

Identifying Strategic Development Objectives for African Countries Using Dominance-Based Rough Set Approach: The Poverty String Theory

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Abstract

The objective of this article is to expose the results of a research using Dominance-based Rough Set Approach (DRSA) to help African countries and international organizations (both non-governmental organizations and governmental organizations), to identify economical, sociological, political and technological strategic objectives for international development. We hope that the results of this research will aid politicians and leaders to prioritize African countries strategic development objectives according to political, economical, sociological and technological (PEST) needs. In this study we use 23 various indicators to classify all the African countries according to the following three different categories: [A] African countries that are doing well according to the selected indicators; [B] African countries that need support to acquire category A status; [C] African countries ranked the lowest and needing special support with regard to the criterion or criteria considered. The three categories are delimited by tertiles obtained from the average ranking of countries. The chosen criteria are measured in order to provide decision rules based on this classification. These decision rules thus focus on the political, economic, sociological and technological needs of countries with respect to improve their development and classification. We strongly believe that by targeting these identified needs, this research will help the development of African countries, target and prioritize International funding, evaluate economic growth and sociological improvements. Our results, from both the correlation matrix and DRSA, clearly demonstrate that top priority should be given to analphabetism, school life and reducing the amount of adolescents pregnancies in order to improve both economically and sociolog-

ically. Also, our analysis of the African map belonging to the overall classification results, puts the light over the fact that most countries in category C are, geographically connected to one another, what we named the “Poverty String”. This is the first research of a series of three articles using DRSA in identifying strategic objectives for international development. The second research will discuss the use of DRSA to identify strategic objectives for Bosnia Herzegovina as a potential candidate to the European Union. The third research will use DRSA to help define poverty for all the United Nations countries and propose decision rules for international development.

Keywords

International Development, African Countries, International Aid, Economic Growth, Strategic Objectives, Rough Set Theory, Dominance-Based Rough Set Approach (DRSA), Selection of Portfolio Projects, Multi-Criteria Analysis, Sustainable Development

1. Introduction

This is the first research of a series of three articles using a systematic approach using a combination of statistics and DRSA to help specific territories identifying strategic objectives to improve their development. The first article helps to determine strategic objectives for African countries for international development. The second uses the same methodology to determine strategic objectives for potential candidate countries for the European Union, more precisely with the case of the country of Bosnia-Herzegovina. The third will help identify poverty for all United Nations countries and strategic objectives for sustainable development.

The systematic approach was first presented for a large scale project in the Northern Region of the Province of Quebec (Canada). What we are proposing is a selection of statistical data taken from different census, the World Bank and various indexes. We categorize these variables using different perspectives (Political, Economical, Sociological and Technological) and rank all selected territories (Region, Province or Country) according to these perspectives. When information is missing, we compare states by weighting the average. The last step is to use DRSA to help determine decision rules and conditions for each specific territory. These conditions become strategic objectives in order to improve the territory’s development compared to others.

2. Literature Review

There are several decision tools to help decision makers and leaders defining strategy and courses of action. Rough set theory, developed by Pawlak [1] [2] and by Pawlak and Slowinski [3], is a mathematical tool that is used to support

decision-making processes in fields such as medicine, banking, engineering, learning, location selection, pharmacology, finance, market analysis and economics [4]-[11]. It was modified by Greco, Matarazo and Slowinski [12] and renamed the “Dominance-based Rough Set Approach” (DRSA) and later Zaras developed it for mixed data (deterministic, probabilistic and fuzzy) [13]. This research uses DRSA for the purpose of developing sound strategic objectives for all African countries in order to help decision makers, leader, non-governmental organizations, help funds and other international organization or interest groups targeting specific objectives to improve the economic, political, sociological and technological situation in Africa. A total of 114 economic, sociologic, politic and technologic indicators for all 54 African countries were researched. Out of these 114 indicators, a group of DM has selected 23 indicators which were considered most relevant in order to categorize the countries in four different perspectives (PEST).

In this paper, a statistical analysis is presented in Section 2. In this analysis we identify the significant correlations between considered indicators classified per perspectives (PEST). After, in Section 3, we apply DRSA to classify all the African countries with regard to the perspectives (PEST) and present decision rules for each category (countries classified as: A, B and C). Section 4 will propose a strategy map for each individual country, proposing strategic objectives and performance measures to improve and monitor the sustainable development of all African countries.

2.1. Political, Economic, Sociological and Technological Indicators

The data of the 23 variables considered in this research were obtained from the World Bank, the United Nations and the International Institute for Strategic Studies [14] [15] [16] during January and March 2018 period. They were divided into four perspectives: political, economic, sociological and technological (PEST) as summarized in **Table 1**. Several of these indicators were selected and converted per capita to avoid biases due to the size of the population. It is important to understand that some indexes are scales where a lower score is better and others are more appropriate when the specific subject has a higher score. **Table 1** demonstrates each variable divided into perspectives, their definitions and arrows showing if a higher score or lower score is more appropriate.

2.2. Portrait of Africa

2.2.1. Statistics

Using the various databases presented earlier, we were able to calculate each indicator for the 54 African countries. It is important to mention that we also added 4 indicators for our statistical portrait: % of type of religion per country (Christianity, Islam, Buddhism, Hinduism, Irreligion, Folk religions and Judaism), oil rents (% of GDP) and finally percentages of analphabetism male and female. Those variables were not included in the overall classification.

Table 1. Summary of the PEST indicators considered in this research.

Perspectives and Measurement	Definition	Indicator	↑ = High is better ↓ = Low is better
Political			
1.1 Deaths from internal conflict	Number of battle deaths from internal conflict between at least one government armed forces (2017).	Scale 1-5	↓
1.2 Military expenditure	Cash outlays of central or federal government to meet the costs of national armed forces (2017).	Scale 1-5	↓
1.3 Corruption perception index	A ranking of countries according to the extent to which corruption is believed to exist (2017).	Scale 0-100	↑
1.4 Global competitiveness index	Competitiveness along various pillars (2017).	Scale 1-7	↑
1.5 Ease of doing business index	Ease of doing business index (2017).	Ranking of world country	↓
1.6 Women in government	Proportion of seats held by women in national parliaments (2017).	%	↑
Economic			
2.1 GNP per capita	Gross National Product (US Constant 2016) divided per capita.	\$	↑
2.2 GNI per capita	Gross National Income per capita Atlas method (Current US 2017).	\$	↑
2.3 Broad money	Broad money (% of GNP 2017).	%	↑
2.4 Unemployment	Unemployment, total (% of labor force 2017).	%	↓
2.5 Exports of G & S	Exports of goods and services (% of GNP 2017).	%	↑
Sociological			
3.1 Life expectancy, female	Life expectancy at birth, female (years 2017).	Number of years	↑
3.2 Life expectancy, male	Life expectancy at birth, male (years 2017).	Number of years	↑
3.3 Analfabetism	Percentage of analfabetism (2015).	%	↓
3.4 School life	School life expectancy (2017).	Number of years	↑
3.5 Urban population	Percentage of urban population (2017).	%	↑
3.6 Adolescent fertility	Number of births per 1000 women ages 15 - 19 (2017).	Number	↓
3.7 Homicides	Intentional homicide refers to death deliberately inflicted on a person by another person (2017).	Scale 1-5	↓
Technological			
4.1 Academic papers	Number of scientific published papers per 1M population (2017).	Number	↑

Continued

4.2 Internet	Fixed broadband internet subscriptions per 100 people (2017).	Number	↑
4.3 Fixed telephones	Fixed telephone subscription per 100 people (2017).	Number	↑
4.4 Secure internet	Secure internet servers per million people (2017).	Number	↑
4.5 Mobile phones	Mobile cellular subscription per 100 people (2017).	Number	↑

Correlation is defined as a measure of the linear relationship between variables [17]. Researching the possibility of relationship between variables will help determine the relationships between the various perspectives (PEST). Since we do only want to check for relationship, and not to invest in understanding the behavior of a variable, we limited our research to correlation, instead of regression analysis.

All correlations presented in this research are significant at the 0.01 level (2-tailed). The correlation matrix is presented in **Appendix B**.

2.2.2. Relationship between the Various Indicators

Testing for significant relationship between two indicators according to:

Null Hypothesis 0: There is no relation between the two indicators.

Alternative Hypothesis 1: There is relation between the two indicators.

Then, after reviewing the data, we reject or not the null hypothesis 0.

2.2.3. Relationship between the Political Indicators and Other Variables

Table 2 is a summary of all the correlations for the Political indicators. Using the correlation matrix, it is plausible that:

1) Military expenditures is positively correlated with the number of fixed telephones;

2) The corruption perception index is positively correlated to the global competitiveness index, GNI per capita, school life (in years), internet subscriptions, secure internet and mobile phones subscriptions. It is negatively correlated to the ease of doing business index;

3) The global competitiveness index is negatively correlated to the ease of doing business index, to all illiteracy variables and adolescent fertility. It is positively correlated to the corruption index, GNP per capita, GNI per capita, broad money, life expectancy for both women and men and all technological indicators except fixed phones;

4) The ease of doing business is negatively correlated to the corruption perception index, global competitiveness, GNI per capita, life expectancy for both females and males, school life in years and all technological indicators. It is positively correlated to illiteracy;

5) The number of women with seats in government has no correlation.

Table 2. Political perspective correlations.

Political Perspective	Other Political	Economical	Sociological	Technological
Internal Conflict				
Military expenditures				+Fixed Telephones
Corruption perception index	+Global competitiveness index -Ease of doing business index	+GNI per capita	+School life in years	+Internet +Secure internet +Mobile phones
Global competitiveness index	-Ease of doing business +Corruption index	+GNP per capita +GNI per capita +Broad money	+Life expectancy female +Life expectancy male -All analphabetism variables -Adolescent fertility	+Academic papers +Internet +Secure internet +Mobile phones
Ease of doing business index	-Corruption index -Global competitiveness index	-GNI per capita	-Life expectancy for both female and male -School life in years +Analphabetism female	-All indicators
Women in government				

2.2.4. Relationship between the Economical Perspective and Other Variables

Table 3 is a summary of all the correlations for the Economical perspective. Using the correlation matrix, it is plausible that:

1) GNP per capita is positively correlated to the GNI per capita, export of goods and services, global competitiveness index, life expectancy for both women and men, school life expectancy, urban population, internet subscriptions, fixed telephones, secure internet and mobile phone subscriptions. GNP per capita is negatively correlated to all the analphabetism variables (women, men and total);

2) GNI per capita is positively correlated to the GNP per capita, broad money, export of goods and services, life expectancy for both women and men, school life expectancy, urban population and all the technological variables. GNI per capita is negatively correlated to ease of doing business, all analphabetism variables and adolescents fertility;

3) Broad money is positively correlated to the global competitiveness index, GNI per capita, life expectancy for both women and men, urban population, academic papers per capita, internet subscriptions and fixed telephones. Broad money is negatively correlated to adolescent fertility;

4) Unemployment is positively correlated to homicides, mobile phones subscriptions and negatively correlated to analphabetism for women;

5) Exports of goods and services are positively correlated to GNP, GNI, school life expectancy, urban population and mobile phones subscriptions.

Table 3. Economical perspective correlations.

Economical Perspective	Political	Other Economical	Sociological	Technological
GNP per capita	+Global competitiveness index	+GNI per capita	+Life expectancy for both women and men	+Internet
		+Export of goods and services	-All analphabetism variables +School life expectancy +Urban population	+Fixed telephones +Secure internet +Mobile phones
GNI per capita	+Corruption perception index	+GNP per capita	+Life expectancy for both women and men	+All indicators
	+Global competitiveness index	+Broad money	-All Analphabetism variables	
	-Ease of doing business index	+Export of goods and services	+School life in years +Urban population -Adolescent fertility	
Broad Money	+Global competitiveness index	+GNI per capita	+Life expectancy for both women and men	+Academic papers
			+Urban population -Adolescent fertility	+Internet +Fixed telephones
Unemployment			-Analphabetism women +Homicides	+Mobile phones
Exports of goods and services		+GNP per capita	+School life in years	+Mobile phones
		+GNI per capita	+Urban population	

2.2.5. Relationship between the Sociological Perspective and Other Variables

Table 4 is a summary of all the correlations for the Sociological perspective. Using the correlation matrix, it is plausible that:

1) Life expectancy for women is positively correlated with the global competitiveness index, GNP and GNI per capita, broad money, life expectancy for men, school life in years, urban population, and all technological variables. Life expectancy for women is negatively correlated to ease of doing business index, analphabetism variables and adolescent fertility;

2) Life expectancy for men is positively correlated with the global competitiveness index, GNP and GNI per capita, broad money, life expectancy for women, school life in years, urban population, academic papers per capita, internet subscriptions, fixed telephones and mobile phones. Life expectancy for men is negatively correlated to ease of doing business index, analphabetism for males and total, adolescent fertility and homicides;

3) Analphabetism (total) is positively correlated with adolescent fertility. It is negatively correlated to the global competitiveness index, GNP and GNI per capita, life expectancy for women and men, school life, internet subscriptions and fixed telephones;

4) School life is positively correlated with the corruption perception index,

Table 4. Sociological perspective correlations.

Sociological Perspective	Political	Economical	Other Sociological	Technological
Life expectancy women	+Global competitiveness index	+GNP +GNI	+Life expectancy men +School life +Urban population	+All technological variables
	-Ease of doing business	+Broad money	-All illiteracy variables -Adolescent fertility	
Life expectancy men	+Global competitiveness index	+GNP +GNI	+Life expectancy women -Analphabeticism for men and total +School life +Urban population	+Academic papers +Internet +Fixed telephones +Mobile phones
	-Ease of doing business	+Broad money	-Adolescent fertility -Homicides	
Analphabeticism total	-Global competitiveness index	-GNP -GNI	+Adolescent fertility -Life expectancy for women and men -School life	-Internet -Fixed telephones
School life	+Corruption perception index	+GNP +GNI	+Life expectancy for women and men -All illiteracy variables -Adolescent fertility	+All technological variables
Urban population		+GNP +GNI +Broad money +Export of G&S	+Life expectancy for women and men -Analphabeticism for men	+Academic papers +Mobile phones
Adolescent fertility	-Global competitiveness index	-GNI -Broad money	+All illiteracy variables -School life -Life expectancy for women and men	-Academic papers -Internet -Fixed telephones
Homicides		+Unemployment	-Life expectancy men	

GNP and GNI per capita, exports of goods and services, life expectancy for women and men and all technological variables. School life is negatively correlated to ease of doing business index, all the variables related to illiteracy and adolescent fertility;

5) Urban population is positively correlated with the GNP and GNI per capita, broad money, exports of goods and services, life expectancy for women and men, academic papers per capita and mobile phones. Urban population is negatively correlated to illiteracy for men;

6) Adolescent fertility is positively correlated with the illiteracy variables. It is negatively correlated to the global competitiveness index, GNI per capita, broad money, school life in years, life expectancy for women and men, academic papers per capita, internet subscriptions and fixed telephones;

7) Homicides index is positively correlated with unemployment and negatively correlated to life expectancy for men.

2.2.6. Dependency between Technological Perspective and Other Variables

Table 5 is a summary of all the correlations for the Technological perspective. Using the correlation matrix, it is plausible that:

1) Academic papers per capita is positively correlated to global competitiveness index, GNI, broad money, life expectancy for women and men, school life, urban population, internet, fixed telephones and mobile phones. Academic papers per capita is negatively correlated to the ease of doing business and adolescent fertility;

2) Internet subscriptions is positively correlated to the corruption perception index, global competitiveness index, GNP and GNI per capita, broad money, life expectancy for women and men, school life and all other technological variables. Internet subscriptions is negatively correlated to the ease of doing business, analphabetism variables and adolescents fertility;

3) Fixed telephones is positively correlated to military expenditures, global competitiveness index, GNP and GNI per capita, broad money, life expectancy for women and men, school life and all the technological variables. Fixed telephones is negatively correlated to the ease of doing business, analphabetism variables and adolescent fertility;

4) Secure internet is positively correlated to the corruption perception index,

Table 5. Technological perspective correlations.

Technological Perspective	Political	Economical	Sociological	Other Technological
Academic papers per capita	+Global competitiveness index -Ease of doing business	+GNI +Broad money	+Life expectancy for women and men +School life +Urban population -Adolescent fertility	+Internet +Fixed telephones +Mobile phones
Internet subscriptions	+Corruption perception index +Global competitiveness index -Ease of doing business	+GNP +GNI +Broad money	+Life expectancy for women and men -All analphabetism variables +School life -Adolescents fertility	+All technological variables
Fixed telephone	+Military expenditure +Global competitiveness index -Ease of doing business	+GNP +GNI +Broad money	+Life expectancy for women and men -All analphabetism variables +School life -Adolescents fertility	+All technological variables
Secure internet	+Corruption perception index -Ease of doing business	+GNP +GNI	+Life expectancy for women -Analphabetism for women +School life	+Internet +Fixed telephones +Mobile phones
Mobile phones	+Corruption perception index +Global competitiveness index -Ease of doing business	+GNP +GNI +Unemployment +Exports of G & S	+Life expectancy for women and men -Analphabetism for women +School life +Urban population	+All technological variables

GNP and GNI per capita, life expectancy for women, school life, internet subscriptions, fixed telephones and mobile phones subscriptions. Secure internet is negatively correlated to the ease of doing business, analphabetism for women;

5) Mobile phones subscriptions is positively correlated to the corruption perception index, global competitiveness index, GNP and GNI per capita, unemployment, exports of G & S, life expectancy for women and men, school life, urban population and all other technological variables. Mobile phones subscriptions is negatively correlated to the ease of doing business and analphabetism for women.

3. The Dominance-Based Rough Set Approach (DRSA) Applied to Estimate the Strategic Developmental Goals of African Countries

3.1. Description

The following section presents the application of the Dominance-based Rough Set Approach (DRSA) in order to determine the strategic objectives of each African country and improve their overall classification. Our methodology consists of the following steps: First, all the African countries are classified per perspectives in category A, B or C: Category [A] African countries that are doing well according to the selected indicators; [B] African countries that need support to acquire category A status; [C] African countries ranked the lowest and needing special support with regard to the criterion or criteria considered. **Table 6** demonstrates the evaluation of the 54 African countries with respect to the four conditional criteria as determined on the basis of each perspectives (PEST) and with respect to the decisional criterion. Second, decision rules are determined for all the variables on a first time, and on a second time individually on each perspective (PEST). Third, each African country could determine and prioritize its strategic objectives with regard to their respective variables and values.

3.2. Formulation of the Multi-Criteria Problems

The first issue was the ranking of the 54 countries on the basis of the 23 criteria measured by 23 indicators. Next, the same was done for each perspective on the basis respective criteria. It can be represented using the AXE model, where:

A is a finite set of countries a_i for $i = 1, 2, \dots, 54$.

X is a finite set of criteria X_k for $k = 1, 2, \dots, 23$ or X_{kj} for $k_j = 1, 2, \dots, n_j$ for each perspective j .

E is the set of evaluations measured by indicators e_{ik} with respect to criterion X_k or indicators e_{ikj} with respect to criterion X_{kj} for each perspective j .

The ranking of countries was obtain using the weighted average rank method, in which the countries are ranked from the most to the least preferable in terms of each indicator in relation to each criterion. Next, we calculate for each country the weighted average rank in order to obtain the ranking of the countries with respect to a given perspective and overall. (In this study the weights of indicators are assumed equal.)

Table 6. Overall classification of the 54 African countries according to the four perspectives.

Decision	Countries	Political	Economic	Sociological	Technological
A	Seychelles	A	A	A	A
A	Mauritius	A	A	A	A
A	Tunisia	A	A	A	A
A	Cabo Verde	A	A	A	A
A	South Africa	A	A	A	A
A	Morocco	A	A	A	A
A	Botswana	A	A	A	A
A	Algeria	B	A	A	A
A	Namibia	A	A	B	A
A	Egypt	B	A	A	A
A	Ghana	A	A	A	A
A	Gabon	B	A	A	A
A	Senegal	A	B	B	A
A	Sao Tome and Principe	B	B	A	B
A	Libya	C	B	A	A
A	Djibouti	B	A	A	B
A	Rwanda	A	C	A	B
A	Swaziland	B	A	C	A
B	Kenya	A	B	A	B
B	Equatorial Guinea	A	A	B	B
B	Benin	B	A	B	B
B	Zambia	A	B	B	B
B	Cameroon	B	B	A	B
B	Zimbabwe	C	B	B	A
B	Togo	B	B	B	B
B	Côte d'Ivoire	B	B	C	A
B	Republic of the Congo	C	A	B	B
B	Tanzania	A	B	B	C
B	Lesotho	A	B	C	B
B	Mauritania	C	B	B	B
B	Gambia, the	C	C	B	A
B	Angola	C	A	C	B
B	Ethiopia	A	C	B	B
B	Comoros	C	C	B	B
B	Madagascar	B	B	A	C

Continued

B	Burkina Faso	B	B	C	C
C	Liberia	B	C	B	C
C	Uganda	B	C	C	B
C	Nigeria	C	B	C	B
C	Eritrea	C	B	B	C
C	Mozambique	B	C	C	C
C	Malawi	B	C	B	C
C	Sudan	C	C	B	C
C	Sierra Leone	B	C	C	C
C	Guinea-Bissau	C	B	C	C
C	Mali	C	C	C	B
C	Guinea	B	C	C	C
C	Somalia	C	B	C	C
C	Niger	A	C	C	C
C	Burundi	C	C	B	C
C	Central African Republic	C	C	C	C
C	Chad	C	C	C	C
C	Democratic Republic of the Congo	C	C	C	C
C	South Sudan	C	C	C	C

For each perspective j , the weighted average of country i ,

$$r_{ij} = \sum_{kj} w_{kj} r_{kij} \tag{1}$$

The overall weighted average of country i ,

$$r_i = \sum_k w_k r_{ki} \tag{2}$$

where:

w_k is the weight of criterion k and w_{kj} for perspective j ;

r_{ki} is a rank of country i with respect to criterion k and r_{kij} for perspective j .

Then, with the obtained classifications of 54 countries, overall and for each perspective, we have to group into three categories A, B and C, each containing 18 countries. The final overall classification of the 54 African countries according to the four perspectives is presented in **Table 6**.

Some decision-makers, after analyzing the position of their country in classification, will want to take actions in the direction of improving their position. To do this, they will need more information that will answer the questions: what criteria are relevant to the given country? What criteria are in conflict? What are the critical values of the criteria? To answer these questions, it was proposed the DRSA explanatory method which allows us with aid of decision rules to find

critical values of a criterion and determine the placement of a country in one category or another.

3.3. Geographical Analysis of the Overall Classification Decision Table

When analysis the overall classification presented in **Table 6**, most countries listed in category C seem to be geographically in contact with one another (Sierra Leone, Guinea, Liberia, Mali, Niger, Nigeria, Chad, Sudan, Eritrea, Central African Republic, South Sudan, Uganda and Democratic Republic of the Congo). We decided to call this phenomenon as the “Poverty String” since they are all connected to one another. Most North African countries are categorized as A (Egypt, Morocco, Tunisia and Algeria). Finally, countries neighbouring South Africa are mostly categorized as B. A map of Africa with all the classifications (A, B and C) is presented in **Appendix A**.

3.4. The Decision Rules

The calculations were performed using 4eMka2 software, developed by the intelligent decision support systems laboratory (IDSS) at the computing science institute of the Poznan University of Technology. **Table 7** describes the rules for all the various perspectives combined. Rules presented below have each a minimal relative strength of 20% and are limited to 3 conditional criteria in order to get the most significant combination.

From rules 1, 2 and 3, we can conclude that if in the country, the value of the GNP per capita is at least equal to 7503.27\$ or life expectancy of the men is at least equal to 64.34 years or adolescent fertility is at most equal to 21.18 per 1000 then this country is in the class A no matter the other criteria. For others countries which belong to the classes B or C these critical values determine the strategic objectives to reach and to be in the class A.

The same we can say about countries which belong to the class C. Rules 4 and 5 dictate that for those which homicides index is at most equal to 1.85 or fixed telephone subscriptions is at least equal to 1.22 per 100 then the country is in the class B at least.

In the same manner we can obtain strategies for each perspective individually.

Table 7. Decision rules for all perspectives combined.

#	Decision Rules	Condition 1	Condition 2
1	Decision \geq A	GNP per capita \geq 7503.27\$	
2	Decision \geq A	Life expectancy men \geq 64.34 years	
3	Decision \geq A	Adolescents fertility \leq 21.18 per 1000	
4	Decision \geq B	Fixed telephone sub. \geq 1.22 per 100	
5	Decision \geq B	Homicides index \leq 1.85	

Decision Rules for Each Perspective (PEST)

Table 8 describes the decision rules for each individual perspective (PEST).

Table 8. Decision rules for each perspective.

#	Decision Rules	Condition 1	Condition 2	Condition 3
Political Perspective				
1	Decision \geq A	Ease of doing bus. \leq 106		
2	Decision \geq A	Military exp. \geq 1.54	Ease of doing bus. \leq 144	Competitive. Index \geq 3.71
3	Decision \geq B	Ease of doing bus. \leq 140		
4	Decision \geq B	Military exp. \leq 1.31	Women in gov. \geq 12.3%	
5	Decision \geq B	Military exp. \leq 1.7	Corruption Index \geq 35	
Economic Perspective				
6	Decision \geq A	GNP per cap. \geq 1579.92\$		
7	Decision \geq B	GNP per cap. \geq 820\$		
Sociological Perspective				
8	Decision \geq A	Life exp. Women \geq 68.71 years		
9	Decision \geq A	Homicides \leq 1.85	Urban population \geq 35.74%	
10	Decision \geq A	Analphabetism \leq 11.5%	Homicides \leq 2.175	
11	Decision \geq B	Life exp. men \geq 59.66 years		
12	Decision \geq B	School life \geq 12 years	Life exp. men \geq 59.13 years	
13	Decision \geq B	Analphabetism \leq 13.1%	Life exp. men \geq 58.59 years	
Technological Perspective				
14	Decision \geq A	Academic papers \geq 6.63 per million		
15	Decision \geq A	Mobile phones \geq 122.02 per 100	Internet \geq 0.31 per 100	
16	Decision \geq A	Internet \geq 0.63 per 100	Academicpapers \geq 2.59 per million	Secure Internet \geq 5.19 per million
17	Decision \geq B	Academic papers \geq 3.48 per million		
18	Decision \geq B	Internet \geq 0.1 per 100	Fixedtelephones \geq 0.46 per 100	Academicpapers \geq 0.18 per million
19	Decision \geq B	Mobile phones \geq 106.57 per 100	Fixedtelephones \geq 1.2 per 100	

For the political perspective, according to rules 1 and 2, we can conclude that if in the country, the value of ease of doing business is at most equal to 106 or ease of doing business is at most equal 144 and military expenditures is at least equal to 1.54 and competitive index is at least equal to 3.71 then this country is in the class A. For others countries which belong to the classes B and C these critical values determine the strategic objectives to attain and to be in the class A.

The same we can say about countries which belong to the class C. Rules 3, 4 and 5 dictate that for those which ease of doing business is at most equal to 140 or military expenditures is at most equal to 1.31 and women in governments is at least equal to 12.3 or military expenditures is at most equal to 1.7 and corruption index is at least equal to 35 are strategic objectives which allow countries to be classify in category B at least.

For the economical perspective, according to rule 6, we can conclude that if in the country, the value of GPN per capita is at least equal to 1579.92\$ then this country is in the class A. For others countries which belong to the classes B and C these critical values determine the strategic objectives to attain and to be in the class A.

The same we can say about countries which belong to the class C. Rule 7 dictates that for those which GPN per capita is at least equal to 820\$ is strategic objective which allow to classify this country to the class B at least.

For the sociological perspective, according to rules 8, 9 and 10, we can conclude that if in the country, the value of life expectancy women is at least equal to 68.71 years or homicide is at most equal to 1.85 and urban population is at least equal to 35.74% or analphabetism is at most equal to 11.5% and homicides is at most equal to 2.175 then this country is in the class A.

The same we can say about countries which belong to the class C. Rules 11, 12 and 13 dictate that for those which life expectancy men is at least equal to 59.66 years or school life is at least equal to 12 years and life expectancy men is at least equal to 59.13 years or analphabetism is at most equal to 13.1% and life expectancy men is at least equal to 58.59 years are strategic objectives which will allow to classified this country to the class B at least.

For the technological perspective, according to rules 14, 15 and 16, we can conclude that if in the country, the value of academic papers is at least equal to 6.63 per million or mobile phones is at least equal to 122.02 per 100 and internet is at least equal to 0.31 per 100 or internet is at least equal to 0.63 per 100 and academic papers is at least equal to 2.59 per million and secure internet is at least equal to 5.19 per million then this country is in the class A.

The same we can say about countries which belong to the class C. Rules 17 to 19 dictate that for those which academic papers is at least equal to 3.48 per million or internet is at least equal to 0.1 per 100 and fixed telephones is at least equal to 0.46 per 100 and academic papers is at least equal to 0.18 per million or mobile phones is at least equal to 106.57 per 100 and fixed telephones is at least

equal to 1.2 per 100 are strategic objectives which will allow to classified this country to the class B at least.

4. Strategic Decision-Making

This section demonstrates how to apply the decision rules for each country in order to develop strategic objectives and performance measures based on the data provided by the decision rules. Each country categorized overall as [C] (African countries ranked the lowest and needing special support with regard to the criterion or criteria considered) are provided with targets based on the decision rules that apply. In order to improve strategically, each country in category C must be interested in the decision rules listed in category B (Decision \geq B) in the overall evaluation described in **Table 7**. For countries in category B, they must be interested in the decision rules listed in category A (Decision \geq A). **Table 9** describes all the strategic objectives and targets for all the countries classified in category C. **Table 10** describes all the strategic objectives and targets for all the countries classified in category B. All countries may decide to evaluate each perspective individually and apply the same process to determine more specific strategic objectives in order to improve their socio-economic situation. **Appendix C** shows all the strategic objectives for the various perspectives.

Table 9. Strategic objectives for the countries in category C.

Country	Decision Rule #4	Decision Rule #5	Strategic Objective	Strategic Objective
	Fixed telephone subscriptions \geq 1.22 per 100	Homicides index \leq 1.85 per 100	Improve fixed telephone subscriptions per 100 by:	Lower homicide Index by:
Liberia	0.17	2.3	1.05	0.45
Uganda	0.89	4.18	0.33	2.33
Nigeria	0.08	4.01	1.14	2.16
Erythrea	0.95	3.925	0.27	2.075
Mozambique	0.3	2.4	0.92	0.55
Malawi	0.06	1.9	1.16	0.05
Sudan	0.34	3.125	0.88	1.275
Sierra Leone	0.26	1.95	0.96	0.1
Guinea-Bissau	0	3.975	1.22	2.125
Mali	1.2	4.02	0.02	2.17
Guinea	0	3.675	1.22	1.825
Somalia	0.42	2.9	0.8	1.05
Niger	0.56	2.625	0.66	0.775
Burundi	0.18	2.5	1.04	0.65
Central Africa	0.04	4.32	1.18	2.47
Chad	0.1	3.8	1.12	1.95
Congo Dem. Rep.	0	4.05	1.22	2.2
South Sudan	0	4.39	1.22	2.54

Table 10. Strategic objectives for the countries in category B.

Country	Decision Rule #1	Decision Rule #2	Decision Rule #3	Strategic Objective	Strategic Objective	Strategic Objective
	GNP per capita \geq 7503.27\$	Life expectancy men \geq 64.34 years	Adolescents fertility \leq 21.18 per 1000	Improve GNP per capita (USD constant) by:	Improve Life expectancy for men in years by:	Lower number of births per 1000 adolescents by:
Kenya	1143.07	64.29	90.22	6360.2	0.05	69.04
Equatorial Guinea	12278.13	56.14	107.53	Maintain	8.2	86.35
Benin	837.34	59.13	81.78	6665.93	5.21	60.6
Zambia	1627.27	58.9	87.86	5876	5.44	66.68
Cameroon	1495.44	56.4	102.36	6007.83	7.94	81.18
Zimbabwe	917.56	58.59	108.94	6585.71	5.75	87.76
Togo	558.12	59.15	92.06	6945.15	5.19	70.88
Côte d'Ivoire	1552.77	51.63	135.63	5950.5	12.71	114.45
Congo Rep.	2798.07	62.52	116.12	4705.2	1.82	94.94
Tanzania	866.95	63.08	117.72	6636.32	1.26	96.54
Lesotho	1352.48	51.27	93.17	6150.79	13.07	71.99
Mauritania	1296.01	61.6	77.9	6207.26	2.74	56.72
Gambia, the	531.92	59.66	112.46	6971.35	4.69	91.28
Angola	3582.65	58.42	161.93	3920.62	5.92	140.75
Ethiopia	511.19	63.2	56.61	6992.08	1.14	35.43
Comoros	768.44	61.81	67.1	6734.83	2.53	45.92
Madagascar	416	64	114.82	7087.27	0.34	93.64
Burkina Faso	663.91	59.19	107.15	6839.36	5.15	85.97

5. Conclusions

5.1. Poverty String Phenomenon

With the help of the statistical data, we classified all the African countries in three categories: A, B and C. This classification was done according to political, economic, sociological and technological indicators. We were able to obtain a decision table for all perspectives combined and for each perspective individually. It is now clear that there is a strong correlation between different indicators and that economical success requires large investments in improving school life and solutions to reduce adolescent fertility level in order to improve both economically and sociologically. Also, we remind the positive correlation between unemployment and homicides, as well for the negative correlation between unemployment and analphabetism for women. Economic indicators and technological indicators are results indicators. Sociological and political indicators are drivers that will greater impact the overall classification of all the African countries. Leaders, politicians, non-governmental agencies, international organiza-

tions may now target their investments and know precisely where the development is required and by how much it is required to be improved or reduced.

When analyzing the African map in **Appendix A** and all the classification results, we can clearly observe that most countries in category C are, in majority, geographically touching one another. The opposite is the same as wealth seems to be also grouped. Therefore, it seems that both wealth and poverty spread like diseases. Most countries in category C share borders with one another along the same latitude. This region is also named Sahel. As demonstrated in the analysis, DRSA shows precisely which indicators should be improved, given priority and by how much for each country classified in category C. Both the correlation matrix and DRSA clearly demonstrate that top priority should be given to analphabetism, school life and reducing the amount of adolescents pregnancies. These three sociological indicators seem to affect directly economic indicators such as GDP, GNI and all technological indicators. The results of the DRSA analysis indicates all the African countries in category C and by how much each of the actual indicators must be improved since they represent their major weaknesses with regard to other countries.

5.2. Limitations of the Research

This research did not include environmental statistics for each country or cultural indicators such as religion percentages. Since most countries in category C are along the same latitude, climate may play an important role and impact poverty.

5.3. Future Research

The original data collection included the percentages of all the different religions within each African country. The researchers understand the sensitivity of the topic discussed in this paragraph. The purpose was to integrate religion since it affects greatly the culture of a nation, its history, laws and traditions. Understanding the importance of religion in all aspect of international relations, politics and sociology, we propose that further research, with the help of sociologists, is needed to study the correlations found between the various PEST indicators and the various religion indicators found in all the African countries.

References

- [1] Pawlak, Z. (1982) Rough Set. *International Journal of Parallel Programming*, **11**, 341-356.
- [2] Pawlak, Z. (1991) *Rough Sets: Theoretical Aspects of Reasoning about Data*. Kluwer Academic Publishing, Dordrecht. <https://doi.org/10.1007/978-94-011-3534-4>
- [3] Pawlak, Z. and Slowinski, R. (1994) Rough Set Approach to Multi-Attribute Decision Analysis. *European Journal of Operational Research*, **72**, 443-459. [https://doi.org/10.1016/0377-2217\(94\)90415-4](https://doi.org/10.1016/0377-2217(94)90415-4)
- [4] Pawlak, Z. (2002) Rough Set Theory and Its Applications. *Journal of Telecommunications and Information Theory*, **3**, 7-10.

- [5] Zaras, K., Marin, J.-C. and Boudreau-Trudel, B. (2012) Dominance Rough Set Approach as a Decision-Making Method for the Selection of Sustainable Development Projects. *American Journal of Operational Research*, **2**, 506.
- [6] Ho, H., Fann, W., Chiang, H., Nguyen, P., Pham, D., Nguyen, P. and Nagai, M. (2016) Application of Rough Set, GSM and MSM to Analyze Learning Outcome—An Example Introduction to Education. *Journal of Intelligent Learning Systems and Applications*, **8**, 23-38. <https://doi.org/10.4236/jilsa.2016.81003>
- [7] Renaud, J., Thibault, J., Lanouette, R., Kiss, L.N., Zaras, K. and Fonteix, C. (2007) Comparison of Two Multi-Criteria Methods: Net Flow and Rough Set Methods for aid to Decision Making in a High Yield Pulping Process. *European Journal of Operational Research*, **177**, 1418-1432. <https://doi.org/10.1016/j.ejor.2005.04.013>
- [8] Marin, J., Zaras, K. and Boudreau-Trudel, B. (2014) Use of the Dominance-Based Rough Set Approach as a Decision Aid Tool for the Selection of Development Projects in Northern Quebec. *Modern Economy*, **5**, 723-741. <https://doi.org/10.4236/me.2014.57067>
- [9] Prema S. and Umamaheswari, P. (2016) Multitude Classifier Using Rough Set Jelinek-Mercer Naïve Bayes for Disease Diagnosis. *Circuits and Systems*, **7**, 701-708. <https://doi.org/10.4236/cs.2016.76059>
- [10] Songbian, Z. (2016) Business Intelligence from Customer Review Management Using Rough Set Model. *International Journal of Advanced Research*, **4**, 816-824.
- [11] Emam, O., Farhan, M. and Abohany, A. (2017) Faults Repairing Analysis Using Rough Sets after Implementation of Labor Force Redistribution Algorithm: A Case Study in Telecom Egypt. *Information Sciences Letter*, **6**, 39-48.
- [12] Greco, S., Matarazzo, B. and Słowiński, R. (2001) Rough Sets Theory for Multi-Criteria Decision Analysis. *European Journal of Operational Research*, **129**, 1-47. [https://doi.org/10.1016/S0377-2217\(00\)00167-3](https://doi.org/10.1016/S0377-2217(00)00167-3)
- [13] Zaras, K. (2004) Rough Approximation of a Preference Relation by a Multi-Attribute Stochastic Dominance for Deterministic, Stochastic and Fuzzy Evaluation Problems. *European Journal of Operational Research*, **159**, 196-206. [https://doi.org/10.1016/S0377-2217\(03\)00391-6](https://doi.org/10.1016/S0377-2217(03)00391-6)
- [14] World Bank (2018) Indicators. <https://data.worldbank.org/indicator>
- [15] United Nations (2018) UN Data. <http://data.un.org/Explorer.aspx?d=UNODC>
- [16] International Institute for Strategic Studies. <https://www.iiss.org>
- [17] Field, A. (2005) *Discovering Statistics Using SPSS*. Second Edition, Sage Publications, New Delhi.

Appendix A



Appendix B

Correlation Matrix

Christianity	1
Islam	-.954** 1
Irreligion	.392** -.499** 1
Hinduism	-0.093 -0.085 -0.081 1
Buddhism	-0.097 0.101 -0.018 1
Folk religion	-0.022 -0.183 0.146 -0.066 -0.1 1
Other religions	.313* -.354** .388** 0.021 -0.045 0.009 1
Judaisme	-0.071 0.076 0.102 -0.025 0.2 -0.089 -0.041 1
Internal conflict	-0.216 0.243 -.290* -0.068 0.221 0.031 -0.196 -0.103 1
Military exp.	-0.22 0.195 -0.05 -0.028 .396** 0.1 -0.026 -0.124 0.243 1
Corruption index	0.205 -0.235 .282* 0.257 -0.092 -0.192 0.125 0.004 -.333* -0.224 1
Global comp.	-0.034 -0.031 0.116 .353* 0.109 -0.164 0.162 0.145 -0.125 0.092 .579** 1
Ease of bus.	-0.128 0.171 -0.135 -.427** 0.017 0.237 0.029 -0.026 .319* 0.209 -.631** -.602** 1
Women in gov.	0.214 -0.162 0.043 -0.111 0.074 -0.097 -0.023 0.039 -0.11 -0.005 0.057 0.226 -0.206 1
GNP per capita	0.159 -0.202 0.192 .349* 0.201 -0.192 0.139 0.035 -0.069 0.08 .303* .496** -.334* 0.02 1
GNI per capita	0.141 -0.204 0.143 .408** 0.163 -0.181 0.141 0.084 -0.055 0.114 .381** .500** -.394** 0.003 .962** 1
Broad money	-.286* 0.215 -0.048 .346* 0.139 -0.053 -0.181 .282* -0.063 0.209 0.256 .495** -.296* -0.005 0.278 .433** 1
Unemployment	-0.022 0.022 .345* -0.042 .300* -0.197 -0.023 0.046 -0.014 0.154 0.153 0.102 -0.235 0.006 .338* .317* 0.196 1
export G&S	0.233 -.333* .420** 0.188 0.017 0.131 0.126 -0.018 -.326* -0.021 0.285 0.071 -0.254 -0.255 .556** .498** 0.123 .345* 1
Oil rents	0.4 -0.361 -0.216 -0.172 -0.201 0.225 -0.103 -0.197 0.136 0.181 -0.428 -0.301 .556* -0.125 0.44 0.453 -0.194 -0.087 .599** 1
Life exp. F	-0.11 0.104 -0.034 .294* 0.193 -.276* 0.009 -0.009 -0.111 .309* .330* .598** -.457** 0.209 .464** .537** .651** 0.172 0.104 -0.059 1
Life exp. M	-0.23 0.224 -0.11 0.248 0.131 -0.23 -0.012 -0.035 -0.085 .315* .292* .570** -.370** 0.164 .354** .407** .636** 0.073 0.055 -0.043 .970** 1
Alphabets m	-.347* .363** -.274* -0.173 -0.243 0.165 -.363** -0.233 0.199 -0.169 -0.103 -0.410** .336* -0.184 -.436** -.450** .300* -.342* -0.266 -0.004 -.503** -.376** 1
Analph M	-.309* .324* -0.266 -0.161 -0.249 0.164 -0.371** -0.208 0.187 -0.193 -0.08 -0.400** .280* -0.178 -.415** -.424** .344* -.283* -0.259 0.001 -.519** -.407** .978** 1
Analph F	-.366** .382** -.274* -0.178 -0.231 0.163 -.348* -0.244 0.202 -0.146 -0.122 -.407** .369** -0.187 -.438** -.455** -0.261 -.377** -.026 -0.01 -.479** -.344* .989** .936** 1
school life total	0.241 -.328* .295* 0.272 0.108 0.071 0.263 -0.159 -0.234 0.096 .375** .358* -.493** 0.029 .462** .492** 0.246 .334 .424** 0.148 .489** .428** -.613** -.580** -.618** 1
Urban pop.	-0.191 0.188 0.157 -0.031 .326* -0.132 0.233 0.266 -0.017 .296* 0.211 .330* 0.039 -0.177 .405** .392** .443** .282* .387** 0.143 .410** .439** .344* -.400** -.293* .291* 1
Adol. Fert.	0.095 -0.068 0.064 -0.196 -.295* 0.052 0.022 -0.215 -0.051 -.279* -0.25 -.601** .327* -0.172 -.320* .382** .545** -0.205 -0.037 0.124 -.599** -.558** .532** .522** .524** -.433** -.343* 1
Homicides	0.268 -0.273 0.244 -0.144 0.011 0.12 -0.023 0.107 0.101 0.088 -0.004 -0.031 0.076 0.009 0.034 0.059 -0.163 .400** 0.213 0.211 -.358* -.449** -0.035 0.02 -0.075 -0.164 -0.007 0.142 1
Academic papers	-0.252 0.246 0.008 0.101 0.199 -0.168 -0.067 0.084 -0.029 0.133 0.239 .419** -.371** 0.123 .351* .392** .450** .290* 0.149 -0.182 .529** .508** -.298* -.323* -0.272 .481** .357** -.490** -0.127 1
Fixed Intern.	-0.122 0.025 -0.071 .681** 0.068 -0.182 0.018 0.068 -0.062 0.195 .369** .501** -.485** -0.055 .679** .804** .600** 0.098 0.225 -0.024 .674** .584** -.380** -.371** -.376** .501** .282* -.460** -0.263 .494** 1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Appendix C

Strategic Objectives for the four perspectives (PEST)

All Perspectives Objectives (Table 7)	Strategic Objective 1 (To reach category A) Rule #1	Strategic Objective 2 (To reach category A) Rule #2	Strategic Objective 3 (To reach category A) Rule #3	Strategic Objective 4 (To reach category B) Rule #4	Strategic Objective 5 (To reach category B) Rule #5
Conditions	GNP per capita \geq 7503.27\$	Life expectancy men \geq 64.34 years	Adolescents fertility \leq 21.18 per 1000	Fixed telephone sub. \geq 1.22 per 100	Homicides index \leq 1.85
Liberia	7150.62	3.29	-85.94	1.05	-0.45
Uganda	6840.84	6.98	-87.77	0.33	-2.33
Nigeria	5047.35	12.11	-88.12	1.14	-2.16
Erythrea	6989.09	1.8	-31.82	0.27	-2.08
Mozambique	6987.88	8.8	-115.75	0.92	-0.55
Malawi	7021.82	4.3	-114.17	1.16	-0.05
Sudan	5579.85	1.63	-50.87	0.88	-1.28
Sierra Leone	7047.68	13.47	-95.55	0.96	-0.1
Guinea-Bissau	6920.9	9.07	-66.35	1.22	-2.13
Mali	6757.4	7.55	-152.56	0.02	-2.17
Guinea	6767.55	5.42	-118.39	1.22	-1.83
Somalia	7503.27	10.07	-81.44	0.8	-1.05
Niger	7112.14	5.62	-179.98	0.66	-0.78
Burundi	7284.99	9.2	-6.67	1.04	-0.65
African Centre Rep.	7177.55	14.71	-69.48	1.18	-2.47
Chad	6643.62	12.97	-108.57	1.12	-1.95
Congo Dem. Rep.	7115	6.6	-101.1	1.22	-2.2
South Sudan	6757.93	9.01	-42.25	1.22	-2.54

Political Perspective (Table 8)	Strategic Objective 1 (To reach category A) Rule #1	Strategic Objective 2 (To reach category A) Rule #2			Strategic Objective 3 (To reach category B) Rule #3	Strategic Objective 4 (To reach category B) Rule #4		Strategic Objective 5 (To reach category B) Rule #5	
Conditions	Ease of doing business \leq 106	Military expenditure \geq 1.54%	Ease of doing business \leq 144	Competitive Index \geq 3.71	Ease of doing business \leq 140	Military expenditure \leq 1.31%	Women in gov. \geq 12.3%	Military expenditure \leq 1.31%	Corruption Index \geq 35
Liberia	-66	Maintain	-28	0.63	-32	Maintain	Maintain	0.39	Maintain
Uganda	-16	-0.321	Maintain	0.01	18	-0.551	Maintain	-0.161	11
Nigeria	-39	Maintain	-1	0.41	-5	Maintain	6.7	0.506	7
Erythrea	-83	-0.542	-45	Maintain	-49	-0.772	Maintain	-0.382	17
Mozambique	-32	Maintain	Maintain	0.82	2	-0.196	Maintain	0.194	8
Malawi	-4	Maintain	Maintain	0.6	30	Maintain	Maintain	0.453	4

Continued

Sudan	-64	-0.516	-26	3.71	-30	-0.746	Maintain	-0.356	21
Sierra Leone	-54	Maintain	-16	0.51	-20	Maintain	Maintain	0.513	5
Guinea-Bissau	-70	-0.593	-32	0.14	-36	-0.823	Maintain	-0.433	19
Mali	-37	-1.416	Maintain	0.38	-3	-1.646	3.5	-1.256	3
Guinea	-47	Maintain	-9	0.24	-13	Maintain	Maintain	0.423	8
Somalia	-84	-0.225	-46	3.71	-50	-0.455	Maintain	-0.065	25
Niger	-38	Maintain	Maintain	3.71	-4	-0.106	Maintain	0.284	0
Burundi	-58	-0.423	-20	0.5	-24	-0.653	Maintain	-0.263	15
African Centre Rep.	-78	-0.318	-40	3.71	-44	-0.548	3.7	-0.158	Maintain
Chad	-74	-0.694	-36	0.72	-40	-0.924	Maintain	-0.534	15
Congo Dem. Rep.	-76	-2.421	-38	3.71	-42	-2.651	3.4	-2.261	15
South Sudan	-81	-2.088	-43	0.36	-47	-2.318	Maintain	-1.928	24

Economical Objectives (Table 8)

Strategic Objective 1

(To reach category A refer to rule #6 and to reach category B refer to rule #7)

Conditions	Rule #6 GNP (US\$) \geq 1579.92\$	Rule #7 GNP (US\$) \geq 820\$
Liberia	1227.27	467.35
Uganda	917.49	157.57
Nigeria	Maintain	Maintain
Erythrea	1065.74	305.82
Mozambique	1064.53	304.61
Malawi	1098.47	338.55
Sudan	Maintain	Maintain
Sierra Leone	1124.33	364.41
Guinea-Bissau	997.55	237.63
Mali	834.05	74.13
Guinea	844.2	84.28
Somalia	1579.92	820
Niger	1188.79	428.87
Burundi	1361.64	601.72
African Centre Rep.	1254.2	494.28
Chad	720.27	Maintain
Congo Dem. Rep.	1191.65	431.73
South Sudan	No data	No data

Sociological Objectives (Table 8)	Strategic Objectives (To reach category A)					Strategic Objective 4 (To reach category B)		Strategic Objective 5 (To reach category B)		Strategic Objective 6 (To reach category B)	
	Objective 1 (To reach category A) Rule #8	Strategic Objective 2 (To reach category A) Rule #9	Strategic Objective 3 (To reach category A) Rule #10	Strategic Objective 4 (To reach category B) Rule #11	Strategic Objective 5 (To reach category B) Rule #12	Strategic Objective 6 (To reach category B) Rule #13	Strategic Objective 4 (To reach category B) Rule #11	Strategic Objective 5 (To reach category B) Rule #12	Strategic Objective 6 (To reach category B) Rule #13	Strategic Objective 6 (To reach category B) Rule #13	
Conditions	Life expectancy women ≥ 68.71 years	Homicides ≤ 1.85	Urban population $\geq 35.74\%$	Analphabetism $\leq 11.5\%$	Homicides ≤ 2.175	Life expectancy men ≥ 59.66 years	School life ≥ 12 years	Life expectancy men ≥ 59.13 years	Analphabetism $\leq 13.1\%$	Life expectancy men ≥ 58.59 years	
Liberia	5.75	-0.45	Maintain	-40.9	-0.13	Maintain	1	Maintain	-39.3	Maintain	
Uganda	6.94	-2.33	19.3	-14.7	-2.01	2.301	2	1.77	-13.1	1.23	
Nigeria	14.95	-2.16	Maintain	-28.9	-1.84	7.425	3	6.9	-27.3	6.36	
Erythrea	1.9	-2.08	35.74	-14.7	-1.75	Maintain	7	Maintain	-13.1	Maintain	
Mozambique	8.93	-0.55	3.23	-29.7	-0.23	4.12	2	3.59	-28.1	3.05	
Malawi	3.54	-0.05	19.29	-22.5	Maintain	Maintain	1	Maintain	-20.9	Maintain	
Sudan	2.88	-1.28	1.73	-29.9	-0.95	Maintain	5	Maintain	-28.3	Maintain	
Sierra Leone	16.72	-0.1	Maintain	-40.1	Maintain	8.793	12	8.26	-38.5	7.72	
Guinea-Bissau	9.99	-2.13	Maintain	-28.7	-1.8	4.394	1	3.86	-27.1	3.32	
Mali	10.55	-2.17	Maintain	-55.4	-1.85	2.874	4	2.34	-53.8	1.8	
Guinea	8.8	-1.83	Maintain	-58	-1.5	0.743	3	0.21	-56.4	Maintain	
Somalia	11.15	-1.05	Maintain	Maintain	-0.73	5.393	5	4.86	Maintain	4.32	
Niger	8.01	-0.78	16.73	-69.4	-0.45	0.943	7	0.41	-67.8	Maintain	
Burundi	9.62	-0.65	23.38	-3	-0.33	4.517	1	3.99	-1.4	3.45	
African Centre Rep.	15.5	-2.47	Maintain	-51.7	-2.15	10.028	5	9.5	-50.1	8.96	
Chad	14.92	-1.95	13.12	-48.5	-1.63	8.288	5	7.76	-46.9	7.22	
Congo Dem. Rep.	8.03	-2.2	Maintain	-9.2	-1.88	1.918	3	1.39	-7.6	0.85	
South Sudan	11.38	-2.54	16.71	-56.5	-2.22	4.334	12	3.8	-54.9	3.26	

Technological Objectives (Table 8)	Strategic Objective 1 (To reach category A)		Strategic Objective 2 (To reach category A)		Strategic Objective 3 (To reach category A)		Strategic Objective 4 (To reach category B)		Strategic Objective 5 (To reach category B)		Strategic Objective 6 (To reach category B)	
	Objective 1 (To reach category A) Rule #14	Strategic Objective 1 (To reach category A) Rule #14	Strategic Objective 2 (To reach category A) Rule #15	Strategic Objective 2 (To reach category A) Rule #15	Strategic Objective 3 (To reach category A) Rule #16	Strategic Objective 3 (To reach category A) Rule #16	Strategic Objective 4 (To reach category B) Rule #17	Strategic Objective 4 (To reach category B) Rule #17	Strategic Objective 5 (To reach category B) Rule #18	Strategic Objective 5 (To reach category B) Rule #18	Strategic Objective 6 (To reach category B) Rule #19	Strategic Objective 6 (To reach category B) Rule #19
Conditions	Academic papers ≥ 6.63 per million	Academic papers ≥ 6.63 per million	Mobile phones ≥ 122.02 per 100	Mobile phones ≥ 122.02 per 100	Internet ≥ 0.31 per 100	Internet ≥ 0.31 per 100	Internet ≥ 0.63 per 100	Internet ≥ 0.63 per 100	Academic papers ≥ 2.59 per million	Academic papers ≥ 2.59 per million	Secure Internet ≥ 5.19 per million	Secure Internet ≥ 5.19 per million
Liberia	6.09	38.92	0.14	0.46	2.05	1.51	2.94	Maintain	0.29	-0.36	23.47	1.03
Uganda	3.64	66.95	0.05	0.37	Maintain	2.85	0.49	Maintain	Maintain	-2.81	51.5	0.31
Nigeria	0.43	40.2	0.3	0.62	Maintain	2.39	Maintain	0.085	0.38	-6.02	24.75	1.12

Continued

Erythrea	no data	114.73	0.3	0.62	no data	no data	no data	0.09	Maintain	no data	99.28	0.25
Mozambique	6.1	55.77	0.17	0.49	2.06	3	2.95	Maintain	0.16	-0.35	40.32	0.9
Malawi	4.68	81.7	0.26	0.58	0.64	3.31	1.53	0.05	0.4	-1.77	66.25	1.14
Sudan	3.27	53.39	0.25	0.57	Maintain	4.95	0.12	0.04	0.12	-3.18	37.94	0.86
Sierra Leone	6.04	24.4	0.31	0.63	2	4.51	2.89	0.1	0.2	-0.41	8.95	0.94
Guinea-Bissau	5.09	51.76	0.27	0.59	1.05	5.19	1.94	0.061	0.46	-1.36	36.31	1.2
Mali	5.7	1.71	0.28	0.6	1.66	3.47	2.55	0.065	Maintain	-0.75	Maintain	Maintain
Guinea	6.39	36.69	0.3	0.62	2.35	5.03	3.24	0.091	0.46	-0.06	21.24	1.2
Somalia	6.46	63.9	Maintain	Maintain	2.42	4.98	3.31	Maintain	0.04	0.01	48.45	0.78
Niger	6.21	73.15	0.24	0.56	2.17	5	3.06	0.032	Maintain	-0.24	57.7	0.64
Burundi	6.28	73.98	0.27	0.59	2.24	4.52	3.13	0.065	0.28	-0.17	58.53	1.02
African Centre Rep.	6.01	96.53	0.29	0.61	1.97	4.32	2.86	0.08	0.42	-0.44	81.08	1.16
Chad	6.51	77.54	0.24	0.56	2.47	4.91	3.36	0.025	0.36	0.06	62.09	1.1
Congo Dem. Rep.	6.58	82.54	0.31	0.63	2.54	4.81	3.43	0.099	0.46	0.13	67.09	1.2
South Sudan	6.63	100.47	0.31	0.63	2.59	4.94	3.48	0.099	0.46	0.18	85.02	1.2