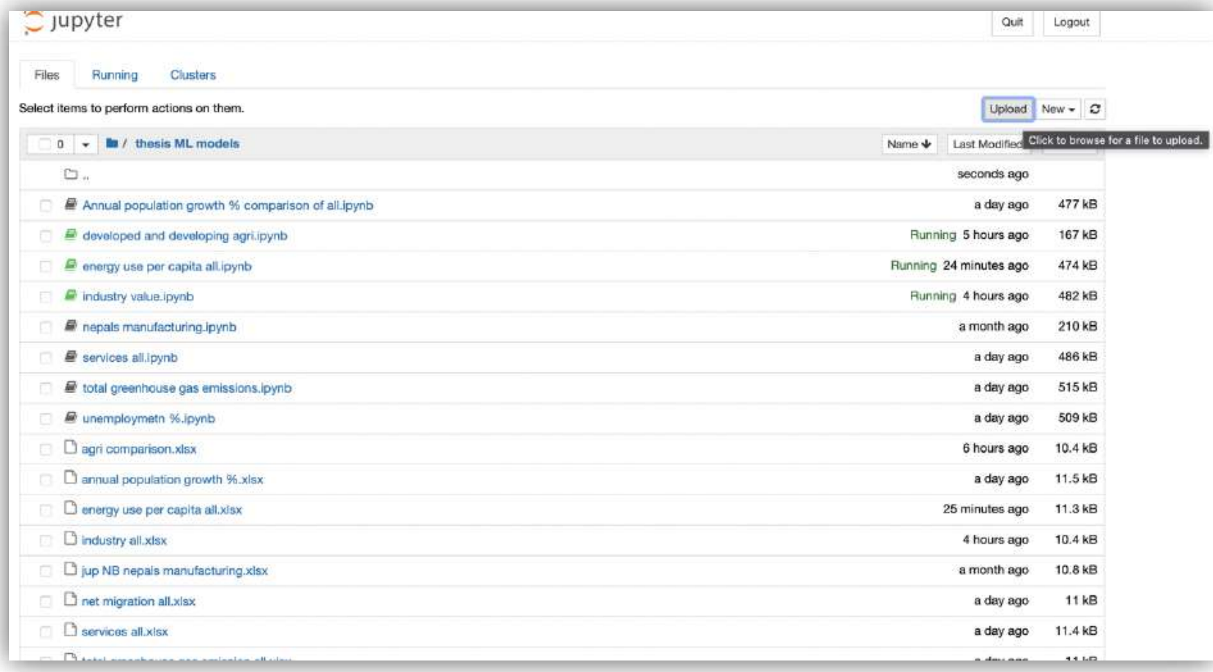


Figure 2, uploading a file.

There is an upload option in the top right corner to upload a file. For this paper, an Excel file extracted from worlbank.org was uploaded.

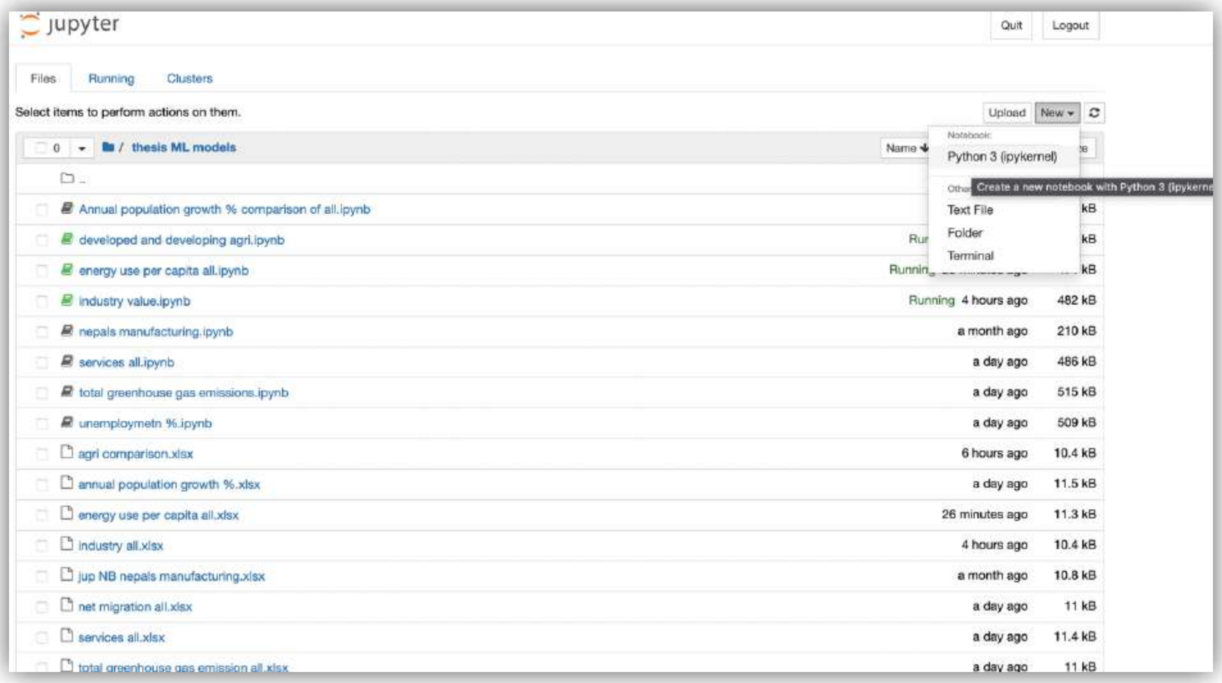


Figure 3, creating a Python file.

A new python file can be created by clicking the new option in the top right corner, which opens a fresh python page.

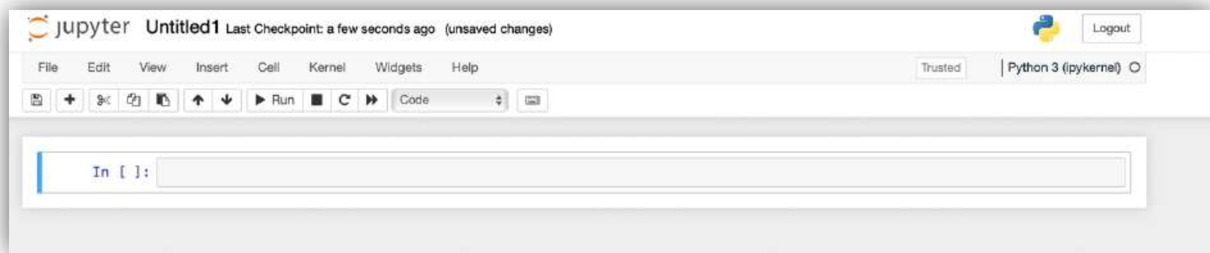
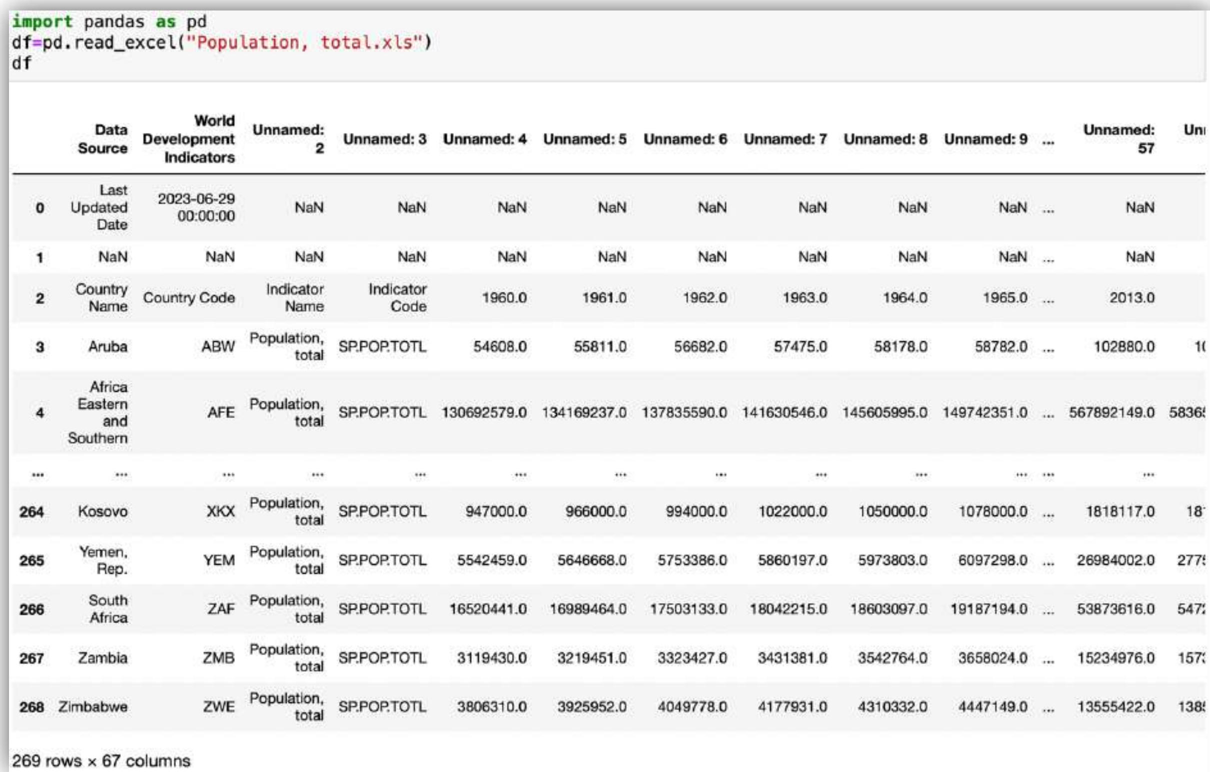


Figure 4, New Python file.

The figure above is where this paper's data cleaning and transforming part has been carried out.

5.2 Total population (cleaned and transformed data)



```
import pandas as pd
df=pd.read_excel("Population, total.xls")
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Un
0	Last Updated Date	2023-06-29 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	
3	Aruba	ABW	Population, total	SP.POP.TOTL	54608.0	55811.0	56682.0	57475.0	58178.0	58782.0	...	102880.0	1
4	Africa Eastern and Southern	AFE	Population, total	SP.POP.TOTL	130692579.0	134169237.0	137835590.0	141630546.0	145605995.0	149742351.0	...	567892149.0	5836
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	18
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	277
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	547
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	157
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	138

269 rows × 67 columns

Figure 5 Data cleaning using jupyter notebook.

In the presented Figure 1, the data cleaning process is demonstrated through utilising Jupyter Notebook software. The first step in the cleaning process is to import the library Pandas, a component of the widely used programming language Python. Managing large data sets is made easy by Python's Pandas library, which offers various functions for analysis, cleaning, exploration, and manipulation. With its statistical theories, users can draw valuable insights from their data. Moreover, Pandas can effectively organise and refine messy data sets to make them more meaningful and coherent (Pandas introduction, 2023). To load the Excel dataset for the total population into Jupyter Notebook, the panda's library is imported as "pd" and the "read_excel" command is applied. The dataset is named "df" and is sourced from the globally renowned website "worldbank.org”. (world bank, Population, total 2023), It is necessary to clean the data as it contains numerous null values and has 268 rows representing countries with 67 columns. However, only data from four countries is required for the research analysis, which amounts to four rows, one header, and fewer columns than 67. Therefore, the dataset needs to be cleaned to ensure accurate analysis.

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 269 entries, 0 to 268
Data columns (total 67 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Data Source                 268 non-null    object
 1   World Development Indicators 268 non-null    object
 2   Unnamed: 2                  267 non-null    object
 3   Unnamed: 3                  267 non-null    object
 4   Unnamed: 4                  265 non-null    float64
 5   Unnamed: 5                  265 non-null    float64
 6   Unnamed: 6                  265 non-null    float64
 7   Unnamed: 7                  265 non-null    float64
 8   Unnamed: 8                  265 non-null    float64
 9   Unnamed: 9                  265 non-null    float64
 10  Unnamed: 10                 265 non-null    float64
 11  Unnamed: 11                 265 non-null    float64
 12  Unnamed: 12                 265 non-null    float64
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 27  Unnamed: 27                 265 non-null    float64
 28  Unnamed: 28                 265 non-null    float64
 29  Unnamed: 29                 265 non-null    float64
 30  Unnamed: 30                 265 non-null    float64
 31  Unnamed: 31                 265 non-null    float64
 32  Unnamed: 32                 265 non-null    float64
```

Figure 6 df.info ()

In the second figure, the command df.info () provides essential information about the dataset. This includes the total number of entries, 269 rows, and the total number of columns, 67. It also includes information for each column with indexes, such as the number of non-null values and the data type of each row, whether it is a float, int, or object. This command helps summarise the earlier stages of data cleaning.

```
 34   Unnamed: 34                   266 non-null    float64
 35   Unnamed: 35                   266 non-null    float64
 36   Unnamed: 36                   266 non-null    float64
 37   Unnamed: 37                   266 non-null    float64
 38   Unnamed: 38                   266 non-null    float64
 39   Unnamed: 39                   266 non-null    float64
 40   Unnamed: 40                   266 non-null    float64
 41   Unnamed: 41                   266 non-null    float64
 42   Unnamed: 42                   266 non-null    float64
 43   Unnamed: 43                   266 non-null    float64
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 55   Unnamed: 55                   266 non-null    float64
 56   Unnamed: 56                   266 non-null    float64
 57   Unnamed: 57                   266 non-null    float64
 58   Unnamed: 58                   266 non-null    float64
 59   Unnamed: 59                   266 non-null    float64
 60   Unnamed: 60                   266 non-null    float64
 61   Unnamed: 61                   266 non-null    float64
 62   Unnamed: 62                   266 non-null    float64
 63   Unnamed: 63                   266 non-null    float64
 64   Unnamed: 64                   266 non-null    float64
 65   Unnamed: 65                   266 non-null    float64
 66   Unnamed: 66                   266 non-null    float64
dtypes: float64(63), object(4)
memory usage: 140.9+ KB
```

Figure 7 Continuation of cleaning.

In continuation of the '.info ()' command, Figure 3 summarises the number of data types and total memory usage.

```
index_list = list(range(0,2))
df.drop(df.index[index_list], inplace =True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Ui
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	
3	Aruba	ABW	Population, total	SP.POP.TOTL	54608.0	55811.0	56682.0	57475.0	58178.0	58782.0	...	102880.0	
4	Africa Eastern and Southern	AFE	Population, total	SP.POP.TOTL	130692579.0	134169237.0	137835590.0	141630546.0	145605995.0	149742351.0	...	567892149.0	583
5	Afghanistan	AFG	Population, total	SP.POP.TOTL	8622466.0	8790140.0	8969047.0	9157465.0	9355514.0	9565147.0	...	31541209.0	32
6	Africa Western and Central	AFW	Population, total	SP.POP.TOTL	97256290.0	99314028.0	101445032.0	103667517.0	105959979.0	108336203.0	...	387204553.0	397
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13

267 rows × 67 columns

Figure 8 uses functions list, range, index, drop & inplace.

In the above figure, I have dropped two rows before the country name. To carry this out, the list function is used to fit the rows to be dropped. Python offers a helpful function called 'list' that allows you to create an ordered and mutable data collection, known as a list object. This is an excellent option for storing multiple items in a single variable and is one of the four default data types in Python commonly used for storing data collections. The list function makes analysing data easier (w3school, Python lists 2023). Python's range function quickly generates a sequence of numbers within a specified range, making it easy to repeat actions or achieve desired results (Simplilearn, 2023). Here, the range function is used to drop the sequence of rows, explicitly starting from 0 to 2. The 'index ()' function in Python is used for finding the position of an element in a string or list. It returns the element's index from the list's lowest possible work (S, 2023). The index function is used to pinpoint the rows' positions that need to be dropped. The 'in place ()' function is used to modify and store the desired results permanently; here, it is used to drop the rows permanently. Finally, the function 'drop. ()' is utilised to drop the rows in question.

```python
index_list = list(range(1,14))
df.drop(df.index[index_list], inplace =True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
17	Austria	AUT	Population, total	SP.POP.TOTL	7047539.0	7086299.0	7129864.0	7175811.0	7223801.0	7270889.0	...	8479823.0	8546356.0
18	Azerbaijan	AZE	Population, total	SP.POP.TOTL	3894500.0	4045750.0	4168150.0	4293550.0	4439250.0	4574650.0	...	9416801.0	9535079.0
19	Burundi	BDI	Population, total	SP.POP.TOTL	2746628.0	2815972.0	2887398.0	2948133.0	3033221.0	3118134.0	...	10149577.0	10494913.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1812771.0
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27753304.0
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54729551.0
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15737793.0
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13855753.0

254 rows × 67 columns

Figure 9 Removal of Rows.

In Figure 5, the same functions are used, and the same process is repeated to drop the unwanted rows/columns permanently.

```python
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0
85	Georgia	GEO	Population, total	SP.POP.TOTL	3645600.0	3703600.0	3760300.0	3816100.0	3870300.0	3921600.0	...	3717668.0	3719414.0
86	Ghana	GHA	Population, total	SP.POP.TOTL	6911510.0	7109029.0	7281192.0	7458243.0	7640196.0	7827726.0	...	27525597.0	28196358.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1812771.0
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27753304.0
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54729551.0
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15737793.0
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13855753.0

187 rows × 67 columns

Figure 10 Further Removal of Rows.

The identical procedure is repeated in Figure 6 to skim the rows further.

```
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0
85	Georgia	GEO	Population, total	SP.POP.TOTL	3645600.0	3703600.0	3760300.0	3816100.0	3870300.0	3921600.0	...	3717668.0	3719414.0
86	Ghana	GHA	Population, total	SP.POP.TOTL	6911510.0	7109029.0	7281192.0	7458243.0	7640196.0	7827726.0	...	27525597.0	28196358.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1812771.0
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27753304.0
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54729551.0
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15737793.0
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13855753.0

187 rows × 67 columns

Figure 11 Further Removal of Rows.

Removing rows and any unwanted columns till only the desired four countries, Australia, the United Kingdom, Nepal, and the Philippines, remain.

```
index_list = list(range(3,99))
df.drop(df.index[index_list], inplace =True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0
181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	...	27381555.0	27462106.0
182	Nauru	NRU	Population, total	SP.POP.TOTL	4582.0	4753.0	4950.0	5198.0	5484.0	5804.0	...	10694.0	10940.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1812771.0
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27753304.0
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54729551.0
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15737793.0
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13855753.0

91 rows × 67 columns

Figure 12 Further Trimming of Rows.

In the figure above (Figure 8), Australia, the UK, and Nepal have been filtered out.

```
index_list = list(range(4,12))
df.drop(df.index[index_list], inplace =True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0
181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	...	27381555.0	27462106.0
190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	32805538.0	...	99700107.0	101325201.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Population, total	SP.POP.TOTL	947000.0	966000.0	994000.0	1022000.0	1050000.0	1078000.0	...	1818117.0	1812771.0
265	Yemen, Rep.	YEM	Population, total	SP.POP.TOTL	5542459.0	5646668.0	5753386.0	5860197.0	5973803.0	6097298.0	...	26984002.0	27753304.0
266	South Africa	ZAF	Population, total	SP.POP.TOTL	16520441.0	16989464.0	17503133.0	18042215.0	18603097.0	19187194.0	...	53873616.0	54729551.0
267	Zambia	ZMB	Population, total	SP.POP.TOTL	3119430.0	3219451.0	3323427.0	3431381.0	3542764.0	3658024.0	...	15234976.0	15737793.0
268	Zimbabwe	ZWE	Population, total	SP.POP.TOTL	3806310.0	3925952.0	4049778.0	4177931.0	4310332.0	4447149.0	...	13555422.0	13855753.0

83 rows × 67 columns

Figure 13 Further Trimming of Rows.

Figure 9 depicts the filtering process that successfully identified the four desired countries. However, it is observed that 78 rows require cleaning.

```
index_list = list(range(5,83))
df.drop(df.index[index_list], inplace =True)
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0
181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	...	27381555.0	27462106.0
190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	32805538.0	...	99700107.0	101325201.0

5 rows × 67 columns

Figure 14 Four countries.

Figure 10 displays the four countries that are under analysis in this project. However, additional transformation is necessary since the data must be cleaned.

```
header_row = 0
df.columns = df.iloc[header_row]
df
```

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0	23
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0	65
181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	...	27381555.0	27462106.0	27
190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	32805538.0	...	99700107.0	101325201.0	103

5 rows × 67 columns

Figure 15, Renaming Header.

Figure 11 shows the renamed header, as there was no transparent header when the dataset was initially loaded.

```
df.drop([2],inplace=True)
df
```

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	
16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	...	23128129.0	23475686.0	23
84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	...	64128273.0	64602298.0	65
181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	...	27381555.0	27462106.0	27
190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	32805538.0	...	99700107.0	101325201.0	103

4 rows × 67 columns

```
df=df.reset_index()
df
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0
0	16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	...	23128129.0	23475686.0	23815995.0
1	84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	...	64128273.0	64602298.0	65116219.0
2	181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	...	27381555.0	27462106.0	27610325.0
3	190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	...	99700107.0	101325201.0	103031365.0

4 rows × 68 columns

Figure 16, Further Data Cleaning.

The first row in Figure 12 has been removed because it is identical to the header. Additionally, the 'reset index' command has been utilised to number the index of each column in ascending order.

```
with pd.option_context('display.max_rows', None, 'display.max_columns', None):
    display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	1967.0	
0	16	Australia	AUS	Population, total	SP.POP.TOTL	10276477.0	10483000.0	10742000.0	10950000.0	11167000.0	11388000.0	11651000.0	11799000.0	120
1	84	United Kingdom	GBR	Population, total	SP.POP.TOTL	52400000.0	52800000.0	53250000.0	53650000.0	54000000.0	54348050.0	54648500.0	54943600.0	552
2	181	Nepal	NPL	Population, total	SP.POP.TOTL	10167941.0	10365144.0	10570716.0	10782717.0	11002819.0	11232951.0	11470199.0	11715579.0	119
3	190	Philippines	PHL	Population, total	SP.POP.TOTL	28486871.0	29342411.0	30185979.0	31043711.0	31916622.0	32805538.0	33704749.0	34616857.0	355

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4 entries, 0 to 3
Data columns (total 68 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   index           4 non-null      int64
 1   Country Name    4 non-null      object
 2   Country Code    4 non-null      object
 3   Indicator Name  4 non-null      object
 4   Indicator Code  4 non-null      object
 5   1960.0          4 non-null      float64
 6   1961.0          4 non-null      float64
 7   1962.0          4 non-null      float64
 8   1963.0          4 non-null      float64
 9   1964.0          4 non-null      float64
 10  1965.0          4 non-null      float64
 11  1966.0          4 non-null      float64
 12  1967.0          4 non-null      float64
 13  1968.0          4 non-null      float64
 14  1969.0          4 non-null      float64
 15  1970.0          4 non-null      float64
```

Figure 17, Results of the Cleaned dataset.

Here in Figure 13, the function ‘option context’ allows to set options and display the maximum number of rows and columns of the entire dataset. The function ‘info’ is used again to display the total number of columns, 68 columns, and the total number of entries, which is four, whereas before cleaning, it was 269 and 67 columns.

```
 59   2014.0            4 non-null      float64
 60   2015.0            4 non-null      float64
 61   2016.0            4 non-null      float64
 62   2017.0            4 non-null      float64
 63   2018.0            4 non-null      float64
 64   2019.0            4 non-null      float64
 65   2020.0            4 non-null      float64
 66   2021.0            4 non-null      float64
 67   2022.0            4 non-null      float64
dtypes: float64(63), int64(1), object(4)
memory usage: 2.2+ KB
```

```
df.isna().sum()
```

```
2
index             0
Country Name      0
Country Code      0
Indicator Name    0
Indicator Code    0
                 ..
2018.0            0
2019.0            0
2020.0            0
2021.0            0
2022.0            0
Length: 68, dtype: int64
```

Figure 18, Results of cleaned data.

Figure 14 shows that the data memory usage has significantly decreased from 140.9+ KB to 2.2+KB after cleaning. Detecting null or missing values within the data is quickly done using the 'is na' function. Furthermore, the 'sum' function provides the total value of these null or missing values. Hence, applying the 'is na' and 'sum' functions allows for quick checking of the total number of null values in the data, which is zero. This confirms that the data has been successfully cleaned and is now free of missing values.

More datasets have been sourced from the World Bank. They are cleaned similarly; datasets of annual population growth, manufacturing, services, agricultural forestry and fishing, net migration, etc., have been transformed and cleaned for data visualisation/modelling. All of the transformed and cleaned data are listed in the appendix section.

5.3 Tableau

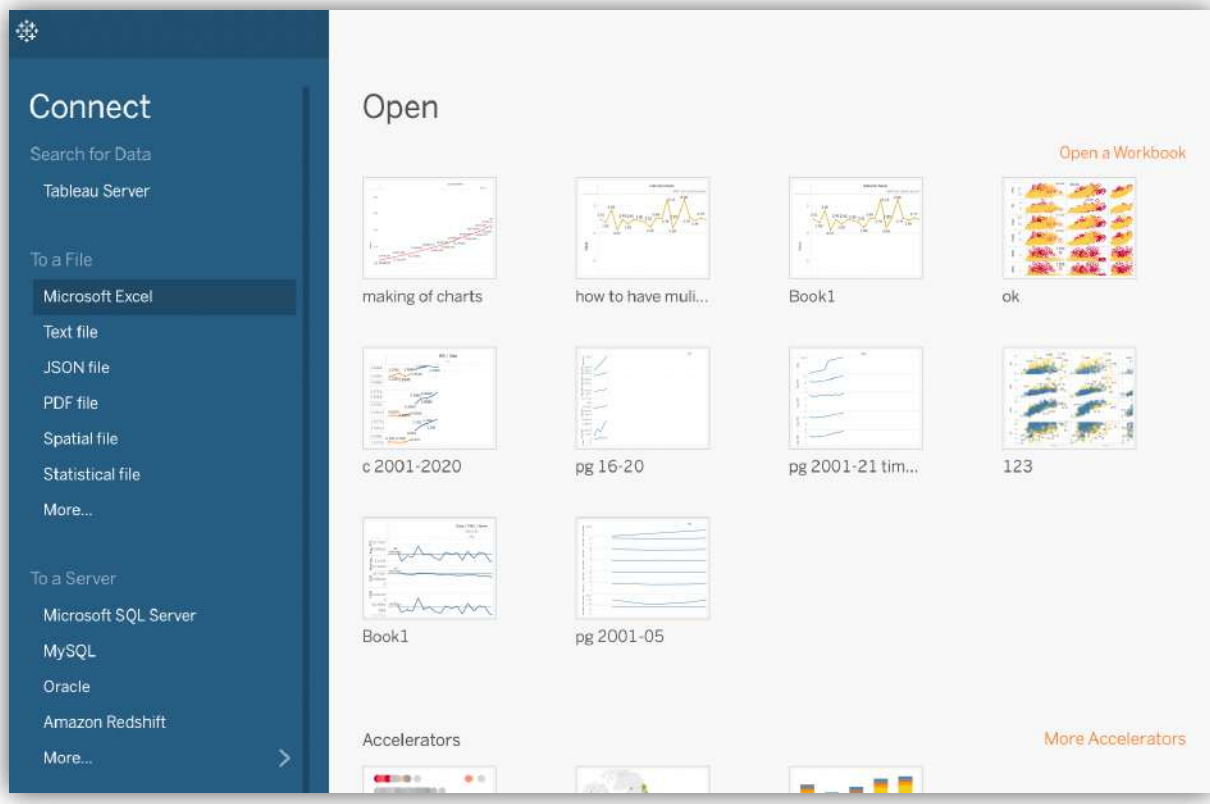

Figure 19, Tableau loading screen.

After cleaning the dataset in Jupyter Notebook, it was saved in Excel and imported into Tableau using the Microsoft Excel option.

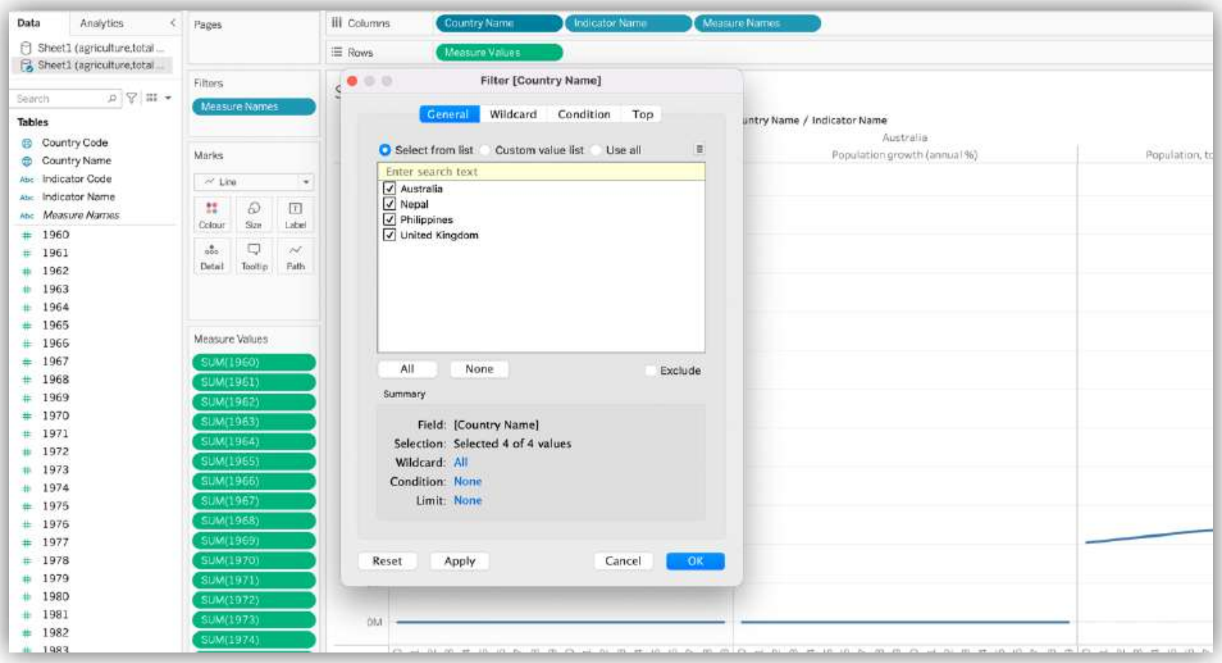

Figure 20, after loading the file.

Upon loading an Excel dataset into Tableau, the software will display a screen featuring tables on the left-hand side that show the values of the uploaded dataset. On the top right-hand side of the screen, there are rows and column options where data from the tables on the left can be dragged and dropped. To create a comparison line chart, it is necessary to filter the selected data to a specific country.

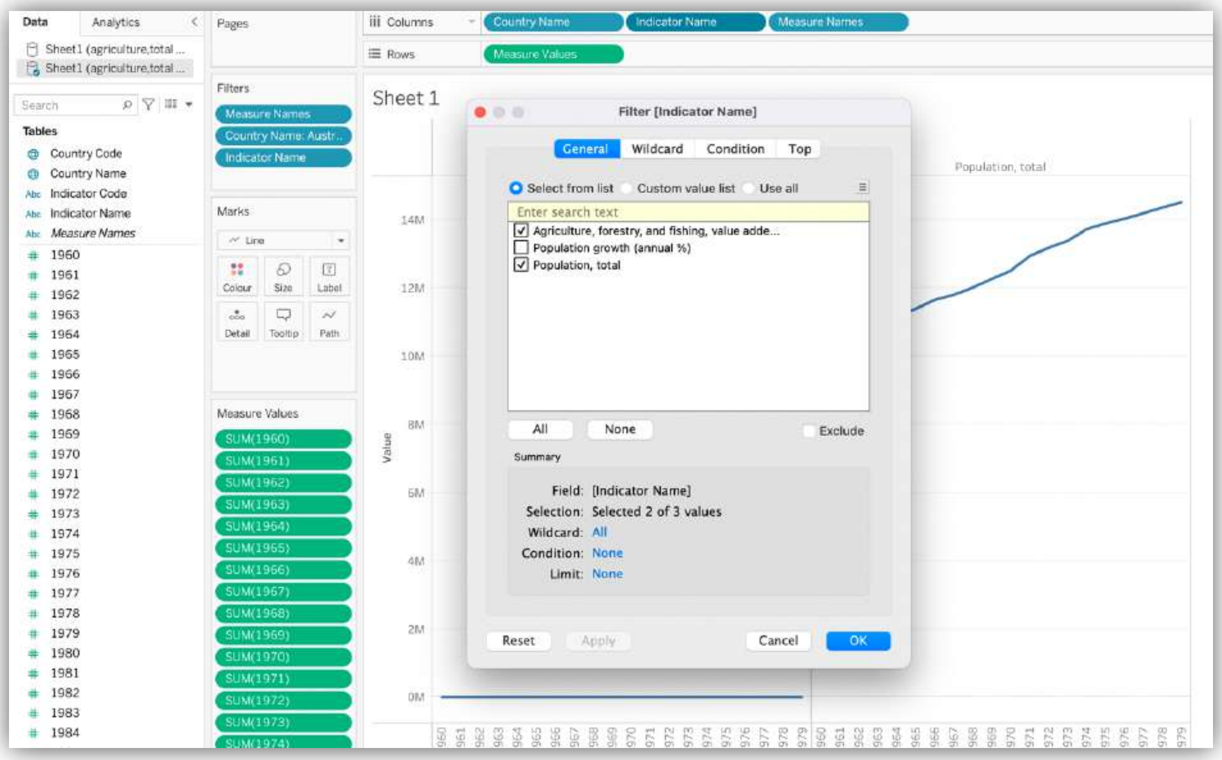

Figure 21, selection of specific topic.

In the above figure, agriculture, forestry, fishing, and total population growth have been filtered out for comparison.

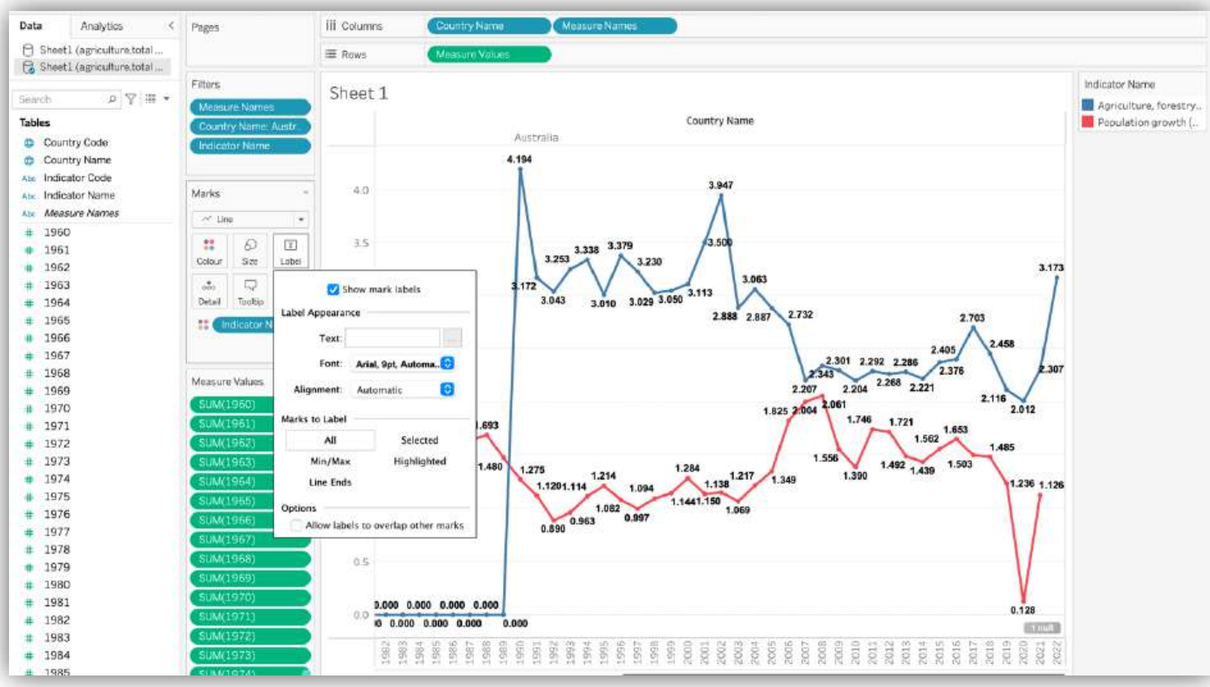

Figure 22, the result of the line chart.

In the line chart, the indicator chart was dragged to the colour option in the middle section to create two different colours to distinguish the line. Moreover, the label option indicated the agriculture and population growth rate from 1990 to 2022.

6 Results and Discussions

6.1 Developing Countries

6.1.1 Nepal

Figure 23, Political Map of Nepal (Political Map of Nepal, 2023).

Nepal, located in the Himalayas north of India, has a diverse population of various ethnicities, languages, and religions. It is a landlocked country that boasts some of the world's tallest mountains, including Sagarmatha (also known as Mt. Everest), which it shares with Tibet, a province of China. Kathmandu, with a population of 30.3 million in 2021, is the largest city in Nepal. Nepali is the official language spoken by half of the people, while the other half says one of the 120 Tibeto-Burman languages. The majority of Nepalese, about 81%, practice Hinduism as their primary religion, with around 9% following Buddhism. (*Nepal - A country profile - nations online project*, 2023).

Nepal is classified as a developing country due to its inadequate infrastructure and low individual income compared to global standards. The World Bank has published data indicating that Nepal has reduced poverty by 50% in just seven years, which is commendable progress. However, Nepal still faces obstacles in achieving sustainable economic growth and increasing per capita income, putting it behind other Asian countries (*Climbing higher: Toward a middle-income Nepal*, 2017).

6.1.1.1 Economic

6.1.1.1.1 Industry sector

Figure 24, Line chart comparison of industry value added % of GDP against annual population growth % & total population growth. Created from Tableau & sourced from the World Bank (Industry (including construction), value added (% of GDP), 2023).

The red line shows the percentage of industry value added to total GDP, which increased from 10.85% in 1965 to 21.49% in 1996 before falling to 12.05% in 2020. Meanwhile, the blue line depicts the total population growth, which increased from 11 million in 1965 to 29 million in 2020. This indicates that population growth does not directly impact industry value, and other factors such as the economy, environment, diseases, war, and politics may play a role.

Nepal's industrial growth is hindered due to insufficient infrastructure development despite a growing population. More funding is needed to ensure infrastructure development in Nepal (Collegenp, 2023). The government's limited budget and lack of private sector investments cannot meet the growing population's needs. Increasing investments in new infrastructure development and maintaining existing infrastructure is crucial to address this issue (Collegenp, 2023). Political disputes and frequent government changes are adversely affecting infrastructure development in Nepal. These delays have significantly impeded progress in the sector (Collegenp, 2023). Another significant obstacle is the need for more technical expertise in government and private sectors (Collegenp, 2023). The absence of skilled personnel to design, build, and maintain infrastructure projects has resulted in substandard infrastructure (Collegenp, 2023). Nepal's rugged terrain and complex geography have also made infrastructure development highly challenging in many parts of the country (Collegenp, 2023). As a result, rural areas have limited access to essential services such as electricity, water supply, and sanitation (Collegenp, 2023). Corruption has been a significant hurdle in developing Nepal's infrastructure and access to services (Collegenp, 2023).
The lack of transparency and accountability in government procurement and contracting processes has led to corruption in allocating contracts for infrastructure projects (Collegenp, 2023). *Corruption* is a serious matter that requires attention. The Nepalese government appears to rely heavily on the BOOT model for infrastructure project development. While this model has been successful for hydropower projects, it is unsuitable for large projects like roads, as revenue risk cannot be allocated under this model. The government should consider alternatives such as Build Own Lease (BOL), Built Lease Operate (BLOT), or Engineering, Procurement, Construction and Financing (EPCF) models (Neupane et al., 2017). Infrastructure development is crucial for economic growth, and Nepal is no exception. However, the country has faced challenges such as insufficient funding, poor planning, and inadequate maintenance. Despite these challenges, the government has improved infrastructure by investing in roads, bridges, and

hydroelectric power plants to increase access to electricity (Collegenp, 2023). Unfortunately, Nepal's infrastructure development has been slow compared to neighbouring countries. The lack of maintenance has also been a significant issue, with many roads and bridges falling into disrepair. According to the World Bank, only 40% of rural residents can access essential services like electricity, water, and sanitation, hindering economic growth and development (Collegenp, 2023). Poor road conditions in rural areas also make it difficult to transport goods and people, negatively impacting agriculture, which is the primary source of income for many rural families (Collegenp, 2023).

6.1.1.1.2 Service sector

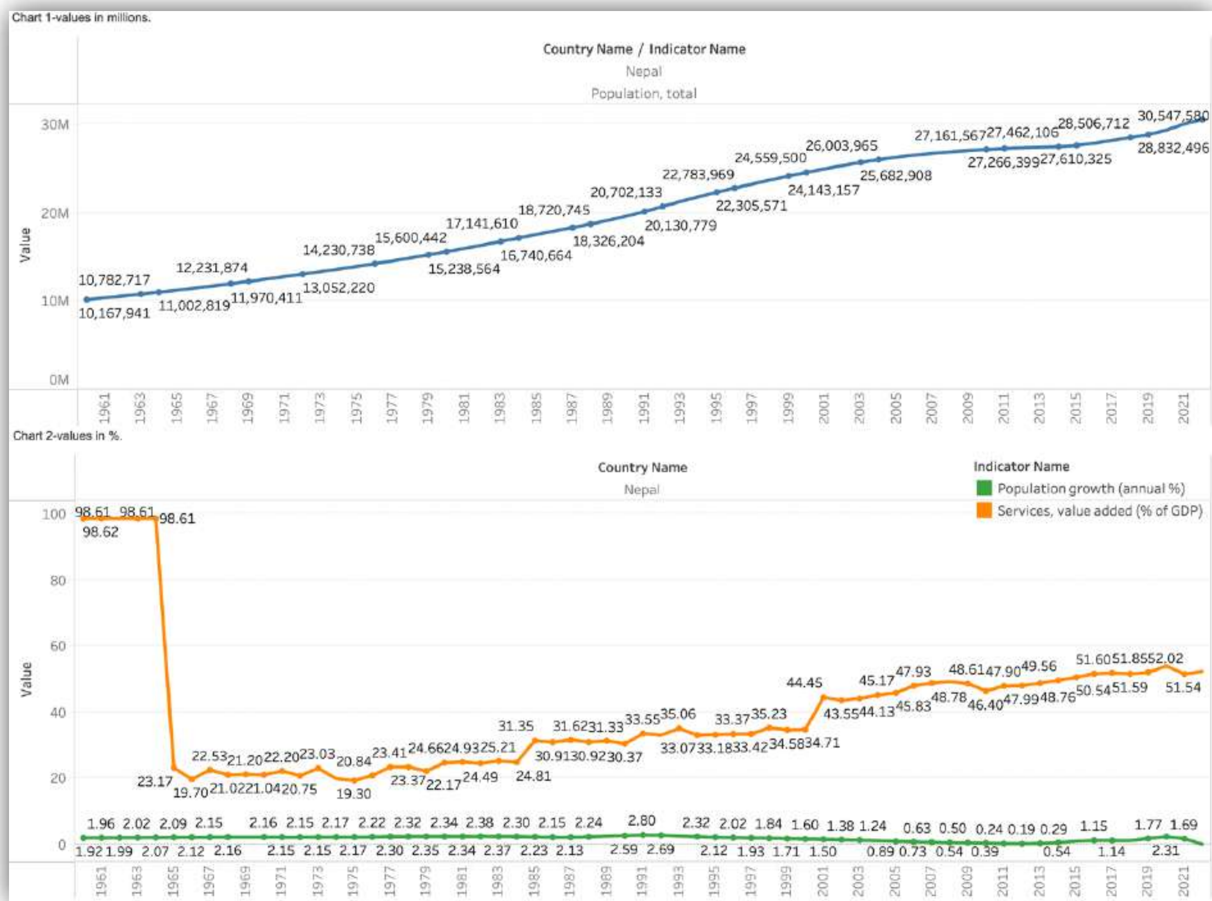

Figure 25, Line chart comparison of Service Sector value added % of GDP against Annual Population Growth % & Total Population. Created from Tableau & sourced from the World Bank (Services, value added (% of GDP), 2023).

The chart shows Nepal's service value added to GDP (orange line) from 1965 to 2019, reaching a peak of 52.2%. Meanwhile, the total population (blue line) grew from 11 million to 28 million, indicating a positive impact of population trends on the service sector.

The service sector is the most significant contributor to Nepal's GDP, accounting for 61.76% (Hays, 2019). The service sector plays a crucial role in reducing Nepal's unemployment problem. Although the lack of industries and unfavourable trade conditions force many Nepalese to seek employment abroad, establishing private hospitals, restaurants, schools and colleges, banks, and hotels provides employment opportunities that boost individuals' and the nation's economic status (*Present State Of Service Sectors And Its Importance,* 2020). However, the persistent high population growth rate means the employment problem still exists (*Present State Of Service Sectors And Its Importance,* 2020). Many Nepalese work overseas and send money back to Nepal to support their livelihoods, contributing to the nation's increasing per capita income (*Present State Of Service Sectors And Its Importance,* 2020). Growing concerns about climate change and an unreliable fuel market have led Nepal to plan a shift towards an electric-based transportation system (Mali et al., 2022). To attract electric vehicle (EV) companies, favourable policies and tax exemptions should be introduced, and public charging stations and parking lots should be constructed (Mali et al., 2022). To limit costs, concentrated points of energy demand in cities can be met through power infrastructure upgrades (Mali et al., 2022). Nepal can spark new city growth by improving transportation infrastructure in newly established nodes (Pokharel, 2021). A study found that transport improvements facilitate urbanisation and lead to higher regional GDP per capita in Nepal (Pokharel, 2021). However, regional income inequality is associated with uneven distribution of transport infrastructure and cities (Pokharel, 2021). Motorised transportation would increase public health facility coverage within a 5-minute distance by 62.13% (Cao et al., 2021). Travel time to primary, secondary, and tertiary facilities would be 17.91, 39.88, and 69.23 minutes respectively (Cao et al., 2021). Low accessibility to primary and tertiary facilities was found in less developed areas (Cao et al., 2021). A study uses 16 five-star hotels in Kathmandu (the capital of Nepal) with 1,343 rooms and 54 restaurants. They employed 3,065 people, averaging 192 per hotel. The study suggests that employees in the five-star hotel sector should receive refresher training (Jha & Rijal, 2022). The government and hotels should work together to improve policies and offer retirement benefits to retain employees (Jha & Rijal, 2022). Online education in Nepal faces challenges in delivering technical subjects due to low attendance and technological barriers (Reader et al., 2020). Sustainable online learning relies heavily on information and communication technology (ICT) and educational technology (Reader et al., 2020). Higher education students face challenges such as poor internet access, irregular electricity, and inadequate support (Reader et al., 2020). Institutions should provide more digital resources and support services. The teacher-centred approach creates passive learners (Reader et al., 2020). Nepalese women prefer private healthcare for maternal and child needs (Adhikari et al., 2021). This highlights the importance of public-private partnerships in healthcare (Adhikari et al., 2021). In Nepal, Cardiovascular diseases (CVD) is the primary cause of mortality (Shrestha et al., 2021). Less than 10% have health insurance, and over 50% of health spending is out of pocket (Shrestha et al., 2021). Nepal's CVD prevention and management programs are negatively affected by a lack of resources, weak monitoring, and inadequate stakeholder engagement (Shrestha et al., 2021). Funding for CVDs is negligible, and policies and strategies must be strengthened (Shrestha et al., 2021). Governments should prioritise CVD care and partner with NGOs to improve services (Shrestha et al., 2021). The government needed to coordinate COVID-19 prep, resulting in inadequate resources and testing (Shrestha et al., 2022). Coordination and incentives are necessary for healthcare workers (Shrestha et al., 2022). Green supply chain management (GSCM) enhances sustainability and reduces environmental impact (Pandey & Jjirojhul, 2023). The Nepalese garment industry commonly uses eco-design, green sourcing, logistics, and end-of-life management as the most common GSCM strategies (Pandey & Jjirojhul, 2023). This strategy reduces emissions and waste and conserves resources (Pandey & Jjirojhul, 2023). GSCM also improves supply chain efficiency and brand reputation and promotes well-being (Pandey & Jjirojhul, 2023).

6.1.1.2 Environmental

6.1.1.2.1 Total Greenhouse gasses (CO2 equivalent).

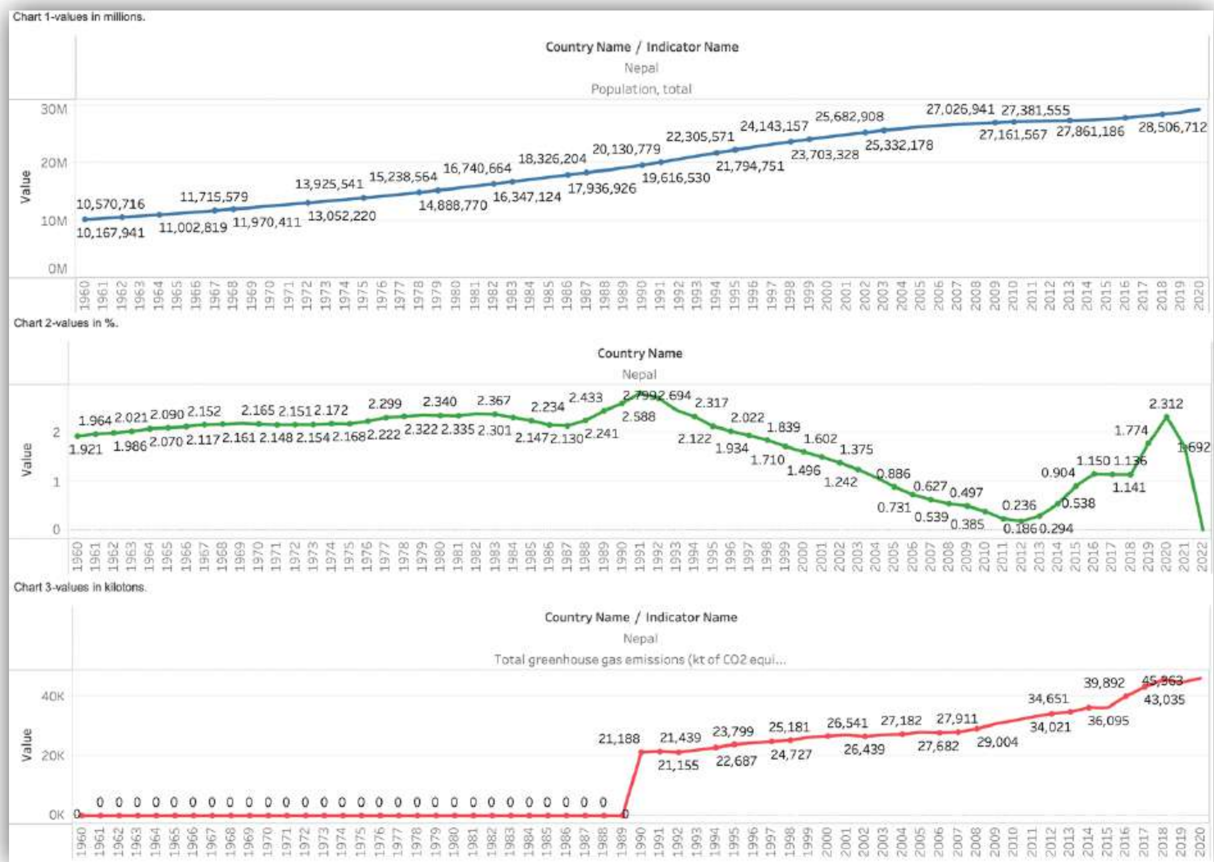

Figure 26, Line chart comparison of total greenhouse gas emission (kt of CO2 equivalent) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Total greenhouse gas emissions (kt of CO2 equivalent), 2023).

From 1990 to 2020, greenhouse gas emissions (represented by the red line), the Greenline means annual population growth and population growth (represented by the blue line) increased. This suggests a positive correlation between population growth and greenhouse gas emissions, negatively impacting greenhouse gas emissions.

The study on the impact of carbon emissions on Nepal's population growth has revealed some crucial findings. The study found a strong positive correlation between carbon dioxide emissions and fossil fuel energy consumption over the long term (Regmi & Rehman, 2021). In contrast, a negative correlation exists between CO2 emissions, population growth, and economic progress (Regmi & Rehman, 2021). The study also found a positive correlation between CO2 emissions and fossil fuel energy consumption (Regmi & Rehman, 2021). It has been discovered that the increase in population and economic development elevates CO2 emissions (Regmi & Rehman, 2021). Nepali officials must take prompt and efficient action to reduce CO2 emissions to contribute to the global effort to decrease air pollution. A study on Nepal's energy sector and the Kyoto Protocol discovered that Nepal utilises the Kyoto Protocol to regulate the use of resources to reduce or limit the emission of gases that contribute to the greenhouse gas inventory in the atmosphere (Pokharel, 2006). The research indicates that the increased presence of biomass-based greenhouse gases is primarily a result of population growth (Pokharel, 2006).

6.1.1.2.2 Energy Consumption/Production

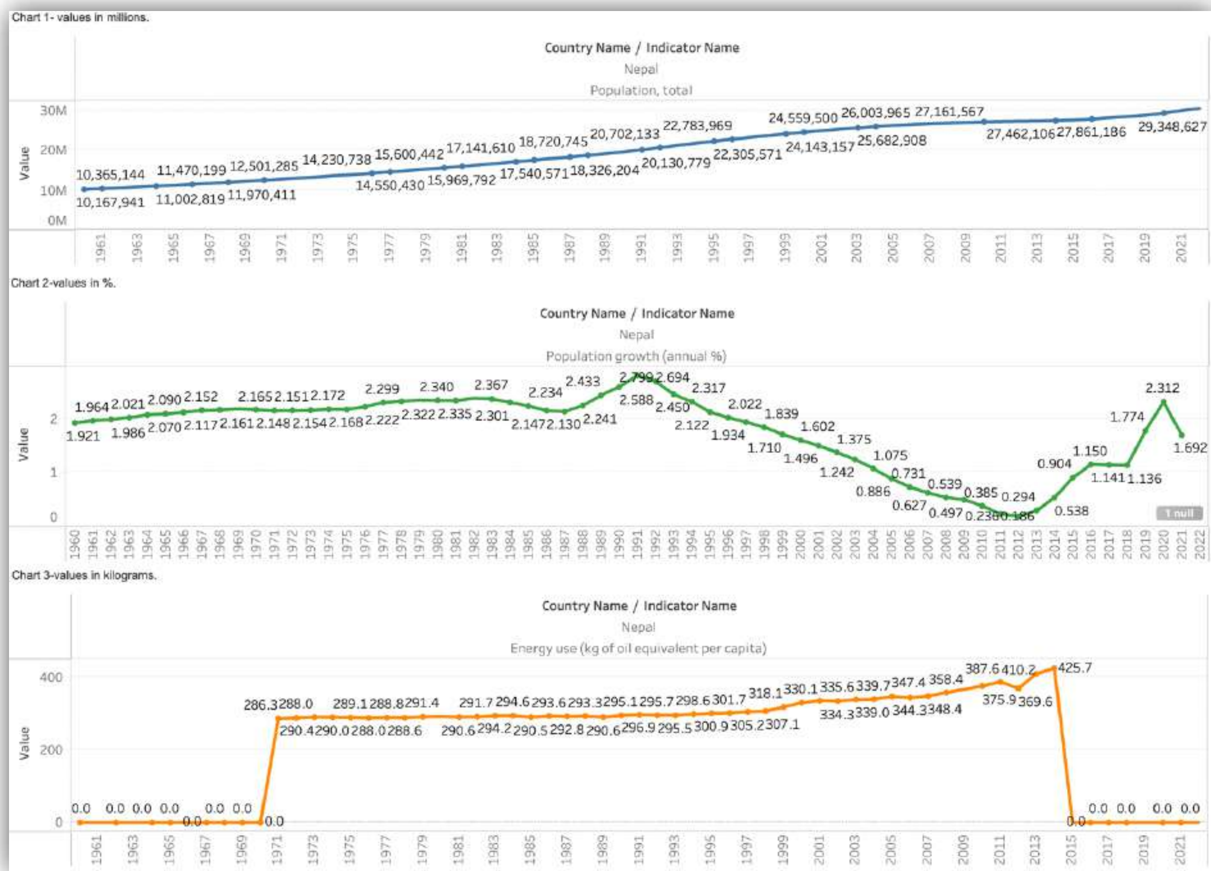

Figure 27, Line chart comparison of 3 different charts. Created from Tableau & sourced from the World Bank (Energy use (kg of oil equivalent per capita), 2014).

The orange line, representing energy use, shows a steady increase from 286 kilograms in 1971 to 425.7 kilograms in 2015. At the same time, the blue line, representing total population growth, rises from 10 million to 30 million between 1961 and 2022. This indicates a positive correlation between population growth and energy use. In other words, as the population grows, energy use per person also increases over time, suggesting a negative impact on energy sustainability.

A study on renewable energy in Nepal revealed that 90% of energy consumption is used for residential purposes, while 3% is used for industrial, 5% for transport, and 1% for commercial and agricultural purposes (K.C. et al., 2011). According to the study, Nepal primarily relies on wood as a fuel source, which falls under biomass (K.C. et al., 2011). Nepal's modern energy consumption is gradually increasing, with approximately 20% coming from electricity, petroleum, and renewables (Sanjel et al., 2022). Petrol consumption is highest at 65%, while Electricity makes up 15%. Access to Electricity is limited in remote areas, leading to rising demand for renewable energy sources. Nepal has set targets for sustainable, modern energy for all, aiming for net-zero emissions by 2045 and 15% clean energy by 2030. However, fuel consumption patterns could be more sustainable (Sanjel et al., 2022).

Nepal's traditional fuel consumption has decreased from 90% to less than 70% over 15 years. However, energy consumption has increased from 8,616,000 Tons of oil equivalent to 14,464,000 Tons of oil Equivalent, met mainly by commercial energy sources. Nepal's primary commercial fuels, petroleum and coal, are entirely imported, leading to a growing trade deficit. The shift in fuel consumption could be more sustainable due to high demand and inadequate domestic supply, resulting in importing energy from India (Sanjel et al., 2022).

Nepal's electricity usage has increased but still has low energy consumption rates. Most of the demand comes from households, but the industrial and domestic market is expected to grow. The surplus of electrical energy may result in wastage, challenging efficient utilisation (Sanjel et al., 2022).

Urban areas have higher access to modern fuels like LPG and Electricity, reducing their dependency on biomass fuels. As the urban population increases, so does the demand for modern household fuel (Sanjel et al., 2022).

Although Electricity is a significant energy source in Nepal, it only accounts for 3% of total energy consumption. As a result, it relies heavily on imported modern energy, including Electricity, on a seasonal basis. Unfortunately, this shift towards imported energy sources makes Nepal more vulnerable for three reasons. Firstly, the cost of importing modern fuels has exceeded the net income from all our exports, which is a cause for concern. Secondly, with limited foreign currency reserves, we may need more time to afford the required quantity of modern fuels. Finally, as the world's natural reserves of modern fuels continue to decrease, the prices of these fuels are skyrocketing in the international market, making them unaffordable for a country like Nepal (Sanjel et al., 2022).

6.1.1.3 Social.

6.1.1.3.1 Unemployment rate (% of labor force, modelled ILO estimate)

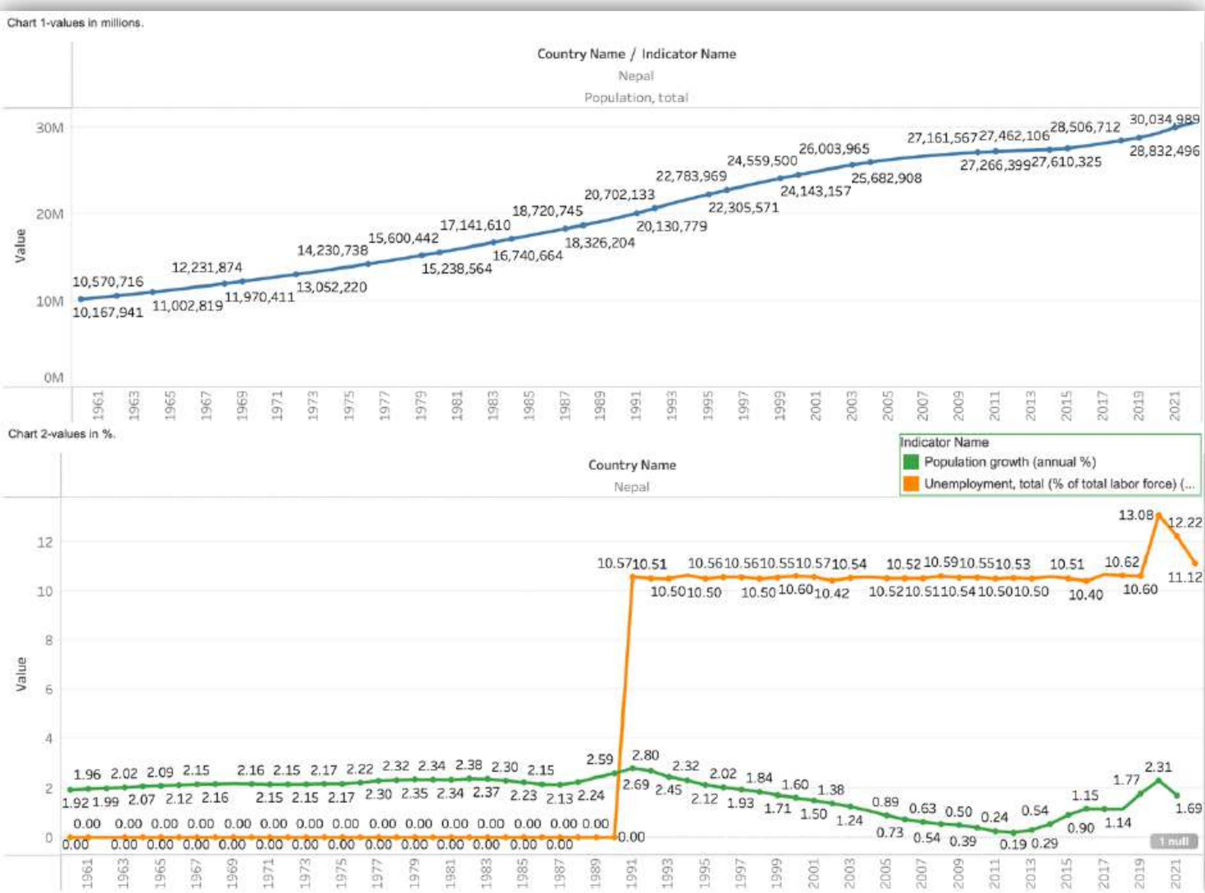

Figure 28, Line chart comparison of total unemployment (% of total labour force, modelled ILO estimate) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Unemployment, total (% of total labor force) (modeled ILO estimate), 2023).

The unemployment rate (% of labor force, modelled ILO estimate) is the percentage of people who are without work but actively seeking employment, sourced from the World Bank (Unemployment, total (% of total labor force) (modeled ILO estimate), 2023). The ILO provides internationally comparable labour statistics through its modelled estimates series, which includes nationally reported observations and imputed data for countries with missing data (Ilo Modelled Estimates (ILOEST database), 2023). From 1991 to 2019, the unemployment rate (indicated by the orange line) remained stable, ranging from 10.57% to 10.60%. However, it spiked to 13.08% in 2020 due to the pandemic before decreasing to 11.12% in 2022. Meanwhile, the population growth trend (represented by the blue line) has steadily increased from 10 million to 30 million from 1961 to 2022. This suggests that population growth has little impact on unemployment, resulting in a neutral outcome for social sustainability.

A survey on urban unemployment in Nepal reveals that 77% of respondents aged 23-50 and graduating between 1989 and 2000 are dissatisfied with their income range (Shakya, P., 2011). This underemployment causes economic, social, and psychological problems. Political instability, lack of opportunities, and corruption cause unemployment or underemployment (Shakya, P., 2011). Respondents suggest that organisational development can be enhanced by political stability, better education, and proper educational policies, leading to skilled graduates that meet the global market demands (Shakya, P., 2011). The government is mainly responsible for the country's unemployment problem, and it should formulate better economic policies, establish political stability, secure opportunities for investors, establish international links, and create new job areas (Shakya, P., 2011). The pandemic has worsened unemployment and food insecurity (Magar et al., 2021). The government must revitalise agriculture to create sustainable employment and increase productivity (Magar et al., 2021). Agriculture currently contributes 65% to the workforce and 24.3% to GDP (Magar et al., 2021). Nepal has reported 237,589 infections and 1551 deaths due to COVID-19 (Magar et al., 2021). Lockdowns have severely impacted the economy, causing the collapse of tourism, trade, and hospitality industries, resulting in the loss of over a million jobs (Magar et al., 2021). The service sectors have suffered greatly, with 31.5% of workers losing their jobs, primarily in the informal sector (Magar et al., 2021).

6.1.2 Philippines

Figure 29, Map of the Philippines (Map of the Philippines, 2023).

The Philippines' economy is dynamic due to urbanisation, a growing middle class, and a young population. Robust remittances, a strong labour market, and positive private sector performance in services, real estate, and tourism support consumer demand. Despite global headwinds, poverty fell from 23.5% to 18.1% from 2015 to 2021. The government aims to increase human and physical capital investments for long-term growth (The World Bank in the Philippines, 2023). The Philippines' unique culture blends traditional Filipino and Spanish Catholic customs and influences from other parts of Asia and America. Filipinos value family religion and appreciate art, fashion, music, and cuisine. They are hospitable, love socialising, singing, dancing, and eating, and celebrate festivals throughout the year that combine pre-Christian practices with Catholic beliefs (Philippines - history and culture, 2023).

6.1.2.1 Economic

6.1.2.1.1 INDUSTRY SECTOR

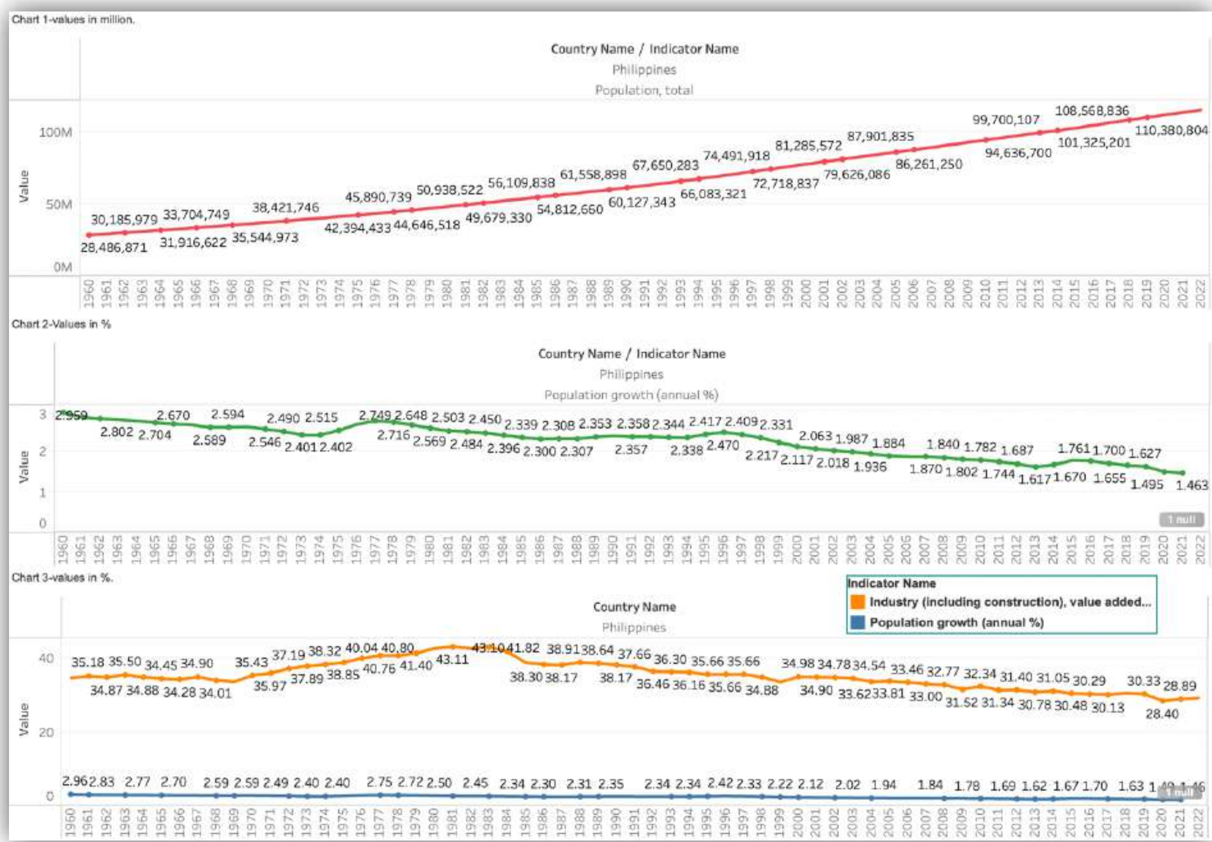

Figure 30, Line chart comparison of industry value added % of GDP against annual population growth % & total population growth. Created from Tableau & sourced from the World Bank (Industry (including construction), value added (% of GDP), 2023).

The orange line on the graph represents the industry's contribution to the GDP, and it shows a fluctuation from 35.18% in 1960 to a peak of 43.11% in 1982. However, it has declined since then and reached 28.40% in 2020. On the other hand, the blue line shows an increase in population from 28 million in 1960 to 112 million in 2020. This indicates that the population growth positively impacted the industry value only between 1969 and 1982. The decline in industrial value could be due to other sectors' development, such as agriculture and industry, or external factors like inflation, wars, diseases, etc.

The World Bank once rated the Philippines second in Asia's industrialisation race in the early 1960s (Ofreneo, 2015). However, the country's export-oriented industrialisation (EOI) in the 1970s-1990s failed to take off due to its narrow program, which needed more focus on industrial upgrading and value-adding linkages with the domestic economy (Ofreneo, 2015). The absence of systemic governance and policy coherence also contributed to the failure (Ofreneo, 2015). Despite this, the Philippines has experienced favourable growth rates in recent decades, driven by remittances from Filipino migrants, transforming the country into a service-sector-led economy without undergoing industrial transformation (Ofreneo, 2015). 1983, the Philippines faced a severe economic crisis due to inefficient investments, distorted incentives, and foreign borrowing (Pante and Medalla, 1990). The economy contracted 7.0% in 1984 and 4.1% in 1985, increasing unemployment and inflation (Pante and Medalla, 1990). President Aquino's government implemented reforms in 1986 to increase efficiency and revitalise the private sector through trade policy reform, investment incentives reform, privatisation, tax reform, and financial sector reform (Pante and Medalla, 1990). These changes aimed to rely more on market forces to develop the Philippine industrial sector (Pante and Medalla, 1990).

6.1.2.1.2 SERVICE SECTOR

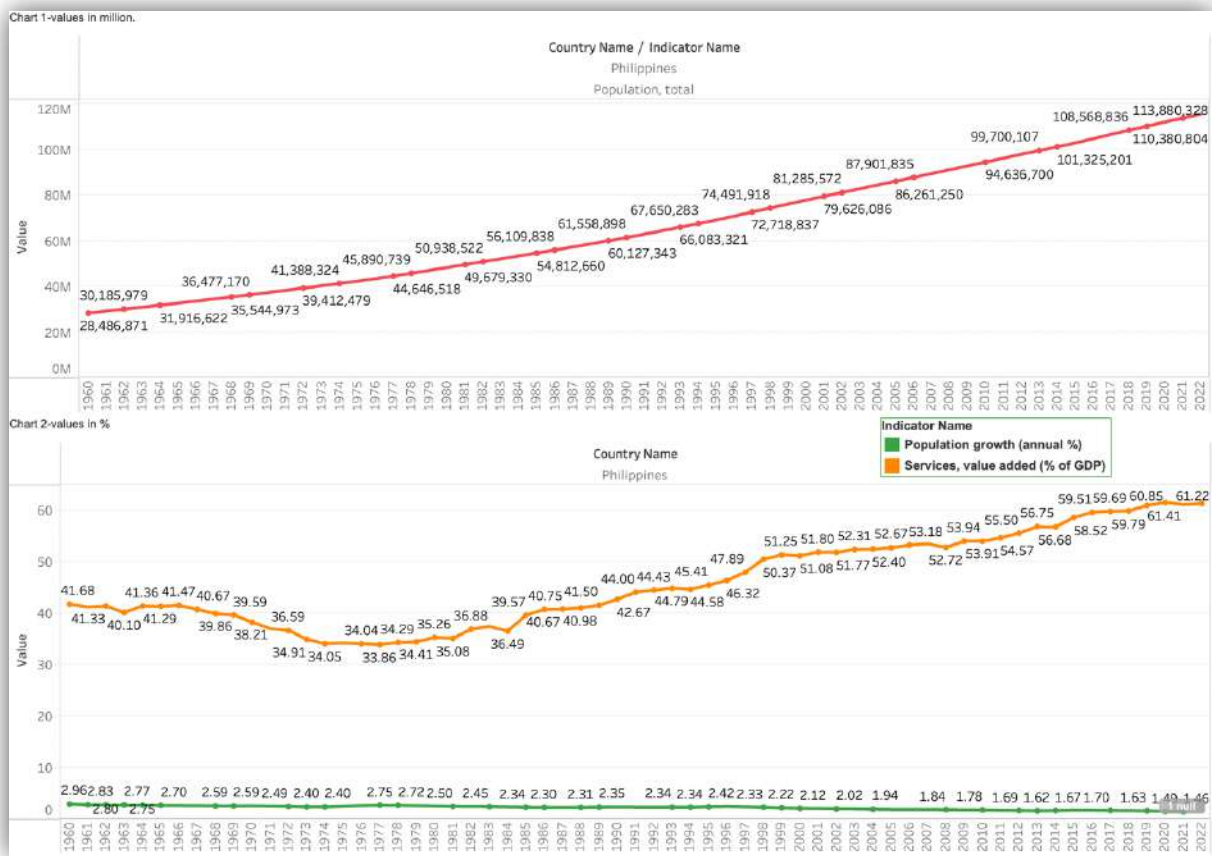

Figure 31, Line chart comparison of Service Sector value added % of GDP against Annual Population Growth % & Total Population. Created from Tableau & sourced from the World Bank (Services, value added (% of GDP), 2023).

The orange line represents the value of the service sector, which began at a high of 41.68% in 1960 and declined to its lowest point of 34.05% in 1973 before gradually increasing to a peak of 61.22% in 2022. Conversely, the red line representing population trends risen from 28 million in 1960 to 113 million in 2021. This implies a positive correlation between population trends and the growth of the service sector, as well as an impact on the industry's value.

The Philippines' service sector has been the principal engine of economic growth since the mid-1980s (Mitra, 2013). To leverage this growth, there are three significant opportunities: expanding the export and domestic markets for modern services in urban areas, fostering tourism for economic development, and enhancing domestic prospects for Filipino talent (Mitra, 2013). Infrastructure, logistics, broadband connections, power supply, education, healthcare, financial, legal, and public administration services must be improved to take advantage of these opportunities (Mitra, 2013). According to a recent study, ten key factors impact the quality of e-trike operations in Manila, Philippines (Gumasing et al., 2022). These factors include availability, intensity, comfort, ride smoothness, accessibility, discount rate, affordability, acceptability, land use, and noise level. E-trikes are three-wheeled electric vehicles ideal for small group travel on side streets (Gumasing et al., 2022). A study of 600 jeepney passengers used structural equation modelling to identify factors affecting passenger satisfaction (Ong et al., 2023). Safety was the most critical factor, with driver behaviour, value for money, service adequacy, and information materials also playing a significant role (Ong et al., 2023). A recent study found that "value" is the most important attribute for customer loyalty in Philippines single-dish restaurants, followed by "food" and "service." "Atmosphere" ranked last (Padillo et al., 2022). "Dining experience" and "tastiness" were top priorities, while "music" was last (Padillo et al., 2022). These findings can inform strategies to improve customer base (Padillo et al., 2022). A study in the Philippines examined the readiness of teacher education institutions for Education 4.0. While teachers have skills in selecting and integrating digital resources, they need help using the learning management system and other online class modalities, as well as augmented reality, robotics, and digital enablers (Alda et al., 2020). This is due to limited digital infrastructure and virtual laboratories. Research programs and initiatives for Education 4.0 are also lacking (Alda et al., 2020). Teacher education institutions need to improve infrastructure planning, research initiatives, and teacher-training capabilities to become Education 4.0-ready (Alda et al., 2020). A paper examines the use of e-portfolios in teacher education institutions in Central Visayas, Philippines (Boholano et al., 2022). The study surveyed 85 college teachers and found that e-portfolios were mainly used to monitor progress rather than enhance learning (Boholano et al., 2022). E-portfolios were used to track student progress and schoolwork but not extensively to improve learning experiences (Boholano et al., 2022). They are valuable tools for improving learning and assessment experiences, especially during COVID-19 (Boholano et al., 2022). The Philippine healthcare system needs help with costly drugs and limited access to care in rural areas. Traditional herbal medicine is well-accepted but underappreciated (Maramba-Lazarte, 2020). The government endorses traditional medicine, and Ten Medicinal Plants have been developed into modern formulations. Lagundi and Sambong tablets are successful and have contributed to the growth of the pharmaceutical industry (Maramba- Lazarte, 2020). Developing more herbal medicines for primary health care would decrease import dependence and increase accessibility. Empowering rural communities through herbal medicine gardens is also possible (Maramba- Lazarte, 2020). Robust research is necessary for integrating herbal medicine into mainstream clinical practice (Maramba- Lazarte, 2020).

6.1.2.2 Environmental

6.1.2.2.1 Total Greenhouse gasses (CO2 equivalent).

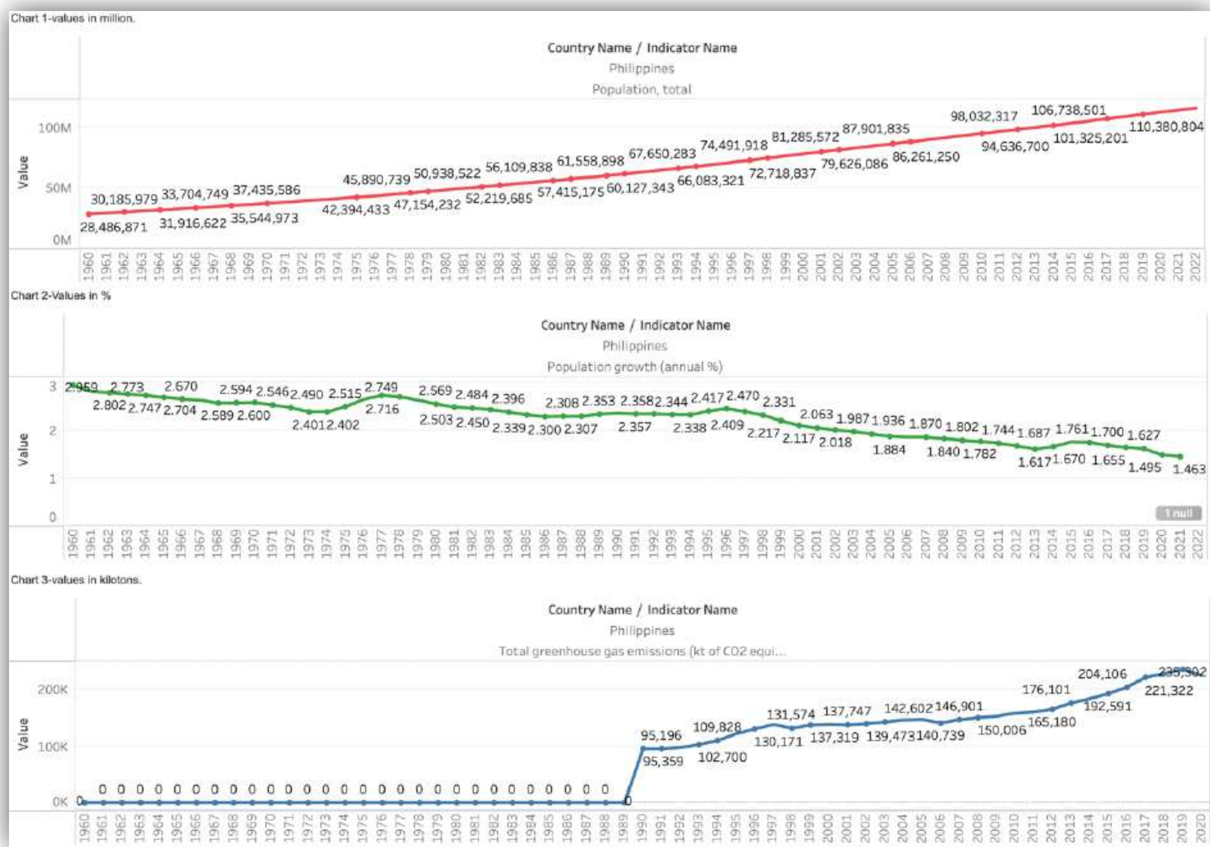

Figure 32, Line chart comparison of total greenhouse gas emission (kt of CO2 equivalent) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Total greenhouse gas emissions (kt of CO2 equivalent), 2023).

The total greenhouse gas emissions, represented by the blue line, increased from 95,196 kilotons in 1990 to 235,302 kilotons in 2020. At the same time, the total population grew from 28 million in 1960 to 114 million in 2022. This indicates a positive correlation between population growth and greenhouse gas emissions. Therefore, it can be inferred that population trends negatively affect greenhouse gas emissions.

Rice is a widely grown crop in South and Southeast Asia that leaves a significant amount of straw in the field (Gadde et al., 2009). The Straw-to-Grain Ratio (SGR) is used to quantify the amount of rice straw produced (Gadde et al., 2009). It is estimated that 10.68 million tons of rice straw residue are made in the Philippines, with approximately 95% of this residue being burned in open fields, contributing to greenhouse gas emissions (Gadde et al., 2009).
Using paddy rice residues as fuel could generate up to 10,444 GWh (gigawatt hour) of electrical energy while utilising the resulting fly ashes could reduce around 681 kt(kilotons) of CO2 annually (Jamora et al., 2023). Municipal solid waste management in the Philippines should be given utmost attention as it poses a crucial environmental threat, affecting climate change and Sustainable Development Goals (Premakumara et al., 2018). In a research study, an Emission Quantification Tool was used to analyse data, finding that controlling methane from disposal practices and Black carbon from waste collection and open burning is urgently needed in the country (Premakumara et al., 2018). A study in the Philippines used the logarithmic mean Divisia index (LMDI) to identify the driving forces behind CO2 emissions from 1991 to 2014 (Sumabat et al., 2016). It was found that Economic growth and higher living standards negatively impact emissions, while inconsistent energy structures harm a country's emissions performance (Sumabat et al., 2016). Policies are recommended to protect energy structures from fluctuating oil prices, improve energy planning capabilities, and promote industrial symbiosis (Sumabat et al., 2016). Economic activity and energy intensity offset each other's contribution to CO2 emissions (Sumabat et al., 2016). A Philippines study examined how economic growth, renewable energy, urbanisation, industrialisation, tourism, agricultural productivity, and forest cover affect CO2 emissions (Raihan, 2023). The methodology used to analyse yearly time series data from 1990 to 2020 was Dynamic Ordinary Least Squares (DOLS) (Raihan, 2023). Estimates show that a 1% increase in economic growth, urbanisation, industrialisation, and tourism will result in a 0.16%, 1.25%, 0.06%, and 0.02% increase in CO2 emissions in the Philippines, respectively (Raihan, 2023). In contrast, a 1% increase in renewable energy consumption, agricultural productivity, and forest area may reduce CO2 emissions by 1.50%, 0.20%, and 3.46%, respectively (Raihan, 2023).

6.1.2.2.2 Energy use (Kg of oil equivalent per capita).

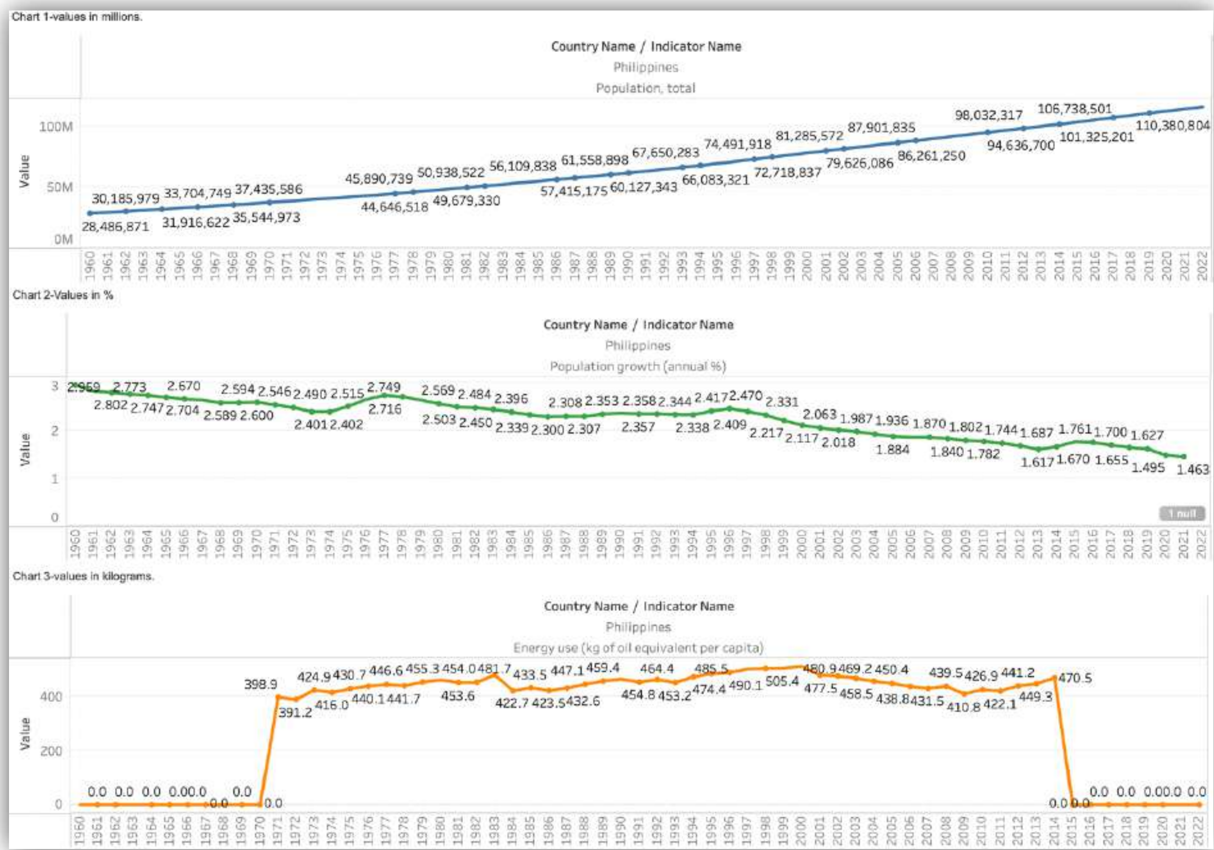

Figure 33, Line chart comparison of 3 different charts. Created from Tableau & sourced from the World Bank (Energy use (kg of oil equivalent per capita), 2014).

The orange line shows the energy use per capita, fluctuating from 1971 to 2014, where the value starts with 398.9 kilograms and 470.5 kilograms, respectively. The total population growth represented by the blue line increased from 28 million in 1960 to 101 million in 2015. This suggests that population growth may not have directly impacted energy consumption, and other factors like the economy, war, diseases, etc., might have affected the fluctuating patterns of energy use per capita.

In 2019 and 2020, the energy consumption in the Philippines amounted to more than 108,000 and 101,000 GWh, respectively (Balcita et al., 2021). This energy consumption is produced by various providers like Manila Electric, Visayan Electric, and Occidental Electric Cooperative (Balcita et al., 2021). These providers cater primarily to residential, commercial, and industrial needs (Balcita et al., 2021). The Philippines relies on four primary energy sources: coal, oil-based, natural gas, and

renewable (Balcita et al., 2021). According to the 2020 Power Statistics Report by the Department of Energy, the COVID-19 pandemic had contrasting effects on energy generation. Energy generated for households increased due to the pandemic, which prompted a shift towards remote work and studying.
On the other hand, energy generated for commercial and industrial sectors decreased as lockdowns encouraged remote setups instead of in-person activities (Balcita et al., 2021). This change in energy usage patterns could lead to inaccurately measured power consumption, resulting in higher electricity bills for both sectors and the involved companies (Balcita et al., 2021). A survey of 603 households in the Philippines' second-largest urban centre found that most use LPG and fuelwood for cooking, with multiple fuel use every day (Bensel and Remedio, 1995). Electricity is used by 93% of households for lighting and appliances, with consumption increasing by 1500% between the lowest and highest income groups (Bensel and Remedio, 1995). An illustrative case study in the Philippines found that transport activity was the primary driver for energy consumption and CO2 emissions, followed by energy intensity, contrary to previous studies in developed and rapidly urbanising countries where transport activity was the primary contributor to emissions (Lopez et al., 2018). In the Philippines, however, energy intensity was the primary contributing factor (Lopez et al., 2018). The Department of Energy in the Philippines found a 0.5% annual growth rate in road transport fuel consumption and CO2 emissions from 2000 to 2010 (Gota, 2014). This contrasts with the significant increase in vehicle numbers and economic activity (Gota, 2014).

6.1.2.3 Social.

6.1.2.3.1 Unemployment rate (% of labor force, modelled ILO estimate).

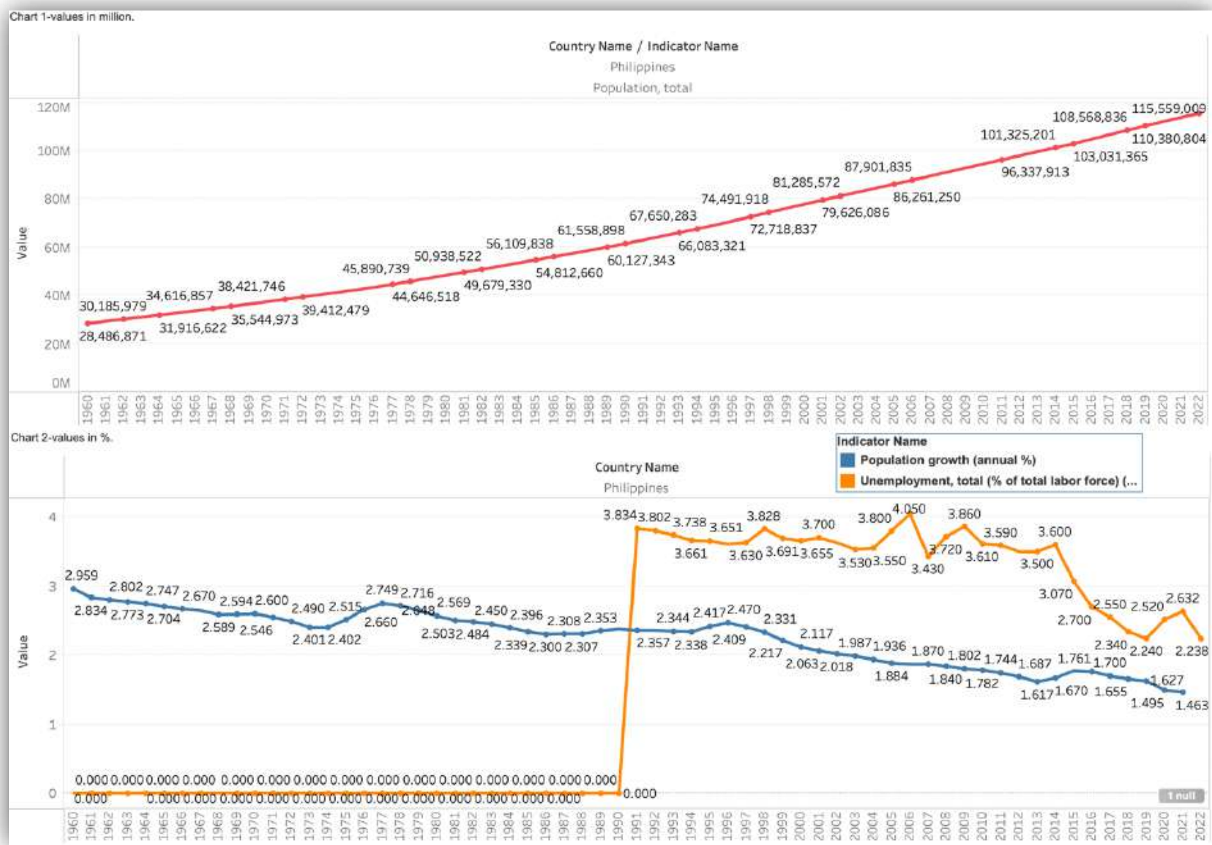

Figure 34, Line chart comparison of total unemployment (% of total labour force, modelled ILO estimate) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Unemployment, total (% of total labor force) (modeled ILO estimate), 2023).

The graph displays the relationship between population growth, annual growth percentage, and total unemployment percentage. As the yearly population growth percentage declines, unemployment decreases, indicating a positive correlation. Conversely, as the total population growth increases, the unemployment percentage decreases, reflecting a negative correlation. This means that both positive and negative correlations positively impact the unemployment percentage.

The unemployment rate in the Philippines was 5.2% as of January 2019, with fresh graduates contributing to a large portion of unemployment (OFW, 2022). However, many retrenched workers and those without renewed employment contracts contribute to this issue (OFW, 2022). One problem is the need for more quality graduates due to an outdated education system that fails to produce students with the necessary skills demanded by the job market (OFW, 2022). Discriminatory hiring practices, such as requiring unnecessary physical attributes, further exacerbate the problem (OFW, 2022). Poverty is also a significant factor, as families unable to afford education force their children into low-paying jobs with little opportunity for career growth (OFW, 2022). The country's rapid population growth only adds to the challenge, with jobs needing help to keep up with the influx of graduates (OFW, 2022). To address this issue, the education system must adapt to emerging technologies, and employers must focus on skills and experience rather than superficial requirements (OFW, 2022). The government must also address poverty by investing in education and creating opportunities for decent employment (OFW, 2022). COVID-19 had a profound impact on Filipinos (Khatibi, 2021). Unemployment surged to 10.3%, leaving 4.5 million jobless, up from 5.1% in 2019 (Khatibi, 2021).

6.2 Developed Countries

6.2.1 United Kingdom

Figure 35, Map of the United Kingdom (WorldAtlas, 2023).

The UK, a dominant force in the British Isles situated off the northwest coast of mainland Europe, is commonly known as such (WorldAtlas, 2023). It is bordered by the English Channel to the south, separating it from continental Europe, and the Irish Sea and North Atlantic Ocean to the west (WorldAtlas, 2023). The North Sea lies to the east, separating the UK from Scandinavia and the rest of continental Europe (WorldAtlas, 2023). With an area of approximately 242,495 km2, the UK is a significant regional presence (WorldAtlas, 2023). The UK has four constituent countries with unique geography (WorldAtlas, 2023). England has hills and lowlands, Scotland has mountains, Wales has rugged landscapes and coastal plains, and Northern Ireland has plateaus and hills (WorldAtlas, 2023).

6.2.1.1 Economic-Sustainability

6.2.1.1.1 Industry (including construction), value added (% of GDP)

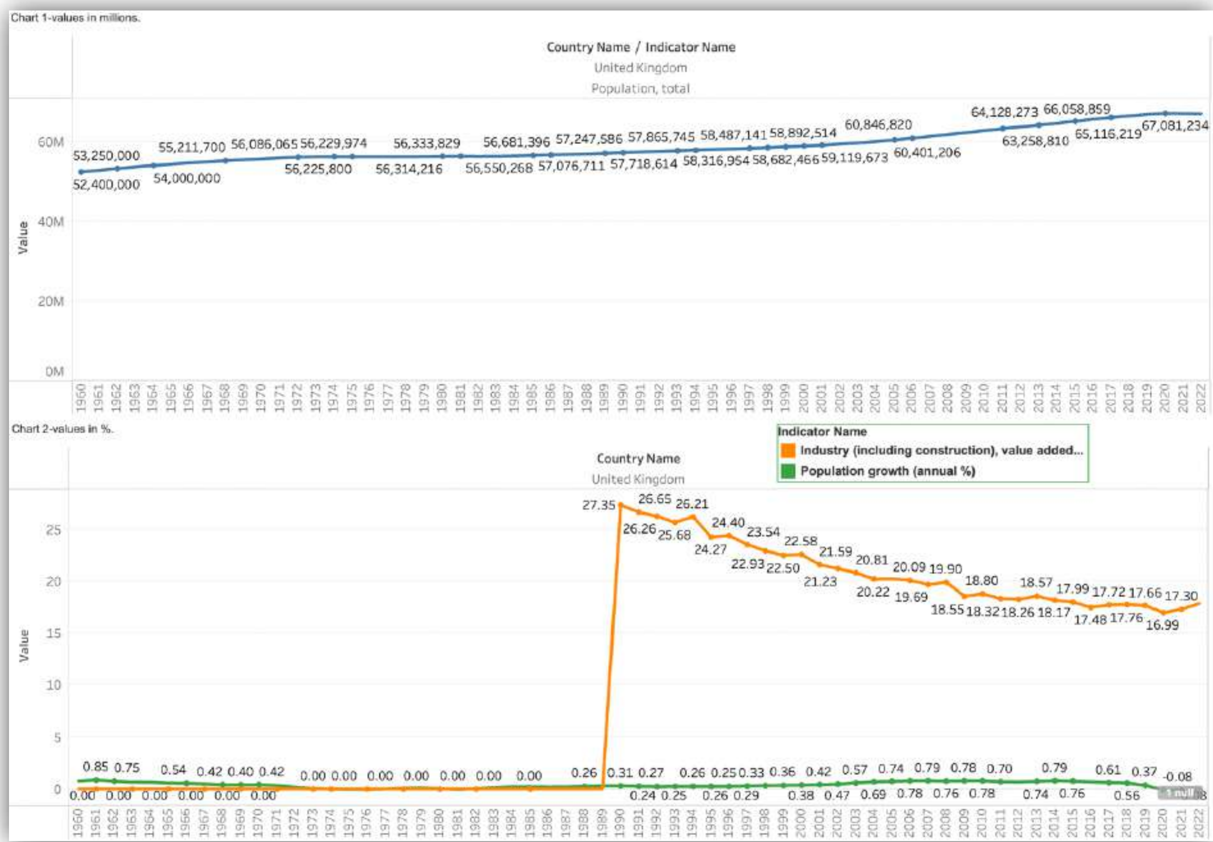

Figure 36, Line chart comparison of industry value added % of GDP against annual population growth % & total population growth. Created from Tableau & sourced from the World Bank (Industry (including construction), value added (% of GDP), 2023).

Chart one shows total population growth (blue line). Chart two shows industry value added to GDP (orange line) and annual population growth % (green line). Industry value data is only available from 1990 to 2022. Population growth is linked to decreased industry value; when the population rises, the opposite occurs when industry value diminishes.

Industry, including construction, comprises the value added in mining, manufacturing, construction, electricity, water, and gas (*Industry (including construction), value added (% of GDP)* 2023). Manufacturing industries employ 2.6 million jobs, while the construction industry employs 2.3 million. People may hold more than one job (Hutton, 2022). Despite a decrease in industry GDP from 27.35% in 1990 to 17.30% in 2021, the UK remains the ninth-largest manufacturing nation globally, with an annual output of £183 billion (*UK manufacturing, the facts 2022*, 2021). Despite misconceptions, the average manufacturing wage is 12% higher than the whole economy (*UK manufacturing, the facts 2022*, 2021). The UK ranks 10th in exports for goods, 5th in import of goods, 2nd for service trade, and 5th for GDP (*UK manufacturing, the facts 2022*, 2021). This suggests a decline in the manufacturing labour force and an increase in other sectors, like services (*UK manufacturing, the facts 2022*, 2021). Manufacturers reported declining production and sales due to high energy costs and the rising cost of living. Sales of beer fell by £0.5 billion (13%) to £3.3 billion in 2022, while sales of acrylic or vinyl paints and varnishes declined by £0.4 billion (28%) to £0.9 billion (Robinson, 2023).

6.2.1.1.2 Services, value added (% of GDP)

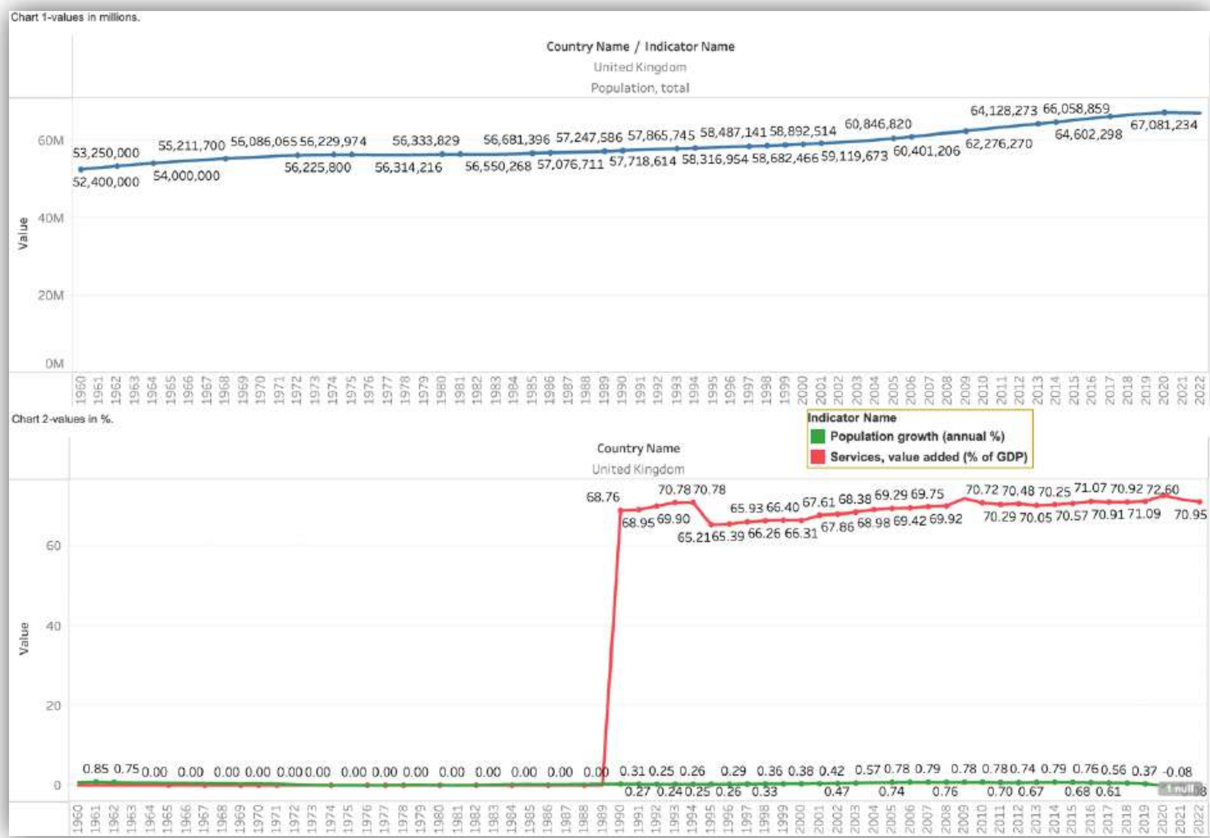

Figure 37, Line chart comparison of Service Sector value added % of GDP against Annual Population Growth % & Total Population. Created from Tableau & sourced from the World Bank (Services, value added (% of GDP), 2023).

The blue line shows total population growth, the red line shows the percentage of services added to the UK GDP, and the green line shows the annual population growth percentage. The charts indicate a positive correlation between the service industry and population growth. This suggests that population growth impacts the service industry positively.

Service industries, such as retail, hospitality, professional services, business administration, and finance, dominate the UK economy (Hutton, 2022). These industries employed around 84% of UK workers, supporting 30.0 million jobs as of March 2022 (Hutton, 2022). The UK is a diverse exporter specialising in personal, cultural, and recreational services, intellectual property, pharmaceuticals, beverages, aircraft and works of art (Resolution Foundation, 2022). While some political debates have suggested reorienting the UK's economy to manufacturing, the report notes that the UK's export specialisms are persistent and that a services-oriented economy is likely in the future (Resolution Foundation, 2022). Organisational culture is crucial in the hospitality industry (Reidhead, 2020). It promotes high employee performance and satisfaction (Reidhead, 2020). Employees who are firmly committed to the culture are more likely to fulfil organisational goals. Their commitment also strengthens their employment outlook (Reidhead, 2020). The determining factor for employee satisfaction and retention is the organisational culture (Reidhead, 2020). In 2010, the Energy Performance Building Directive introduced the idea of constructing buildings that consume almost no energy, known as 'nearly zero energy buildings' (nZEBs) (Salem et al., 2020). A recent study analysed the energy performance of a UK hotel that met the nZEB standards and revealed that it is possible to achieve nZEB, but it comes at a cost (Salem et al., 2020). It was found that there is a 30% gap between the nZEB solution and the most cost-effective solution (Salem et al., 2020). This highlights the fact that the current nZEB standard is not the most financially viable solution and that the cost-effective level is the one that provides the lowest energy performance at the most reasonable cost (Cost-optimal level definition, 2023). The study surveyed 200 customers through structured interviews to compare eight UK hotels and analyse the subcategories to answer the research questions (Gupta & Sharma, 2021). While some hotels have self-service kiosks, others need to become more comfortable with self-service (Gupta & Sharma, 2021). Kiosks are easy, fast, and fun but lack human interaction (Gupta & Sharma, 2021). They help reduce bottlenecks in hotel operations (Gupta & Sharma, 2021). Concerns about technology anxiety and counter-service arguments will disappear (Gupta & Sharma, 2021). Kiosk adoption depends on operations and customer demographics (Gupta & Sharma, 2021). A study used hedonic pricing to analyse 400+ UK hotel transactions from 2000-2015 to study the impact of brands on hotel market values (Aroul et al., 2023). Initial results showed that hotel brands have a negative association with values (Aroul et al., 2023). It was found that brand affiliation did not significantly affect hotel transaction values (Aroul et al., 2023). Instead, the characteristics of branded hotels, rather than the fact that they are branded, determine their transaction values (Aroul et al., 2023). A study analysed 153 UK hotels over ten years to explore the link between hotel performance, learning, and adopting best practices (Tan et al., 2021). Findings show that matching cash flow potential with market opportunities is key to superior performance (Tan et al., 2021). UK consumers' ethical beliefs regarding their intention to dine at green restaurants were studied (Nimri et al., 2021). Qualitative data collected from four focus groups were analysed using the Hunt-Vitell theory of ethics (Nimri et al., 2021). The results reveal the importance of perceived personal and environmental benefits, concerns, reference groups, facilitators, and barriers when eating at green restaurants (Nimri et al., 2021). Promoting informative and educative green initiatives can raise awareness among the public (Nimri et al., 2021). The COVID-19 pandemic had varying effects on UK sales. Food and non-store retailers saw a £4 billion increase in sales (Panzone et al., 2021). In contrast, non-food stores and food and beverage serving services experienced a significant decline, with a £20 billion and £25 billion loss in turnover, respectively (Panzone et al., 2021). A study evaluated energy and nutrient content changes in menu items sold by 29 large UK chain restaurants from 2018 to 2020 (Huang et al., 2021). Results show that sugar content declined across all menu items, notably beverages, sandwiches, and desserts (Huang et al., 2021). Energy, salt, and saturated fat remained constant (Huang et al., 2021). Fewer food categories had significant changes in core menu items than in all (Huang et al., 2021). Menu items in restaurants had less sugar between 2018-2020, possibly due to the sugar reduction strategy and soft drinks industry levy (Huang et al., 2021). Other nutrients had little change (Huang et al., 2021). Policies addressing overall nutritional quality could encourage healthier foods (Huang et al., 2021). Transportation is the most significant contributor to the UK's greenhouse gas emissions (Ling-Chin et al., 2023). Hydrogen-fuelled transportation is being developed to reduce its environmental impact and achieve net-zero emissions by 2050 (Ling-Chin et al., 2023). This article outlines the challenges and technologies of using hydrogen in the UK for on-road, aviation, maritime, and rail transportation (Ling-Chin et al., 2023). While hydrogen has potential in all transportation modes, each sector requires improvements in performance, cost, infrastructure, and regulations to support its use (Ling-Chin et al., 2023). Nearly one-third of the UK's greenhouse gas emissions are attributed to the transportation industry (Ling-Chin et al., 2023). All transportation modes need significant changes to move towards a zero-carbon industry, with hydrogen-fuelled transportation as one potential solution (Ling-Chin et al., 2023). However, several challenges exist, such as the performance, design, and cost of fuel cells and hydrogen-fueled engines, hydrogen storage capacity, integration with energy storage systems, and infrastructure for refuelling (Ling-Chin et al., 2023). The UK has 7,000 miles of inland waterways built for bulk goods transport. They bring economic and societal benefits (Terziev et al., 2023). Using them for freight transport can provide eco-friendly solutions and local health benefits. Prioritising these blue-green spaces is crucial for future planning (Terziev et al., 2023). A survey investigated road transport incidents (Hall et al., 2020). 342 out of 2116 participants reported incidents. Over 50% were due to horse behaviour during the first hour of the journey (Hall et al., 2020). Over 50% resulted in horse injuries, with vehicle malfunction accounting for 68% (Hall et al., 2020). UK medical schools now require global health education (GHE) as a curriculum component (Matthews et al., 2020). However, there are still significant gaps in the current provision of GHE despite the increasing interest among students (Matthews et al., 2020). All medical students should have access to fundamental global health education (Matthews et al., 2020). Governing bodies in medical education must develop a nationwide strategy to achieve this goal (Matthews et al., 2020). The introduction of postgraduate loans has increased UK student numbers, including those from disadvantaged backgrounds (House, 2020). Master's fees are now closer to the maximum value of postgraduate loans, leaving little for living costs (House, 2020). EU student numbers declined, but non-EU student numbers increased, mainly by Chinese students (House, 2020). The number of female postgraduates continues to exceed that of male postgraduates (House, 2020). Lifelong learning opportunities have decreased for older part-time students (House, 2020). Participation in postgraduate courses is low among the White British population and males from low-participation neighbourhoods (House, 2020). Black African British demographic shows high participation. More students study for UK postgraduate qualifications abroad than non-UK students studying in the UK (House, 2020). With genetics, environmental data, and imaging, the UK Biobank comprises more than 500,000 participants as a large cohort (Davis et al., 2020). A mental health questionnaire was designed for the participants, with 157,366 completed by August 2017. Lifetime depression and hazardous/harmful alcohol use were common (Davis et al., 2020). Mental disorders were associated with high neuroticism scores, adverse life events, and long-term illness, while addiction and bipolar disorder were linked to deprivation (Davis et al., 2020). Healthcare workers (HCWs) have been facing a significant increase in anxiety and depression levels since the COVID-19 pandemic began (Gilleen et al., 2021). Several controllable factors, such as inadequate personal protective equipment availability, insufficient workplace preparation, poor training, and high workload, were associated with severe psychiatric symptoms (Gilleen et al., 2021). Front-line workers and those with previous psychiatric diagnoses or traumatic events were more susceptible to severe symptoms (Gilleen et al., 2021). However, sharing stress, resilience, and ethical support was associated with low psychiatric symptoms (Gilleen et al., 2021). The NHS is in crisis. Patients wait for hours, and staff morale is low. The UK cannot afford to let the NHS fail (McNally, 2023). A healthy workforce is vital for a prosperous economy (McNally, 2023). Disability claims and early retirements are increasing. 9 million people are now economically inactive (McNally, 2023). The NHS provides effective treatment and is crucial for people's health and returning the UK workforce to work (McNally, 2023). It needs practical support and investment for the country's health and prosperity (McNally, 2023). According to a study, ten of the top retailers in the UK have been driven to adopt the circular business model in their operations due to environmental awareness, stakeholder pressure, and government regulations (Upadhyay et al., 2021). The circular economy provides a solution for industries and businesses of all sizes to reduce, reuse, and recycle waste (About the circular economy, 2023). This approach benefits the environment and promotes sustainability in business practices (Upadhyay et al., 2021).

6.2.1.2 *Environmental sustainability*

6.2.1.2.1 Total greenhouse gas emissions (kt of CO2 equivalent)

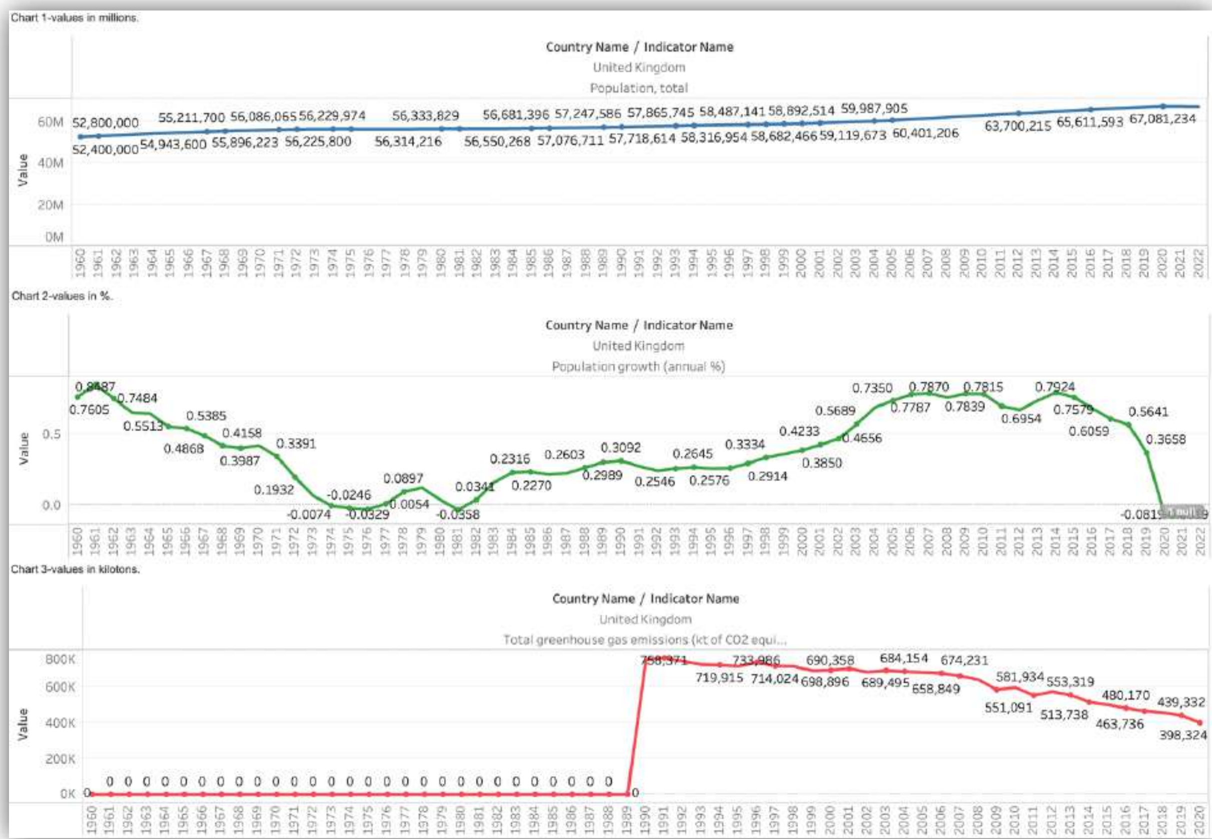

Figure 38, Line chart comparison of total greenhouse gas emission (kt of CO2 equivalent) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Total greenhouse gas emissions (kt of CO2 equivalent), 2023).

The total greenhouse gas emissions represented by the red line decreased from 758,371 kilotons in 1990 to 398,324 kilotons in 2020. Meanwhile, the total population growth represented by the blue line increased from 57.7 million in 1990 to 67.1 million in 2020. These trends suggest a negative correlation between population growth and greenhouse gas emissions, indicating that population growth positively impacts greenhouse gas emissions.

The Food Climate Research Network (FCRN) published a report estimating that food consumption in the UK accounts for 19% of all greenhouse gas emissions generated through goods and services (Audsley et al., 2010). The report recommended reducing emissions by up to 70% through a combination of technological improvements and changes in consumption (Audsley et al., 2010). It also suggested that policymakers implement measures to change how we produce and consume food and what we drink to contribute proportionately to the UK's target of reducing its emissions by 80% by 2050 (Audsley et al., 2010). Meat makes up 32% of GHG emissions from food, while drinks, dairy, cakes, biscuits, and confectionery contribute 15%, 14%, and 8% (Rippin et al., 2010). Non-vegetarian diets produce 59% more emissions than vegetarian diets (Rippin et al., 2010). Men have 41% higher emissions than women. Meeting RNIs for saturated fats, carbs, and sodium reduces GHG emissions (Rippin et al., 2010). Greenhouse gas emissions from personal transport in the UK are increasing, and a new method has been developed to profile emissions across all modes of transportation (Brand and Boardman, 2008). Car and air travel contribute the most to emissions, while land-based public transport has minimal impact. 43% of emissions are emitted by the top 10%, where income, economic activity, age, household structure, and car availability significantly affect emissions levels (Brand and Boardman, 2008). Emissions increase with income, household size, and employment status (Gough et al., 2011). Lower-income and pensioner households emit more due to their greater use of welfare state services (Gough et al., 2011). Carbon pricing policies focused on domestic energy are counter-effective (Gough et al., 2011). Eco-social approaches, such as house retrofitting and social tariffs for domestic energy, are better alternatives to compensate fuel-poor families (Gough et al., 2011).

6.2.1.2.2 Energy use (kg of oil equivalent per capita)

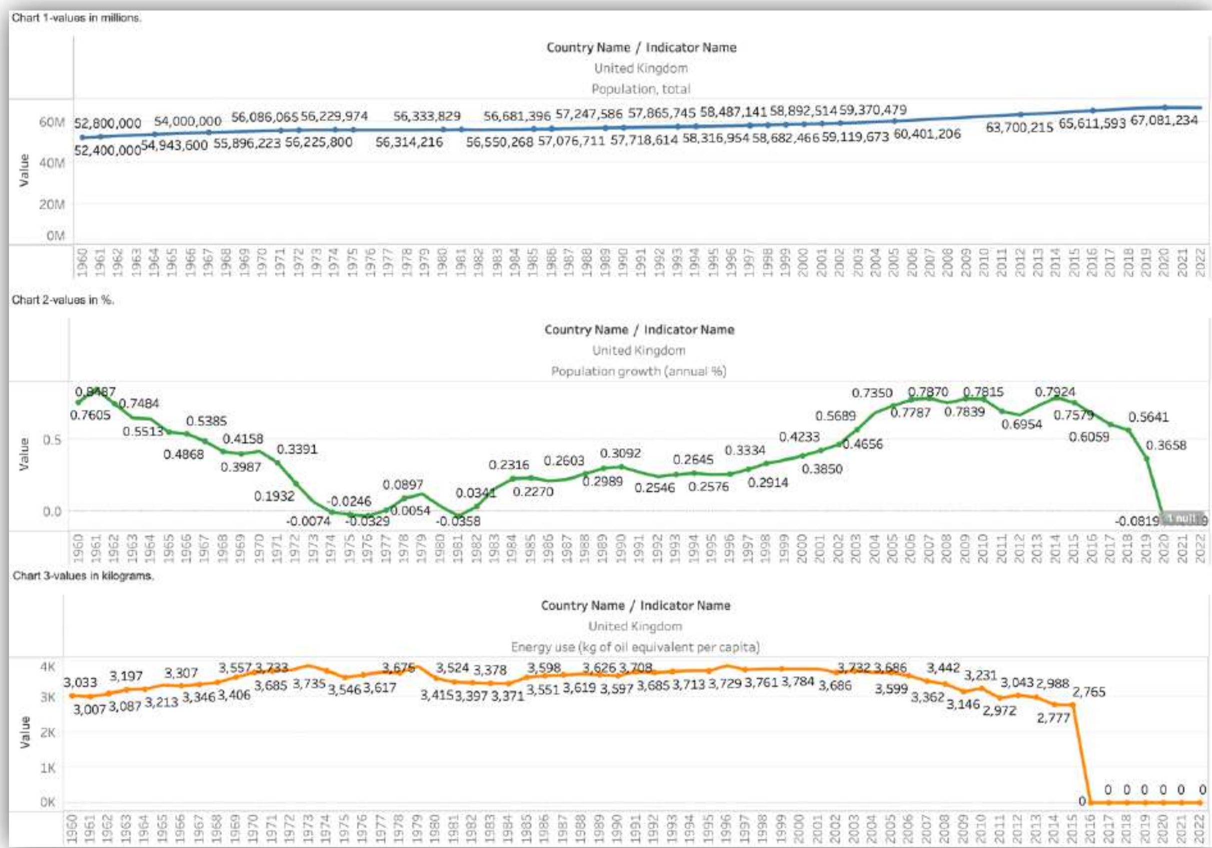

Figure 39, Line chart comparison of 3 different charts. Created from Tableau & sourced from the World Bank (Energy use (kg of oil equivalent per capita), 2014).

The orange line shows energy use per capita from 1960 to 2015. Consumption fluctuated between 3000-3,600 KG, dropping to 2,988 KG in 2013 and reaching a low of 2,765 kg in 2015. Energy consumption positively correlates with population growth, represented by the blue line from 1960 to 2005. As the blue line increased, so did the energy consumption reflected by the orange line. From 2006 to 2015, energy consumption has decreased, indicating a negative correlation, which implies that population growth has positively impacted energy use in the last decade as it is consumed less.

The largest industrial sector is the iron and steel sector regarding energy demand and GHG emissions (Griffin & Hammond, 2019). Utilising the Best Available Techniques (BAT) can reduce energy and CO2 emissions in the short term (Griffin & Hammond, 2019). Key technologies such as energy efficiency, bioenergy, CCS, and decarbonisation of electricity supply are crucial in achieving significant falls in carbon emissions by 2050 (Griffin & Hammond, 2019). Several existing technologies can reduce process energy loss, and BAT for hot rolling can reduce energy consumption by 18% and GHG emissions by 12% (Griffin & Hammond, 2019). Non-technological barriers may hinder technology uptake, and new process innovations may become available in the longer term (Griffin & Hammond, 2019). A study analysed UK universities' progress in achieving net-zero emissions by 2050 using HESA estate management data from 2012-13 to 2018-19 (Eskander & Nitschke, 2021). The study employed a Log Mean Divisa Index decomposition method to measure carbon emissions and the impact of energy sources on energy use and carbon efficiency (Eskander & Nitschke, 2021). Universities decreased emissions by 29%, with most reductions coming from improvements in carbon efficiency and energy intensity (Eskander & Nitschke, 2021). Total energy consumption rose 4.6% from 2020 to 2021 to 134M tonnes of oil equivalent, but still below pre-pandemic levels (including non-energy use) (Parker, 2022). Transport saw a 7.3% rise in consumption, industry saw a 4.2% rise, and domestic consumption rose by 2.2M tonnes of oil equivalent due to lower temperatures (Parker, 2022). Service consumption rose by 5.2% to 20.7M tonnes of oil equivalent as pandemic restrictions were relaxed (Parker, 2022).

6.2.1.3 Social sustainability

6.2.1.3.1 Unemployment, total (% of total labor force) (modelled ILO estimate)

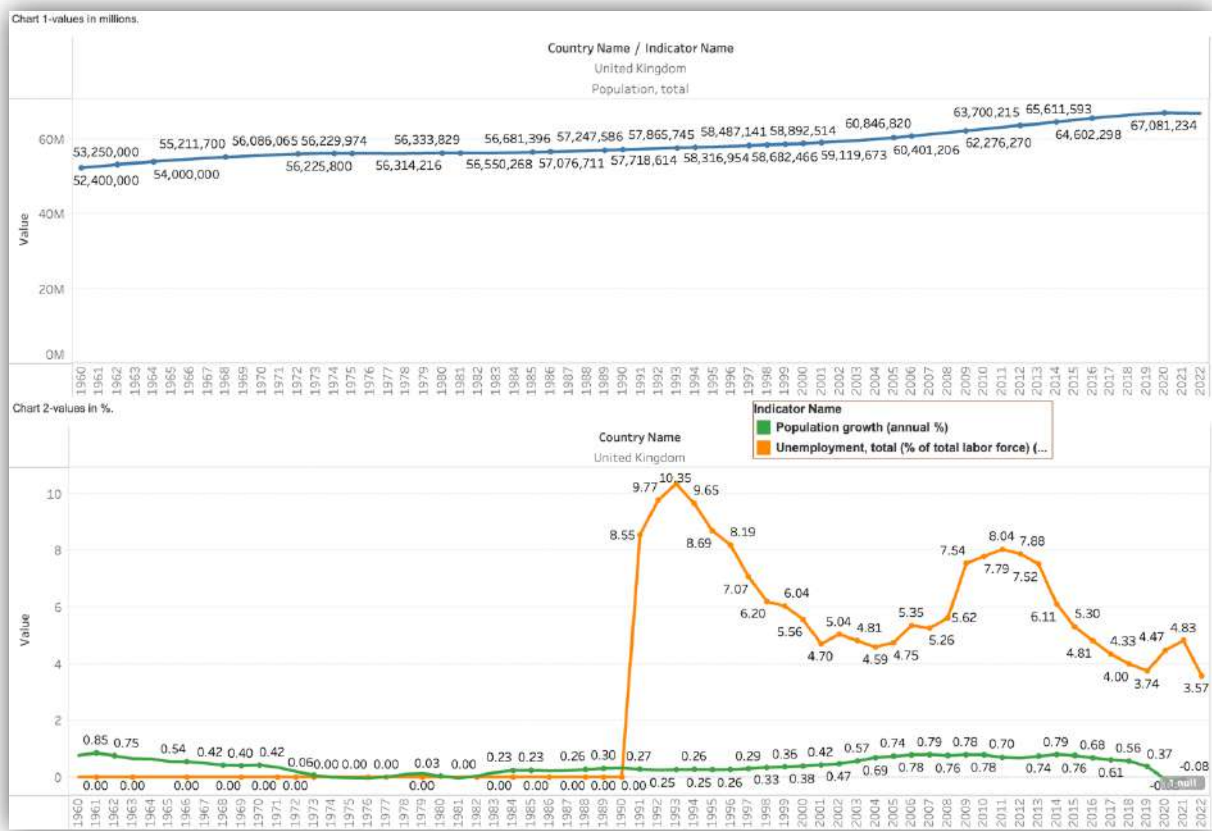

Figure 40, Line chart comparison of total unemployment (% of total labour force, modelled ILO estimate) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Unemployment, total (% of total labor force) (modeled ILO estimate), 2023).

From 1990 to 1993, the orange line representing unemployment rose from 8.55% to a peak of 10.35%, then fell to 4.70% in 2001. It fluctuated and rose to 8.04% in 2012 before falling to 3.57% in 2022. During this time, the blue line representing total population growth rose from 57 million to 68 million in 2022. This suggests that population growth does not directly impact unemployment. Factors like the economy, job opportunities, and social responsibility might play a role.

A research paper utilised data from the UK labour force survey between 2005 and 2012 to propose a new classification of unemployment (Moffat and Yoo,2015). The findings suggest that this classification could include job seekers currently unavailable for work due to non-personal reasons, those who are marginally attached and waiting for job application outcomes, and individuals who have a job starting more than two weeks in the future (Moffat and Yoo,2015). In each quarter, 7% of the working-age population switch between inactive, employed, or unemployed (Gomes,2012). Additionally, 2.1% of working-age people change their employer (Gomes,2012). The job separation probability is 1% if the person was previously employed, 5% inactive, and 11% unemployed (Gomes,2012). Moreover, the job-finding rate is 20% if the person has been unemployed for two periods, but it is 48% if they were previously employed (Gomes,2012). The job-finding and job-separation rates are important determinants of unemployment fluctuations (Gomes,2012). Every quarter, 6% of employees search for a different job and are seven times more likely to change jobs than those not searching (Gomes,2012). Individuals in the lowest education category face a three times higher unemployment and inactivity rate, twice as high separation rate, and half the job-finding rate than individuals in the highest education category (Gomes,2012). According to a study on the 2008 financial crisis, recessions can significantly harm population health (Astell-Burt and Feng,2013). Decision-makers should consider the cost of illness caused by economic policy options that increase unemployment (Astell-Burt and Feng,2013). The UK unemployment rate rose to 4.2% in 3 months to June 2023, the highest since late 2021, and above market forecasts (*United Kingdom Unemployment Rate* 2023). This was driven by those unemployed for up to 6 months, with a net movement from economic inactivity into unemployment (*United Kingdom Unemployment Rate* 2023). The economic inactivity rate fell slightly to 20.9%, Primarily driven by individuals who are inactive due to caregiving responsibilities or house hunting (*United Kingdom Unemployment Rate* 2023). In contrast, inactive people have increased to a record high due to long-term sickness (*United Kingdom Unemployment Rate* 2023). The employment rate decreased to 75.7%, driven by full-time employees and self-employed workers (*United Kingdom Unemployment Rate* 2023).

6.2.2 Australia

Australia is a country consisting of six states and two territories (WorldAtlas, 2023). The states are New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia (WorldAtlas, 2023). The Australian Capital Territory and Northern Territory (WorldAtlas, 2023) are the two territories. Australia is the smallest continent and the largest country in Oceania, located between the Indian Ocean and the Pacific Ocean in the Southern Hemisphere (WorldAtlas, 2023).

6.2.2.1 Economic sustainability

6.2.2.1.1 Industry (including construction), value added (% of GDP)

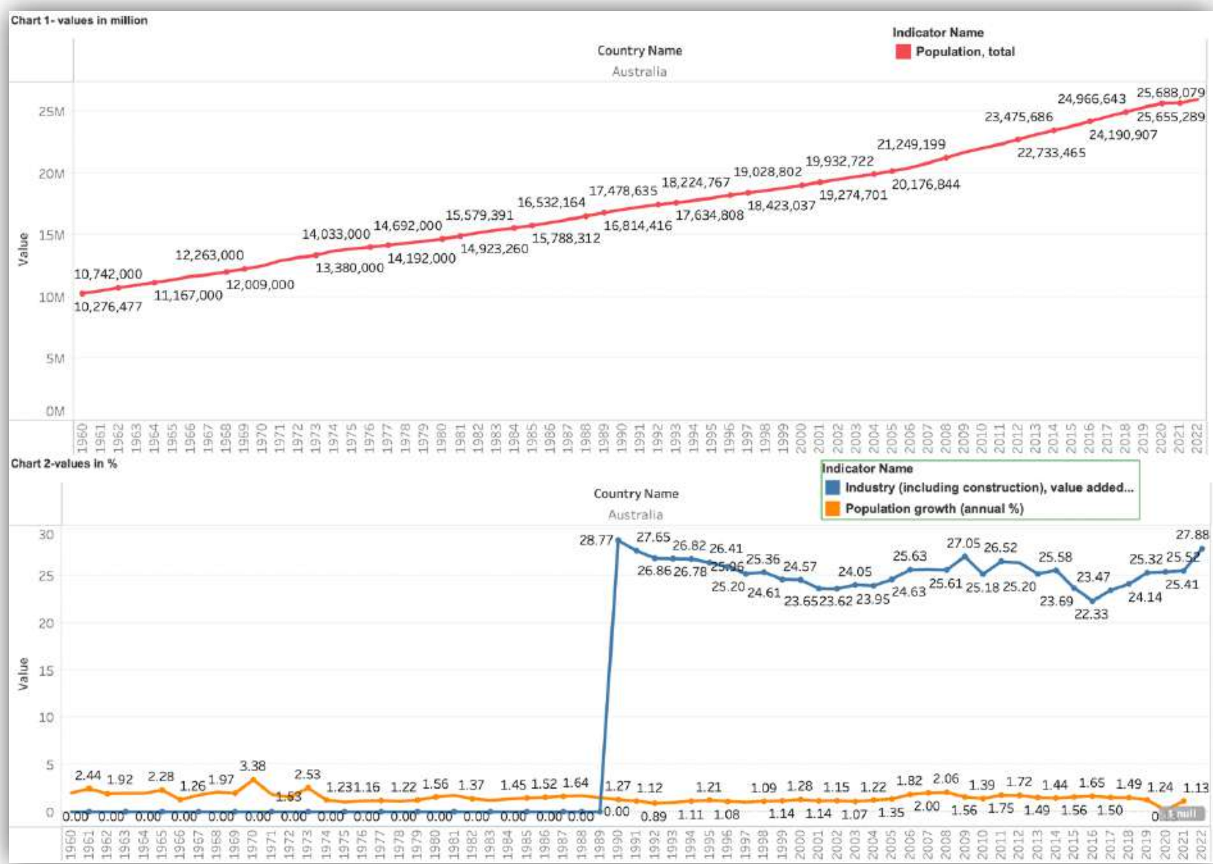

Figure 41, Line chart comparison of industry value added % of GDP against annual population growth % & total population growth. Created from Tableau & sourced from the World Bank (Industry (including construction), value added (% of GDP), 2023).

Industry value added, represented by the blue line, fluctuates between 22.33% to 28.77% of Australia's GDP. Meanwhile, the total population grows from 16 million in 1990 to approximately 26 million in 2022, indicating other factors beyond population growth impact the GDP's industrial value added.

A study found that mandatory safety training for Australian construction employees did not improve their attitudes towards safety (Loosemore & Malouf, 2019). The most positive impact was on cognitive and behavioural perspectives (Loosemore & Malouf, 2019). Safety training should be more interactive, emotionally engaging, and customised based on worker demographics and learning styles (Loosemore & Malouf, 2019). The current mining trends display a rise in production, a decrease in ore grades, difficulties in managing waste rock from open-cut mining, an expanding economic resource base, a greater emphasis on sustainability reporting, and higher resource intensity (Mudd, 2010). The study of the Australian hotel industry's labour turnover costs revealed high operational and managerial staff turnover rates, indicating common reasons for departure (Davidson et al., 2010). The study strongly recommends implementing an integrated HR strategy aligned with the organisation's objectives to mitigate turnover (Davidson et al., 2010). Australia's coal seam gas (CSG) industry has experienced rapid growth, but social opposition has caused delays and cancellations (Lacey & Lamont, 2014). The industry recognises the need for a social license to operate (Lacey & Lamont, 2014). Ethical aspects of conflicts around CSG development are often implicit or not explored in depth, but the concept of a social license seeks to formalise some of these assumptions (Lacey & Lamont, 2014). Despite technological and economic uncertainties, policymakers need assistance decarbonising their electricity industries (Elliston et al., 2010). This study compares the costs of one medium-carbon and two low-carbon fossil fuel scenarios for the Australian National Electricity Market (NEM) against the costs of a previously published method for 100% renewable electricity in 2030 (Elliston et al., 2010). The comparison is made by projecting the prices for 2030 (Elliston et al., 2010). The study concludes that policies promoting high renewable electricity penetration based on commercially available technology offer a low-risk and cost-effective way of significantly reducing emissions in the electricity sector (Elliston et al., 2010). The COVID-19 outbreak has impacted waste management in the construction industry, requiring new solutions (Shooshtarian et al., 2010). It is imperative to note that Australia has yet to implement Extended Producer Responsibility (EPR) policies for construction and demolition (C&D) waste (Shooshtarian et al., 2010). This move has already been implemented in other countries for different waste streams (Shooshtarian et al., 2010). A study analysed barriers and enablers to implementing EPR policies for C&D waste in Australia, finding challenges such as cost, stakeholder involvement, and safety (Shooshtarian et al., 2010). Corruption in Australian construction is driven by personal gain, often involving kickbacks, fraud, and bribery (Brown & Loosemore, 2015). It is facilitated by attitudes, subjective norms, and perceived control over being caught (Brown & Loosemore, 2015). A study found a need for more trust, non-standardized information, and ineffective project management as hindrances in the construction industry (Fulford & Standing, 2014).

6.2.2.1.2 Services, value added (% of GDP)

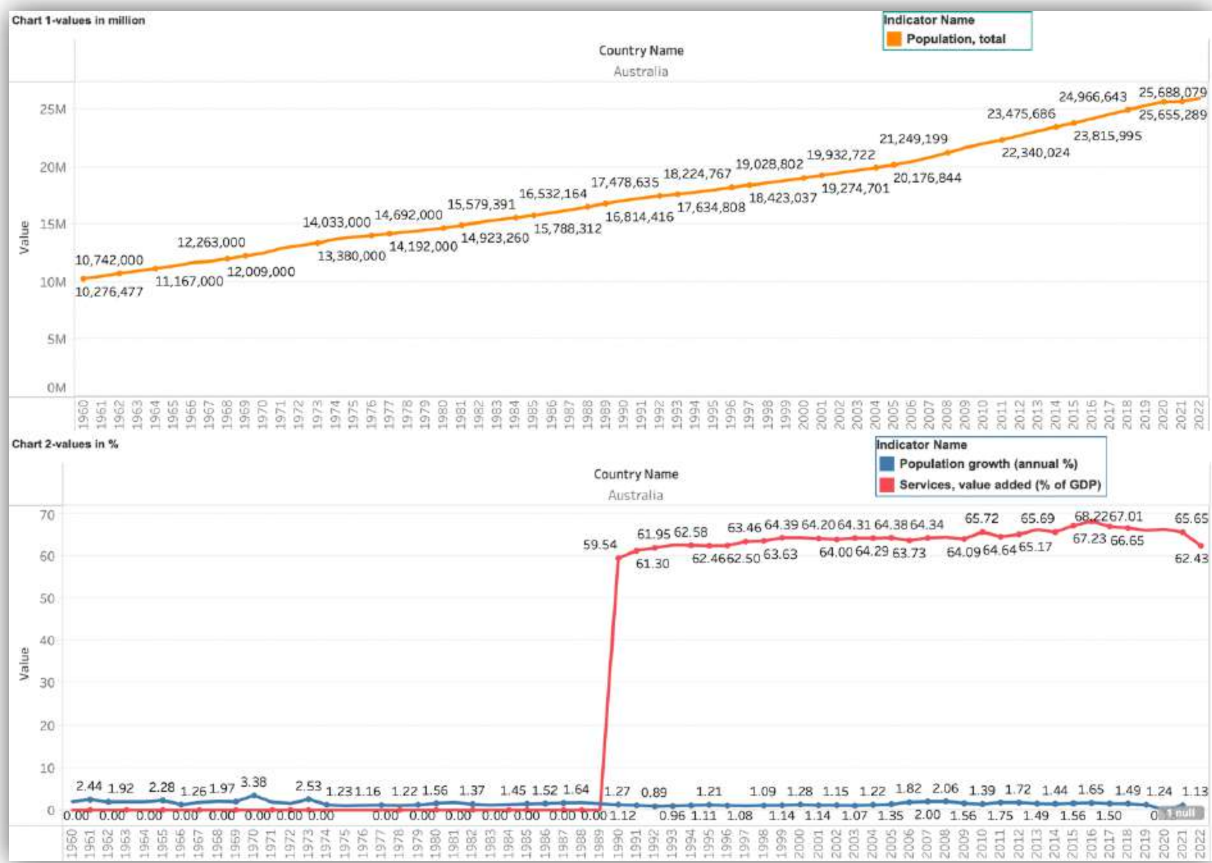

Figure 42, Line chart comparison of Service Sector value added % of GDP against Annual Population Growth % & Total Population. Created from Tableau & sourced from the World Bank (Services, value added (% of GDP), 2023).

The service industry, represented by the red line, accounts for the majority of GDP value added to the country. It started at 59.54% in 1990 and increased to 61%-68% from 1991 to 2022. In contrast, the population growth represented by the orange line increased from 16 million to 26 million from 1990 to 2022. This suggests that the population positively correlated with the service value until 2016 when the service value peaked at 68.22% and then fell to 62.43% in 2022. This implies that population growth and other factors are responsible for the overall increase in the value of services in Australia.

One study discovered that enhancing the entrepreneurial skills of restaurant owners results in creative, innovative, and value-adding establishments, which are crucial for success in the restaurant industry (Lee et al., 2016). Such efforts are essential for government-led campaigns like 'Restaurant Australia' to achieve their objectives and for Australia to become a world-class dining destination (Lee et al., 2016). Universities and employers must recognise the dynamic nature of accounting roles and the expenses involved in providing generalist degrees (Howieson et al., 2014) . The insights gained from interviewing practitioners, graduates, and students highlight the significance of universities in refining professional skills (Howieson et al., 2014). Nurses faced stressors such as work overload, role conflicts, and aggression (Lim et al., 2010). They utilised effective coping strategies such as seeking support, problem-solving, and self-control (Lim et al., 2010). Studies have shown that nursing work stress significantly impacts physical and mental well-being (Lim et al., 2010). Therefore, promoting effective coping and supportive relationships that consider personal and work-related stresses is recommended (Lim et al., 2010). A study in Australia found that customers prefer employee service over AI and that emotional intelligence impacts customer engagement (Prentice & Nguyen, 2020). Both employee service and AI are related to customer engagement and loyalty (Prentice & Nguyen, 2020). Employee service positively impacts customer loyalty (Prentice & Nguyen, 2020). Internet of Things (IoT) is a network that facilitates the integration of an organisation's supply chain infrastructure with its suppliers and customers (De Vass et al., 2021). The study found that IoT can improve supply chain performance by providing additional capabilities in data auto-capture, visibility, intelligence, and information sharing, leading to enhanced financial, social, and environmental sustainability (De Vass et al., 2021). According to a survey of retail workers in Australia, employment policies that prioritise employers' needs lead to "care theft" (CORTIS et al., 2023). This happens when flexible schedules and low pay drain workers' resources for care, transferring the burden onto low-income families and communities (CORTIS et al., 2023). Care theft results from power imbalances and employer practices, affecting multiple generations and hurting working-class communities' long-term care (CORTIS et al., 2023). The survey gathered data from Austria's retail sector in five Australian cities: Sydney, Perth, Melbourne, Brisbane, and Adelaide (Hussain & Chimhundu,2023). Using social media channels, a targeted audience of 385 valid responses from the retail industry was surveyed (Hussain & Chimhundu,2023). Results showed that social media positively correlates with consumer purchase intention (Hussain & Chimhundu,2023). Teacher education policies should prioritise research literacy and use research to inform accountability (Mayer & Mills,2021)—policies in Australia deprofessionalize educators (Mayer & Mills,2021). Hotel management graduates in Australia need strong soft skills, leadership, communication, customer service, people skills, and financial capabilities (Fraser,2020). Young Australian migrants and hospitality workers are at risk of suicide due to adverse working conditions and low pay (Burnett et al., 2022). Better support and access to mental health resources are recommended (Burnett et al., 2022).

6.2.2.2 Impact on Environmental Sustainability

6.2.2.2.1 Total greenhouse gas emissions (kt of CO2 equivalent)

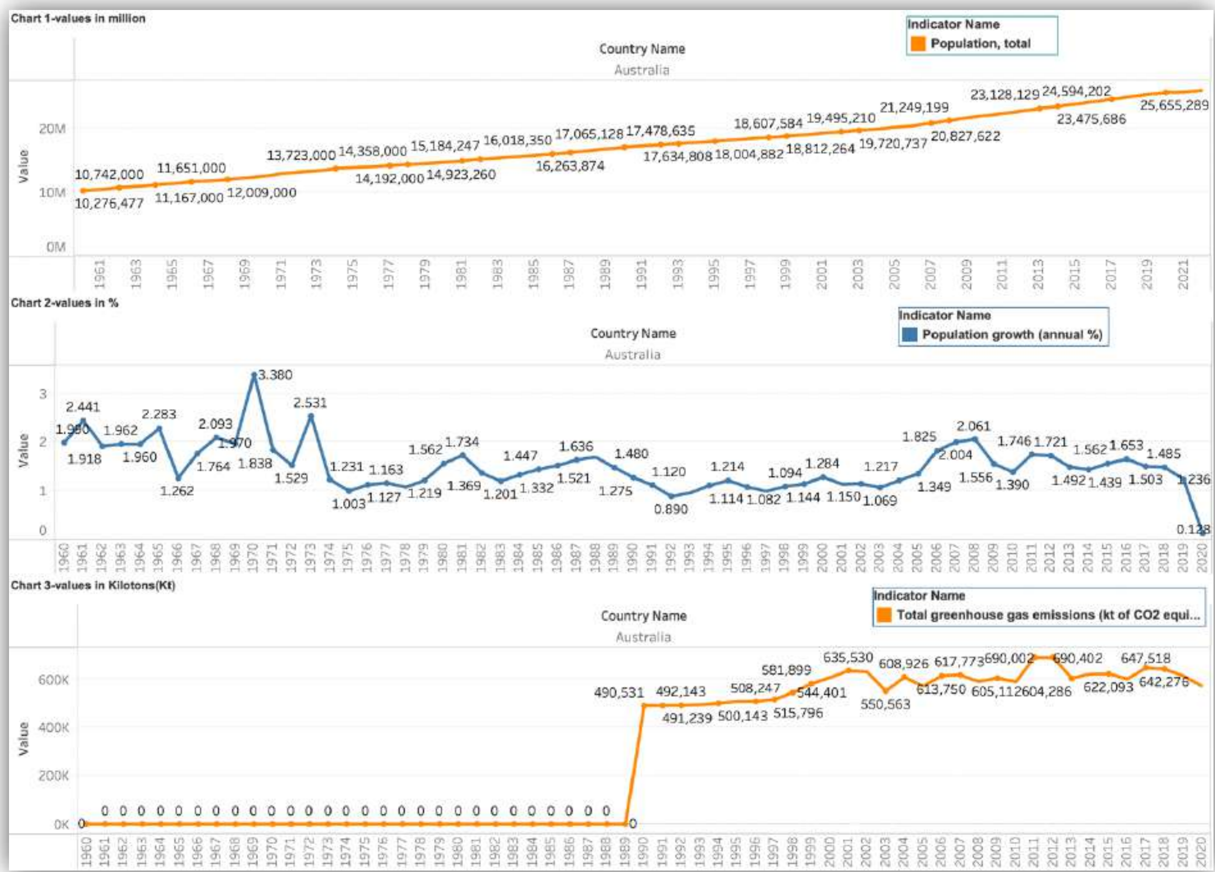

Figure 43, Line chart comparison of total greenhouse gas emission (kt of CO2 equivalent) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Total greenhouse gas emissions (kt of CO2 equivalent), 2023).

Australia's electricity sector is responsible for 33% of the country's emissions. Eight industries, including transport, agriculture, and waste, contribute to rising emissions (Bourne et al., 2018). A more robust climate and energy policy is needed to meet the

Paris Climate Agreement targets, as Australia's current target of a 26-28% reduction by 2030 is inadequate (Bourne et al., 2018). Climate change authority suggests that by 2030, Australia should aim for 45-65% emissions, with zero net emissions before 2050(Bourne et al., 2018). Implementing a pro-rata emissions reduction target of 26-28% by 2030 for each sector is less cost-effective than other methods (Bourne et al., 2018). To decrease emissions, carbon emissions must be cut. Stationary energy by 31%, agriculture by 23%, industrial processes by 22%, and waste by 5% (Bourne et al., 2018). Electricity can lead the way in reducing emissions at a lower cost (Bourne et al., 2018). The electricity sector only needs to reduce cumulative emissions by 8% compared to business as usual from 2018 to 2030 to achieve a pro-rata reduction (Bourne et al., 2018). All sectors, except waste, must cut emissions by more than the electricity sector. Transport and fugitive emissions must be cut by around a third (Bourne et al., 2018). Cost-effective technologies like energy efficiency, renewable energy, and storage are available for reducing electricity emissions (Bourne et al., 2018). They can be rapidly deployed to create time for policies in other sectors to be established and implemented (Bourne et al., 2018). Several studies have consistently found no technical barriers to Australia achieving secure, reliable power from a high proportion of renewable electricity (Bourne et al., 2018). Smart Farming tech can cut greenhouse gas emissions from the agriculture industry without harming productivity or economics (Panchasara et al., 2021). In Queensland, Australia, the livestock sector alone is responsible for 70% of emissions (Panchasara et al., 2021). New detached dwellings in Australia built in 2019 will produce approximately 545 tCO_2e (tonnes (t) of carbon dioxide (CO_2) equivalent (e)) by 2050 (Schmidt et al., 2020). This is higher than projected emissions for Australia by 2030 (Schmidt et al., 2020). GHG emissions from housing are underestimated by 60% due to the need to consider embodied GHG emissions (Schmidt et al., 2020). Emissions in Australia have risen since 2014 and meeting the Paris Agreement target of reducing emissions by 26-28% below 2005 levels may still be necessary (Ivanovski & Churchill, 2020). States and territories are making efforts, but more progress is needed to reach the 1.5°C goal (Ivanovski & Churchill, 2020). A recent study found that state income, urbanisation, and trade impact reducing greenhouse gases (Ivanovski & Churchill, 2020). Due to packaging materials, online food delivery services in Australia produce 0.15 to 0.29 kg CO_2e of greenhouse gas emissions per order (Arunan & Crawford, 2021). The emissions are predicted to increase by 132% by 2024 (Arunan & Crawford, 2021).

6.2.2.2.2 Energy use (kg of oil equivalent per capita)

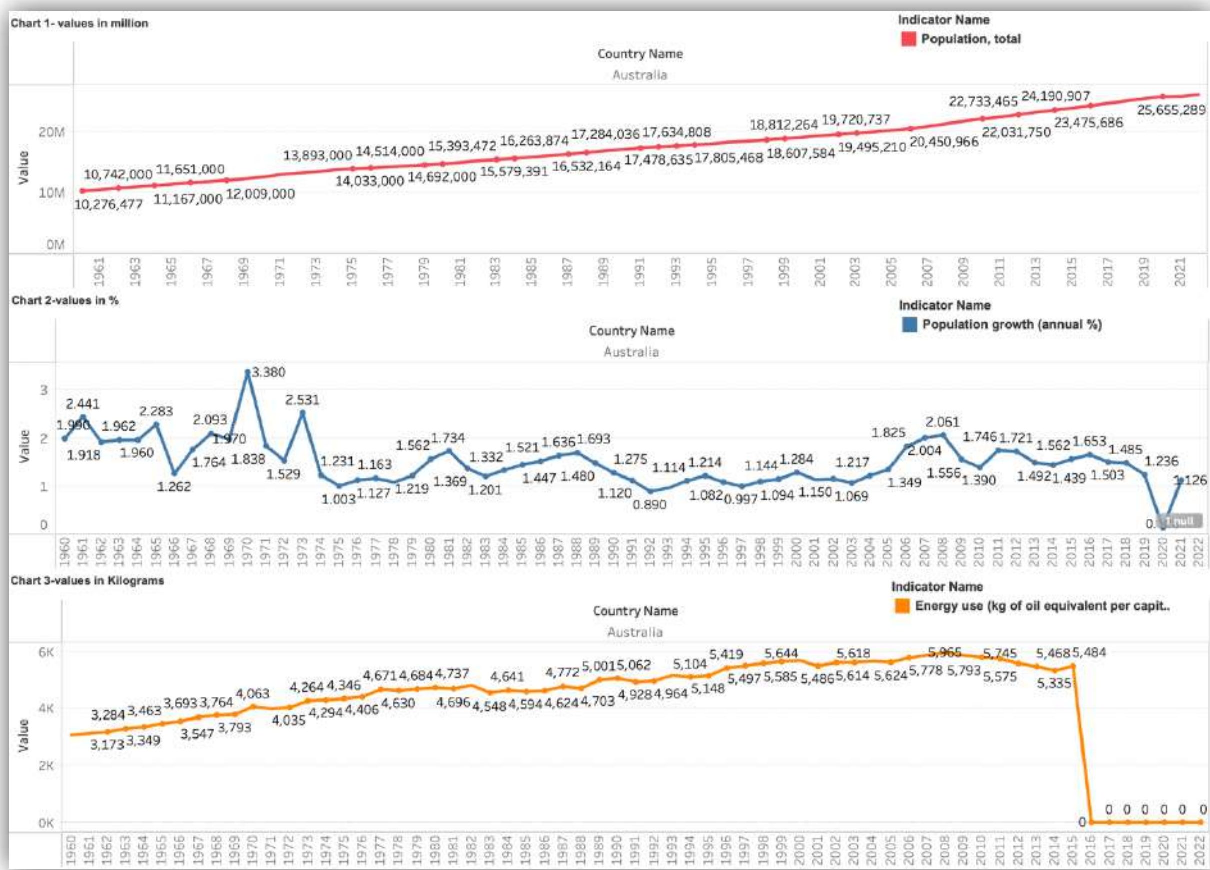

Figure 44, Line chart comparison of 3 different charts. Created from Tableau & sourced from the World Bank (Energy use (kg of oil equivalent per capita), 2014).

A study of 122 university buildings in subtropical Australia found that wet laboratories and health buildings use the most energy due to their equipment and ventilation needs (Gui et al., 2020). Research buildings have the highest energy use, but growing teaching spaces significantly impact energy consumption (Gui et al., 2020). Australia is increasing its use of renewable energy sources (Li et al., 2020). A research paper analysed 118 documents and found that time-varying feed-in tariffs, waste-to-energy integration, subsidised geothermal energy installations, and public-private partnerships could enhance renewable energy infrastructure development (Li et al., 2020). Industrialisation and non-renewable energy use increase CO_2

emissions, while renewable energy use, financial development, and automation reduce CO2 emissions in Australia, according to a study from 1990 to 2020 that used econometric techniques (Rahman & Alam,2022). A survey of the Australian Capital Territory Energy Efficiency Improvement Scheme shows that replacing natural gas heaters with electric alternatives reduces natural gas consumption and slightly increases electricity usage (Hammerle & Burke,2022). Electric water heaters significantly reduce natural gas use for vulnerable households (Hammerle & Burke,2022). The impact on emissions depends on the emissions factor for grid electricity. Residential electrification can aid decarbonisation efforts if low-emission sources are used (Hammerle & Burke,2022). A recent study shows that economic growth and energy use positively impact CO2 emissions, while trade liberalization has a negative impact (Yusuf et al., 2023). Policymakers should consider the role of energy usage and trade liberalisation in promoting economic development while impeding environmental health (Yusuf et al., 2023). A study looked at how oil, gas, coal, and electricity use affect the environment in Australia, China, and the USA (Munir & Riaz, 2020). They used data from 1975 to 2018 and found that Australia increased oil and coal use while decreasing gas and electricity use (Munir & Riaz, 2020). The study recommends investing in research and development to control pollution and promote renewable energy (Munir & Riaz, 2020). An energy use database was created for Australian public primary schools, containing data from 3,701 schools (Daly et al., 2022). The database showed that energy consumption was related to enrolments, gross floor area, climate zone, and remoteness. Schools with solar PV used 16% less energy on average. Those with gas used more fuel (Daly et al., 2022). A study in Australia found that a Perovskite-based solar cell integrated with a naturally ventilated double-skin facade is the best option for energy efficiency and reducing heating/cooling loads (Yang et al., 2020). A Research study assessed the energy and carbon efficiencies of green-certified commercial offices in eight Australian central business districts for 2011-2020 (Kim et al., 2022). The results suggest that the highest National Australian Built Environment Rating System rating does not necessarily help reduce energy consumption and that a whole-building design approach should be promoted (Kim et al., 2022).

6.2.2.2.3 Unemployment, total (% of total labor force) (modeled ILO estimate)

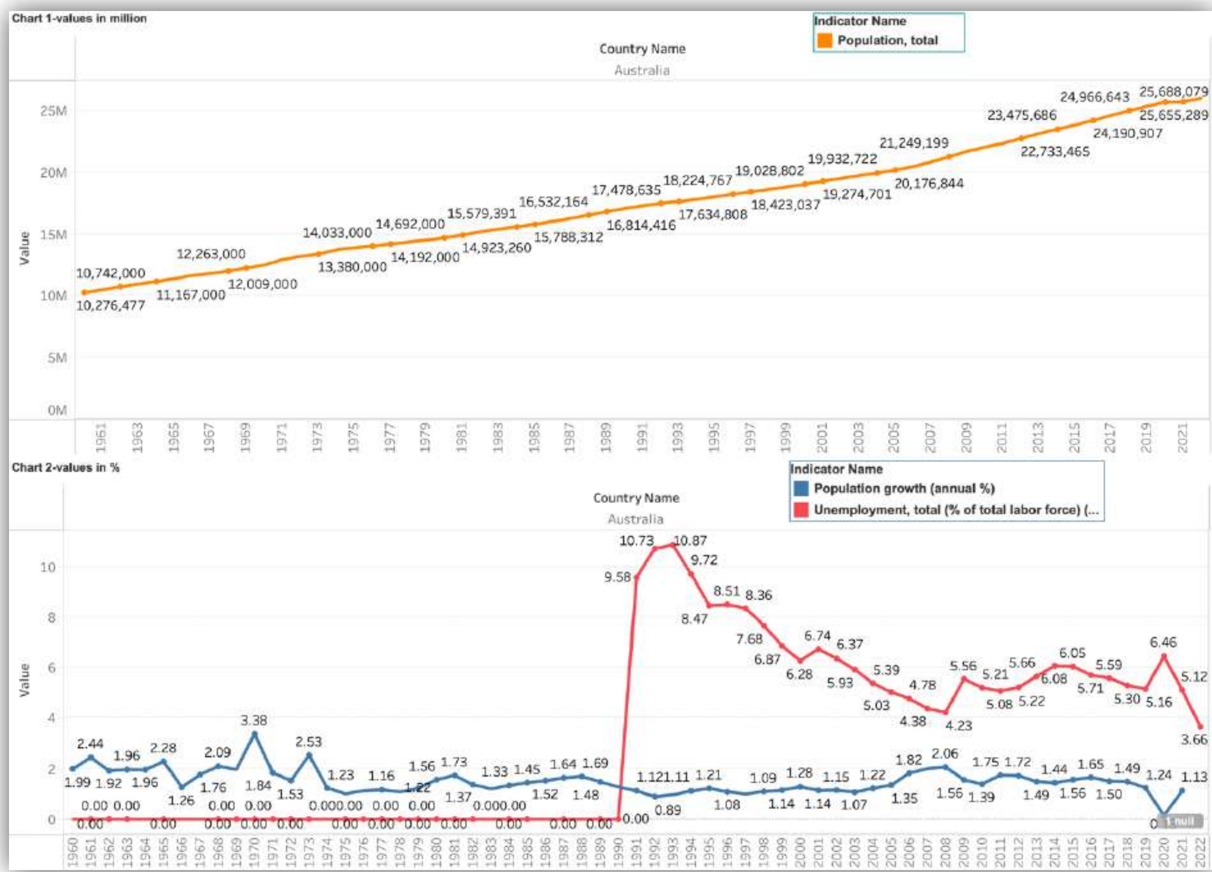

Figure 45, Line chart comparison of total unemployment (% of total labour force, modelled ILO estimate) with total population growth & annual population growth %. Created from Tableau & sourced from the World Bank (Unemployment, total (% of total labor force) (modeled ILO estimate), 2023).

Long-term unemployment has risen in the past decade, with older, less educated men less likely to find future employment (Cassidy et al., 2020). Extended unemployment can also adversely affect job prospects (Cassidy et al., 2020). A study examines the relationship between immigration, unemployment, GDP, and wages in Australia's labour market (AboElsoud et al., 2020). Positive policy developments since 1996, such as increased permanent migration and skilled labour immigration, have impacted these variables (AboElsoud et al., 2020). A study on COVID-19's impact on Australia's states found that international mobility was affected, particularly in education, tourism, and the labour market (Munawar et al., 2021). COVID-19 has hit tertiary education in Australia hard, with enrolment dropping by over 8,000 students in the technology network and 14% in the innovative research group (Munawar et al., 2021). This decline is due to border restrictions and bans on international travel, resulting in a 99.4% decline in the arrival of international students since 2019 (Munawar et al., 2021). Australian universities lost 6% of their income in 2020 alone and over 17,000 job losses (Munawar et al., 2021). COVID-19 has heavily impacted tourism and employment in the industry, with border closures and lockdowns causing a decline in both international and domestic tourism (Munawar et al., 2021). Employment has decreased by 15-18% per quarter. However, the essential status of home deliveries may help reduce the impact (Munawar et al., 2021). Despite COVID-19's impact on the Australian economy, unemployment has decreased from 7.1% to 5.1% from May 2020 to May 2021 (Munawar et al., 2021). Employment rates have increased in all states and territories thanks to initiatives like Job Keepers and Job Seekers (Munawar et al., 2021). The reopening of borders will further improve the employment situation (Munawar et al., 2021). A study in Australia found that the impact of unemployment and sentiment on suicide rates is nonlinear and varies by gender (Botha & Nguyen, 2022). Men are more affected by unemployment, while women are more affected by changes in opinion (Botha & Nguyen, 2022). Expectations of the future are a stronger predictor of suicide rates than current conditions. Sentiment has a more significant effect on male suicide rates than females (Botha & Nguyen, 2022). Research in Australia found that benefit eligibility requirements can make it harder for individuals to find employment, resulting in lower wages and fewer hours during the first year of work (Gerards & Welters, 2022). This is due to externalised job search motivation and increased stress (Gerards & Welters, 2022).

7 Sustainability impacts

7.1 Socio-Economic Impact analysis

Population growth in many regions has been found to have a negative impact on the employment rate, thus increasing unemployment in an area (Maijama'a et al, 2019). Various online studies show that this situation is especially prevalent in developing countries or countries less prosperous than the Western economic powers. Case studies were conducted in developing nations across Asia, Africa, and Europe (Maijama'a et al., 2019; Hjazeen et al., 2021; Ali et al., 2021; Andrei et al., 2021). Some evidence also suggests that population growth significantly hinders an increase in wage/salary per hour (Alexopoulos, 2003).

7.1.1 Analysis- Developing Countries

From Figure 28, a similar trend can be observed in the Philippines. From the figure, the population growth rate in the Philippines is seen to be in a declining trend. The population growth rate in 2022 is just 1.46% compared to 2.35% in 1990. This is reflected in the unemployment rate and the value of 2.23% in 2022 compared to 3.83% in 1990.

Although there is a significant connection between the population growth rate and the unemployment rate, other factors play a more crucial role in the current statistics. From Figure 25, it can be observed that there is significant growth in service sectors, which would negate the unemployment rate that would have been caused by population growth as more people would be employed in the service sectors (Lorence, 1991; Anxo and Storrie, 2002). Similarly, from Figure 24, there seems to be constant growth in the Industrial sector since 1990, which would also significantly reduce the unemployment ratio (Njoku and Ihugba, 2011).

However, this scenario fails to prevail in the case of Nepal. From Figure 18, it is observed that the industrial sector has been in decline since 1999. However, the unemployment rate has been constant at about 10.5%, with a spike of 13% in 2020 and 12.22% in 2021. However, this was most likely caused by the COVID-19 pandemic (Raut, 2020). Although there has been a slight increase in the service sector since 1990, this also does not impact the unemployment rate. The population growth rate has been constant in Nepal since 1990. Therefore, there is no correlation between population and growth in industrial and service sectors.

7.1.2 Analysis- Developed Countries

From Figure 25, the Unemployment rate in the UK has been on a declining trend since 1992. The unemployment rate of the UK in 1992 was at a staggering 10.35%. However, this value has declined to 3.57% in 2022. The population Growth rate in the UK from Figure 31 shows that it has been at constant with less than 1% throughout this period. Although the growth in the Industrial Sector has declined (From Figure 31), the values are still positive, indicating the increase in Industries in the UK. From Figure 32, it can be observed that the service sector has grown at a constant rate. There is no clear link between the population and the socio-economic status of the UK. In the UK, like Nepal, other external factors impact the Socioeconomic status. Various online literature cites that different National and Firm policies play a much more significant impact on the socioeconomic sector in the UK (Cole, 2008; Johnson and Layard, 1986; Clasen, 2002).

Similarly, in the case of Australia, there seems to be no relevant connection between the population growth rate and unemployment (Figure 41). While the population growth has been constant between 1990 and 2022, the unemployment rate has dropped significantly. 10.8% in 1992 to 3.66% in 2022. Thus, the increase in population does not impact unemployment in Australia either. However, Figure 37 shows that growth in the Industrial sector does affect the unemployment rate as growth in the Industrial sector has increased by about 6.5%, and the unemployment rate in the same period has decreased significantly, i.e. 2.8%. Thus, there is a correlation between industrial growth and the unemployment rate in Australia. However, the population growth rate impacts the service sector, as shown in Figure 38. The dip in population growth has also caused a slight dip in the growth service sector. This research also aligns with the findings of (Bellamy and Pravica, 2011).

7.2 Environmental Impact Analysis

With a growing population, there is always an increasing energy demand. Currently, most fossil fuel is one of the most significant sources of the world’s energy (Ediger, 2019). Thus, the greenhouse emissions of a country should increase with the increase in population. Currently, most developed nations (especially in Europe) are trying to dampen emissions by reverting to sustainable sources of energy (Dixon et al., 2022). However, due to high costs, most developing nations have been reluctant to use renewable sources (Cantarero, 2020). This section of the dissertation aims to analyse the correlation between population growth and greenhouse emissions in the Philippines, Nepal, the UK, and Australia.

7.2.1 Developed Nations

Figure 33 shows that in the United Kingdom, there is only slight population growth between 1990 and 2022, with a total population growth of about 10 million. However, the total greenhouse emissions have been on a steep decline, with 758,371 kilotons of CO2 being emitted in 1990 and only 398,324 in 2022. The data indicates that the CO_2 emissions per annum have decreased by over 52% in the UK between 1990 and 2022 despite the slight population growth. However, this does not mean that population growth doesn't impact CO_2 emissions. In the case of the UK, the main reason for this decline is mainly attributed to the increase in reliance on renewable energy.

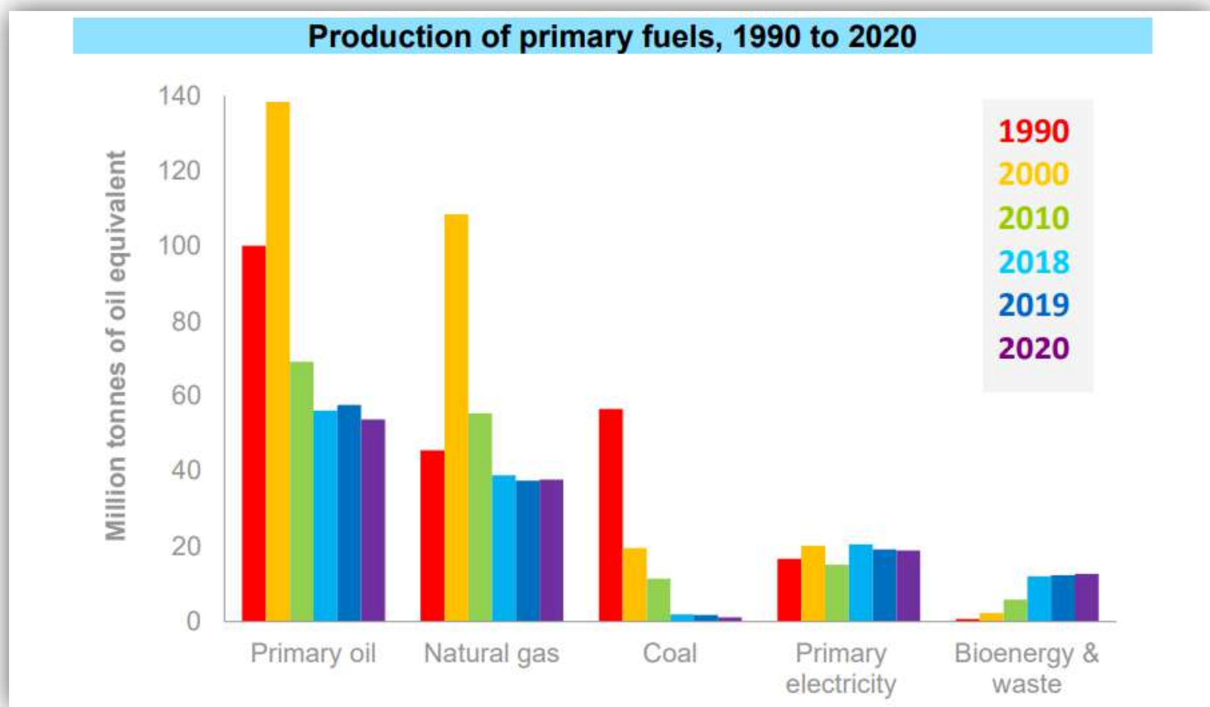

Figure 46, Energy Sources in the UK in 1990, 2000, 2010, 2018, 2019, and 2020 (UKGOV,2021) (Figure generated from Appendix 1).

From the figure above, it can be observed that the use of coal and oil has significantly declined since 1990 compared to 2020, with 56.4 million tonnes of oil equivalent coal used in 1990 and only 1.2 million tonnes of oil equivalent in 2022.

Thus, these changes in Energy sources are the primary cause behind the UK's declining emissions.

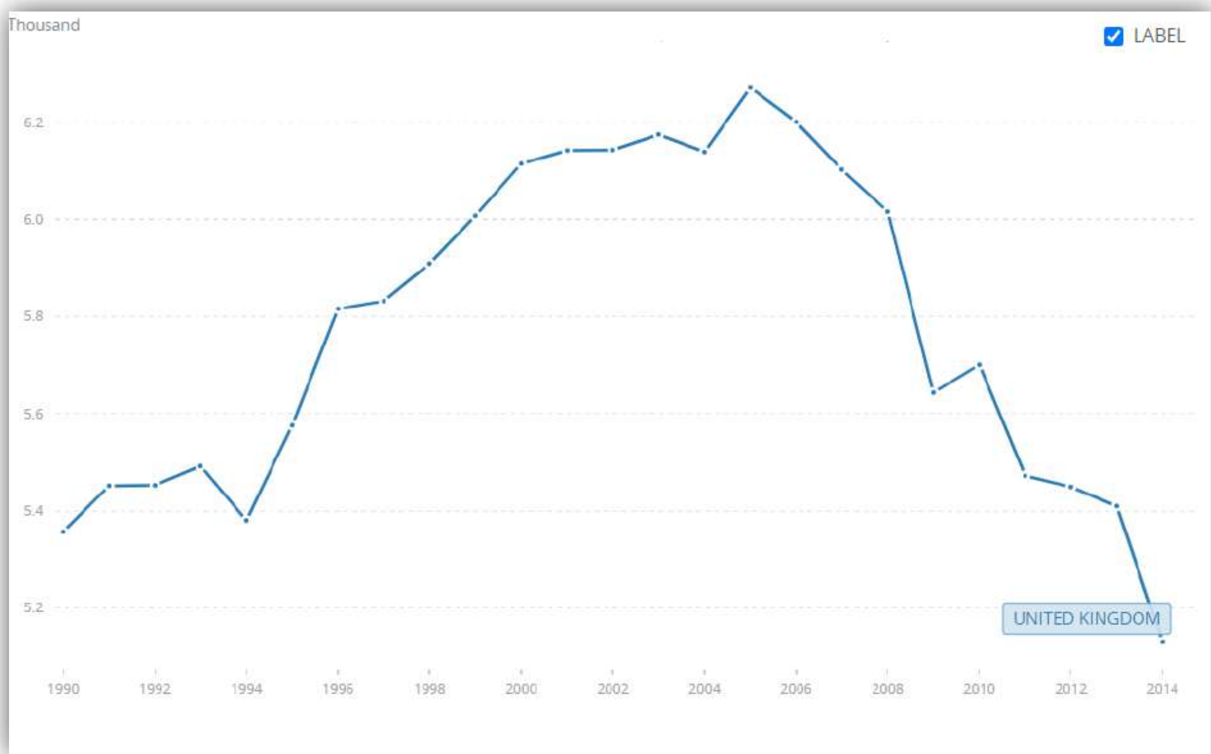

Figure 47, energy demand in the UK in thousand kWh per capita (Source: World Bank,2014)

From the Figure above, it can be observed that the energy demand had been growing in the UK from 1990 to 2006. However, from Figure 33, it can be observed that total greenhouse gas emissions have declined by about 60 kilotons in the same period. This data reflects the impact of using low-carbon energy on greenhouse gas emissions. The decrease in energy consumption observed since 2006 can be attributed to the enhanced efficiency of diverse energy incentive mechanisms implemented across various sectors.

In the case of Australia, from Figure 39, total greenhouse emissions have slightly increased in 2022 (642,276 kilotons) compared to 1990 (490,531 kilotons). This correlates with the population increase in Australia as the population has also increased from about 10 million to 25 million in this period. Australia's Environmental policy has not become as rigid as that of the United Kingdom as Australia has not set any specific emissions goal like the UK's net zero target or target of other EU countries (Fragkos. 2021). Thus, due to the lack of strict emission policies, Australia's CO2 emission is also increasing with the increase in population.

However, the dampening of emission increase is primarily due to improvements in the efficiency of various devices used across different industrial and economic sectors.

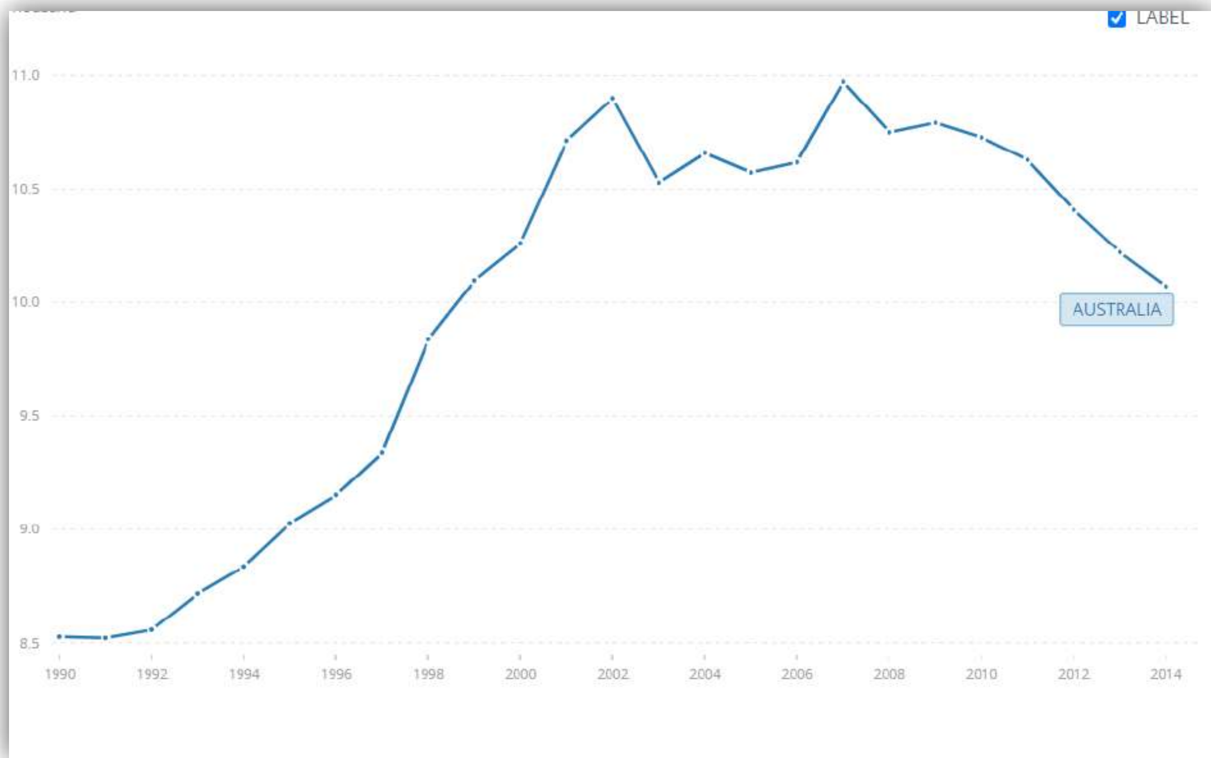

Figure 48, Australia Energy Demand in thousand kWh per capita (Source: World Bank, 2014)

From the figure above, it can be observed that, unlike the UK, energy demand per capita in Australia has also been on the incline from 1990 till 2007 and declined from 2007 onwards. This also correlates with increasing emissions from greenhouse gasses in Figure 39.

In 1995, around 90% of energy in Australia was generated using fossil fuels; however, this number has gone down to 71%. This would also reflect why the emission is not constant with population growth.

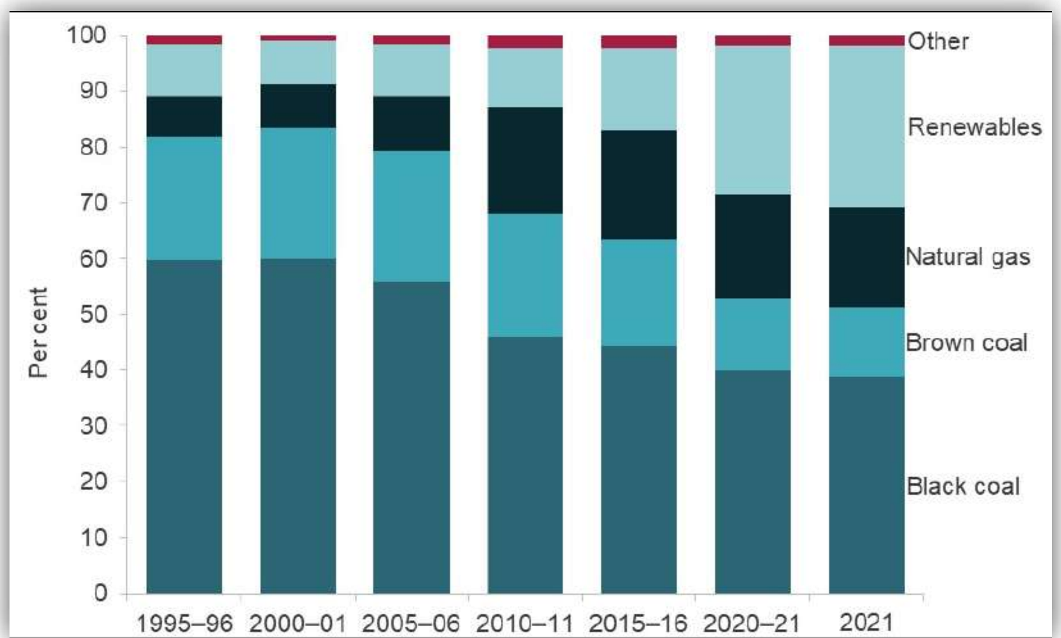

Figure 49, Energy Mix in Australia 1995 to 2021 (Gov.AU, 2021).

7.2.2 Developing Nations

In the case of Nepal, it can be observed that the emission trend coincides with the population growth. Since 1990, the total CO_2 emission in Nepal has increased by 49%. In contrast, the Population of Nepal has grown by about 68% (From Figure 19). From Figure 19, it can also be observed that emission growth follows a similar trend with population growth. This is mainly due to Nepal still heavily relying on biomass. Although there has been some development in the renewable energy sector in Nepal, it needs to be more significant to achieve the trend line of the UK or Australia mentioned in the previous chapter (Surendra et al., 2011). Thus, in the case of Nepal, the escalation in CO2 emissions is a direct cause of the surge in population. From Figure 26, a similar scenario in the Philippines can be observed. From 1990 to 2022, the population of the Philippines has grown by 54% while the CO_2 emissions in the same period have increased by 43%. As mentioned in 6.1.2.2.1, just like Nepal, the Philippines also heavily relies on biomass for energy. Resulting in an increase in emissions due to demand caused by the population growth. Like in Nepal, despite government efforts, there hasn't been any significant growth in renewable energy sectors (Brahim, 2014).

8 Conclusion

It is apparent from the findings in Chapter 7 that the population does not necessarily influence the Socio-Economic aspect of Sustainability, and instead is mainly driven by external factors. This was evident in both developed and developing nations studied in this dissertation. However, in this dissertation, due to the limitation in time, the unemployment rate was the only social aspect taken. For the economic part, only the Industrial and Service sectors were considered. However, the Economic factors consist of various sectors such as Agriculture, Resources and minerals, commodities, etc. Some of the significant social aspects not considered in this dissertation are Crime rates, job security, and happiness index.

Although no correlation was found between population and the discussed Economic and Social sectors, other social and economic aspects could be correlated to the research. Various online literature shows a significant correlation between population and socio-economic factors (Le et al., 2011; Svendsen et al., 2014).

In the case of emissions, there doesn't seem to be a direct correlation with population in Developed nations (UK and Australia). However, from Chapter 7, it can be deduced that this is primarily due to changes in the Energy mix as these countries were increasing their reliance on Eco-friendly energies. Also, both Australia and the UK are heavily industrialised nations with highly developed infrastructures being accessible to the majority of its population, which were both well developed by 1990. Thus, switching to renewables and improving the efficiency of devices significantly lowered the energy demand, negating the increase in GHG emissions caused by population growth. That is why this dissertation shows that although the UK and Australia's CO_2 emissions have declined or remained constant, the total emission is still significantly higher compared to that of Nepal and the Philippines.

However, in the Philippines and Nepal (developing countries), where both energy sources and way of use have remained constant, the CO_2 emissions have increased correspondingly to the population. This indicates that population directly impacts the energy demand, which increases the CO_2 emissions if green energy sources are not developed in the country. From the analysis in this dissertation, it can be deduced that the impact of population growth on emissions can be negated with the development of low-carbon technologies. However, not all countries have the financial capacity to introduce the technology to offset this impact.

Overall, this dissertation indicates that population growth in developing countries has an enormous sustainability impact on developing than developed countries. Thus, developing countries could get valuable insights into tackling sustainability issues using various population data studies.

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10 APPENDIX:

10.1 Appendix 1

				Million tonnes of oil equivalent		
	1990	**2000**	**2010**	**2018**	**2019**	**2020**
Primary oil	100.1	138.3	69.0	56.0	57.4	53.6
Natural gas	45.5	108.4	55.3	38.8	37.4	37.7
Coal	56.4	19.6	11.4	1.9	1.8	1.2
Primary electricity	16.7	20.2	15.1	20.5	19.2	18.9
Bioenergy & waste	0.7	2.3	5.8	12.0	12.3	12.7
Total	**219.4**	**288.7**	**156.7**	**129.3**	**128.2**	**124.1**

10.2 Appendix 2

Screenshots of all cleaned and transformed data (done using jupyter notebook) include annual population growth %, unemployment %, industry value %, services %, total greenhouse gas emissions & energy use per capita.

1. Annual population growth %:

```
import pandas as pd
df=pd.read_excel("Population growth (annual %).xls")
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
0	Last Updated Date	2023-06-29 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
3	Aruba	ABW	Population growth (annual %)	SP.POP.GROW	NaN	2.179059	1.548572	1.389337	1.215721	1.032841	...	0.749301	0.6
4	Africa Eastern and Southern	AFE	Population growth (annual %)	SP.POP.GROW	NaN	2.660180	2.732633	2.753248	2.806915	2.840787	...	2.780207	2.7
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.2
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.8
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.5
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.2
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.1

269 rows × 67 columns

[2]:
```
index_list = list(range(0,2))
df.drop(df.index[index_list], inplace =True)
df
```

[2]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Un
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.
3	Aruba	ABW	Population growth (annual %)	SP.POP.GROW	NaN	2.179059	1.548572	1.389337	1.215721	1.032841	...	0.749301	0.
4	Africa Eastern and Southern	AFE	Population growth (annual %)	SP.POP.GROW	NaN	2.660180	2.732633	2.753248	2.806915	2.840787	...	2.780207	2.
5	Afghanistan	AFG	Population growth (annual %)	SP.POP.GROW	NaN	1.925952	2.014879	2.078997	2.139651	2.216007	...	3.466788	3.
6	Africa Western and Central	AFW	Population growth (annual %)	SP.POP.GROW	NaN	2.115789	2.145723	2.190827	2.211360	2.242567	...	2.761839	2.
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.

[3]:
```
index_list = list(range(1,14))
df.drop(df.index[index_list], inplace =True)
df
```

[3]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.4
17	Austria	AUT	Population growth (annual %)	SP.POP.GROW	NaN	0.548472	0.612896	0.642363	0.666548	0.649730	...	0.589387	0.7
18	Azerbaijan	AZE	Population growth (annual %)	SP.POP.GROW	NaN	3.810165	2.980534	2.964160	3.337155	3.004475	...	1.293447	1.2
19	Burundi	BDI	Population growth (annual %)	SP.POP.GROW	NaN	2.493352	2.504826	2.081634	2.845300	2.760965	...	3.551108	3.3
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.2
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.8
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.5
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.2
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.1

254 rows × 67 columns

4]:
```
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

4]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.4
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.7
85	Georgia	GEO	Population growth (annual %)	SP.POP.GROW	NaN	1.578436	1.519342	1.473022	1.410306	1.316771	...	-0.300972	0.0
86	Ghana	GHA	Population growth (annual %)	SP.POP.GROW	NaN	2.817753	2.392892	2.402528	2.410339	2.424879	...	2.452427	2.4
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.2
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.8
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.5
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.2
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.1

187 rows × 67 columns

5]:
```
index_list = list(range(3,99))
df.drop(df.index[index_list], inplace =True)
df
```

5]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.4
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.7
181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.2
182	Nauru	NRU	Population growth (annual %)	SP.POP.GROW	NaN	3.664041	4.061158	4.888636	5.356083	5.671257	...	2.365519	2.2
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.2
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.8
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.5
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.2
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.1

91 rows × 67 columns

[6]:
```
index_list = list(range(4,12))
df.drop(df.index[index_list], inplace =True)
df
```

[6]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.4
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.7
181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.2
190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	NaN	2.959063	2.834360	2.801870	2.773070	2.747040	...	1.686956	1.6
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Population growth (annual %)	SP.POP.GROW	NaN	1.986474	2.857337	2.777956	2.702867	2.631731	...	0.607468	-0.2
265	Yemen, Rep.	YEM	Population growth (annual %)	SP.POP.GROW	NaN	1.862737	1.872291	1.839467	1.920052	2.046198	...	2.859237	2.8
266	South Africa	ZAF	Population growth (annual %)	SP.POP.GROW	NaN	2.799492	2.978651	3.033440	3.061378	3.091501	...	1.361621	1.5
267	Zambia	ZMB	Population growth (annual %)	SP.POP.GROW	NaN	3.156056	3.178563	3.196632	3.194441	3.201590	...	3.271299	3.2
268	Zimbabwe	ZWE	Population growth (annual %)	SP.POP.GROW	NaN	3.094865	3.105320	3.115408	3.119878	3.124829	...	2.163267	2.1

83 rows × 67 columns

[7]:
```
index_list = list(range(5,83))
df.drop(df.index[index_list], inplace =True)
df
```

[7]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unn
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.0
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.4
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.7
181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.2
190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	NaN	2.959063	2.834360	2.801870	2.773070	2.747040	...	1.686956	1.6

5 rows × 67 columns

[8]:
```
header_row = 0
df.columns = df.iloc[header_row]
df
```

[8]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.000000	2
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.491566	
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.736464	
181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.293748	
190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	NaN	2.959063	2.834360	2.801870	2.773070	2.747040	...	1.686956	1.616841	

5 rows × 67 columns

```
[9]: df.drop([2],inplace=True)
     df
```

[9]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	2016.0	2
16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.491566	1.439217	1.561940	1.65
84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.736464	0.792368	0.757874	0.67
181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.293748	0.538271	0.904474	1.14
190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	NaN	2.959063	2.834360	2.801870	2.773070	2.747040	...	1.686956	1.616841	1.669830	1.773824	1.76

4 rows × 67 columns

```
[10]: df=df.reset_index()
      df
```

[10]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2016.0	2017.0
0	16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	NaN	1.989740	2.440639	1.917816	1.962354	...	1.721151	1.491566	1.439217	1.561940	1.653391
1	84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	NaN	0.760460	0.848661	0.748366	0.650258	...	0.669741	0.736464	0.792368	0.757874	0.679374
2	181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	NaN	1.920891	1.963890	1.985704	2.020694	...	0.185922	0.293748	0.538271	0.904474	1.149954
3	190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	NaN	2.959063	2.834360	2.801870	2.773070	...	1.686956	1.616841	1.669830	1.773824	1.761023

4 rows × 68 columns

```
[11]: df.drop([1960.0],inplace=True, axis=1)
      df
```

[11]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	2016.0	2017
0	16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	1.989740	2.440639	1.917816	1.962354	1.959717	...	1.721151	1.491566	1.439217	1.561940	1.6533
1	84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	0.760460	0.848661	0.748366	0.650258	0.642469	...	0.669741	0.736464	0.792368	0.757874	0.6793
2	181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	1.920891	1.963890	1.985704	2.020694	2.070000	...	0.185922	0.293748	0.538271	0.904474	1.1499
3	190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	2.959063	2.834360	2.801870	2.773070	2.747040	...	1.686956	1.616841	1.669830	1.773824	1.7610

4 rows × 67 columns

```
[12]: with pd.option_context('display.max_rows', None, 'display.max_columns', None):
          display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	1967.0	1968.0	1969.0	1970.0
0	16	Australia	AUS	Population growth (annual %)	SP.POP.GROW	1.989740	2.440639	1.917816	1.962354	1.959717	2.283184	1.262277	1.764159	2.093023	1.970189
1	84	United Kingdom	GBR	Population growth (annual %)	SP.POP.GROW	0.760460	0.848661	0.748366	0.650258	0.642469	0.551303	0.538544	0.486768	0.415803	0.398722
2	181	Nepal	NPL	Population growth (annual %)	SP.POP.GROW	1.920891	1.963890	1.985704	2.020694	2.070000	2.090077	2.116721	2.151836	2.160731	2.178627
3	190	Philippines	PHL	Population growth (annual %)	SP.POP.GROW	2.959063	2.834360	2.801870	2.773070	2.747040	2.704140	2.670201	2.645798	2.588785	2.593516

2. Energy use per capita:

1]:
```
import pandas as pd
df=pd.read_excel("energy use.xlsx")
df
```

1]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unname
0	Last Updated Date	2023-07-25 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	Na
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	Na
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000000	2014.0000
3	Aruba	ABW	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	Na
4	Africa Eastern and Southern	AFE	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	719.005743	734.2182
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.695977	1219.3266
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.314052	Na
266	South Africa	ZAF	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	2593.835487	2686.3761

2]:
```
index_list = list(range(0,2))
df.drop(df.index[index_list], inplace =True)
df
```

2]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000000	2014.000
3	Aruba	ABW	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
4	Africa Eastern and Southern	AFE	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	719.005743	734.218
5	Afghanistan	AFG	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
6	Africa Western and Central	AFW	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	612.821698	602.378
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.695977	1219.326
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.314052	N

```
3]: index_list = list(range(1,14))
    df.drop(df.index[index_list], inplace =True)
    df
```

3]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.391369
17	Austria	AUT	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	1546.261468	1554.034906	1675.873621	1823.995225	1855.085155	1851.843564	...	3919.044419
18	Azerbaijan	AZE	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1474.003433
19	Burundi	BDI	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.695977
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.314052

```
4]: index_list = list(range(2,69))
    df.drop(df.index[index_list],inplace=True)
    df
```

4]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.391369
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.700589
85	Georgia	GEO	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1048.341057
86	Ghana	GHA	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	325.247006
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.695977
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.314052

[5]:
```
index_list = list(range(3,99))
df.drop(df.index[index_list], inplace =True)
df
```

[5]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.391369
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.700589
181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	410.221516
182	Nauru	NRU	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.695977
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.314052

6]:
```
index_list = list(range(4,12))
df.drop(df.index[index_list], inplace =True)
df
```

6]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.00000
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.39136
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.70058
181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	410.22151
190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	449.29493
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	1296.69597
265	Yemen, Rep.	YEM	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	306.31405

7]:
```
index_list = list(range(5,83))
df.drop(df.index[index_list], inplace =True)
df
```

7]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.00000
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.39136
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.70058
181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	410.22151
190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	449.29493

5 rows × 67 columns

8]:
```
header_row = 0
df.columns = df.iloc[header_row]
df
```

8]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	201
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.391369	533
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.700589	277
181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	410.221516	42
190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	449.294934	47

5 rows × 67 columns

9]:
```
df.drop([2],inplace=True)
df
```

9]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	
16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	...	5468.391369	533
84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	...	2987.700589	277
181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	410.221516	42
190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	NaN	...	449.294934	47

4 rows × 67 columns

10]:
```
df=df.reset_index()
df
```

10]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0
0	16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	...	5468.391369	5334.681679
1	84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	...	2987.700589	2777.310987
2	181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	...	410.221516	425.666371
3	190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	NaN	NaN	NaN	NaN	NaN	...	449.294934	470.496654

4 rows × 68 columns

```
11]: df.fillna(0,inplace=True)
     df
```

11]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0
0	16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	...	5468.391369	5334.681679
1	84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	...	2987.700589	2777.310987
2	181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	0.000000	0.000000	0.000000	0.000000	0.000000	...	410.221516	425.666371
3	190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	0.000000	0.000000	0.000000	0.000000	0.000000	...	449.294934	470.496654

4 rows × 68 columns

```
12]: with pd.option_context('display.max_rows', None, 'display.max_columns', None):
         display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	
0	16	Australia	AUS	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3063.554271	3115.787084	3172.974865	3284.050959	3349.414167	3463.215578	3546.537980	36
1	84	United Kingdom	GBR	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	3033.050649	3006.747386	3087.341972	3196.831184	3212.534556	3329.410163	3306.781613	33
2	181	Nepal	NPL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	
3	190	Philippines	PHL	Energy use (kg of oil equivalent per capita)	EG.USE.PCAP.KG.OE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	

3. Services value added % of GDP:

[2]:
```python
import pandas as pd
df=pd.read_excel("Services, value added (% of GDP).xls")
df
```

[2]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	I
0	Last Updated Date	2023-06-29 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	20
3	Aruba	ABW	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	80.178374	
4	Africa Eastern and Southern	AFE	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.878153	
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587	
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318	
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743	
267	Zambia	ZMB	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.137643	

3]:
```python
index_list = list(range(0,2))
df.drop(df.index[index_list], inplace =True)
df
```

3]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2
3	Aruba	ABW	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	80.178374	
4	Africa Eastern and Southern	AFE	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.878153	
5	Afghanistan	AFG	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	52.682743	
6	Africa Western and Central	AFW	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	47.765488	
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587	
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318	
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743	

[4]:
```
index_list = list(range(1,14))
df.drop(df.index[index_list], inplace =True)
df
```

[4]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	20
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632	
17	Austria	AUT	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	62.326583	
18	Azerbaijan	AZE	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	30.914028	
19	Burundi	BDI	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	36.023776	
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587	
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318	
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743	
267	Zambia	ZMB	Services, value	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.137643	

[5]:
```
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

[5]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	20
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632	
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093	
85	Georgia	GEO	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	62.187381	
86	Ghana	GHA	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	40.588551	
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587	
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318	
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743	

```
6]: index_list = list(range(3,99))
    df.drop(df.index[index_list], inplace =True)
    df
```

6]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093
181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	...	48.755217
182	Nauru	NRU	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743
267	Zambia	ZMB	Services, value added (%	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.137643

```
[7]: index_list = list(range(4,12))
     df.drop(df.index[index_list], inplace =True)
     df
```

[7]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093
181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	...	48.755217
190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	41.285604	...	56.751128
...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	46.797587
265	Yemen, Rep.	YEM	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	32.350318
266	South Africa	ZAF	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	54.168667	53.975721	54.136947	53.824326	53.840749	53.347616	...	64.053743
267	Zambia	ZMB	Services, value added (%	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	53.137643

```
8]: index_list = list(range(5,83))
    df.drop(df.index[index_list], inplace =True)
    df
```

8]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	20
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632	
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093	
181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	...	48.755217	
190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	41.285604	...	56.751128	

5 rows × 67 columns

```
9]: header_row = 0
    df.columns = df.iloc[header_row]
    df
```

9]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	20
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.000000	1961.000000	1962.000000	1963.000000	1964.000000	1965.000000	...	2013.000000	2014.000
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632	65.687
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093	70.252
181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	...	48.755217	49.564
190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	41.285604	...	56.751128	56.680

5 rows × 67 columns

```
10]: df.drop( [2],inplace=True)
     df
```

10]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	
16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	66.251632	65.687600	67.232837	6
84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	70.050093	70.252740	70.571443	7
181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	...	48.755217	49.564020	50.539897	5
190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	41.285604	...	56.751128	56.680874	58.521550	5

4 rows × 67 columns

11]:
```
df=df.reset_index()
df
```

11]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2016
0	16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	66.251632	65.687600	67.232837	68.2177
1	84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	70.050093	70.252740	70.571443	71.0727
2	181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	...	48.755217	49.564020	50.539897	51.5980
3	190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	...	56.751128	56.680874	58.521550	59.5089

4 rows × 68 columns

12]:
```
df.fillna(0,inplace=True)
df
```

12]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2016
0	16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	0.000000	0.000000	0.000000	0.000000	0.000000	...	66.251632	65.687600	67.232837	68.2177
1	84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	0.000000	0.000000	0.000000	0.000000	0.000000	...	70.050093	70.252740	70.571443	71.0727
2	181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	...	48.755217	49.564020	50.539897	51.5980
3	190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	...	56.751128	56.680874	58.521550	59.5089

4 rows × 68 columns

13]:
```
with pd.option_context('display.max_rows', None, 'display.max_columns', None):
    display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	1967.0	1968.0
0	16	Australia	AUS	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
1	84	United Kingdom	GBR	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	181	Nepal	NPL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	98.605729	98.618307	98.605391	98.613518	98.606407	23.170297	19.698947	22.525334	21.023285
3	190	Philippines	PHL	Services, value added (% of GDP)	NV.SRV.TOTL.ZS	41.681600	41.169835	41.329310	40.095719	41.358367	41.285604	41.467152	40.665945	39.861517

4. Total greenhouse gas emissions (kt of CO2 equivalent):

[2]:
```
import pandas as pd
df=pd.read_excel("Total greenhouse gas emissions (kt of CO2 equivalent).xls")
df
```

[2]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unname
0	Last Updated Date	2023-06-29 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2.013000e+03	2.01400(
3	Aruba	ABW	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
4	Africa Eastern and Southern	AFE	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	1.331479e+06	1.358902
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
265	Yemen, Rep.	YEM	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	4.894616e+04	4.763641
			Total greenhouse										

[3]:
```
index_list = list(range(0,2))
df.drop(df.index[index_list], inplace =True)
df
```

[3]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2.013000e+03	2.0140(
3	Aruba	ABW	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
4	Africa Eastern and Southern	AFE	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	1.331479e+06	1.3589(
5	Afghanistan	AFG	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	3.043030e+04	3.1165ŧ
6	Africa Western and Central	AFW	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	7.382876e+05	7.5899
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
			Total										

4]:
```
index_list = list(range(1,14))
df.drop(df.index[index_list], inplace =True)
df
```

4]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnai
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000000	2014
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.667600	621420
17	Austria	AUT	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	78909.033810	75143
18	Azerbaijan	AZE	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	51037.923340	52262
19	Burundi	BDI	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	3244.959156	3242
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
			Total										

[5]:
```
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

[5]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unname
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.00000	2014.
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.
85	Georgia	GEO	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	16151.19020	16805.
86	Ghana	GHA	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	29002.19025	28547.
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
			Total										

[6]:
```
index_list = list(range(3,99))
df.drop(df.index[index_list], inplace =True)
df
```

[6]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.00000	2014.(
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.4
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.(
181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.4
182	Nauru	NRU	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	52.39139	55.7
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	

[7]:
```
index_list = list(range(4,12))
df.drop(df.index[index_list], inplace =True)
df
```

[7]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.00000	2014.(
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.4
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.(
181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.4
190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	176101.21190	183726.1
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	

8]:
```
index_list = list(range(5,83))
df.drop(df.index[index_list], inplace =True)
df
```

8]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.00000	2014.
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.
181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.
190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	176101.21190	183726.

5 rows × 67 columns

9]:
```
header_row = 0
df.columns = df.iloc[header_row]
df
```

9]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.00000	2014.00000	2015.00000	20
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.42890	622092.64140	6006
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.07310	498506.33180	4801
181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.41084	36045.56905	398
190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	176101.21190	183726.78730	192590.65600	2041

5 rows × 67 columns

10]:
```
df.drop([2],inplace=True)
df
```

10]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	
16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.42890	622092.64140	6006
84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.07310	498506.33180	4801
181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.41084	36045.56905	398
190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	NaN	...	176101.21190	183726.78730	192590.65600	2041

4 rows × 67 columns

11]:
```
df=df.reset_index()
df
```

11]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2
0	16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	...	604285.66760	621420.42890	622092.64140	600642.7
1	84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	...	553319.10510	513738.07310	498506.33180	480170.1
2	181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	...	34650.88974	36095.41084	36045.56905	39891.5
3	190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	NaN	NaN	NaN	NaN	NaN	...	176101.21190	183726.78730	192590.65600	204105.5

4 rows × 68 columns

12]:
```
df.fillna(0,inplace=True)
df
```

12]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	20
0	16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	...	604285.66760	621420.42890	622092.64140	600642.76
1	84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	...	553319.10510	513738.07310	498506.33180	480170.14
2	181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	...	34650.88974	36095.41084	36045.56905	39891.57
3	190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	...	176101.21190	183726.78730	192590.65600	204105.56

4 rows × 68 columns

13]:
```
with pd.option_context('display.max_rows', None, 'display.max_columns', None):
    display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	1967.0	1968.0	1969.0	1970.0	1971.0
0	16	Australia	AUS	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	84	United Kingdom	GBR	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	181	Nepal	NPL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	190	Philippines	PHL	Total greenhouse gas emissions (kt of CO2 equi...	EN.ATM.GHGT.KT.CE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

5. Unemployment, total (% of total labor force) (modeled ILO estimate):

```
import pandas as pd
df=pd.read_excel('Unemployment, total (% of total labor force) (modeled ILO estimate).xls')
df
```

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnam
0	Last Updated Date	2023-07-25 00:00:00	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000000	2014.000
3	Aruba	ABW	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
4	Africa Eastern and Southern	AFE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	6.512784	6.555
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	N
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264000	13.470
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040000	22.610
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005000	8.133
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994000	4.770

269 rows × 67 columns

```
2]: index_list = list(range(0,2))
    df.drop(df.index[index_list], inplace =True)
    df
```

2]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unna
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000000	2014.00
3	Aruba	ABW	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
4	Africa Eastern and Southern	AFE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	6.512784	6.55
5	Afghanistan	AFG	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.949000	7.91
6	Africa Western and Central	AFW	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	3.804447	3.98
...	...	...	...	...	...	...	...	...	...	...	...	...	
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264000	13.47
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040000	22.61
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005000	8.13
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994000	4.77

3]:
```
index_list = list(range(1,14))
df.drop(df.index[index_list], inplace =True)
df
```

3]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080
17	Austria	AUT	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.340	5.620
18	Azerbaijan	AZE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.970	4.910
19	Burundi	BDI	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	1.576	1.570
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264	13.470
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040	22.610
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005	8.133
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994	4.770

4]:
```
index_list = list(range(2,69))
df.drop(df.index[index_list],inplace=True)
df
```

4]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110
85	Georgia	GEO	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	19.420	17.440
86	Ghana	GHA	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	2.170	4.495
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264	13.470
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040	22.610
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005	8.133
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994	4.770

5]:
```
index_list = list(range(3,99))
df.drop(df.index[index_list], inplace =True)
df
```

5]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110
181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576
182	Nauru	NRU	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264	13.470
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040	22.610
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005	8.133
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994	4.770

6]:
```
index_list = list(range(4,12))
df.drop(df.index[index_list], inplace =True)
df
```

6]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110
181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576
190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	3.500	3.600
...	...	...	...	...	...	...	...	...	...	...	...	...	...
264	Kosovo	XKX	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN
265	Yemen, Rep.	YEM	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	13.264	13.470
266	South Africa	ZAF	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	22.040	22.610
267	Zambia	ZMB	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	8.005	8.133
268	Zimbabwe	ZWE	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	4.994	4.770

[7]:
```
index_list = list(range(5,83))
df.drop(df.index[index_list], inplace =True)
df
```

[7]:

	Data Source	World Development Indicators	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...	Unnamed: 57	Unnamed: 58
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110
181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576
190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	3.500	3.600

5 rows × 67 columns

[8]:
```
header_row = 0
df.columns = df.iloc[header_row]
df
```

[8]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	2016.0	2017.0
2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.000	2014.000	2015.000	2016.000	2017.00
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080	6.050	5.710	5.59
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110	5.300	4.810	4.33
181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576	10.512	10.403	10.66
190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	3.500	3.600	3.070	2.700	2.55

5 rows × 67 columns

[9]:
```
df.drop([2],inplace=True)
df
```

[9]:

2	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	...	2013.0	2014.0	2015.0	2016.0	2017.0	2018.0
16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080	6.050	5.710	5.59	5.300
84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110	5.300	4.810	4.33	4.000
181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576	10.512	10.403	10.66	10.623
190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	NaN	...	3.500	3.600	3.070	2.700	2.55	2.340

4 rows × 67 columns

```
[10]: df=df.reset_index()
      df
```

[10]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2016.0	2017.0	2018.0	201
0	16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	5.660	6.080	6.050	5.710	5.59	5.300	5.
1	84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	7.520	6.110	5.300	4.810	4.33	4.000	3.
2	181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	10.502	10.576	10.512	10.403	10.66	10.623	10.
3	190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	NaN	NaN	NaN	NaN	NaN	...	3.500	3.600	3.070	2.700	2.55	2.340	2.

4 rows × 68 columns

```
[11]: df.fillna(0,inplace=True)
      df
```

[11]:

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	...	2013.0	2014.0	2015.0	2016.0	2017.0	2018.0	201
0	16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	...	5.660	6.080	6.050	5.710	5.59	5.300	5.
1	84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	...	7.520	6.110	5.300	4.810	4.33	4.000	3.
2	181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	...	10.502	10.576	10.512	10.403	10.66	10.623	10.
3	190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	...	3.500	3.600	3.070	2.700	2.55	2.340	2.

4 rows × 68 columns

```
[12]: with pd.option_context('display.max_rows', None, 'display.max_columns', None):
          display(df)
```

2	index	Country Name	Country Code	Indicator Name	Indicator Code	1960.0	1961.0	1962.0	1963.0	1964.0	1965.0	1966.0	1967.0	1968.0	1969.0	1970.0	1971.0
0	16	Australia	AUS	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	84	United Kingdom	GBR	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	181	Nepal	NPL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	190	Philippines	PHL	Unemployment, total (% of total labor force) (...	SL.UEM.TOTL.ZS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

11 List of abbreviations

AFF- agricultural, forestry & fishing.

Export-oriented industrialisation (EOI)

GWh (gigawatt hour)

logarithmic mean Divisia index (LMDI)

Dynamic Ordinary Least Squares (DOLS)

Sustainable Development Goals (SDG)

Most vulnerable countries (MVCs)

data frame (DF)

Pandas (PD)

Build Own Lease (BOL)

Built Lease Operate (BLOT)

Engineering, Procurement, Construction and Financing (EPCF)

Electric vehicle (EV)

Information and communication technology (ICT)

Cardiovascular diseases (CVD)

Green supply chain management (GSCM)

'Nearly zero energy buildings (nZEBs)

Global health education (GHE)

The Food Climate Research Network (FCRN)

Best Available Techniques (BAT)

National Electricity Market (NEM)

Internet of Things (IoT)