MENDEL UNIVERSITY IN BRNO

Faculty of Regional Development and International Studies

Analysis of Composite Indicators of Sustainable Development and Interpretation for the Democratic Republic of Congo

DIPLOMA THESIS

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ABSTRACT

KRATINOVÁ, P., Bc. *Analysis of Composite Indicators of Sustainable Development and their Interpretation for the Democratic Republic of the Congo.* Diploma thesis. Brno, 2015.

Diploma thesis deals with construction of a composite indicator and its interpretation for the Democratic Republic of Congo. The theoretical part is focused on sustainable development and steps how to construct a composite indicator. In the practical part, there is subsequently constructed a composite indicator and performed its analysis. Analysis is based on each pillar of sustainable development. The closing part of the thesis is devoted to proposals and suggestions on how to improve the current situation in DRC.

KEYWORDS: composite indicator, sustainable development, DRC, Rwanda, Burundi, normalisation, aggregation, development, Africa

ABSTRAKT

KRATINOVÁ, P., Bc. *Analýza kompozitních indikátorů udržitelného rozvoje a jejich interpretace pro Demokratickou republiku Kongo.* Diplomová práce. Brno, 2015.

Diplomová práce se zabývá tvorbou kompozitního indikátoru a jeho interpretací pro Demokratickou republiku Kongo. Teoretická část práce se zabývá udržitelným rozvojem a postupem tvorby kompozitního indikátoru. V praktické části je následně zkonstruován kompozitní indikátor a provedena jeho analýza. Analýza je provedena na základě jednotlivých pilířů udržitelného rozvoje. Závěr práce se věnuje návrhům, jak zlepšit současnou situaci v DRC.

KLÍČOVÁ SLOVA: kompozitní indikátor, udržitelný rozvoj, DRK, Rwanda, Burundi, normalizace, agregace, rozvoj, Afrika

CONTENT

LIST OF ABBREVIATION

APX	Appendix
CI	Composite Indicator
DRC	Democratic Republic of the Congo
EIA	U.S. Energy Information Administration
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GNI	Gross National Income
HDI	Human Development Index
HDR	Human Development Reports
MDGs	Millennium Development Goals
MPI	Multidimensional Poverty Index
OECD	Organization for Economic Co-operation and Development
SA	Sensitivity Analysis
SD	Sustainable Development
UA	Uncertainty Analysis
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
WB	World Bank
WCED	World Commission on Environment and Development
WHO	World Health Organization

INTRODUCTION

The Democratic Republic of Congo is the second biggest and fourth populous country in Africa with 70 million inhabitants, and its area is nearly equal to that of the Western Europe. Nevertheless, it has been troubled by almost continuous civil war for over 15 years which has been one of the bloodiest conflicts since the Second World War, and is often called *"Africa's First World War"*. Since its beginning in 1997, this conflict has claimed more than 5 million lives. The causes of the conflict are varied, however, the most significant cause is the ethnic differentiation in the country and also the rich natural resources which can be found in DRC.

Congolese government also fails to maintain control over its territory and provide basic functions of the country. DRC is currently in a poor economic situation and is intensively crippled by corruption. Every citizen is exposed to violation of human rights. This is also evidenced by fact that DRC was placed as the last country in HDI scale in 2011. Many internal problems are also attributed to the difficult situation in DRC, such as interference of neighbouring countries or regional military groups, which threaten internal affairs. The overall situation of DRC is also highly influenced by the lack of concern of the general public. A lack of interest is caused due to long-term conflicts and many inaccuracies. But it is also one of the reasons why DRC is in such a critical situation.

Nowadays, the most discussed phenomenon is sustainable development. Anyway, it is important and significant to consider, whether the whole concept of sustainable development is not too demanding on developing countries which often have to deal with a current economic and social situation. We should question whether the developed countries should pressurize developing countries into an implementation of this concept into their development, even if the developed countries did not deal with it during their own development.

In order to ascertain whether sustainable development is truly sustainable, it is necessary to use tools that will help us to measure sustainability. Nowadays, the most useful tool to analyse the sustainability is the composite indicator. This is a summary aggregate numeric indicator which shows us what is the quality of life and sustainable development in the region. Currently, Human Development Index is the best known indicator

for assessment of quality of life, nevertheless, composite indicator involves all pillars of sustainability and consequently, helps better analyse the development in the region.

The Diploma thesis is composed of four main parts. The First chapter is Theoretical part which is subsequently divided into two sub-chapters where the first one is devoted to the description of sustainable development, its pillar and principles, and the second one deals with composite indicators describes the steps which are necessary to be able to construct a composite indicator.

Chapter 2 is Country Review describes a brief history of DRC, and the evaluation of the Human Development Index and Multidimensional Poverty to provide an overview of why DRC is ranked among developing countries.

Chapter 3 is called Analytical Part where the author follows each step described in the theoretical part to construct a composite indicator, and subsequently to analyse each pillar of sustainable development and at the end the overall position of the country in the sustainable development.

Last part of the diploma thesis is the Proposal where suggestions are proposed on how to enhance the situation in the given country, sustain development and to improve the quality of life.

AIM AND METHODOLOGY

The aim of the diploma thesis is to construct a composite indicator of the sustainable development for Democratic republic of Congo. For each pillar of the sustainable development there are five indicators which are analysed in the analytical part of the thesis. Obtained results are evaluated and presented using graphic, table or map illustration in a given time period. Secondary aim is to compare development achievements to Rwanda and Burundi and analysed an influence of foreign aid for development process.

The closing part of this thesis is devoted to my suggestion and recommendation to improve the current situation in the field of sustainable development. A Simultaneous objective of this thesis is to analyse how a development and current situation of DRC were influenced by the Belgian colonialism. Thus, the whole analysis is based on the comparison of the DRC with Rwanda and Burundi which were colonised by Belgium, too.

There are several science methods used in this thesis. One of them is the review of literature to familiarize with the given issues and to create the theoretical part of the thesis. The Other method is analysis of secondary data which are necessary to construct composite indicator. Secondary data are collected from publicly available sources, such as:

- the World Bank,
- the United Nations and its agencies (such as Statistics Division, Development Programme, Refugee Agency, etc.),
- the Central Intelligence Agency,
- the World Health Organization,
- the Food and Agriculture Organization,
- the International Monetary Fund,
- the Millennium Development Goals, and
- the World Commission on Environment and Development.

These secondary data has to be converted to appropriate variables, and thus transformation of raw data is used. The composite indicator is created using the software STATISTICA 12 using methods such as:

- Correlation,
- Data normalisation,
- Aggregation of data.

The Data and results are the presented visually through tables, bar charts, radar charts, cartograms and profile diagrams. Among other scientific methods used in this thesis are:

- abstraction,
- analysis,
- deduction,
- generalization,

- induction,
- classification,
- comparison, and
- synthesis.

1 THEORETICAL PART

1.1 Sustainable Development

Sustainable development is a relatively new phenomenon and is becoming to be increasingly discussed. There hasn't been an emphasised on the environment until 1980s, when the European Community has changed its attitude to these issues and has started to protect the environment. The whole concept of sustainable development is based on intergenerational solidarity. It means the environmental policy is based not only on the current generation but also on the future generations. Thus, the main aim should be to improve the environment on a global, continental and national scale.[1]

1.1.1 Definition

Sustainable Development (SD) might be defined by many definitions. However, the meaning of this term remains the same. There should be mentioned three different definitions of the SD mentioned in this thesis. One of them is by Mirovitskaya and Ascher (2001: p.74), who defined it as *"a development path that meets the major needs of the present without endangering subsequent needs and aspirations of future generations, allowing for the conservation of nature to be part of this path."* [2]

Although, there are many definitions, there is one, which is world-wide the most widespread. It was created by WCED and published in its report *Our Common Future* in 1987: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* [3]

The last definition is by OECD, which defined it as *"development that ensures non-declining per capita national wealth by replacing or conserving the sources of that wealth; that is, stocks of produced, human, social and natural capital."* [4]

1.1.2 Principles and Three Pillars of Sustainable Development

A shift of social aims is required for successful transition into the SD. These aims should be based on the following principles:

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[1] DUŠEK, Hynek. *Udržitelný rozvoj*. Kunovice: Evropský polytechnický institut, s.r.o., 2010, 108 p. ISBN 978-80-7314-195-0. p. 7-16

[2] MIROVITSKAYA, Natalia a William ASCHER. *Guide to Sustainable Development and Environmental Policy*. Durham and London: Duke University Press, 2001, 391 p. ISBN 0-8223-2735-x. p. 74

[3] World Commission on Environment and Development. *Our Common Future* [on-line].

[4] OECD. *OECD glossary of statistical terms* [on-line]. Paris: OECD, 2008, 601 p. ISBN 978-926-4025-561. p. 61

1) Economic growth recovery;

2) Change of growth quality;

3) Preservation and enrichment of basis of natural resources;

4) Ensuring of a sustainable level of population;

5) New orientation of technology and elimination of risks;

6) Integration of economic aspects with the aspects of the environment during decision- making;

7) Reform of multinational economic relationships;

8) Strengthening of international cooperation.[5]

For successful SD must be considered three pillars (dimensions) must be considered – *economic, social, and environmental.* (See Figure 1)

The economic pillar is based on sustaining of a registered capital and on using of a produced profit. It covers both the produced capital produced by humans and nature capital. The aim of the economic pillar is to provide equal distribution and efficient allocation of resources to ensure economic growth and stability.

The social pillar is related not only to people as individuals but also to the society. In the case of human development, it is based on eradication of poverty, health improving, and extension of average age, reducing of diseases, higher literacy, higher standard of living, and/or security. On the opposite side, the social development is connected to democracy, ensuring of human rights and freedoms, and social equality.
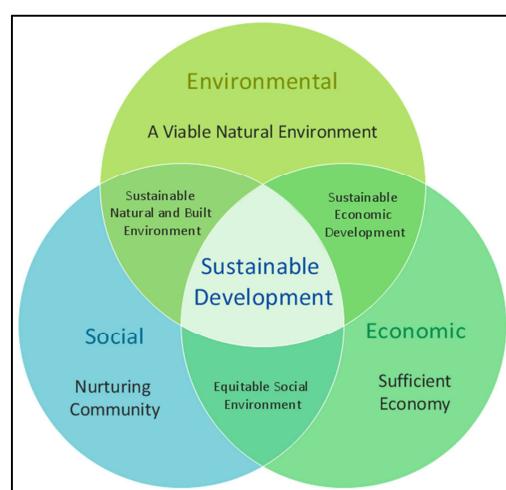

Figure 1: Three Pillar Basic Model *(Source: Concept Draw, 2014)*

[5] JENÍČEK, Vladimír a Jaroslav FOLTÝN. *Globální problémy světa: v ekonomických souvislostech*. Vyd. 1. V Praze: C.H. Beck, 2010, xix, 324 p. Beckovy ekonomické učebnice. ISBN 978-80-7400-326-4. p. 273

The last pillar, the environmental pillar, is introducing, how economic and human development influence environment. People are part of Earth's biosphere and are addicted to the natural resources. Thus, this pillar is mainly based on water resources, pollution or using of natural resources.[6]

1.2 Composite Indicator

Composite indicator (CI) is providing a simple comparison of countries and has become a useful tool in policy analysis and public communication. The number of CIs is still increasing but mostly covers wide-ranging fields, such as environment, economy, society or technological development.[7] Nevertheless, if the CI is poorly formed or misinterpreted, it might lead to misleading or non-robust policy messages.[8] In the following sub-chapter, there are mentioned definitions and pros/cons of CI. However, the most important part is the construction of the composite indicator which is described in detail.

1.2.1 Definition

Indicator is a type of information which provides a measure of improvement of a given phenomenon. There are two types of indicators – *simple indicator* and *composite indicator*. A simple indicator is one-dimensional and the meaning is to provide the information about one phenomenon in a concrete coherence.[9]

A composite indicator is constructed when individual indicators are united into a single index, and is based on an underlying model of the multi-dimensional concept, which is measured. In the context, it means "*a composite indicator measures multi-dimensional concepts (e.g. competitiveness, e-trade or environmental quality) which cannot be captured by a single indicator.*"[10]

1.2.2 Pros and Cons of Composite Indicators

As is mentioned above, CIs are a useful tool for our policy but it might be useless and misleading in the opposite way. In the following table, the main Pros and Cons a

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[6] MOLDAN, Bedřich a William ASCHER. *Ekologická dimenze udržitelného rozvoje*. 1. vyd. Praha: Karolinum, 2001, 102 p. ISBN 80-246-0246-6. p. 14

[7] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 13

[8] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 6

[9] ČÁSLAVKA, Jiří. et al. *Indikátory blahobytu: všechno, co jste kdy chtěli vědět o štěstí (ale báli jste se zeptat)* [online]. Praha: Zelený kruh a Hnutí DUHA, 2010, 55 p. ISBN 978-80-87417-02-7. p. 10

[10] OECD. *OECD glossary of statistical terms* [on-line]. Paris: OECD, 2008, 601 p. ISBN 978-926-4025-561. p. 89

Table 1: Pros and Cons of Composite Indicators *(Sources: OECD, 2008: p. 13-14; NARDO, M., 2005: p. 6)*
Author: Bc. Petra Kratinová

Pros	Cons
– Summarising of complex or multi-dimensional issues with a view to support decision-makers; – Easier interpretation instead of trying to find trend in many separate indicators; – Apprise a progress of countries over time; – Reducing of the size of a set of indicators; – Including more information within existing size limit. – Place issues of country performance and take place at the centre of the policy arena; – Facilitating of communication with ordinary citizens and promoting of accountability; – Effective comparing of complex dimensions for users.	– Probability of sending of misleading policy messages when are poorly constructed or misinterpreted; – Might invite simplistic policy conclusions; – Might provide themselves an instrumental use if the construction process is not transparent and based on statistical or conceptual principles; – Selected indicators and weights could be the target of political dispute; – Might hide serious failings in some dimensions and thus increase the difficulty of identifying the proper remedial action; – Might lead to inappropriate policies, if they are ignored dimensions of performance which are difficult to measure.

1.2.3 Construction of Composite Indicator

The following chapter presents how to construct the CI in an ideal sequence of ten steps. Each of the ten steps is important and coherence is equally vital. Any choices in one step might have important consequences for the others. Therefore, a construction of the CI does not have to only to make the most appropriate methodological choices in each step, but it also identifies whether they fit together well.[11]

1.2.3.1 *Theoretical Framework*

Theoretical framework is a starting point in the construction of the CI. It provides the basis for the selection and combination of single indicators which are subsequently linked into a meaningful CI under a fitness-for purpose principle. Defining of the concept is needed to understand what is being measured by the CI. Theoretical framework also determines the various sub-groups which need not be independent of each other,

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[11] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 19

and identifies the selection criteria for the underlying variables, e.g. input, output, and process. Thus, there are basically three sequential steps according to OECD:

- Defining of the concept which should be measured by the indicator;
- Determination of the sub-indicators, or organization of the sub-groups of the given concept which are independent of each other;
- Identifying of the criteria for the underlying variables, e.g. input, output, and process.[12]

1.2.3.2 Selecting Variables

Selection of variables is based on the indicators' analytical soundness, measurability, country coverage, timeliness, accessibility, relevance, etc., and is related to each other. When the data are not available or cross-country comparability is limited, proxy measures should be used. Data selections needs to be checked for the quality of the available indicators, to be discussed the strengths and weaknesses of each selected indicator need to be discussed, and to be created a summary with data, e.g. availability, source, type has to be created.[13]

From the factual-logical point of view, it is necessary to differentiate between indicators with the effort to achieve the highest values (the indicators of *max values*, such as economic growth, employment), indicators with the effort to achieve the lowest values (the indicators of *min values*, such as volume of emissions, infant mortality, crime), and indicators of *opt values* with the effort to achieve a specific optimal values (such as median of age, fertility). However, indicators' criteria of opt values should be easily converted into eligible criteria for indicators of min values. Selection of sub-indicators should meet the goal of the CI, thus there should be included statistic criteria, too.[14]

1.2.3.3 Imputation of Missing Data

CI is depended on the quality and accuracy of its components,[15] thus imputation of missing data is necessary to provide a complete dataset. It is needed to complete dataset without missing values, to provide a measure of the value's reliability, and to discuss the outliers' presence in the dataset. Missing data might be in a random or non-random fashion.

[12] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 20 - 22
[13] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 20-23
[14] MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji*. 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] p. obr. příl. ISBN 978-80-7431-129-1. p. 125-126
[15] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 10

There might be three basic missing patterns:

1) *Missing completely at random* (MCAR) – missing data are not dependent on the variable of interest or any other observed variable in the dataset;

2) *Missing at random* (MAR) – missing data are not dependent on the variable of interest but are dependent on other variables in the dataset;

3) *Not missing at random* (NMAR) – missing data are dependent on the values themselves.

The most common are MCAR and MAR because there is no statistical test for NMAR and thus it is often difficult to estimate if the data are missing at random or systematically.

However, there are three general methods how to deal with missing data:

1) *Case Deletion* (also called Complete Case Analysis) – this method omits the missing records from the analysis, however, there are ignored possible systematic differences between the complete and incomplete samples and may are produced unbiased estimates, and might be used if variable has more than 5 percent of missing values;

2) *Single Imputation* – this method replaces the missing data individually (e.g. Mean/Median/Mode substitution);

3) *Multiple Imputation* – method based on Markov Chain Monte Carlo algorithm.[16]

1.2.3.4 *Multivariate Analysis*

Multivariate analysis should be used to investigate the overall structure of indicators, assess its suitability, and guide ensuing methodological choices, such as weighting, aggregation.[17] The information should be grouped and analysed along two dimensions – along sub-indicators and along countries.[18] It is needed to identify groups of indicators or groups of countries which are statistically similar and ensure a result's interpretation. Multivariate analysis also compares the statistically-determined structure of the dataset to the theoretical framework and explain possible differences.[19]

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[16] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 20-25

[17] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 20-27

[18] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 15

[19] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 20-27

Grouping information on individual indicators

It is necessary for the analyst firstly to decide whether the nested structure of the CI is well-defined and whether the set of available sub-indicators is adequate or suitable to characterize the phenomena. This decision might be based on an expert's opinion or on the statistical structure of dataset.

In the case of exploration, if the dimensions of a phenomena are statistically well-balanced in the CI, there might be used *Principal Components Analysis* might be used. Its goal is to detect how different variables change in relation to each other, or how they are related. This might be achieved when correlated variables are transformed to a new set of uncorrelated variables using a covariance matrix.

Another technique is *Factor Analysis* which is similar to above mentioned Principal Components Analysis, however, this analysis is based on a particular statistical model,[20,21] where new variables are made and the scale of data is reduced with the minimum loss of information.[22]

There is another option how to investigate the degree of correlation between a set of variables, so called *Cronbach Coefficient Alpha* (c-alpha). C-alpha is currently the most common projection of internal consistency of items in a model or survey.[23]

Grouping information on countries

In this type of grouping, Cluster Analysis is often used *Cluster Analysis* as a mean how to classify large amounts of information into manageable sets.[24] The goal of cluster analysis is to integrate objects into groups (so called clusters) where two objects of the same cluster are more similar to each other than other two object of different clusters. Despite the objects being are different in character.

There are countless of clustering methods in the literatures, and since the cluster analysis is the means to achieve a classification, the methods are distinguished by where the goals

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[20] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 25-26

[21] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 15 - 28

[22] HEBÁK, Petr. *Vícerozměrné statistické metody [3]*. Vyd. 1. Praha: Informatorium, 2005, 155 p. ISBN 80-733-3039-3. p. 81

[23] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 26

[24] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 26

are aimed.[25] The most common division of methods is *hierarchical* and *non-hierarchical clustering.* (See Figure 2)
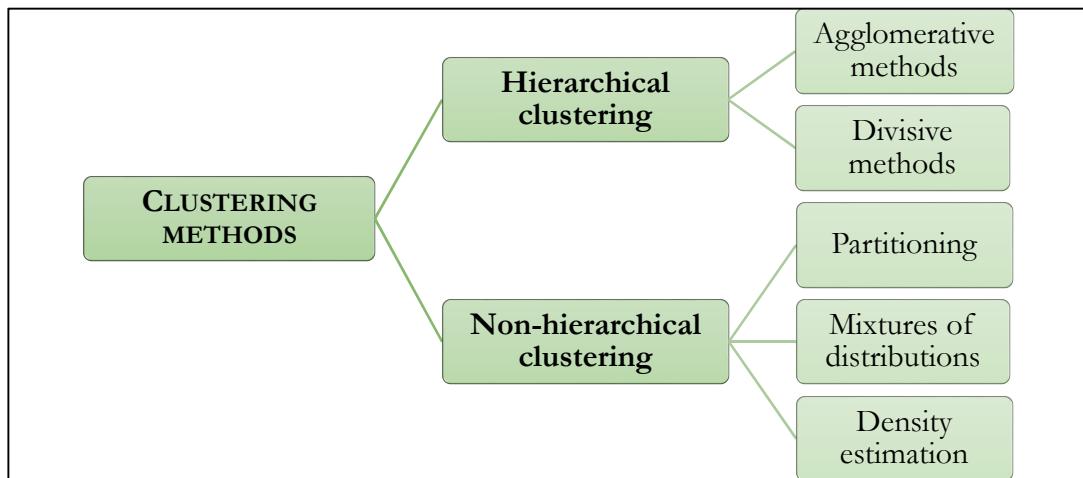

Figure 2: Division of the Clustering methods (*Source: RENCHER, Alvin C., 2002: p. 455 – 493*)

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The hierarchical methods are further divided into *agglomerative methods* where an object or a cluster of objects are united into another cluster, and *divisive methods* where there is initially a single cluster of *n* items which is divided into two clusters at each step and the final result is *n* clusters of each item. However, the most wildly used methods are the agglomerative methods[26] which integrate following techniques:

- *Single linkage* (Nearest Neighbour) where the distance between two clusters is defined by the distance between the nearest elements in the different cluster;
- *Complete linkage* (Farthest Neighbour) where the distance between two clusters is defined by the greatest distance between any two objects which are in different clusters;
- *Un-weighted pair-group average* where the distance between two clusters is counted as the average distance between all objects' pairs in the two clusters, and the most used variation of this method is the centroid of a cluster;
- *Weighted pair-group average* which is similar to the previous method, except that aside from the size of cluster is used as a weight for the average distance;

[25] ŘEZANKOVÁ, Hana. *Shluková analýza dat.* 1. vyd. Praha: Professional Publishing, 2007, 196 p. ISBN 978-80-86946-26-9. p.13 - 17

[26] RENCHER, Alvin C. *Methods of multivariate analysis* [online]. 2nd ed. New York: J. Wiley, 2002, xxii, 708 p. [cit. 2014-10-05]. ISBN 04-714- 1889-7. p. 455 - 481

- *Ward's method* where they are calculated variance of elements is calculated and made relatively small clusters.[27]

The non-hierarchical methods are also separated into further methods. The first, and the most commonly used, method is *partitioning* where the objects are divided into clusters without using a hierarchical approach and it is based on a matrix of distances or similarities among all pairs of points. Generally, this method is well-known as *optimization method* and its most used technique is *k-means analysis*. Other non-hierarchical methods are *mixtures of distributions* and *density estimations*.[28]

1.2.3.5   Normalisation of Data

Indicators should be normalised to ensure their comparability. The most important is to pay attention to extreme values because they should lead to the influencing of further steps in the process of the construction of the CI. Skewed data should be also identified and included. Normalisation of data is needed to select suitable normalisation procedures which have a respect theoretical framework and the data properties. It is also necessary also because of for discussing of the presence of outliers in the dataset, making of scale adjustment and transforming of highly skewed indicators.[29]

There are in total nine different normalisation methods. In this thesis are described some of them considering their application in the following analysis.

Ranking of indicators across countries

Ranking is the simplest normalisation method. It consists of ranking of each indicator across countries. Ranking is expressed by equation:

$$I_{qc}^t = Rank(x_{qc}^t)$$

where x_{qc}^t is a sub-indicator.

The simplicity of this method and its independence to outliers might be considered as an advantage, however, it is necessary to take into consideration that this technique

[27] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 74

[28] RENCHER, Alvin C. *Methods of multivariate analysis* [online]. 2nd ed. New York: J. Wiley, 2002, xxii, 708 p. [cit. 2014-10-05]. ISBN 04-714-1889-7. p. 481 - 493

[29] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 15-20

causes the loss of information on absolute levels and the impossibility to get any conclusion about differences.[30]

Standardisation (or z-scores)

Standardisation, or z-scores, is a convertion of indicators to a common scale where a mean is zero and standard deviation is one. Thus a greater effect on the CI is when indicators have extreme values. If an intention is to reward an exceptional behaviour, it means a good result on a few indicators is considered to be better than a lot of average scores, then this should not be desirable. This effect is possible to correct in the aggregation methodology.

Standardisation is expressed by equation:

$$\mathbf{I_{qc}^t} = \frac{\mathbf{x_{qc}^t} - \mathbf{x_{qc=\bar{c}}^t}}{\mathbf{\sigma_{qc=\bar{c}}^t}}$$

where x_{qc}^t is an individual indicator, $x_{qc=\bar{c}}^t$ is the average across countries and $\sigma_{qc=\bar{c}}^t$ is the standard deviation. All I_{qc}^t have similar dispersion across countries. The actual minima and maxima of I_{qc}^t across countries are reliant on the sub-indicator. The average across countries and the standard deviation is calculated for a reference year.[31]

Min – Max

Min – Max, also called *Re-Scaling*, is a normalisation method where indicators are normalised to have an identical range [0, 1]. The minimum values are subtracted and values of indicator are divided by its range.

The general expression for method Min – Max is:

$$\mathbf{I_{qc}^t} = \frac{\mathbf{x_{qc}^t} - \mathbf{min_c}(\mathbf{x_q^{t_0}})}{\mathbf{max_c}(\mathbf{x_q^{t_0}}) - \mathbf{min_c}(\mathbf{x_q^{t_0}})}$$

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[30] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 46 – 52

[31] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 28, 84

where x_{qc}^t is an individual indicator, $min_c(x_q^t)$ and $max_c(x_q^t)$ are the minimum and maximum values of individual indicator across all countries *c* at time *t*. The normalised indicators are between 0 (*laggard*) and 1 (*leader*).[32]

Distance to a reference

The method distance to a reference unit is creating the reference units for a set of fictitious (no-existing) units that gain the best values for all indicators. Some metric (e.g. Hamming distance) There is used some metric (e.g. Hamming distance) to determine a distance of each real unit from a reference unit.[33]

Equation for this method is:

$$\mathbf{I}_{qc}^t = \frac{\mathbf{x}_{qc}^t}{\mathbf{x}_{qc=\bar{c}}^{t_0}}$$

where x_{qc}^t is an indicator for a generic country *c* and time *t*, and $x_{qc=\bar{c}}^{t_0}$ is the individual indicator for the reference country.[34] The top rated unit is characterized by the lowest distance from reference unit and conversely the worst rated unit is characterized by the greatest distance.[35]

Other normalisation methods

As is mentioned above, there are is totally nine methods in total. Among other methods are categorized:

- *Categorical scale* which allots a score for each indicator and this score is numerical (e.g. one, two or three stars) or qualitative (e.g. fully achieved, partly achieved or not achieved);
- *Indicators above or below the mean* where the values around the mean obtain 0 while the values above/below the mean obtain 1 and -1;
- *Cyclical indicator* whose results are usually used in CIs to decrease the risk of false signals and to predict cycles in economic activities;

[32] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 28, 85

[33] MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji*. 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] p. obr. příl. ISBN 978-80-7431-129-1. p. 129

[34] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 85

[35] MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji*. 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] p. obr. příl. ISBN 978-80-7431-129-1. p. 129

- *Balance of opinions* where managers of companies of different sectors and of varying sizes express their opinion on their companies' performance;
- *Percentage of annual differences over consecutive year*, i.e. the percentage growth in relation to the previous year instead of the absolute level.[36]

1.2.3.6 Weighting and Aggregation

Indicators should be aggregated and weighted by the underlying theoretical framework. Correlation and compensability matters between indicators are necessary to consider and either corrected for or treated as features of the phenomena which is necessary to retain in the analysis. This step of construction of the CI is needed due to appropriate selection of weighting and aggregation procedures which respect not only theoretical framework but the data properties, too. It is also needed to discuss whether correlation matters between indicators should be accounted for and if compensability between indicators should be enabled.[37]

Weighting

If there is *m* indicator, the easiest way is to consider their weights $w_j > 0; j = 1, 2, ..., m$ as constant. Each of indicators might have weight either 1 or $\frac{1}{m}$. Both options might be also used in the case of non-constant weights. There are many methods on how to construct weights and most of them are complex and complicated. Among the simplest and basic methods are the following two weighting methods:

- *Rating scales* – these scales have usually the odd number of grades (e.g. five-grade and nine-point scale separately evaluates seriousness of each indicator on the scale 1, 3, 5, 7, 9 which might be expressed as low, below-average, average, above-average and high seriousness of indicators). Weighting will be performed in theby following way:

$$\frac{\text{number of reached points of given indicator}}{\text{number of reached points of all indicators}}$$

where the sum of weights is 1 in this case.
- *Pairwise comparison method* – this method is based on a table with dimension $m \times m$ which is filled with rows where the box is filled with 1 if the indicator is considered serious in the row, by 0 if it is considered less serious

[36] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 28 - 30
[37] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 15, 21

than in column, and with 0.5 if it is considered equally serious in row as well as in column. The symmetric boxes along the main diagonal are subsequently filled with 0, 1 and again with 0.5. Diagonal boxes are empty because an indicator cannot be compared with itself. The sums of rows are divided by $\frac{m(m-1)}{2}$ and the result is the weight of the indicator and whose sum is standardized to value 1. If the sums of rows are divided by $\frac{(m-1)}{2}$, the results are weights of indicators whose sum is equal to m. The disadvantage of this method is that less seriousness indicators automatically obtains the weight with value 0. On the other hand, this method always compares a couple of indicators and thus there is overview in spite of a high number of indicators.[38]

Aggregation

There are basically two methods how to aggregate indicators:

- *Weighted sum method* (ranking, standardized values, distance to a reference) where there are no missing values;
- *Weighted average method* (ranking, standardized values, distance to a reference) where there are missing values and where it is necessary to omit the value of the sum in the numerator and the relevant weight in the sum of weights in the denominator.

Non-dimensional CI is the result of this aggregation, however different methods might lead to different results.[39]

1.2.3.7 Robustness and Sensitivity Analysis

The sensitivity analysis should be used to determine the robustness of the CI in terms of the mechanism for including or excluding individual indicators, the normalisation scheme, the imputation of missing data, the selection of weights and aggregation method. It is necessary to consider a multi-modelling approach to construct the CI, to define all available sources of uncertainty in the development of the CI, to execute sensitivity

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[38] MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji*. 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] p. obr. příl. ISBN 978-80-7431-129-1. p. 126 - 127

[39] MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji*. 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] p. obr. příl. ISBN 978-80-7431-129-1. p. 129

analysis of the inference and to define which sources of uncertainty are more significant in the scores or ranks.[40]

The robustness of the CI can be assessed by combination of the sensitivity analysis and uncertainty analysis. This combination is also helpful to boost the transparency of the CI and to help framing a debate around it. In particularly, it is necessary to try to tackle all the possible sources of uncertainty which come out:

- Choice of sub-indicators,
- Quality of data,
- Editing of data,
- Normalisation of data,
- Weighting scheme,
- Values of weights,
- Formula of CI.

There are basically suggested two suggested combined tools – uncertainty analysis (UA) and sensitivity analysis (SA), where UA is focused on how the uncertainty in the input factors promotes through the structure of the CI and influences the values of the CI, and SA observes how much each individual sources of uncertainty conduces to the output variance. In the case of the CI construction, there is more often used the UA is used more often rather than SA.

As it was mentioned above there are uncertainty sources thus the approach which propagates the uncertainty can theoretically include all of the following steps:

- Inclusion – exclusion of sub-indicators,
- Modelling of data error,
- Alternative editing schemes,
- Using of alternative data normalisation schemes,
- Using of several schemes of weighting,
- Using of several aggregation systems,
- Values of weights.[41]

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[40] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 16, 21

[41] NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. p. 85 - 86

1.2.3.8 Back to Details

CI is a starting point for analysis thus it should be transparent and decomposable to be decomposed into its individual and basic indicators and values. The CIs might be used as summary indicators to manage policy and data work, however, their decomposition is needed to identify the contribution of subcomponents and individual indicators and to extend the analysis of country performance. In other words, the decomposition of CI might uncover the overall performance of a given country. There are tools, such as Path analysis, Bayesian networks or Structural equation modelling which can help to further clarification of the relationship among the CI and its components.

The individual indicators are subsequently used to introduce strengths and weaknesses. There is no optimal way how to present individual indicators and profiles of country might be introduced differently. There are three basic tools for introducing them:

- *Leaders and laggards* where performance of each indicator is compared to the leader, the laggard and the average performance,
- *Spider diagrams* or radar charts where individual indicator is compared to the three best countries on each indicator and to one other country,
- *Traffic lights* (a colour decomposition presentation) where each indicators obtains a colour (white, light grey, grey, dark grey or black) according to the relative country performance.[42]

1.2.3.9 Links to Other Variables

This step in the construction of the CI is should be provided to correlate the CI or its dimensions with existing indicators and to recognize all links through regression. It is needed to correlate the CI with other relevant measures but it is necessary to consider the result of SA. It is also important to develop data-driven narratives which are based on the results.[43]

1.2.3.10 Presentation and Dissemination

CIs might be visualised or presented in many different ways and it might affect their interpretation. It's not easy to find the right way because CIs have to transfer

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[42] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 16, 35 -38

[43] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 21

all the information to decision-makers and other end-users quickly and accurately. The presenter has to decide which presentation is the most suitable in which situation.

The simplest presentation is a *tabular format* in which the CI presents each country in a table of values where countries are in descending rank. Another way of presenting the CI is a *simple bar charts* where countries are put on the vertical axis and the values of the CI on the horizontal. The next visualisation of the CI is the *line charts* which are used when it is necessary to illustrate the changes of composite or components during time and basically the values of each countries are shown in different colours or symbols. Lastly, the most commonly used presentation of the CI are *trend diagrams* which show the trends in performance of a country as revealed through a CI.[44]

[44] OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. ISBN 92-640-4345-4. p. 39 - 43

2 COUNTRY REVIEW

The following chapter briefly describes the history of the DRC which is necessary to explain why the DRC is among developing countries, because it is closely influenced by its development since its discovery by the Portuguese in 15th century.

The next subchapters introduce the HDI and the MPI which are indexes on how to measure the quality of life in each country in the world or in developing countries.

2.1 Brief History of the DRC

The DRC has been discovered in 15th century by the Portuguese, however, the further exploration has been started in mid-19th century. In 1885, the *Congo Free State* (1885 - 1908) was founded by the Belgian king Leopold II. His regime was characterized by brutality, and the governance of country was focused on a looting of rich natural resources. There was an established an army which terrorized the inhabitants for mining. During this period, the population was decreased by half. After many protests against his regime, Leopold II was forced to give up the territory to the Belgian State.

After that, *Belgian Congo* (1908 – 1960) was established and was under the power of the Belgian Ministry of Colonial Affairs with Colonial Council. The conditions were better during the new regime and the brutality was decreased. The infrastructure and the railways have been constructed, nevertheless, the political situation has not developed, and people lived racially separated in the cities. The ruthless mining of natural resources continued to go on.

In 30th June 1990, Congo became an independent state with new name *Republic of Congo* (1960-1964). In 1964, it was renamed to the *Democratic Republic of Congo.* However, the situation was unstable due to the lack of educated people who could effectively lead the country. This period is significant by the political crisis, due to the inability of the governments to make a deal led to the increasing chaos in the country.

In 1965, Commander-in-chief of the National Army Mobutu Sese Seko overthrew the president Kasavubu, supported by the U.S. and Belgium, and became the president (1965-1997). Other parties were prohibited and he became the absolute ruler. The Mining industry and other important sectors of national economy were nationalized. All profits

from these sectors belonged to Mobutu and his family, friends and allies whereas most of Congolese lived in poverty. In 1971, the DRC was renamed *Zaire*. At the beginning of 1990s, the U.S. stopped supporting Mobutu's regime which caused the collapse of the economy and the increase of the influence of the political opposition. Mobutu was finally brought down in 1996 when the country was divided into provinces which were controlled by many groups.

The history and the development of DRC were strongly influenced not only by political development but also by two Congo Wars, so called First Congo War and Second Congo War. The *First Congo War* (1996-1997) begun due to ethnical reasons. This conflict was linked to the Rwandan Genocide because there were many Rwandan refugees in DRC. At the end of this war, Laurent-Desiré Kabila became the president in 1997, and renamed Congo back to the *Democratic Republic of Congo.*

The *Second Congo War* (1998-2003) is also known as Great War of Africa. It was one the biggest and the most difficult war in the African history. While the previous war was caused by ethnical reasons, the cause for this conflict was a struggle for raw materials because each party had a profit from vast mineral and natural wealth. The main aim was to overthrow president Laurent-Desiré Kabila. The success came in 2001, when Kabila was murdered and replaced by his son, Joseph Kabila who has officially became a president in 2006.[45]

2.2 Human Development Index (HDI)

HDI is created to express the quality of life through comparison of key dimensions of human development – a long and healthy life represented by *life expectancy*, being literate represented by *access to primary education*, and having a decent standard of living represented by *GNI* (formerly by GDP). HDI is calculated as a geometric mean of normalized indices for each of above mentioned dimensions.

HDI covers 187 countries which are divided into four categories – *very high human development, high human development, medium human development* and *low human development,* and where countries are categorized according their HDI values. The position of the DRC

[45] KRATINOVÁ, Petra. *Military spending in developing countries and their consequences for economic development in the Democratic Republic of Congo*. Brno, 2012. Bachelor Thesis. Mendel University in Brno. p. 23 - 28

is very low because out of these 187 countries, its rank was 186 in 2013, and in the 2012 it was even 187.[46]

The Chart 1 shows how the HDI values for the DRC changed from 1980 to 2013 (the latest available data). The highest slump can be seen since 1990s which was caused by dictatorial regime of Mobutu Sese Seko and followed by the First and Second Congo War. None of these historical events were contributed for human development, on contrary they led to a deepening of the standard of living and to a constraint of development in the country. However, the increase might be seen since 2005 where the regime of the DRC was changed and former president overthrown.


	1980	1990	2000	2005	2008	2010	2011	2012	2013
HDI Value	0,336	0,319	0,274	0,292	0,307	0,319	0,323	0,333	0,338
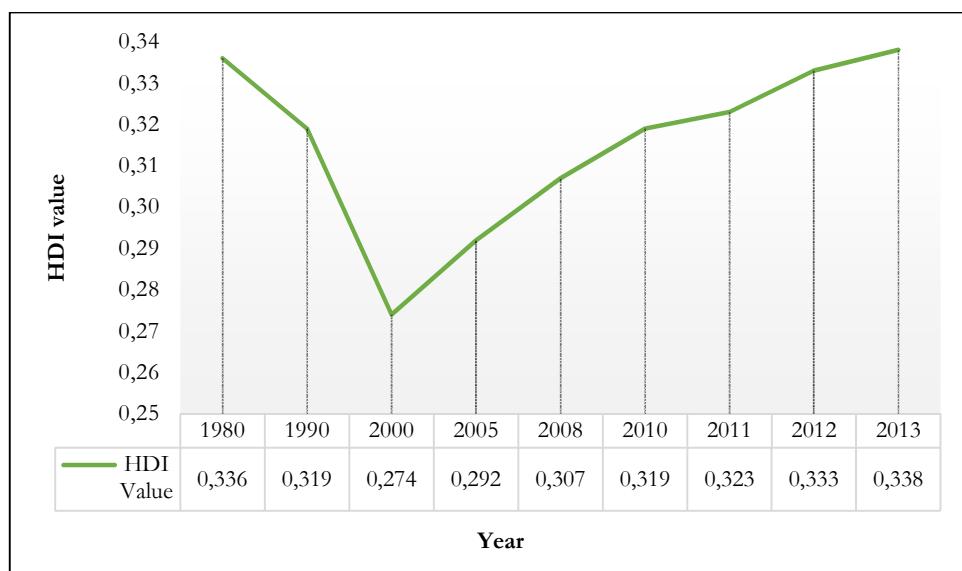
Chart 1: HDI trends in DRC, period 1980 – 2013 (*Source: UN Development Programme, 2014*)
Author: Bc. Petra Kratinová

Even though, there has been a permanent increase in the HDI values since the 2005, if we compare it with Rwanda, its values are still low. In the 2013, Rwanda was ranked as 151st country in HDI Ranking but nonetheless it is categorized as a low human development country. If we compare the DRC with Burundi, there is not high difference because its rank is 180.

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[46] Human Development Index (HDI). In: *United Nations Development Programme: Human Development Reports* [online].
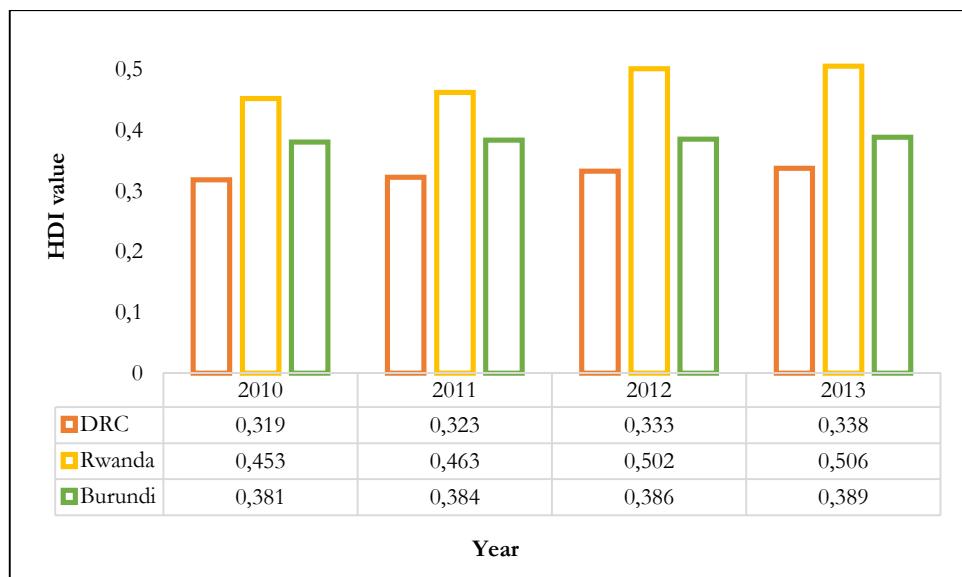
Chart 2: Comparison of HDI values, period 2010 – 2013 (*Source: UN Development Programme, 2014*)
Author: Bc. Petra Kratinová

2.3 Multidimensional Poverty Index (MPI)

MPI was created in 2010 to determine poverty, and to replace Human Poverty Index. It is an international measure of poverty which covers more than 100 developing countries. MPI evaluates poverty at an individual level. It identifies deprivations through the same three dimensions which are covered in HDI, and shows a number of people who are multi-dimensionally poor.[47]

As it is mentioned above, MPI identifies the same deprivations as HDI, thus:

1) *Education* – school attendance for school-age children; and school attainments for household members;
2) *Health* - child mortality; and nutrition;
3) *Living standards* – access to electricity; access to improved drinking water, access to improved sanitation; use of solid fuel for cooking and heating; having of finished floor; assets that allow access to information, support mobility or support livelihood.

After calculation, MPI provides following outputs:

1) *Headcounts* – the ratio of poor people in the population; the ratio of the severely poor in the population; and the ratio of the near-poor in the population;
2) *Intensity of poverty* – average deprivation score for the poor;

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[47] Multidimensional Poverty Index (MPI). In: *United Nations Development Programme: Human Development Reports* [online].

3) *MPI – product of headcount and intensity;*

4) *Coefficient f variation of deprivation score as a measure of inequality across the poor population and across the entire population;*

5) *Contribution of each dimension to overall poverty.*[48]

MPI might help to effectively allocate resources, and prove that it is possible if it targets those with the greatest intensity of poverty. Nowadays, almost 1.5 billion people from country covered by MPI live in multidimensional poverty which accounts for more than a third of their population. And at least 33 percent of them face to acute deprivation in health, education, and standard of living which is around 1.2 billion people in those developing countries who live on $1.25 a day or less.[49]

Based on the UN Development Programme, in 2010, there lived 74.4 percent of population in multidimensional poverty, and 87.7 percent of total population lived below $1.25 PPP per day in the DRC. A revised value of MPI was 0.399 where the least poor country obtains 0, and the poorest one obtained around 0.6 in last reports. According to MPI, the DRC is the fourteenth poorest country in the world, however, in the case of population living below $1.25 PPP per day, it is the first one.

Table 2: Multidimensional Poverty Index of DRC, Rwanda and Burundi in 2010
(Source: *UN Development Programme: Human Development Reports*)
Author: Bc. Petra Kratinová

	MPI (revised)	Intensity of deprivation	Headcount (percentage of population in dimensional poverty)	Population living below $1.25 per day
DRC	0.399	53.7	74.4 %	87.7 %
Rwanda	0.352	49.7	70.8 %	63.2 %
Burundi	0.442	54.0	81.8 %	81.3 %

As far as Rwanda and Burundi, despite Rwanda is being placed as the nineteenth poorest country according to the value of MPI which was 0.352 in 2010, there still live 70.8 percent of population below $1.25 PPP per day and it is placed as the eighth one. There is a total of 74.4 percent of the population who live in multidimensional poverty.

[48] KOVACEVIC, Milorad, M. Cecilia Calderon. UNDP's Multidimensional Poverty Index: 2014 Specifications. In: *United Nations Development Programme: Human Development Reports* [online]. p. 2-4
[49] Multidimensional Poverty Index (MPI). In: *United Nations Development Programme: Human Development Reports* [online].

Burundi obtains the worst evaluation because there live 81.8 percent of the population live in multidimensional poverty, and around 81.3 percent of the population live below $1.25 PPP per day in 2010 which placed Burundi to third place out of all countries covered by MPI. Even though the, population living below $1.25 PPP per day is lower than in the DRC, the value of MPI is higher and it accounts 0.442, and it is ranked as the ninth poorest countries out of covered by MPI.

3   ANALYTICAL PART

3.1   Theoretical Framework

The objective of the analysis part is to construct a composite indicator of each pillar of SD to compare a level of development of the chosen countries. Because the aim of this thesis is to evaluate a development of the DRC and how much it was influenced by the Belgian colonialism, the comparing countries are Rwanda and Burundi which are former Belgian colonies, too. The selection of sub-indicators is based on capturing of the most important aspects of the evolution. However, the selection is influenced by missing data and thus the sub-indicators are chosen according to the importance of indicators in each pillar and availability of data. The period for the analysis is 2004-2013.

3.2   Selecting Variables

Due to the large number of indicators and their variedness, it is not easy to find appropriate indicators of SD. Thus, I have chosen those indicators which were somehow interesting to me and are important for SD according to me. In the following sub-chapters are described five chosen indicators from each pillar of SD.

3.2.1   Economic Indicators

In the Table 3 is a list of chosen economic indicators, their measurable unit and its importance according to the MIN / MAX method. After that, each indicator is briefly described.

Table 3: The list of chosen economic indicators (*Source: The World Bank, 2014*)
Author: Bc. Petra Kratinová

Mark	Name of indicator	Unit	Min / Max
A_1	Unemployment	% of total labour force	Min
A_2	Trade in services	% of GDP	Max
A_3	Health expenditure	% of GDP	Max
A_4	Exports of goods and services	% of GDP	Max
A_5	Imports of goods and services	% of GDP	Min

Unemployment is a percentage of people who are without work but available and seeking for work. It includes people who have lost their jobs or had to leave them.

Trade in services is the sum of exports and imports of services that are divided by the value of GDP in current U.S. dollars.

Health expenditure is expressed as a sum of public and private health spending. This indicator covers the provision of health services, family planning activities, nutrition activities, and emergency aid. But it does not include provision of water and sanitation.

Exports of goods and services introduce the value of all goods and services which are provided to the rest of the world. These are included the value of merchandise, freight, insurance, transport, travel, royalties, and other services, e.g. communication, construction business. But they are not included compensation of employees, and investment income and transfer payments is not included.

Imports of goods and services is defined as the value of all goods and services which are received from the rest of the world. There are included the value of merchandise, freight, insurance, transport, travel, royalties, licence fees, and other services, e.g. communication, construction, financial, information, business, personal and government services are included. Just like exports, they do not include the employee compensation and investment income and transfer payments.[50]

3.2.2 Social Indicators

In the Table 4, chosen social indicators are listed, including their measurable unit and relevance of MIN/MAX.

Table 4: The list of chosen social indicators (*Source: The World Bank, 2014*)
Author: Bc. Petra Kratinová

Mark	Name of indicator	Unit	Min / Max
B_1	Population density	people per sq. km of land area	Min
B_2	Prevalence of HIV	% of population ages 15-49	Min
B_3	Refugee population	% of total	Min
B_4	Urban population	% of total	Min
B_5	Contraceptive prevalence	% of women ages 15-49	Max

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[50] Indicators. In: *The World Bank* [on-line].

Population density represents mid-year population which is divided by land area in square kilometres where population includes all residents irrespective of legal status or citizenship, and land area is a total area of the country.

Prevalence of HIV represents the percentage of population in the age group 15-49 who are infected with HIV.

Refugee population represents the percentage of refugees from total population where refugee is a person recognized as a refugee under the 1951 Convention Relating to the Status of Refugees or its 167 Protocol.

Urban population is the percentage of the people who live in urban areas which are defined by the national statistical offices. For calculation there are used World Bank population estimates and urban ratios from the UN World Urbanization Prospects are used for calculations.

Contraceptive prevalence represents the percentage of women that are using, or their sexual partners that are using, any form of contraception. This indicator is usually measured for married women ages 15 – 49 only.[51]

3.2.3 Environmental Indicators

In the last sub-chapter are described the chosen environmental indicators in the Table 5 and related measurable units and importance according to MIIN / MAX method.

Table 5: The list of chosen environmental indicators (*Source: The World Bank, 2014*)
Author: Bc. Petra Kratinová

Mark	Name of indicator	Unit	Min / Max
C_1	CO$_2$ emissions	million metric tons	Min
C_2	Arable land	% of land area	Max
C_3	Improved water source	% of population with access	Max
C_4	Forest area	% of land area	Max
C_5	Consumption of ozone-depleting substances	tons	Min

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[51] Indicators. In: *The World Bank* [on-line].

CO₂ emissions represent how many metric tons of carbon dioxide emissions are being released into the atmosphere. They stem from the burning of fossil fuels and the manufacture of cement.

Arable land introduces a land which is under temporary crops, temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. There is excluded the land which is abandoned as a result of shifting cultivation.

Improved water source refers to the percentage of the population who have an access to an improved drinking water source, including piped water on premises, and other improved drinking water sources.

Forest area is a land area with are planted stands of trees of at least 5 metres in situ, even unproductive. This area excludes tree stands in agricultural production systems and trees in urban parks and gardens.[52]

Consumption of ozone-depleting substances is focused on the consumption of substances which deplete the ozone layer. There are many kinds of these substances and their variation is based on the Montreal Protocol that covered all these ozone-depleting substances.[53]

3.3   Imputation Missing Data

Data are collected from publicly available sources such as the World Bank, the Food and Agriculture Organization, the UN Development Programme, the World Health Organization, the Millennium Development Goals, the UN Population Division and the UN Refugee Agency. However, the DRC is a country with a lack of data and due to the missing data, the analysis is limited to the period 2004-2013 where data are available for all analysed countries.

3.4   Basic Characteristics of Indicators

In STATISTICA 12, there were calculated basic characteristics of each sub-indicators and its values were calculated in STATISTICA 2 and are shown in the Table 6. These characteristics might be divided into two categories. The first category has the characteristics of level that is covered by mean and median. Second category contains the characteristics of variability which are introduced by the minimum

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[52] Indicators. In: *The World Bank* [on-line].
[53] Indicator Metadata. In: *Millennium Development Goals Indicators* [on-line].

and maximum values, variance, standard deviation and coefficient of variation of sub-indicators.

Table 6: Basic characteristics of sub-indicators made in STATISTICA 12
Author: Bc. Petra Kratinová

Var.	Mean	Median	Min.	Max.	Variance	Std.Dev.	Coef.Var.
A1	5,3062	7,1394	0,60000	8,1791	16,88	4,1087	77,4322
A2	14,5677	15,0484	12,04280	16,6118	5,39	2,3221	15,9403
A3	8,2923	9,1338	6,36110	9,3819	2,81	1,6770	20,2241
A4	17,2417	12,0658	8,06060	31,5987	158,60	12,5938	73,0425
A5	34,1716	36,8770	27,81970	37,8180	30,48	5,5210	16,1566
B1	264,5166	344,6333	26,37530	422,5412	44050,87	209,8830	79,3459
B2	1,9967	1,5900	1,26000	3,1400	1,01	1,0038	50,2743
B3	0,0039	0,0035	0,00280	0,0053	0,00	0,0013	33,3544
B4	24,0126	22,5619	10,27030	39,2055	210,89	14,5220	60,4769
B5	25,9767	28,9500	19,52000	29,4600	31,33	5,5974	21,5480
C1	1,2435	0,7747	0,30110	2,6546	1,55	1,2448	100,1079
C2	29,2586	37,5173	2,98670	47,2719	541,45	23,2691	79,5289
C3	63,0406	69,4330	45,56670	74,1222	234,50	15,3134	24,2914
C4	30,6463	16,8302	6,84480	68,2640	1086,24	32,9582	107,5437
C5	29,0863	9,1120	8,27050	69,8765	1248,06	35,3278	121,4585

3.5   Correlation and Dependence

Comparing and evaluation of indicators is based on the correlation matrix which displayed an interdependence between each variables. Relations might have varied intensity from 0.00 to 1.00 or -1.00 and each range has a different level of dependence (see Table below).

Table 7: Interpretation of values of correlation coefficient *(Source: Chráska, M., 2007: p. 105)*
Author: Bc. Petra Kratinová

Coefficient of correlation	Level of Dependence
1.00	Absolute dependence
1.00 – 0.90	Very high dependence
0.90 – 0.70	High dependence
0.70 – 0.40	Medium dependence
0.40 – 0.20	Low dependence
0.20 – 0.00	Very low dependence
0.00	No dependence

In this case, the high dependence is moved to 0.75 and higher. Correlation is performed through STATISTICA 12 and the final correlation matrices are joined to the APX 4. The correlation matrix which covers all sub-indicators mainly evinces very high dependence. An especially, very high dependence might be seen between *Exports of goods and services* with *Improved water source* and *Forest area*, between *Arable land* and *Population density,* and between *Improved water source* and *Forest area*, where the correlation coefficient is 1.00 or -1.00.

If we focused on correlations between sub-indicators under each pillar, there were very high correlations between all variables in the environmental pillar. In the case of the economic pillar, the correlations are between the level of high dependence and very high dependence. Regarding correlations, the best results are in the social pillar where the correlations are mainly in middle of the high dependence level, only the relation between *Prevalence of* HIV and *Refugee population* have a very high dependence approaching to value 1.00.

3.6 Normalisation of Data

Subsequent step is to normalize the data to reshape values of indicators into dimensionless and easily aggregated variables. Out of all the methods mentioned methods in the theoretical part, I choose the *standardisation method* (Z-Scores) where values of sub-indicators are substituted by standardised scores. Standardisation was performed in STATISTICA 12. In case, a sub-indicator should be minimum, its value is multiplied by -1 to be covered as an inverse indicator in the CI. In Table 8, there are shown

standardised values for all three pillars and because their values are currently dimensionless, they might be aggregated.

Table 8: Standardised data for all sub-indicators in STATISTICA 12
Author: Bc. Petra Kratinová

	A1	A2	A3	A4	A5
DRC	-0,69924	-1,08731	-1,15154	1,140008	-0,66047
Rwanda	1,145421	0,880285	0,649738	-0,41099	1,1505
Burundi	-0,44619	0,207023	0,501799	-0,72902	-0,49003
	B1	**B2**	**B3**	**B4**	**B5**
DRC	1,134638	0,733871	0,827064	-1,0462	0,622307
Rwanda	-0,75292	-1,13899	-1,11137	0,099894	0,531194
Burundi	-0,38172	0,405123	0,284303	0,946304	-1,1535
	C1	**C2**	**C3**	**C4**	**C5**
DRC	-1,13362	-1,12905	-1,14109	1,141375	-1,15462
Rwanda	0,376577	0,77413	0,417436	-0,4192	0,589219
Burundi	0,757038	0,354921	0,723651	-0,72217	0,565399

3.7 Weighting and Aggregation

Weighting and aggregation are subsequent step which are indispensable during the construction of the CI. Weighting might be provided through many methods which are rather expert than subjective to ensure that the target CI is reliable and the evaluated result is transparent. Thus each sub-indicator obtains same weight.

A high level of correlation is important for weight assessment A high level of correlation is important to assess a weight which is almost always in every cases higher than 0.75. These high correlations are consequent and expectable because a group of sub-indicators is closely related to each pillar of SD. Since a position of all sub-indicators is considered as equally weighty, all of these sub-indicators obtain weight 1.

Because the final results are based on the average values of each sub-indicator in a given period, there are no missing data for aggregation. Because of this there is chosen a *weighted sum method* is chosen to aggregate the sub-indicators. In the Table 9 might be seen the aggregated data for each pillar of SD and for the final CI, including a ranking of evaluated countries. Final results are both positive and negative, and the ranking

is provided based on these results. Particular rank indicates how a status of SD is favourable or unfavourable in a given country.

Table 9: Aggregated data in each pillar and ranking for each pillar and CI
Author: Bc. Petra Kratinová

	Econom. pillar	Rank	Social pillar	Rank	Environ. pillar	Rank	CI	Rank
DRC	-2,459	3	-0,101	2	-3,417	3	-3,604	3
Rwanda	3,415	1	-2,372	3	1,738	1	2,781	1
Burundi	-0,956	2	0,101	1	1,679	2	-0,823	2

3.8 Back to Details

For further analysis it is necessary to decompose the indicator. The APX 8, 9 and 10 cover a development of all sub-indicators for each analysed country in the period 2004-2013 (period varies according to availability of data). These visualisations are useful as a background for further evaluation and interpretation of the results.

3.9 Links to Other Variables

The evaluation and interpretation of the results are linked to development of HDI in each country. Even though, HDI is described in the Chapter 2, its values are useful for further analysis.

3.10 Presentation and Dissemination

The results are interpreted and presented by cartograms, diamond charts, and profile diagram for the analysed country. Cartograms show a resulted ranking of countries within each pillar of sustainable development which are colour varied. The first part of the presentation is the evaluation of each pillar of SD for all the analysed countries. The second part is focused on the analysis and evaluation of the composite indicator which covers all pillars.

3.10.1 Economic Pillar

Figure 3 shows how are the countries ranked within the economic pillar where the results are unequivocal. The most favourable status is in Rwanda so, due to it obtains Rank 1 but its status is still average in comparison with the other African countries. Among average countries out of the analysed is Burundi which obtains Rank 2 but its status should be evaluated mostly as likely unfavourable. The DRC obtains Rank 3 and its status is unfavourable within the economic pillar.
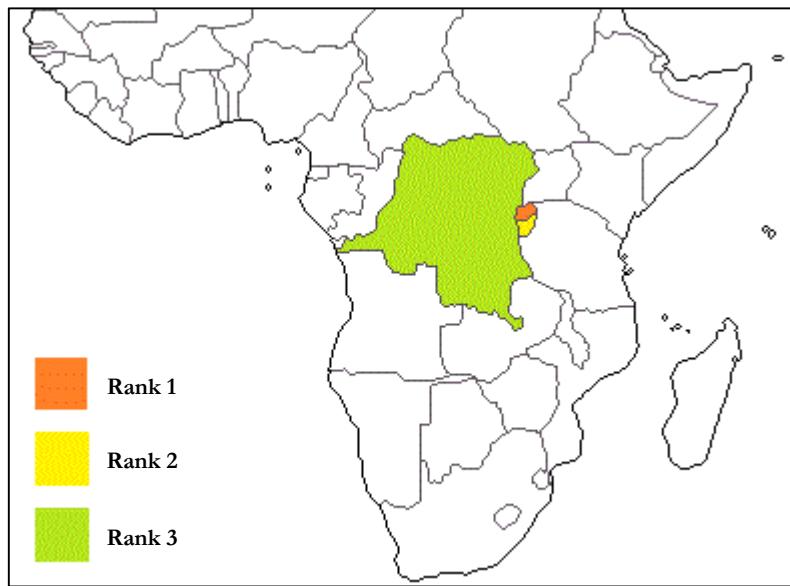
Figure 3: Ranking of countries in economic pillar
Author: Bc. Petra Kratinová

Even though, Rwanda overcame the consequences of the civil war and genocide from the period 1990-1993, the status of the country is still average in comparison with the whole Africa. Its economic situation gets better after many years of recovery, and there is a significant economic growth. Nevertheless, it is one of the poorest countries in the world and dependent on foreign aid where national budget is supported by 40-50 percent by external sources. Among these external sources are the World Bank, the United Nations, the European Union, and other non-governmental or development organizations. Rwandan government promotes trade liberalization and private sector to modernize the economy, thus it becomes a member of an important economic organization, both regional and international, such as the International Monetary Fund, the World Bank, the African, Caribbean and Pacific Group of States, the African Development Bank, the International Labour Organization or the World Trade Organization. However, to achieve these goals it is necessary to implement legislative and political measures.

Burundi also is one of the acceptors of foreign aid, and it obtained almost 2 billion USD during 2012-2015 to be able to recover after the civil war which ended in 2009. This aid might support the economic growth, the establishment of new jobs, development of the private sector, tourism, and the mining industry. Even though, the forecasted economic growth is around 4 percent, Burundi is still dependent on foreign aid which is 60 percent out of the national budget. However, Burundi is mainly dependent on the agriculture sector, and despite the agriculture sector accounting only 30 percent of the GDP, it gives work to the 90 percent of the total population. Although, the civil war

impacted the economy in Burundi, including the agriculture sector, it currently becomes among the attractive countries for investors in all sectors.

Despite the DRC is being the largest country out of the analysed countries, it obtains Rank 3. Thus it is obvious that the size of a country does not influence its development and economic situation. The DRC belong among the biggest acceptors of foreign aid in the sub-Saharan Africa. However, although the DRC is the poorest country in the world, there is a potential to become one of the richest countries because of its large arable land, and precious metals. Also, the economic growth has increased from 2.8 percent in 2009 to 7.4 percent in the period 2010-2013, and there was 8.7 percent in 2014. In the comparison with the rest of sub-Saharan, it is above average. This progress is caused by economic and political measures implemented in the last years. Nevertheless, the economic situation is still quite unstable in the country.

Chart 3 shows how is each analysed country is doing within each sub-indicator in the economic pillar. Radar chart clearly indicates that Rwanda is doing better in the sub-indicator A1, A2, A3 and A5 but it is weaker in the ace of A4 where the DRC has the best results out of the analysed countries. Burundi is almost equal to Rwanda in sub-indicator A3 and A2 but A1 and A5 are alike DRC. In the APX 8 are shown the developments of each sub-indicators during the analysed period.
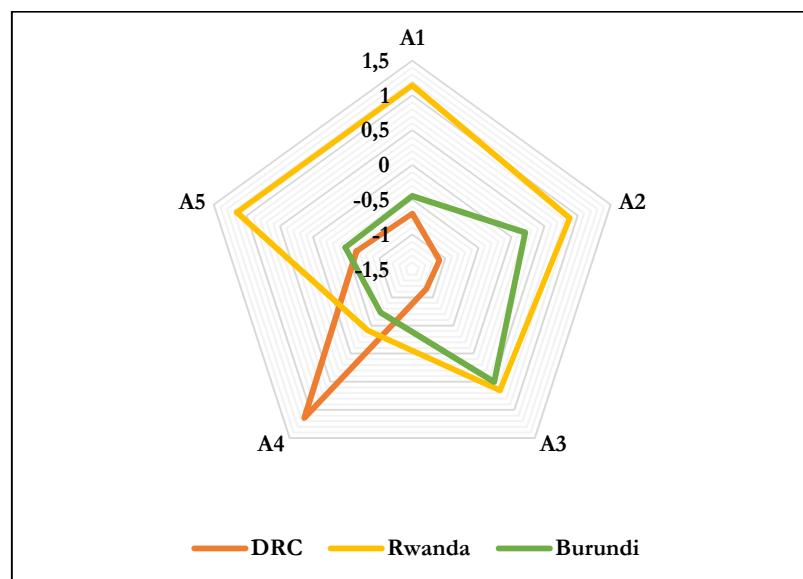

Chart 3: Economic pillar performed in radar chart
Author: Bc. Petra Kratinová

The level of unemployment (A1) is lowest in Rwanda where the rate was under 1 percent during analysed period. Even though, Burundi obtained a foreign aid to increase its employment, the unemployment is still high and accounts for around 7 percent of total the labour force in the analysed period. The difference between Burundi and the DRC is not high because the unemployment rate is around 8 percent of the total labour force in the DRC during analysed period.

Trade in services (A2) is mostly equal in all analysed countries but in comparison with other African states it is still low. However, Rwanda and Burundi keeps their rates around 15 percent of the GDP in the analysed period. The DRC varies every year due to the average rate is 10-15 percent of the GDP during the period, and thus the diamond indicates a huge difference between countries.

Health expenditure (A3) is equal for Rwanda and Burundi but it varies during the period. Rwandan expenditure on health was only 6 percent of the GDP in 2004 and 2005 but then there have occurred an increase to 10 percent of the GDP since 2006. Burundi maintains its expenditure around 10-12 percent of the GDP during the period. In contrast, the health expenditure is low in the DRC and it accounts around 4-6 percent of the GDP.

Exports of goods and services (A4) are highest in the DRC which is clearly indicated in the diamond. During 2004-2006, exports accounted for around 20 percent of the GDP, and since 2007, there is an increase to 40 percent of the GDP. Exports of Rwanda are much lower and it accounts for around 10-12 percent of the GDP, However, as the diamond indicates, the lowest exports are in Burundi where it was only around 5-10 percent of the GDP during analysed period.

Imports of goods and services (A5) are highest in Rwanda where a there is a progress is since 2006 from 30 percent of the GDP to 40 percent of the GDP. Burundi and the DRC are equal and their imports are around 30 percent of GDP, and in 2007 and 2010, the imports in the DRC accounts for almost 50 percent of the GDP.

3.10.2 Social Pillar

Figure 4 shows how are the countries ranked within the social pillar where the results are similar for the DRC and Burundi but worse for Rwanda. The most favourable status is in Burundi, due to it has Rank 1 but its status is average if we compare it with other African countries. Among average countries out of the analysed is the DRC which gets

Rank 2 but its status should be evaluated mostly as likely unfavourable. Rwanda obtains Rank 3 and its status is the most unfavourable within social pillar.
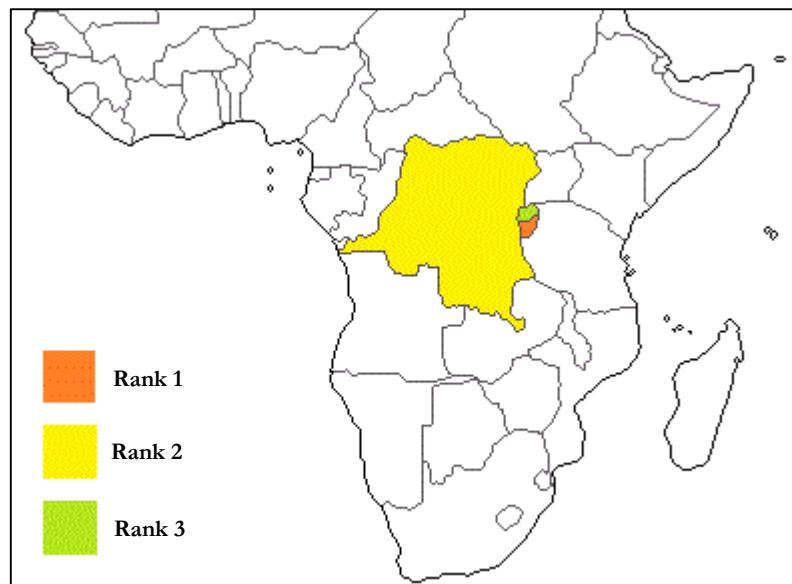

Figure 4: Ranking of countries in social pillar
Author: Bc. Petra Kratinová

Despite the social situation in Burundi have been influenced by long-term conflicts, and the returned refugees after the civil war burdened the social services, it has the best results out of the evaluated countries. The conflicts are mostly ended, and it is due to the UN missions in this area which have been provided since 2004. Even though, a most of the refugees came back, there is still a numbers of people who never come back home. Nowadays, Burundi is a very small country with high population where the inhabitants are predominantly without an access to improved water and an access to health care.

The DRC is the fourth most populous country in Africa which is gravely influenced by civil war, and where most of citizens live under the poverty line. The poor security system in the country has a negative impact on development of health care and education. However, due to the help of non-governmental organizations, the quality of life improved in the recent years which assist to recover and develop health in rural areas, to build schools and enhance the quality of education, to improve hygiene, to ensure a HIV/AIDS prevention and to help the victims of sexual violence. Implementation of measures by the government is also supportive to improve social situation of inhabitants.

Rwanda is influenced by the genocide in 1994 which had an enormous impact on the society, and caused demographic changes in country. Despite the economic growth

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is being quite good and the government implementing many reforms to recover after the civil war, the social issues are still critical because there is a missing an access to improved water source in rural areas, quality of health care is very low and the, a social status of women is still low. But contrarily, the number of children in schools is higher, and an education is provided without fees. Even though, the current social situation is worse than in other analysed countries, this situation might get better in the following years because the government implements new measures to ensure better quality of life.
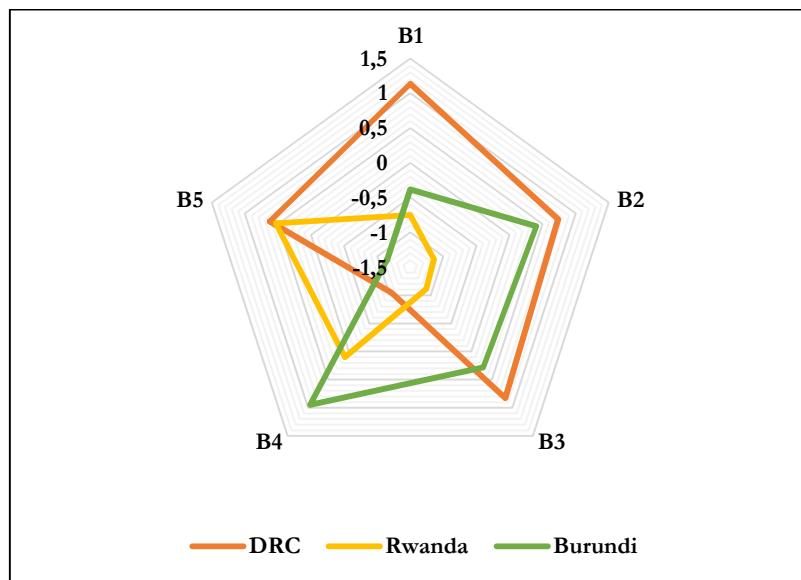

Chart 4: Social pillar performed in radar chart
Author: Bc. Petra Kratinová

Chart 4 again shows again how is each analysed country is doing within each sub-indicator in the social pillar. Radar chart indicates that sub-indicators B1, B2, B3 and B5 are most favourable in the DRC where are contrarily the lowest values of result in sub-indicators B4 out of all chosen countries. Rwanda is at the same level as the DRC in the case of B5 but the other variables are bad. Burundi has the best results of sub-indicator B4, B2 and B3 are similar as in the DRC, B1 is closer to Rwanda but B5 is lowest out of all countries. APX 9 is used a background is used APX 9 where is attached a development of each sub-indicator of the social pillar attached to the given period.

Population density (B1) is characterized by huge difference among countries. On the one side are Rwanda and Burundi where the density is between 350-450 of people per sq. km of land area in the case of Rwanda, and between 300-400 of people per sq. km of land area in the case of Burundi. Development of density in these countries is quite similar. But on the opposite side is the DRC where the density is much lower than

in Rwanda and Burundi. During the analysed period, the density is mostly under 50 people per sq. km of land area which is a very low values whereas the DRC is one of the most populous countries in Africa. This difference might be also clearly seen in the radar chart above.

Prevalence of HIV (B2) is one of the biggest issues of current world, especially the development world. The DRC as well as Burundi deal with HIV quite well in comparison with Rwanda. Average prevalence of HIV in the DRC is around 1.5 percent of population ages 15-49 but it decreases into 1 percent in 2013 which is positive. Burundi evinces a prevalence of HIV around 2-2.5 percent of population ages 15-49 but there also occurs decline in 2013 - around 1-1.5 percent of population ages 15-49. The worst results are in Rwanda whose prevalence of HIV is around 3.5 percent with a subsequent low decrease into 3 percent in 2013.

Refugee population (B3) is low in all analysed countries due to previous civil wars and current conflicts. However, the DRC has the lowest number of refugees who covers around 0.003-0.004 percent of the total population, and after 2012 it is even around 0.001 percent of the total population. Refugee population varies in Burundi. While refugees accounted 0.007 percent of the total population in 2004, in period 2005-2010 it was around 0.003 percent of the total population but then it increased to 0.005 percent of the total population in 2012. Rwanda has the highest refugee population out of the chosen countries where it accounts for around 0.005 percent in the given period.

As it is evident from radar chart, the urban population (B4) is lowest in Burundi where around 10 percent of the total population live in urban areas. Rwanda varies in the given period. While there were 20 percent of the total population in urban areas in 2004, there was an increase to 25 percent of the total population in 2013. The DRC has more or less stable urban population which is around 35-40 percent of the total population.

Contraceptive prevalence (B5) is a problematic issue in developing countries, and it is not mostly very extensive. The DRC and Burundi have lower contraceptive prevalence than Rwanda but it might be a predicted improvement. There are around 20 percent of women ages 15-49 in DRC who use contraceptives, and 15-20 percent of women ages 15-49 in Burundi. Rwanda accounted around 20 percent of women ages

15-49 in 2004-2005 but then there came an increase to 30 percent of women ages 15-49 in 2006, and in 2013 even 50 percent of women ages 15-49.

3.10.3 Environmental Pillar

Figure 5 shows how are the countries ranked within the environmental pillar where the results are almost identical for Rwanda and Burundi but the DRC is much worse. The most favourable status is in Rwanda, due to it has Rank 1 as well as in economic pillar but its status is still average if we compare it with other African countries. Among average countries out of the analysed ones is Burundi which gets Rank 2 but the difference with Rwanda is not large and its status should be evaluated mostly as average. The DRC obtains Rank 3 and its status is the most unfavourable within environmental pillar.
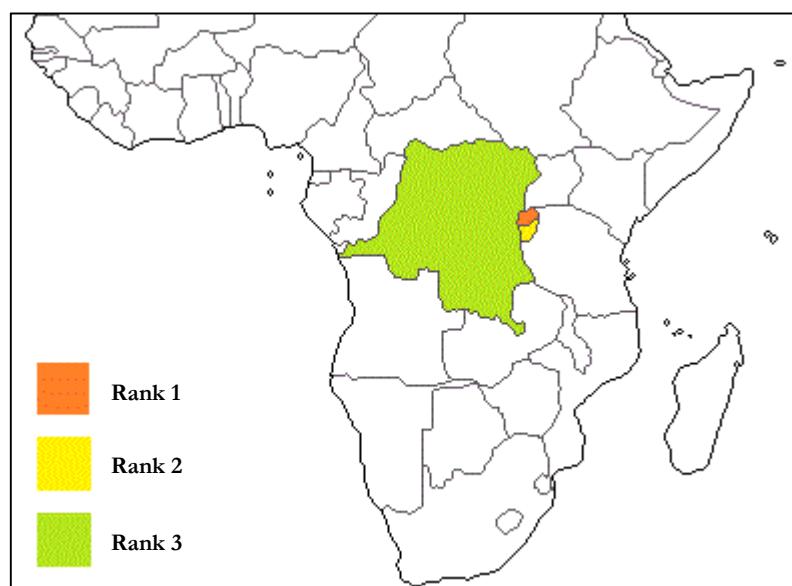

Figure 5: Ranking of countries in environmental pillar
Author: Bc. Petra Kratinová

Rwanda, as well as most of African countries, is dependent on agriculture which accounts for around 31 percent of the GDP, and employs more than 90 percent of the population, however, most of the farms are small family farms where farmers grow food crops in order to survive. Nevertheless, the arable land is depleted due to intensive farming, and missing technology innovations together with climate changes cause a slowing down of the agriculture development. Even though, agriculture production has increased since Rwandan genocide in 1994, Rwanda is dependent on foreign aid because the production does not meet a total demand in the country. Also, the infrastructure and access to water source is supported by foreign aid.

Long-term conflicts in Burundi threw agriculture sector into disarray, and agriculture became to be difficult source of livelihood. Historically, Burundi was self-dependent on food crops production but after civil war and repeated periods of drought, the country is dependent on foreign aid of international organizations. Periods of drought decreases the quality of the land, and because of them, the farmers are exposed to the risk that they do not produce enough food crops. However, nowadays, the agriculture sector accounts 50 percent of the GDP and employs 90 percent of the labour force. Burundi dispose of quite large water source, despite it is being an inland country because of Lake Tanganyika. Nevertheless, demand for improved water source is not fulfilled due to poor quality of the water source. Thus households are forced to use water from lakes, rivers or water wells.

Agriculture and forestry account 37.5 percent of the GDP in the DRC, and it is the most important sector because it employs more than 66 percent of the active population. The DRC dispose of 80 million hectares of arable land and more than 100 million hectares of forests because of the Congo Basin. However, the last Congolese conflict, Second Civil War, caused huge deforestation, and arable land was affected, too. Nowadays, the DRC has huge a hydroelectric potential due to huge and main source of electric energy in lower reaches of Congo River where a large system of dams Inga is located. Nevertheless, most of the produced energy is exported, despite a total domestic consumption is not being fulfilled. And in spite of access to Lank Tanganyika, due to conflicts, environmental degradation, urbanization and poor water infrastructure, the access to drinking water is weak.

Below Chart 5 shows how each chosen country is doing within each sub-indicator in the environmental pillar. Radar chart indicates that Rwanda and Burundi have almost identical values in sub-indicators B1, B2, B3, and B5. Only the sub-indicator B4 is most favourable in the DRC, and contrarily appreciably worse in Rwanda and Burundi. In the APX 10 are shown developments of each sub-indicators during the analysed period.
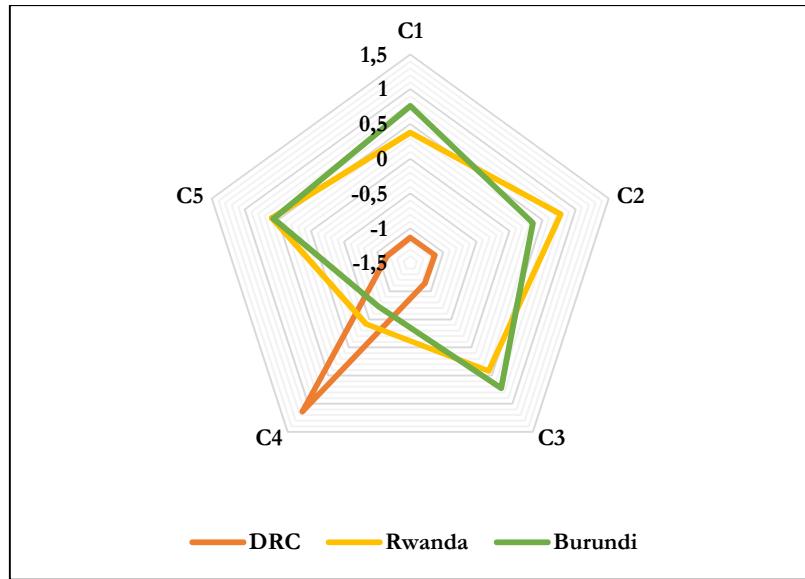
Chart 5: Environmental pillar performed in radar chart
Author: Bc. Petra Kratinová

CO_2 emissions (C1) are quite stable during the given period. While Rwanda and Burundi cause low emissions, the DRC produces much more carbon dioxide into the atmosphere. Rwanda releases ain an average 0.7 million metric tons of carbon dioxide, and Burundi around 0.5 million metric tons. On the contrary, the DRC realises around 2.5 – 3.0 million metric tons of carbon dioxide which is mainly caused by deforestation and forest degradation.

Arable land (C2) also indicates huge difference between the DRC and other countries. Despite DRC dispose of 80 million hectares of arable land, nowadays, there is usable only 5 percent of total land area. While Burundi accounts arable land around 35-40 percent of land area, and Rwanda even 45-50 percent of the total land area.

Improved water source (C3) is poor in all chosen countries, even though all of them have an access to the large Lake Tanganyika. On an average, Burundi disposes of improved water source around 70-75 percent of population with access, Rwanda has around 65-70 percent of population with access, and the DRC even only disposes around 45 percent of population with access.

Final results of the forest area (C4) are predictable if we take account of area of the Congo Basin. All countries dispose of a large forest area due to large rainforest national parks. Burundi has around 10 percent of forest out of total land area, Rwanda has around 15 percent of land area, and the DRC has almost 70 percent of forests out of the land area.

Consumption of ozone-depleting substances (C5) varies in each chosen country during the given period. The DRC depleted almost 360 tons of substances in 2004 but it decreased to 50 tons in 2008, and despite there is a slight increase to 76 tons in 2010. Nowadays, the DRC depletes around 35 tons of substances. However, it is still high depleting in comparison with Rwanda or Burundi. Burundi released around 27.4 tons of substances in 2004 but it reduced to 15.1 tons in 2006, and to 3.8 tons two years later. Even though there was a slight increase in 2011, the depleting is now still around 3.8 tons of substances. Rwanda released only 4.9 tons of substances in 2004 but then the increase came to 8.9 tons in 2007. Today, Rwanda depletes around 7 tons of substances.

3.10.4 Composite Indicator of Sustainable Development
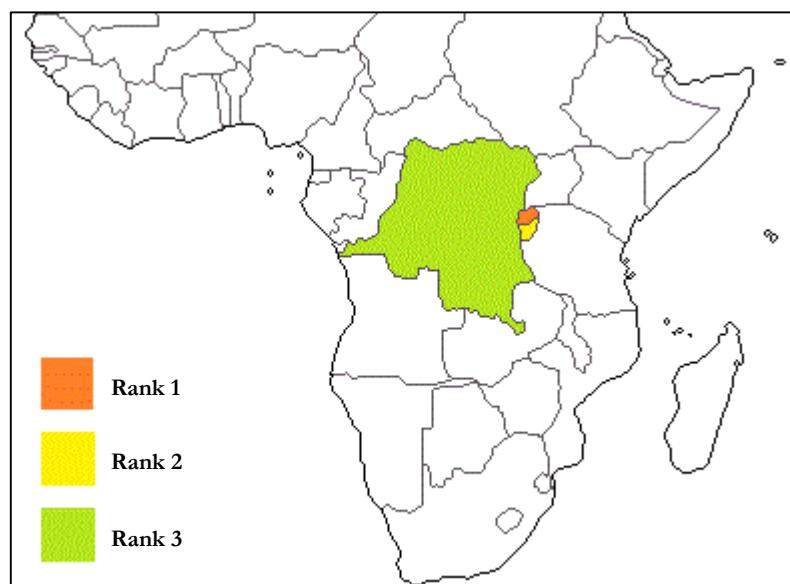

Figure 6: Ranking of countries in composite indicator of sustainable development
Author: Bc. Petra Kratinová

Based on the above mentioned evaluation of the economic, social and environmental pillars mentioned above, there is created a composite indicator of sustainable development. As is shown in Figure 6, Rwanda is placed as first with Rank 1, Burundi is placed as second with Rank 2, and the DRC is last with Rank 3.
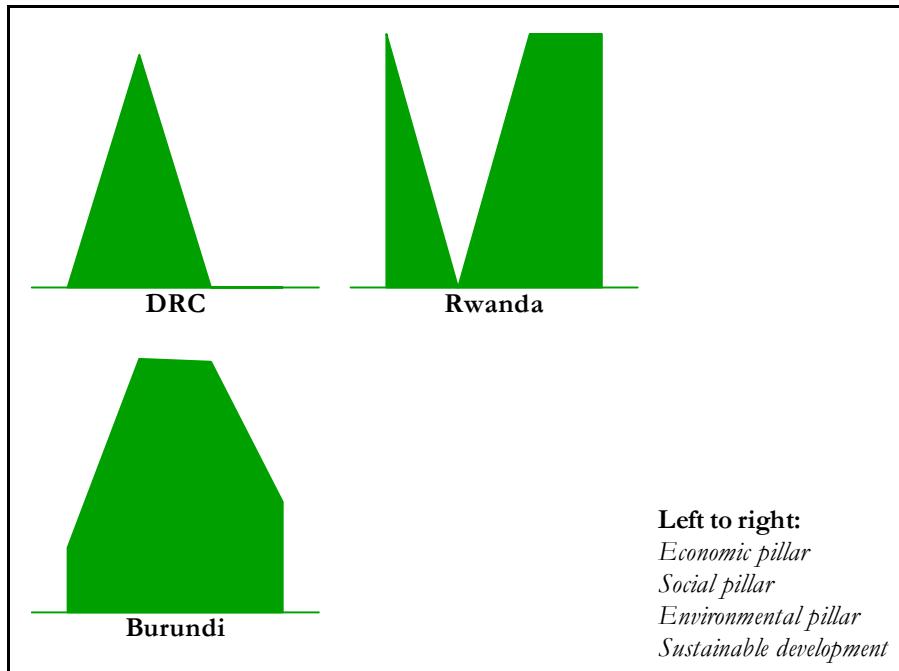
Figure 7: Profile diagram of CI in STATISTICA 12
Author: Bc. Petra Kratinová

Figure 7 describes a position of countries within the composite indicator, and illustrates profiles of each country with their dominance or deficiency in each pillar of sustainable development. Profile of each country is matched to the partial results of analysis. The DRC obtains Rank 3 in the economic and environmental pillars, and Rank 2 in the social pillar. As the profile above indicates, the DRC is equally weak in those two pillars, and quite strong in the social pillar, but the overall position of the country in sustainable development is unfavourable. Rwanda is the inverse of the DRC because it obtains Rank 1 in economic and environmental as it is clearly described in profile but it obtains Rank 3 in social pillar where there is a slump in the profile. However, the overall position of Rwanda in sustainable development is the most favourable out of the compared countries. Finally, Burundi obtains Rank 2 in the economic and environmental pillars, and Rank 1 in the social pillar, thus its profile is without any slumps, and final position of country sustainable development is more or less favourable.

4 PROPOSAL PART

The current situation in Africa indicates how the growth among single countries is unstable and unsustainable. The main reason why the today's world is moving toward this tragic direction is unequal development of material, social and civilization aspects of life in the previous centuries. The Commission on Sustainable Development is mainly focused on agriculture, development in rural areas, land, dryness and desertification in African countries. These topics are very important and significant for African countries, and are oriented towards weaker economics, to rural areas where agriculture is the only source of livelihood, and to other areas where we might be see a high level of poverty. Even though, agriculture has the largest share in the GDP in the most of the African countries, and employs most of the citizens, African is not self-sufficient in agriculture anymore, and also is not able to produce enough food crops to survive on its own due to increasing population and negative tendencies in agriculture.

However, a more intensive cooperation among development organizations, governments and local citizens might strengthen an importance and a significance of a development of the African countries. If the cooperation were deepened and strengthened between these subjects, and if they take into consideration local inhabitants, it might lead to increase in potential of the African countries. Nevertheless, any foreign aid provided in these countries might lead to political conflicts because a position of governments and organization vary in each African country. It could be divided into three parts. The first part accepts a foreign aid, and it considers this aid like a type of compensation for colonialism. Then African countries are seen as victims of colonialism, and Western countries are responsible for losses and current situation. On the opposite, the second part tries to establish equilibrium and welfare, and then African countries are seen as un-self-sufficient and helpless. And finally, the third part is parties or firms who want to help to strengthen the development. However, the question is how efficient and effective is this help.

In the recent years, African countries resolved to resist to these threats from the rest of world, and therefore they founded the New Partnership for Africa's Development in 2001 which provides a sustainable development framework. It emphasises a partnership among African countries and international organizations, and proposes a common targets how to eliminate poverty through sustainable development and economic growth. The aids are provided through financial and technical supports or subsidies to enhance

African development. The most indebted and poorest countries are exempted from debt, and they are offered loans with low interest.

The African continent is also a priority for the UN and its agencies, especially the cooperation with a struggle against pollution of any type, a construction of infrastructure, a development of agricultural technologies, and climate changes. The UN has currently many regional, country and political offices, and there are launched nine peacekeeping missions launched though African countries.

The proposal part provides a recommendation for improvement of three areas of sustainable development – forest area, improved water source, and health care. These areas are chosen to cover main today's issues of developing countries.

4.1   Forest Area

Forests play a crucial role in the survival of the human population. They provide not only the shelter and food for citizens and their domestic animals, but also water, medicinal plants, wood for building, and fuel. But they also regulate our environment, although it is indirect. They slow down soil erosion, control run-off of rainwater and store it, and regulate its release into rivers and lakes. And last but not least, they regulate our climate. Forests play a significant role in the socio-economic development of the industrial sector, and they are a resource for economic stability in Africa. Africa disposes by around 500 hectares of forests, out of which around 18 hectares are in the DRC where vast Congo Basin is. However, long-term conflicts have a huge impact on economic and infrastructure development, and forestry sector was not enough attractive for foreign investors or donors because of whom the foreign aid is necessary, despite a creation of policy focused on a sustainable use of forest resources. Yet the African forestry has a huge potential and might play a significant role in the recovery and development of the African countries, even in the DRC.

Forests have a crucial role and function in production of wood for the energy and construction industry. The efforts to fulfil increasing demand for wood energy sources, especially in the rapidly developing urban areas, lead to a formation of new energy concepts because, nowadays, more than 78 percent of the harvested timber is for the energy sector, and there is forecasted a subsequent decrease is forecasted. Wood will be mainly used for heating in the future due to low costs, especially in Africa where lower economic output is. Regrettably, this higher use causes an extensive mining of wood, and thus

an increase of biodiversity and decrease of the forest area. All of them might cause degradation of natural resources, negative environmental consequences, and the absence of the secondary function of the forests.

Regrettably, deforestation has a huge impact on climate changes which is closely connected to other sub-indicators evaluated in the thesis – CO_2 emissions. Actually, deforestation is the biggest and the most serious issue of today because it disturbs a cycle of water which leads to extensive drought, to extinction of species, or it forces other animals to leave their native environment. And it is the forests that draw CO_2 out of atmosphere, and assist to get ahead of its concentration.

The solution is to find a new system for management and investments. If we created an energy concepts, if it could more efficient use of forest due to restrictions, such as compulsory investments back to mined areas to restore them, payments of fees for transportation of charcoal, or planning of production period in a commercial forest. Another solution is to create a system management based on multi-factors where are control mechanisms included monitoring and reporting, evaluations and analysis of crucial bio-indicators, creation of certified responsible forestry, or creation of forestry management. Among other efficient proposals are investments into the modern technologies or into the creation of quality system management. It is also necessary to include local people to sustain their forestry because it is a crucial factor of development in a country.

4.2 Improved Water Source

The DRC, Rwanda and Burundi are rich for water resources due to Lake Tanganyika and Congo River, however, the sources are not unequally distributed as well as in the rest of Africa, and thus most of people do not have an access to improved water source. The lack of available and drinking water negatively influence the population by many causes. Most of citizens are forced to bring water from distant areas, and the brought water is scarcely sufficient for drinking and cooking. People predominantly draw water from surface sources, such as lakes, rivers, brooks, etc. Unfortunately, these sources are contaminated because they are used by both people and animals, and it caused illnesses which might be fatal, such as cholera. These diseases cause an absence at schools, and subsequently low number of educated people who are not able to find work to secure funding of family.

A demand for drinking water is increasing due to the population growing and required water in agriculture sector which has to be supported due to its large share in the GDP. African countries have rich groundwater sources but it is difficult to draw them because the currently used hand pumps cannot gain water as deep as wells can. But these types of water drawing are quite expensive, and it requires better technologies than those which are currently available. However, improved water source is one of the objectives of MDGs which the international organizations want to reach.

The lack of drinking water might be only solved, if the governments cooperated with international organizations, and if there was created a unified position created to manipulate with water sources properly, and to maximize the economic and social prosperity. Most of the African countries are aware of the issue with lack of water, and some of them created ministries of water affairs. One of many types how to ensure the improved water sources is to extend water networks, or to create new sources of drinking water, such as public taps, wells, protected dug wells, protected fountains, etc. Improvement of access to high-quality sanitation facilities, which corresponds to norms, is another solution.

The proposal is to dig new wells, or restore the current wells. It can provide drinking water for huge communities which might be long-term if it was used properly. Wells are an appropriate source of improved water source but they are often contaminated due to improper use. Thus, it is more efficient is to dig these wells farther away from water sources such as lakes, rivers. However, the question is what is more appropriate – hand pumps or deep wells. Both of them have pros and cons. Deep wells are much deeper than hand pumps, and provide more water but they could lead to waste of water which might have consequences for the future, if we consider growing population. In the case of hand pumps, there is not risk of wasting but it might not provide enough water, and people would still draw water from lakes and rivers. And there is still the question of money. How are international organizations and local governments able to invest in digging of new wells and pumps?

However, the most important and significant step is to inform the population about risks caused by polluted water, and to educate them how they can disinfect the water which they draw from lakes or rivers because most of them do not know the consequences of unimproved water source, and subsequent illnesses. Campaigns provided by specialists

and volunteers might lead to prevention of diseases and the improvement of living standards.

4.3   Health Care

The last part of the proposal chapter is health care, which is connected to the three chosen sub-indicators in this thesis, and at the same time, to two pillars of sustainable development. Specifically, these sub-indicators are health expenditure, prevalence of HIV, contraceptive prevalence.

Health is a significant factor of economic growth and development because if there is poor health, it causes poverty. Development and improvement of health care is a part of Millennium Development Goals to decrease poverty. International development cooperation is primarily focused on decreasing the infant mortality, improvement of mother's health, struggle with HIV/AIDS, malaria or other diseases.

The most expanded disease is HIV/AIDS, and almost third of African population is infected. Unfortunately, though there is long-term research, there has not found a way how to cure this disease has not been found, yet. Even though, there are many organizations specializing in this issue, there are still negatives factors which complicate the solution of current situation. One of the most serious negative factors is religion because it influences African citizens a lot. It is because of religion that people do not use any contraceptives, and thus they put themselves at risk of infection by HIV/AIDS. Nowadays, there is a low percentage of African population who use contraceptives but the aim of operations organizations is to increase the percentage of the population. Among the other negative factors are the policies of the African countries which are affected by large corruption. Most of African leaders reject the researches of scientists and recommendations, and due to corruption, money, given to the health care by organizations and foundations is, are lost. Serious factor is also the low-quality or missing health care. Despite the international organizations decrease of this issue, there are still missing doctors. Health care in African countries is seriously affected by brain-drain when most of the qualified doctors leave to developed countries where there are better conditions are for them.

The first step, how to improve and strengthen the health care is to build or re-build hospitals. Most of hospitals are in urban areas but their quality and equipment is obsolete or is missing, thus it is necessary to provide better technologies to hospitals. However,

new equipment in hospitals does not solve a problem of missing hospitals in the rural areas where people die every day due to the lack of health care. But this objective cannot be fulfilled if the governments and international organizations do not cooperate. It is indispensable to create a report by specialists which is concludes the current health conditions of citizens in a specific location, together with occurred diseases. Based on this report, it might be much easier for international organizations to cooperate with the local governments to improve the situation.

However, it is significant to get the doctors and specialized labour force into these areas, or to convince the local doctors to stay, despite better conditions in the developed countries. Alongside, it is necessary to train local staff, and to improve the administration of hospitals. Nowadays, there are around 4 000 patients on one doctor because of brain drain and low number of educated people. If there is not available health care, health expenditure is low or zero. Increase in number of educated people, doctors and hospitals, access to medicals might lead to grow in health expenditure which could account around 40 percent of the GDP.

The most widespread disease in Africa, HIV/AIDS, is difficult to decrease while population is not informed enough informed. Local inhabitants are very influenced by religion, and because of this it is essential to create an efficient and an effective campaign which revises their opinion on contraceptives and safe intercourse. The aim is not to turn them away from their religion but to help them to understand how the contraceptives are important for them and their health, especially in the developing areas. The campaign might also cover information about other life-threatening diseases, and familiarization with the benefits connected to vaccination against these diseases. Interconnection of local hospitals and doctors with research centres might improve diseases prevention, too.

CONCLUSION

The DRC has been immersed into the bloodiest conflict for many years. Yet, this country has a tremendous potential which could bring unprecedented economic prosperity, if it is realized in the right way. Otherwise, it will continue to be used as a financial tool of civil war, and thus the stability will be decreased in the whole country and also the region. But the Congolese government might not be able to take advantage of this potential, and any support of the UN, such as peacekeeping missions, has been unsuccessful up to now. Other support should be more expansive, more intense and better organized to be efficient. However, it is a question, if there is a place in the UN for this intense support.

The truth is that the situation is not only a regional issue in the DRC but it has a greater importance. Given the size of this country, a calming and an improvement of the current situation should contribute to the stabilization not only of the DRC, but of the whole region, and probably the entire of whole continent.

The aim of this diploma thesis was to evaluate what is the current situation of the DRC within sustainable development, compare it with other former Belgian colonies, in this case Rwanda and Burundi, and assess if the Belgian colonialism influenced the current situation in countries. Proposal part introduced general recommendations of the author which are focused on issues connected to sustainable development. However, the main problem of sustainable development in all African countries is the will of local governments to enforce it which is quite difficult due to often changing political parties in the government whose vision are in most cases various.

My goal was to describe a theoretical approaches to the development process and achievement in the Theoretical part. It dealt with the basic definitions of sustainable development, description of its pillars and fundamental principles. However, the core of the theoretical part was to describe what a composite indicator is and how to construct it according to the general Handbook published by the OECD. The country review introduced a brief history of the DRC, and above provided a comparison of the DRC with Rwanda and Burundi to evaluate the development of countries based on the collected data of the HDI and MPI.

The analytical part dealt with the subsequent construction of the composite indicator where five sub-indicators for each pillar were chosen. The economic pillar covered unemployment, trade in services, health expenditure, exports of goods and services, and imports of goods and services. Among the social sub-indicators were covered population density, prevalence of HIV, refugee population, urban population, and contraceptive prevalence. And finally, the environmental pillar covered CO_2 emissions, arable land, improved water source, forest area, and consumption of ozone-depleting substances.

Variables went through research which was consist of ascertaining of basic characteristics, such as mean, median, standard deviation, etc., transformation of variables, calculation of dependence, and imputation missing data. Subsequently, there was chosen a suitable normalization method was chosen, it was z-scores in this thesis because it does not eliminate extremes. This method is especially appropriate if there is a comparison of difference among countries, and the required result might be different than ranking. After that, the variable was weighted which is a very significant part of constructing the composite indicator, because weighting influences whole analysis. Because there were high correlations which were expected due to the relations of each sub-indicator within the pillars, all sub-indicators were weighted with the same importance.

The final part of the analysis is the aggregation with weighted sum method which resulted in the overall ranking of a countries within each pillar of the sustainable development, and within the composite indicator where the overall ranking was Rwanda, Burundi and the DRC (from the rank one).

One of the most significant factors of the development is a financial aid and its amount which organizations provide to the development countries. Financial aid is also provided by private organization but this aid is frequently characterized by stress to render them local land. It often leads to depletion of natural resources in these countries, and complicates ensuring of sustainable development.

The secondary objective of the thesis is to evaluate how the Belgian colonialism influenced the current situation in the DRC. Nevertheless, even after the analysis, there is not clear answer. Generally, colonialism had a huge impact on the whole African continent, especially coercion to maintain political borders given by colonizers. These regulations

had the hugest impact just on former Belgian colonies where the biggest enemy ethnic groups, Tutsi and Hutu, were united and it has subsequently led to the bloodiest conflict in Africa since the Second World War. And exactly this conflict has affected the development not only in the DRC but in Rwanda and Burundi, too.

LIST OF LITERATURE AND OTHER SOURCES

BIBLIOGRAPHY

DUŠEK, Hynek. *Udržitelný rozvoj.* Kunovice: Evropský polytechnický institut, s.r.o., 2010, 108 p. ISBN 978-80-7314-195-0.

HEBÁK, Petr. *Vícerozměrné statistické metody [3].* Edition 1. Praha: Informatorium, 2005, 155 p. ISBN 80-733-3039-3.

CHRÁSKA, Miroslav. *Metody pedagogického výzkumu: základy kvantitativního výzkumu.* Edition 1. Praha: Grada, 2007, 265 pp. Pedagogika (Grada). ISBN 9788024713694.

JENÍČEK, Vladimír a Jaroslav FOLTÝN. *Globální problémy světa: v ekonomických souvislostech.* Edition 1. V Praze: C.H. Beck, 2010, xix, 324 p. Beckovy ekonomické učebnice. ISBN 978-80-7400-326-4.

KRATINOVÁ, Petra. *Military spending in developing countries and their consequences for economic development in the Democratic Republic of Congo.* Brno, 2012. Bachelor Thesis. Mendel University in Brno. Thesis supervisor Ing. Zbyšek Korecki, Ph.D.

MINAŘÍK, Bohumil, Jana BORŮVKOVÁ a Miloš VYSTRČIL. *Analýzy v regionálním rozvoji.* 1. vyd. Praha: Professional Publishing, 2013, 234 p., [8] s. obr. příl. ISBN 978-80-7431-129-1.

MIROVITSKAYA, Natalia a William ASCHER. *Guide to Sustainable Development and Environmental Policy.* Durham and London: Duke University Press, 2001, 391 p. ISBN 0-8223-2735-x.

MOLDAN, Bedřich a William ASCHER. *Ekologická dimenze udržitelného rozvoje.* 1st edition. Praha: Karolinum, 2001, 102 p. ISBN 80-246-0246-6.

ŘEZANKOVÁ, Hana. *Shluková analýza dat.* 1st edition. Praha: Professional Publishing, 2007, 196 p. ISBN 978-80-86946-26-9.

INTERNET SOURCES

BELLU, Lorenzo Giovanni. Inequality Analysis: The Gini Index. In: *Food and Agriculture Organization* [on-line]. December, 2006. [cit. 2015-03-23]. Available in: http://www.fao.org/docs/up/easypol/329/gini_index_040en.pdf

ČÁSLAVKA, Jiří. et al. *Indikátory blahobytu: všechno, co jste kdy chtěli vědět o štěstí (ale báli jste se zeptat)* [online]. Praha: Zelený kruh a Hnutí DUHA, 2010, 55 p. [cit. 2014-08-02]. ISBN 978-80-87417-02-7. Available in: http://www.zelenykruh.cz/dokumenty/indikatory-blahobytu-2010.pdf

Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings. In: *United Nations Statistics Division* [online]. 2014 [cit. 2014-12-26]. Available on: http://millenniumindicators.un.org/unsd/methods/m49/m49regin.htm#africa

Democratic Republic of Congo map. In: *Mappery.com* [on-line]. April 23, 2008 [cit. 2015-03-18]. Available in: http://www.mappery.com/Democratic-Republic-of-Congo-Map

Human Development Index (HDI). In: *United Nations Development Programme: Human Development Reports* [online]. 2014 [cit. 2014-12-26]. Available on: http://hdr.undp.org/en/content/human-development-index-hdi

Human Development Index and its components. In: *United Nations Development Programme: Human Development Reports* [online]. 2014 [cit. 2014-12-26]. Available on: http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components

Indicator Metadata. In: *Millennium Development Goals Indicators* [on-line]. 2014 [2015-03-02]. Available in: http://mdgs.un.org/unsd/mdg/Metadata.aspx?IndicatorId=208&SeriesId=0

Indicators. In: *The World Bank* [on-line]. 2014 [cit. 2014-12-26]. Available on: http://data.worldbank.org/indicator?display=graph

Interim Poverty Reduction Strategy Paper. In: *International Monetary Fund* [on-line]. March 2002 [cit. 2015-03-23]. Available in: http://www.imf.org/external/np/prsp/2002/cod/01/033102.pdf

KOVACEVIC, Milorad, M. Cecilia Calderon. UNDP's Multidimensional Poverty Index: 2014 Specifications. In: *United Nations Development Programme: Human Development Reports* [online]. Occasional Paper, December 2014 [cit. 2014-12-26]. Available on: http://hdr.undp.org/sites/default/files/specifications_for_computation_of_the_mpi.pdf

Multidimensional Poverty Index (MPI). In: *United Nations Development Programme: Human Development Reports* [online]. 2014 [cit. 2014-12-26]. Available on: http://hdr.undp.org/en/content/multidimensional-poverty-index-mpi

NARDO, Michela, Michaela SAISANA, Andrea SALTELLI a Stefano TARANTOLA. *Tools for Composite Indicators Building* [online]. European Communities, 2005, 134 p. [cit. 2014-07-15]. Available in: http://farmweb.jrc.cec.eu.int/ci/bibliography.htm

OECD. *Handbook on constructing composite indicators: methodology and user guide* [online]. Paris: OECD, 2008, 158 p. [cit. 2014-07-15]. ISBN 92-640-4345-4. Available in: http://www.oecd.org/std/42495745.pdf

OECD. *OECD glossary of statistical terms* [online]. Paris: OECD, 2008, 601 p. [cit. 2014-07-15]. ISBN 978-926-4025-561. Available in: http://www.oecd-ilibrary.org/docserver/download/3008121e.pdf?expires=1405429530&id=id&accname=guest&checksum=F54999A787A3B34AE47B135413E32625

Population distribution by province of the DRC, 2010. In: *Knoema* [on-line]. 2015 [cit. 2015-02-17]. Available in: http://knoema.com/DRPDH2010/population-distribution-by-province-of-the-drc-2010

RENCHER, Alvin C. *Methods of multivariate analysis* [online]. 2nd ed. New York: J. Wiley, 2002, xxii, 708 p. [cit. 2014-10-05]. ISBN 04-714-1889-7. Available in: http://tx.shu.edu.tw/~purplewoo/Literature/!DataAnalysis/Methods%20of%20Multivariate%20Analysis.pdf

The World Bank [online]. 2014 [cit. 2014-12-26]. Available in: http://www.worldbank.org/

Venn Digrams. In: *ConceptDraw* [on-line]. 2014 [2014-08-02]. Available in: http://www.conceptdraw.com/solution-park/DGRM_TOOL_VENNDIAGRMS

World Commission on Environment and Development. *Our Common Future* [on-line]. October 1987 [cit. 2014-07-10]. Available in: http://www.un-documents.net/wced-ocf.htm

World income inequality database V3.0B. In: *United Nations University: UNU-WIDER* [on-line]. September, 2014 [cit. 2015-03-23] Available in: http://www.wider.unu.edu/research/WIID3-0B/en_GB/database/

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Appendix 1   Political map of DRC with provinces

Appendix 2   Human Development Index

Table 1   HDI values for DRC in the period 1980 - 2013

	1980	1990	2000	2005	2008	2010	2011	2012	2013
HDI Value	0,336	0,319	0,274	0,292	0,307	0,319	0,323	0,333	0,338

Source: UN Development Programme: Human Development Reports

Table 2   Comparison of HDI values for DRC with Rwanda and Burundi

	2013	2012	2011	2010
DRC	0,338	0,333	0,323	0,319
Rwanda	0,506	0,502	0,463	0,453
Burundi	0,389	0,386	0,384	0,381

Source: UN Development Programme: Human Development Reports

Appendix 3   Multidimensional Poverty Index (MPI)

Figure 1   MPI in DRC in 2010
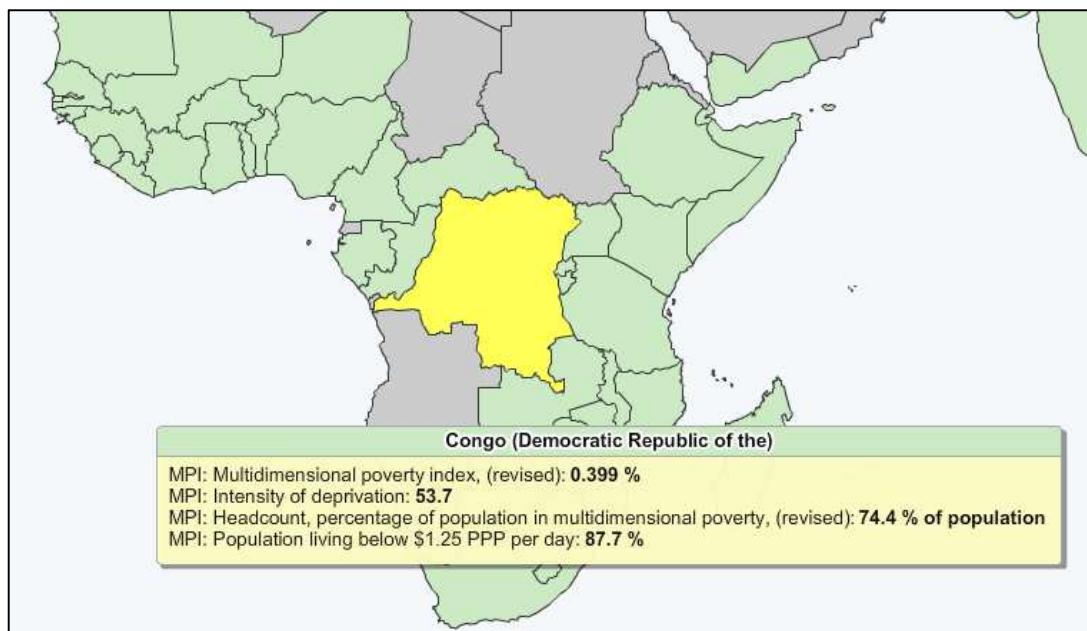
Figure 2   MPI in Rwanda in 2010
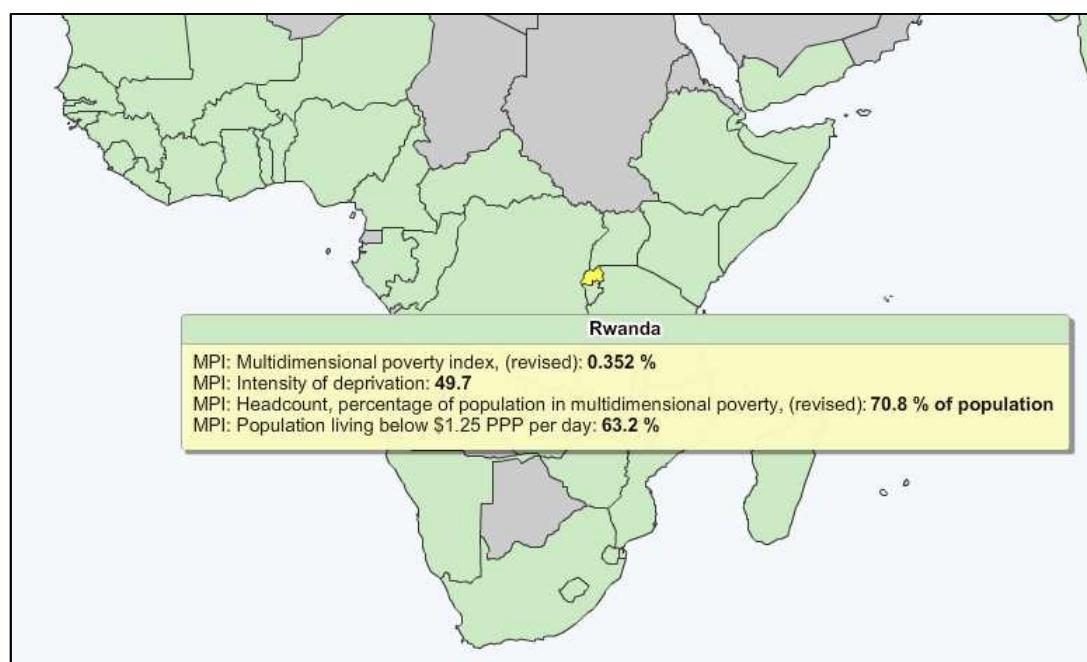
Figure 3   MPI in Burundi in 2010

Appendix 4   Correlation and Dependence

Table 1   Correlation between sub-indicators in economic pillar

Variable	A1	A2	A3	A4	A5
A1	1,000000	-0,838105	-0,662762	0,471306	0,999137
A2	-0,838105	1,000000	0,963958	-0,876126	-0,814728
A3	-0,662762	0,963958	1,000000	-0,972809	-0,631092
A4	0,471306	-0,876126	-0,972809	1,000000	0,434272
A5	0,999137	-0,814728	-0,631092	0,434272	1,000000

Table 2   Correlation between sub-indicators in social pillar

Variable	B1	B2	B3	B4	B5
B1	1,000000	0,767802	0,833331	-0,811746	-0,373232
B2	0,767802	1,000000	0,993989	-0,249092	0,307822
B3	0,833331	0,993989	1,000000	-0,353627	0,201804
B4	-0,811746	-0,249092	-0,353627	1,000000	0,844778
B5	-0,373232	0,307822	0,201804	0,844778	1,000000

Table 3   Correlation between sub-indicators in environmental pillar

Variable	C1	C2	C3	C4	C5
C1	1,000000	-0,920058	-0,999290	0,999227	0,979404
C2	-0,920058	1,000000	0,934166	-0,934750	-0,980213
C3	-0,999290	0,934166	1,000000	-0,999999	-0,986316
C4	0,999227	-0,934750	-0,999999	1,000000	0,986585
C5	0,979404	-0,980213	-0,986316	0,986585	1,000000

Table 3   Correlation between all sub-indicators

Variable	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
A1	1,000	-0,838	-0,663	0,471	0,999	-0,743	-0,999	-0,989	0,212	-0,344	0,443	-0,759	-0,477	0,478	0,615
A2	-0,838	1,000	0,964	-0,876	-0,815	0,988	0,858	0,909	-0,711	-0,224	-0,860	0,991	0,879	-0,880	-0,946
A3	-0,663	0,964	1,000	-0,973	-0,631	0,994	0,691	0,766	-0,872	-0,475	-0,965	0,991	0,974	-0,975	-0,998
A4	0,471	-0,876	-0,973	1,000	0,434	-0,941	-0,505	-0,596	0,962	0,666	0,999	-0,932	-1,000	1,000	0,985
A5	0,999	-0,815	-0,631	0,434	1,000	-0,714	-0,997	-0,982	0,171	-0,383	0,406	-0,731	-0,440	0,441	0,582
B1	-0,743	0,988	0,994	-0,941	-0,714	1,000	0,768	0,833	-0,812	-0,373	-0,929	1,000	0,943	-0,943	-0,985
B2	-0,999	0,858	0,691	-0,505	-0,997	0,768	1,000	0,994	-0,249	0,308	-0,477	0,783	0,510	-0,511	-0,645
B3	-0,989	0,909	0,766	-0,596	-0,982	0,833	0,994	1,000	-0,354	0,202	-0,570	0,847	0,601	-0,602	-0,725
B4	0,212	-0,711	-0,872	0,962	0,171	-0,812	-0,249	-0,354	1,000	0,845	0,970	-0,797	-0,960	0,960	0,901
B5	-0,344	-0,224	-0,475	0,666	-0,383	-0,373	0,308	0,202	0,845	1,000	0,689	-0,350	-0,662	0,660	0,529
C1	0,443	-0,860	-0,965	0,999	0,406	-0,929	-0,477	-0,570	0,970	0,689	1,000	-0,920	-0,999	0,999	0,979
C2	-0,759	0,991	0,991	-0,932	-0,731	1,000	0,783	0,847	-0,797	-0,350	-0,920	1,000	0,934	-0,935	-0,980
C3	-0,477	0,879	0,974	-1,000	-0,440	0,943	0,510	0,601	-0,960	-0,662	-0,999	0,934	1,000	-1,000	-0,986
C4	0,478	-0,880	-0,975	1,000	0,441	-0,943	-0,511	-0,602	0,960	0,660	0,999	-0,935	-1,000	1,000	0,987
C5	0,615	-0,946	-0,998	0,985	0,582	-0,985	-0,645	-0,725	0,901	0,529	0,979	-0,980	-0,986	0,987	1,000

Appendix 5   Economic indicators

Unemployment (% of total labour force) - MIN											
A$_1$	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	8,20	8,20	8,20	8,20	8,20	8,20	8,20	8,20	8,20	8,00	**8,1791**
Rwanda	0,60	0,60	0,60	0,60	0,60	0,60	0,60	0,60	0,60	0,60	**0,6000**
Burundi	7,30	7,30	7,20	7,20	7,20	7,10	7,10	7,10	7,00	6,90	**7,1394**

Source: The World Bank

Trade in service (% of GDP) - MAX											
A$_2$	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC		12,64	9,36	12,28	15,24	13,51	14,15	14,05	8,94	8,21	**12,0428**
Rwanda		15,73	18,64	17,14	20,14	17,04	15,66	16,99	13,07	15,10	**16,6118**
Burundi		15,12	18,59	15,70	21,23	13,02	12,23	13,78	12,31	13,46	**15,0484**

Source: The World Bank

Health expenditure (% of GDP) - MAX											
A$_3$	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	5,36	5,30	5,55	5,88	7,33	9,15	7,02	6,07	5,59		**6,3611**
Rwanda	5,82	6,09	10,01	10,02	10,13	9,95	10,80	10,96	10,66		**9,3819**
Burundi	9,72	10,08	11,63	10,03	7,86	6,96	8,84	8,96	8,13		**9,1338**

Source: The World Health Organization

Exports of goods and services (% of GDP) - MAX										
A_4	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	22,73	20,41	19,34	39,96	40,21	27,38	41,08	39,96	30,67	34,23	**31,5987**
Rwanda	11,12	11,46	11,07	11,14	14,37	10,18	10,17	13,86	12,87	14,41	**12,0658**
Burundi	6,95	8,20	7,28	7,26	9,49	6,80	8,92	9,35	8,95	7,40	**8,0606**

Source: The World Bank

Imports of goods and services (% of GDP) - MIN										
A_5	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	26,61	23,56	25,32	46,69	46,10	36,90	49,60	45,59	37,38	40,43	**37,8180**
Rwanda	24,76	25,21	25,29	24,94	28,82	28,17	29,13	29,62	31,27	30,98	**27,8197**
Burundi	24,62	33,44	46,87	34,22	37,93	43,12	39,18	37,67	37,47	34,25	**36,8770**

Source: The World Bank

Appendix 6   Social indicators

Population density (people per sq. km of land area) - MIN											
B₁	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean**
DRC	23,15	23,83	24,52	25,23	25,95	26,68	27,43	28,20	28,98	29,78	**26,3753**
Rwanda	375,13	382,22	391,61	402,44	414,39	426,82	439,27	451,74	464,44	477,36	**422,5412**
Burundi	292,48	302,59	313,18	324,31	355,84	347,61	359,53	371,51	383,55	395,74	**344,6333**

Source: The World Bank

Prevalence of HIV (% of population ages 15-49) - MIN											
B₂	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean**
DRC	1,40	1,40	1,40	1,30	1,30	1,20	1,20	1,20	1,10	1,10	**1,2600**
Rwanda	3,50	3,30	3,20	3,20	3,20	3,10	3,10	3,00	2,90	2,90	**3,1400**
Burundi	2,30	2,10	2,00	1,80	1,60	1,50	1,30	1,20	1,10	1,00	**1,5900**

Source: Millennium Development Goals

Refugee population (% of total population) - MIN										
B_3	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	0,003798	0,003782	0,003748	0,003102	0,002638	0,003072	0,002675	0,002389	0,000991	0,001679	**0,0028**
Rwanda	0,005427	0,004794	0,005092	0,005396	0,005386	0,005130	0,005112	0,004964	0,005081	0,006228	**0,0053**
Burundi	0,006498	0,002662	0,001638	0,002940	0,002446	0,002797	0,003181	0,003738	0,004245	0,004476	**0,0035**

Source: The World Bank; the UN Refugee Agency

Urban population (% of total population) - MIN										
B_4	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	37,00	37,48	37,96	38,45	38,94	39,44	39,94	40,44	40,95	41,46	**39,2055**
Rwanda	18,43	19,28	20,17	21,09	22,03	22,99	23,95	24,92	25,89	26,87	**22,5619**
Burundi	9,14	9,38	9,62	9,86	10,12	10,38	10,64	10,91	11,19	11,47	**10,2703**

Source: the UN Population Division, the World Bank

Contraceptive prevalence (% of women ages 15-49) - MAX										
B_5	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	20,10	20,20	20,20	20,20	20,20	20,10	20,00	20,70	21,50	22,20	**29,4600**
Rwanda	18,90	20,20	26,50	33,90	38,80	43,90	49,20	50,00	50,80	51,60	**28,9500**
Burundi	15,00	14,30	15,70	17,10	18,60	20,20	21,90	23,00	24,10	25,30	**19,5200**

Source: the UN Population Division

Appendix 7   Environmental indicators

C_1	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
**CO_2 emissions (million metric tons) - MIN**										
DRC	2,37	2,46	2,46	2,76	2,73	2,63	3,17	2,83	2,48		**2,6546**
Rwanda	0,76	0,81	0,83	0,74	0,72	0,76	0,76	0,80	0,77		**0,7747**
Burundi	0,38	0,37	0,36	0,33	0,36	0,20	0,20	0,19	0,32		**0,3011**

C_2	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
**Arable land (% of land area) - MAX**										
DRC	2,96	2,96	2,96	2,96	2,98	3,00	3,00	3,00	3,09		**2,9867**
Rwanda	45,36	45,24	45,72	44,59	48,68	49,05	49,45	49,45	47,90		**47,2719**
Burundi	38,36	37,23	36,99	36,21	36,60	37,77	35,83	35,83	42,83		**37,5173**

C_3	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
**Improved water source (% of population with access) - MAX**										
DRC	44,70	44,90	45,10	45,30	45,60	45,80	46,00	46,20	46,50		**45,5667**
Rwanda	68,10	68,50	68,80	69,10	69,40	69,80	70,10	70,40	70,70		**69,4333**
Burundi	73,00	73,30	73,50	73,80	74,10	74,40	74,70	75,00	75,30		**74,1222**

Forest area (% of land area) - MAX										
C_4	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	68,81	68,68	68,54	68,40	68,26	68,13	67,99	67,85	67,71		68,2640
Rwanda	15,27	15,61	16,01	16,42	16,82	17,23	17,63	18,04	18,44		16,8302
Burundi	7,18	7,05	6,98	6,91	6,84	6,77	6,70	6,63	6,56		6,8448

Source: Food and Agriculture Organization of the United Nations

Consumption of ozone-depleting substances (tons) MIN										
C_5	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
DRC	364,3	312,6	228,2	90,5	50,5	59,82	76,6	56,93	47,85	35,94	69,8765
Rwanda	4,9	8,5	8,9	8,9	7,3	7,3	7,4	6,99	6,99	7,11	8,2705
Burundi	27,4	15,3	15,1	7,4	4,8	3,8	4,4	5,48	3,66	3,78	9,1120

Source: United Nations Environment Programme

Appendix 8   Development of economic sub-indicators

Chart 1   Unemployment in the period 2004-2013
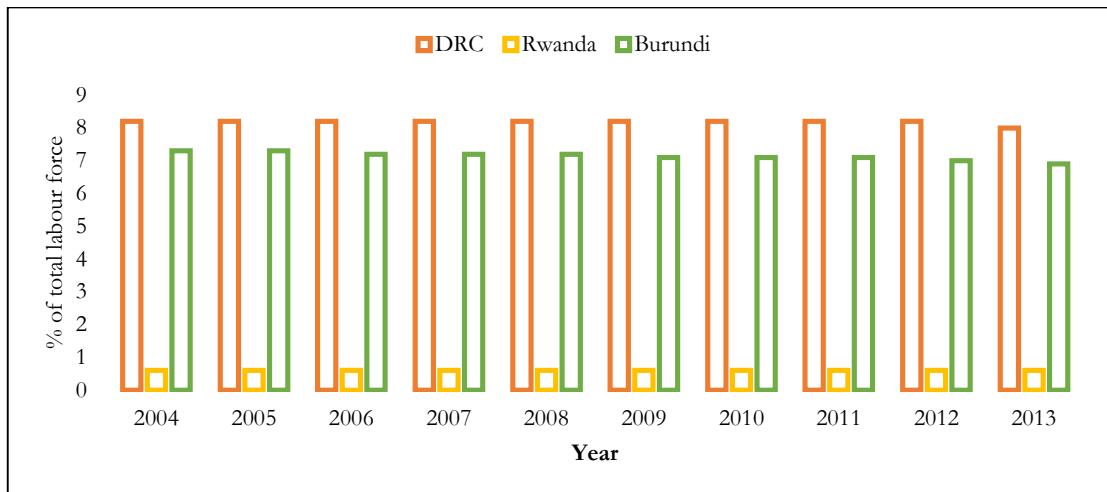
Chart 2   Trade in service in the period 2005-2013
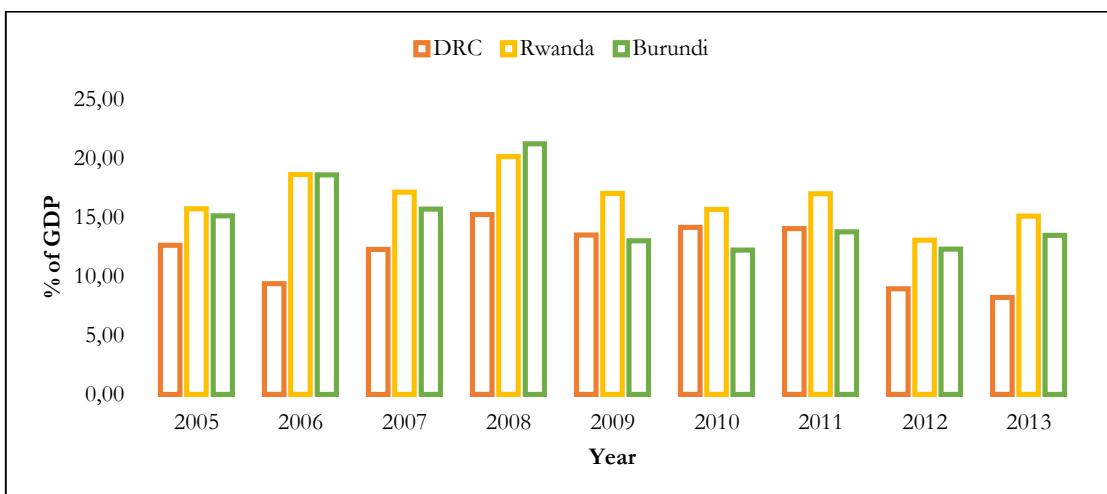
Chart 3   Health expenditure in the period 2004-2012
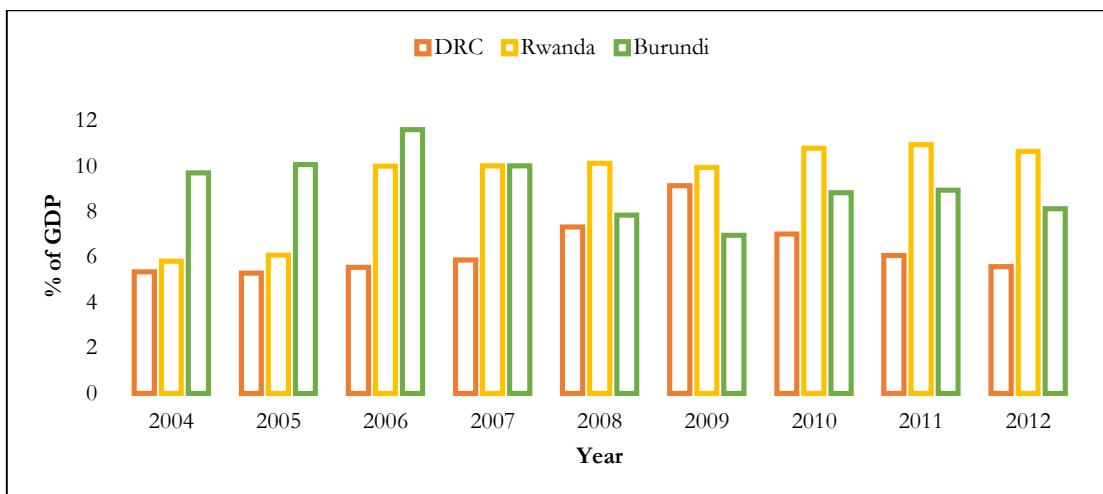
*Chart 4*   Export of goods and services in the period 2004-2013
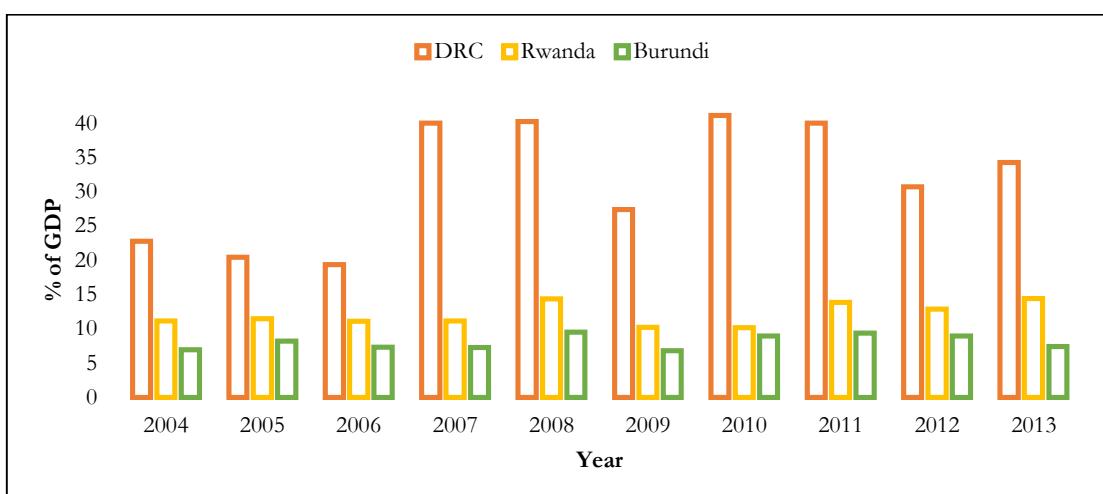
Chart 5   Import of goods and services in the period 2004-2013
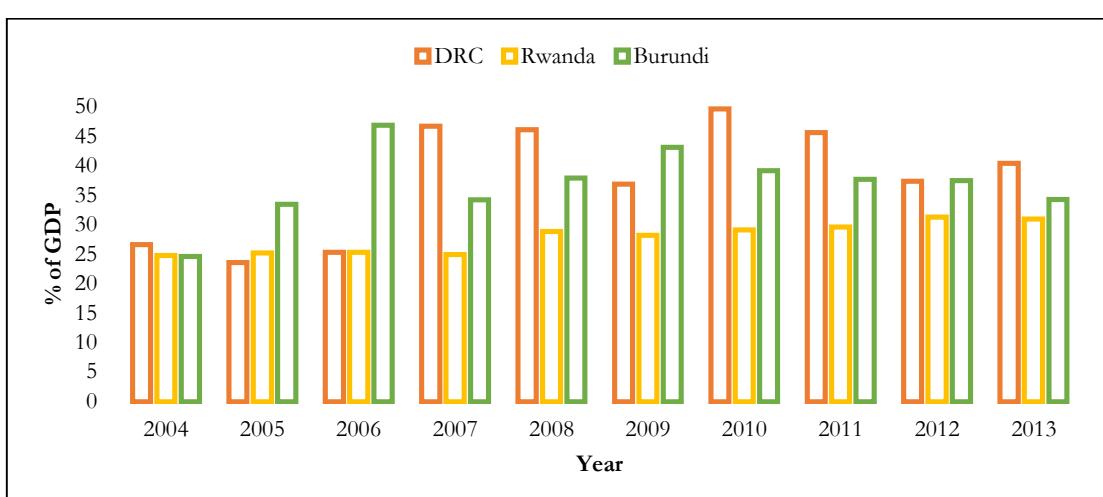
Appendix 9   Development of social sub-indicators

Chart 1   Population density in the period 2004-2013
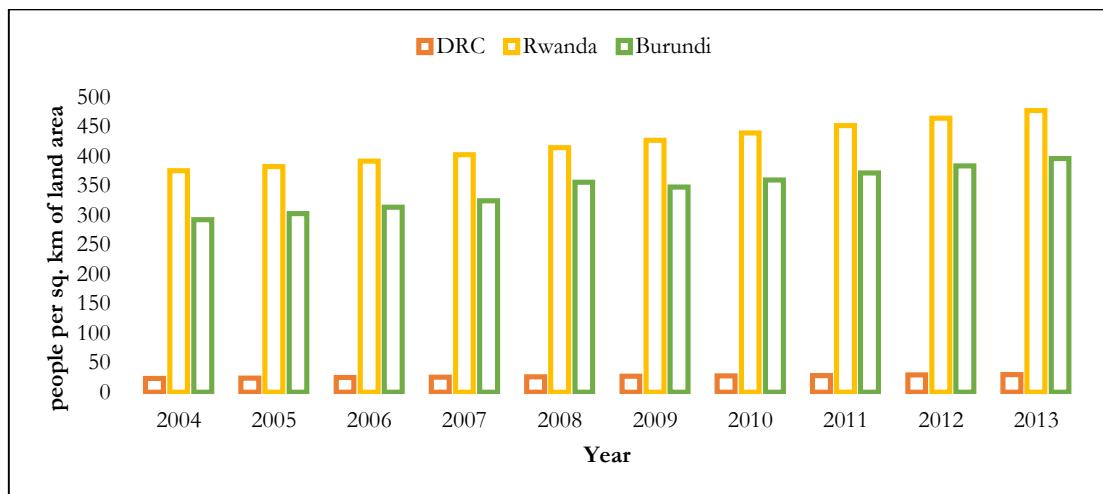
Chart 2   Prevalence of HIV in the period 2004-2013
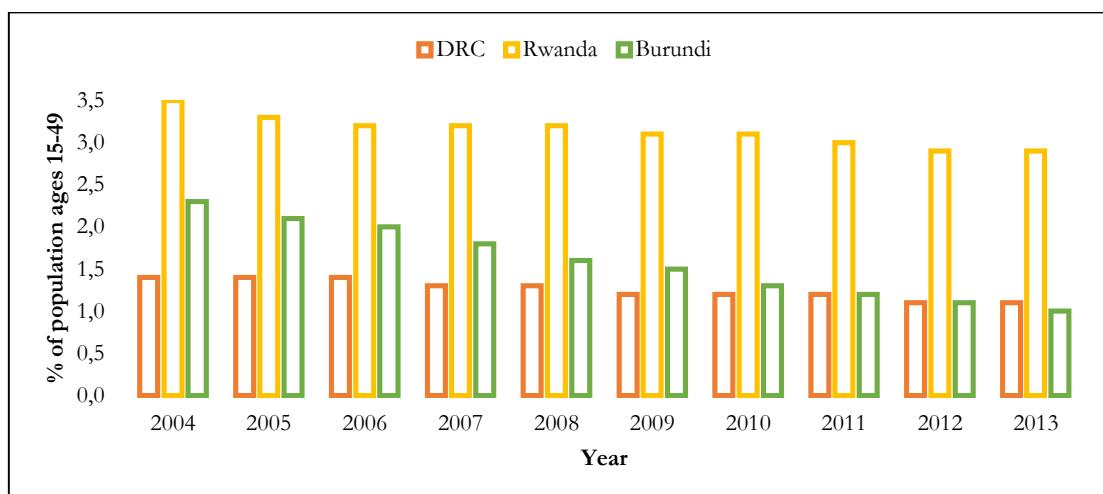
*Chart 3*   Refugee population in the period 2004-2013
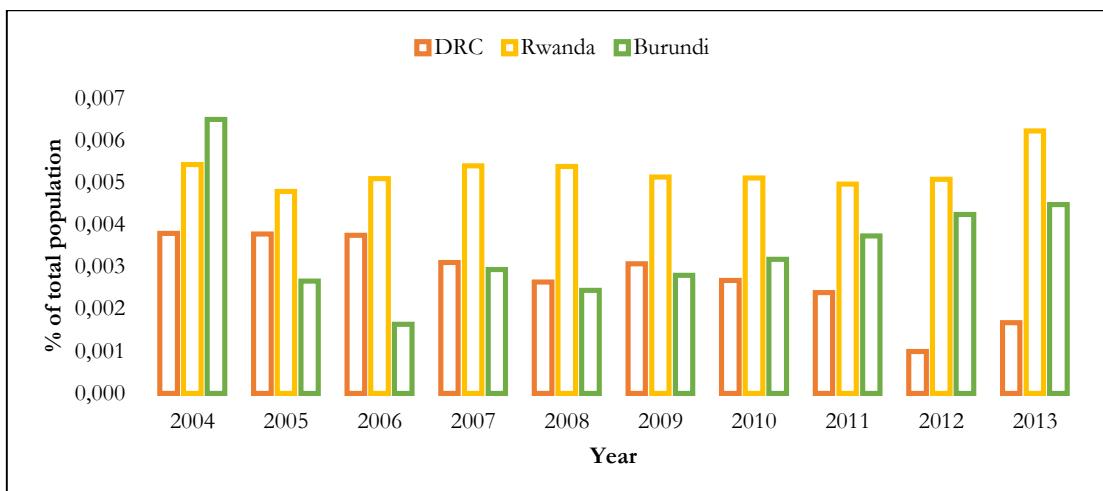
*Chart 4*   Urban population in period 2004-2013
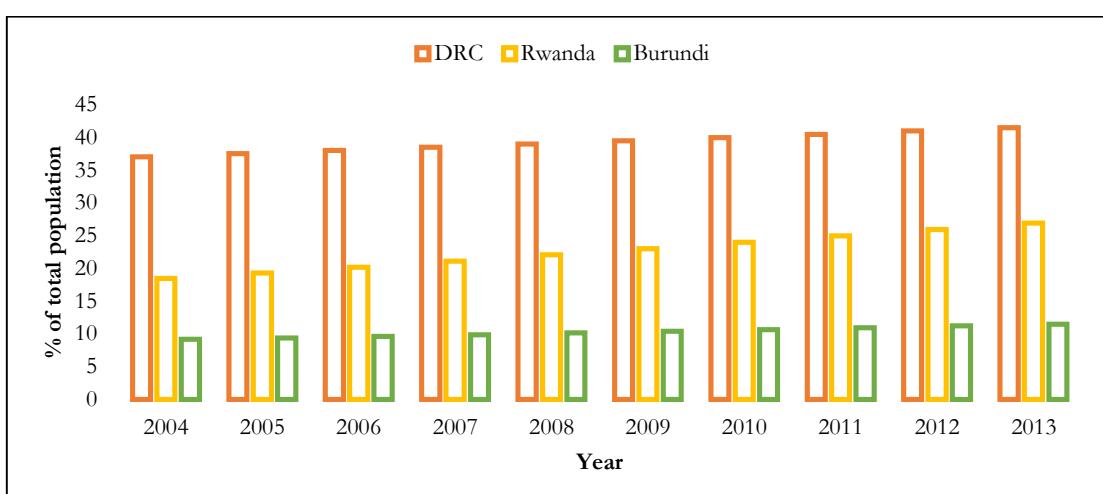
Chart 5   Contraceptive prevalence in the period 2004-2013
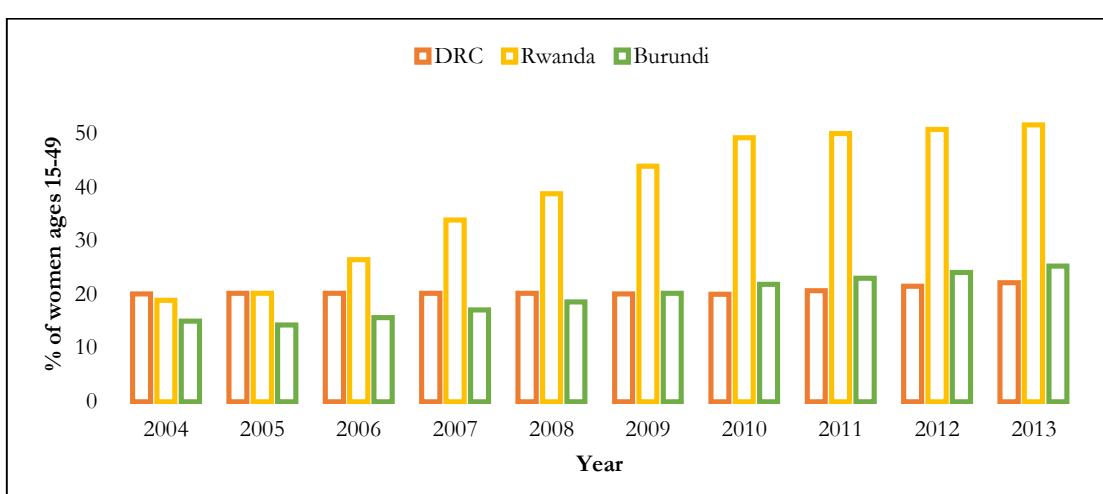
Appendix 10   Development of environmental sub-indicators

Chart 1 CO_2 emissions in the period 2004-2012
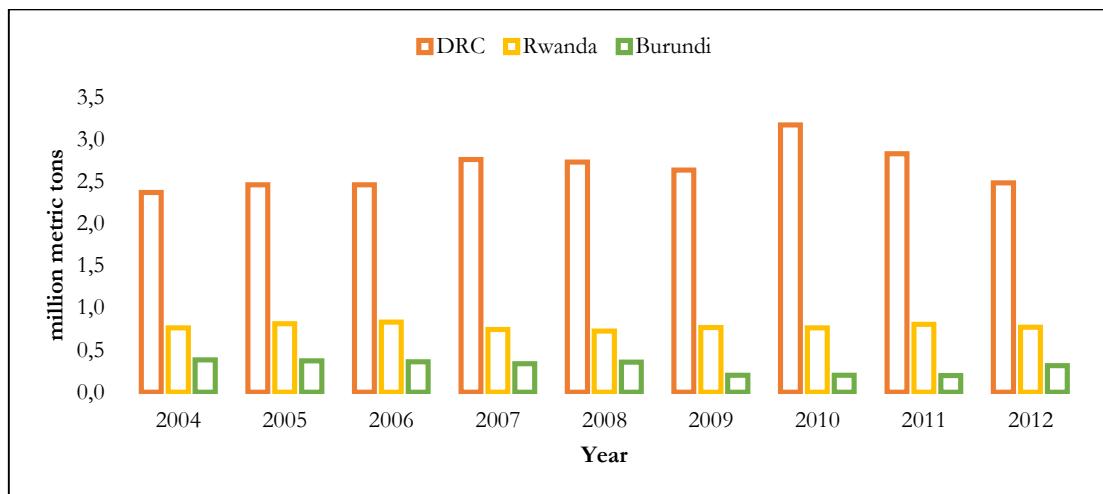

Chart 2   Arable land in the period 2004-2012
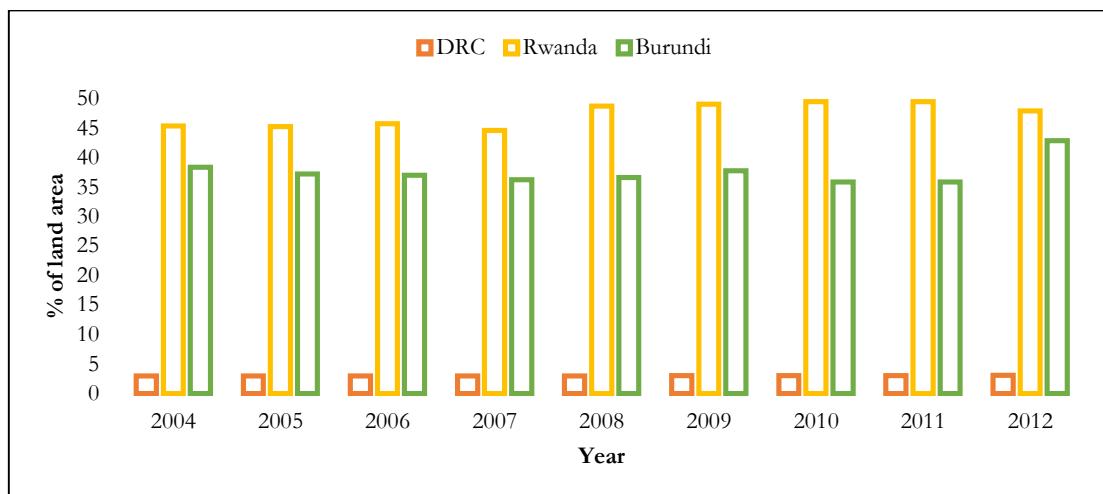
Chart 3   Improved water source in the period 2004-2012
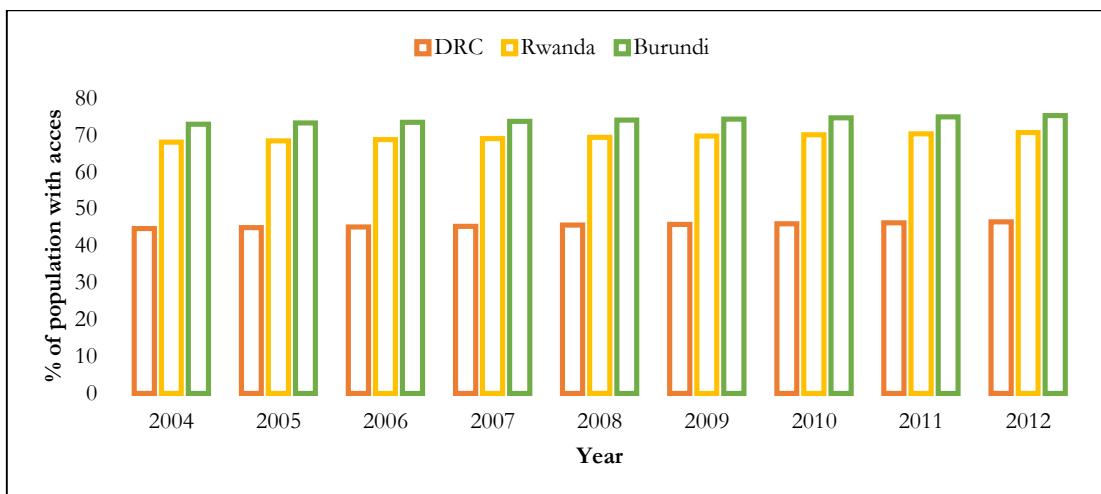

*Chart 4*   Forest area in the period 2004-2012
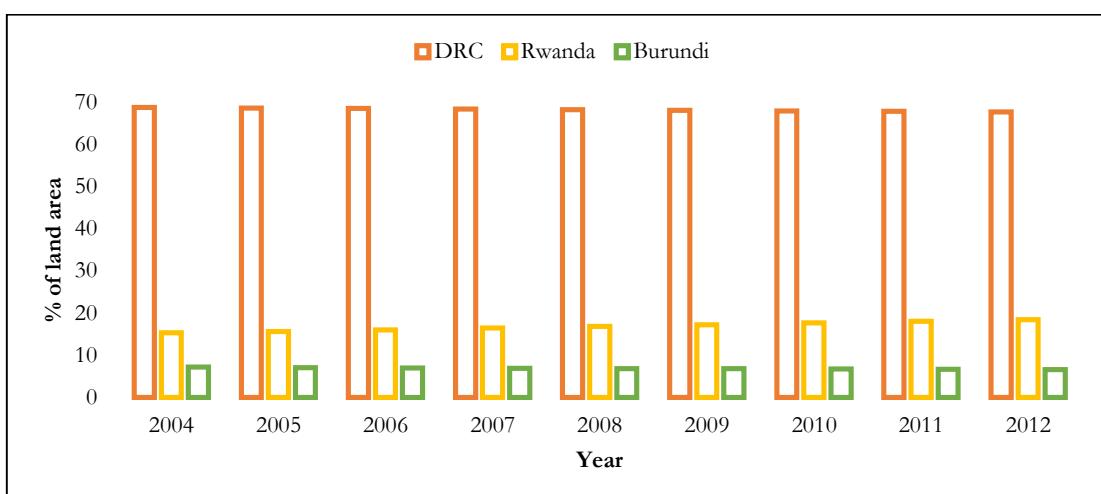
Chart 5   Consumption of ozone-depleting substances in the period 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
DRC	364,3	312,6	228,2	90,5	50,5	59,82	76,6	56,93	47,85	35,94
Rwanda	4,9	8,5	8,9	8,9	7,3	7,3	7,4	6,99	6,99	7,11
Burundi	27,4	15,3	15,1	7,4	4,8	3,8	4,4	5,48	3,66	3,78