SAFERATIONAL ARGUMENT - THE PREREQUISITE SETUP OF A SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES

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Abstract: - The aims of this paper are to critically analyze the global context in terms of several natural resources and to ascertain the best possible responses to the current practices. The solutions considered are of utmost importance as they are at the same time safe and rational for present and future generations. The analysis and solutions presented by this paper may contribute to a better awareness of the general public of present and future constraints, as during informal meetings with academia, researchers and students, the topic of natural resources seemed controversial and the consequences of a given action were not fully grasped. Therefore, the findings of this paper may set a milestone for politicians whom should better incorporate safety and rationality into the future legislation meant for a sustainable global course. The solutions of this paper include the dimensions of the saferational development, safety and rationality, as the society must cope with the present and future needs of a growing population, but most importantly, with a different life style at global level that will modify the global consumption patterns.

Key-Words: - resource management, sustainable development, safety, rationality, welfare

1 Introduction

The world population continues to exploit the natural resources of the planet without taking into consideration the scarcity of them and, unless a crisis is imminent, it will continue to do so. This attitude may lead to several interrelated crises in energy sector, which will spill over the entire industry, agriculture, which will spread out the entire food industry, ecological systems, which will extend on the entire environment. The scarcity of a resource is considered to encompass, beside the material aspect (accessibility with current technologies), also the economic (price of exploitation) and geopolitical aspects (export flows, trade barriers, unstable regions for origin of a resource).

All these will have a dramatic effect on population welfare and even its survival, unless the legislators and politicians around the globe will change the current consumption path. By creating and enforcing better regulations and policies in the management of natural resources, political actors can create the shift of the consumption pattern to a more responsible one. But the first step in this complex process of change is the awareness of present and future constraints, as during informal meetings with academia, researchers and students, the topic of natural resources seemed controversial and the consequences of a given action were not fully grasped. Given this controversy, it is imperative to identify the current practices and their consequences in order advance on a global consensus on the management of natural resources for the future.

Natural resources are the scaffold of any economy and consist of [1]:

- environmental resources: water, air, soil;
- un-renewable and unrecyclable resources: fossil fuels;
- un-renewable and recyclable resources: minerals;
- renewable intermittent resources: wind;
- renewable resources with slow growth*: forests;
- renewable resources with fast growth*: fish.

(*-the renew rate is based on human life lifespan).

Sustainable management of natural resources refers to specific measures meant to protect the natural resources listed above, by a safe and rational exploitation and use. The measures should be the result of an iterative political process that involves the consideration of 3 main elements: the interests

of all stakeholders, the institutional arrangements (regulations, laws, administrative structures, etc.) and the impact assessment of applying the identified measures [2].

This paper critically analyzes the current global situation in terms of 5 natural resources: water, food, fossil fuels, minerals and forests. The solutions offered by this paper include the dimensions of the saferational management of natural resources, safety and rationality, as the society must cope with the present and future needs of a growing population, but most importantly, with a different life style at global level that will modify the global consumption patterns.

2 Problem Formulation

The world needs a reformulation of security issues, which are not only about military action and fighting against the terrorism. There is a deeper form of terrorism and the global population, represented by legislators, is involved: the terror campaign of humanity against its own resources.

Since its introduction as a term in 1987, sustainable development implied the "process of change" in the exploitation of resources [3]. However, until the early 2000s, the sustainability was not taken seriously by the main driver of change, namely corporations. Since then, a notable progress was registered and many companies have today sustainability reports, mainly based on CO_2 reduction. Unfortunately, the reports rarely contain aspects correlated with the exploitation of resources and they rely for the future development on the same behaviour as in the present. Currently, the great majority of business is organized without taking into consideration the planet's scarce resources [4]. On top of this, the world population is expected to grow from 7.5 billion in present to 9 billion in 2050 [5], this being another important driver of change. There are few examples of circular manufacturing, but the business expansion is built on the same business-as-usual attitude based on consumption growth arrived from a growing population, hungry for consumerism.

The world has become more populated, richer, more pollutant and more eager to consume over the past 25 years, disturbing little by little the natural resources in terms of quantity and quality (see table 1). The global policy makers should determine a policy change in the management of natural resources and the first step is to acknowledge the problem and then to tacked it in a safe and rational manner. However, this is a complex and time consuming endeavour, as the interests of nations might be different and sometimes conflicting regarding the exploitation of different natural resources.

Table 1. Selected global indicators for the period 1990-2014.

Indicator	**1990**	**2014**	**% of change**
World Population (billion)	5.3	7.2	+36
World Gross Domestic Product (GDP) (billion)	22.5	786.5	+3395
World GDP/capita (USD)	4,245	10,923	+157
CO_2 emissions (million tons)	21,571	33,472	+55
Renewable internal fresh water per inhabitant (m^3)	8,016	5,926	-26
Agriculture land (% of land area)	39.4	37.5	-5
Forest area (% of land area)	31.8	30.8	-3

Sources: data computed from [5-11].

3 Concise critical analysis of selected natural resources

3.1. Water

Water is necessary for the survival of humankind and the access to freshwater is a universal human right [12]. Unfortunately, water is a menaced resource with tremendous impacts on people's living, environmental health, food chain, industries and economic growth. The water is withdrawn from natural sources in order to be used by:

- agriculture: for irrigation purposes, livestock management and aquaculture (about 70% of the total water withdrawal);
- various industries: for production purposes (about 20% of the total water withdrawal);
- municipalities: for households consumption (about 10% of the total water withdrawal).

The water withdrawal at the global level increased by 7 times from 1990, rising from 600 km^3/year to almost 4000 km^3/year [10]. The available renewable fresh water resources per inhabitant dropped by 26% since 1990, from a global value of 8,016 m^3/capita in 1990, to 5,925 m^3/capita in 2014 [13]. This significant decrease

was determined by climate change, but also by overexploitation, which is significant in some parts of the world, like Africa. The population increase, urbanisation, current consumption pattern based on business-as-usual and climate change, involving rising temperatures and decreasing precipitations, will conduce to a water stressed world by 2040, when an estimated number of 59 countries will be characterised by a high water stress [14]. This situation can be avoided by applying a more responsible management of irrigation, by changing the production to a more efficient one in terms of water resources, and by adopting a more thorough behaviour of consumers. Moreover, the use of water may be safely and rationally adjusted by implementing new technologies and by institutional arrangements.

3.2 Food

The producers of food are involved in businesses placed under the uncertainty of weather conditions. The climate change adds up to this uncertainty and the result is an agriculture at risk at extremes conditions, like high temperature and drought or heavy rain and freezing temperatures.

During the last 20 years the food chain showed important vulnerabilities, starting with the available stocks, which decreased, and price, which increased. Other important vulnerabilities are linked with the lack of quality of ingredients and even dangerous practices, as revealed by 2013 European horsemeat scandal and 2017 controversy on food quality differences between Eastern and Western Europe.

The world grains stocks decreased by 15% from 1990, from 495 million tons in 1990, to 423 million tons in 2012 [15]. At the same time, the food price increased with about 50% from 1990 expressed as food price index (FPI) (expressed in %, where 2002=100) (FPI comprises an average of prices of 5 commodities: meat, dairy, cereals, vegetable oil and sugar) [16].

Unless technology substantially changes, the institutional arrangements are the main factors necessary to avoid food scarcity, as the available quality land is decreasing, while the population is increasing.

3.3 Fossil fuels

The fossil fuels are represented by oil, gas and coal, essentially being deposits of hydrocarbons accumulated in the earth surface for millions of years derived from fossilized debris of animals and plants. Despite the warnings about the CO_2 emissions and climate change due to accumulation of CO_2 in the earth atmosphere, the humankind continues to heavily depend on fossil fuels.

Primary energy consumption increased by 50% since 1990, from 8,136 million tons of oil equivalent (Mtoe) to 13,020 Mtoe in 2014. From the primary energy consumption, fossil fuels accounted in 2014 for about 86%, while 4.5% was recorded for nuclear energy and the rest of about 10% was for renewables [8]. Despite an abundant literature on renewable energy sources (RES) and their importance for a cleaner and greener future, RES continue to represent only 10% of the total consumption, with hydro-energy representing about 7%, and the modern RES only 3%.

The current price of 1 barrel of oil, after major fluctuations, is about the same as in 1990, being 46 USD/barrel in 2017 (13th June 2017) [17], compared with 43 USD/barrel in 1990 [8].

The production of all fossil fuels recorded increasing values over the last 25 years, with the greatest increase registered for gas production (see fig. 1). At the same time, the CO_2 emissions from burning fossil fuels increased by 55%, diminishing global air quality.

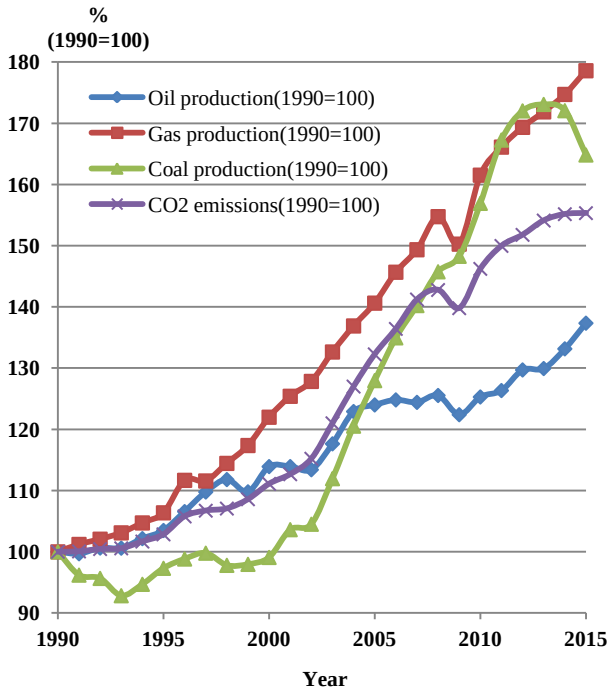

Fig.1. Production of fossil fuels and CO_2 emissions over 1990-2015 period (expressed %, based on million tons).
Source: calculations based on [8].

The cheap oil, together with new technologies that make also unconventional oil cheaper, will hinder the modern renewables development, and,

until cheaper or new technologies will be in place, the fossil fuels will continue to be the first choice that fuels the planet. Therefore, the essential input in modifying the actual patterns and mix of consumption is represented by the political will at global level.

3.4 Minerals

The minerals set at the cornerstone of the civilized world, from the Bronze Age to present, being used also by the green technologies. The industry is relying on minerals and they are heavily excavated globally, but the grade of actual mineral ores is degrading [18]. The yearly extraction rate increased for all minerals within the period 1990-2014, with highest for molybdenum (16.5%/year), followed by chromium (7.65%/year), nickel (7.3%/year), copper (3.9%/year), zinc (3.5%/year) and lead (2.8%/year) [19].

The worldwide production of copper has increased twofold every 25 years since the first recording of data [20]. Within 1990-2014 interval, the copper production has doubled, from 8.95 million tons in 1990 to 18.5 million tons in 2014 [21]. The price of copper increased by 81% during the last 25 years, from 1.6 USD/pound in 1990 to 2.9 USD/pound in 2014 [19].

In respect with the minerals exploitation, the most important aspect is the impact of mineral mining on environment. The effects are massive, ranging from contaminated waste, water and soil, to health problems for miners and near inhabitants. Therefore, in order to have in place a safe and rational use of minerals, international policies and regulations are needed for the exploitation of minerals, as national regulations proved to be not enough to resist to the pressures of large mining corporations.

3.5 Forests

Forests are important resources for many reasons. The wood and industrial activities based on it are important for a region development in terms of economic and social aspects, but the environmental aspect should be also taken into consideration. The forests provide a proper area for wildlife, a large surface for cooling the air, for cleaning the air, by absorbing CO_2 and retaining dust, and also they are an important element for water cycle. But they are involved also in the terrain stabilization and proved to be an effective curtain against strong winds, blizzards and storms. Unfortunately, forest degradation and intensive deforestations derived from logging or agricultural activities lead to increased floods, dangerous blizzards, desertification, soil fertility loss and health problems for livestock in some countries. The massive deforestation and intentional degrading of forests should be prohibited, regardless if these actions come from lack of knowledge or are profit driven. The multiple roles of forests seem to be unknown to common people, but more importantly, to some politicians and legislators. As the forests are attacked, they prove to be an essential aspect of provoking a poverty cycle in the regions with poor forest management. By promoting awareness of the people and by enforcing proper forest exploitation regulations, the poverty cycle may be disrupted. Degraded and missing forests lead to droughts, agricultural loss, flooding, soil displacement and lack of pollinators.

The forest loss within the 1990-2015 period accounted for 129 million hectares, representing a forest loss rate of about 0.13%/year [22]. In 1990 there were globally 4,128 million hectares covered by forest, while in 2015 the figure dropped to 3,999 million hectares.

Therefore, a safe and rational exploitation of forests should be pursued, by the enforcement of international policies and regulations, as national regulations proved to be responsive to the pressures of large logging corporations.

3.6 The framework of the saferational management of resources

The world needs another perspective on available natural resources and a change in the consumption behaviour. The best solution, after the critical analysis that revealed an increased consumption and a lower supply over the last 25 years (see fig.2), is to follow the saferational model, based on two dimensions: safety and rationality, specifically adapted to natural resources [23]. The saferational argument advocated here is based on the bidimensional model of saferational development, developed by the author. Saferational development was previously described as relying on two dimensions, safety and rationality, as a model which "seeks the attainment of welfare for present and future generations", by applying actions in specific areas which "are at the same time accessible, affordable, prudent and based on precautionary upgrading" [24].

Therefore, the safety dimension must encompass the security of natural resources (see table 2), in terms of accessibility of 4 main essential resources: ***water***, ***food***, ***fuel*** (expressed in fossil fuels, as they

represent about 86% of the global primary energy consumption [8]) and ***minerals*** (expressed as one metal, for the convenience of calculations).

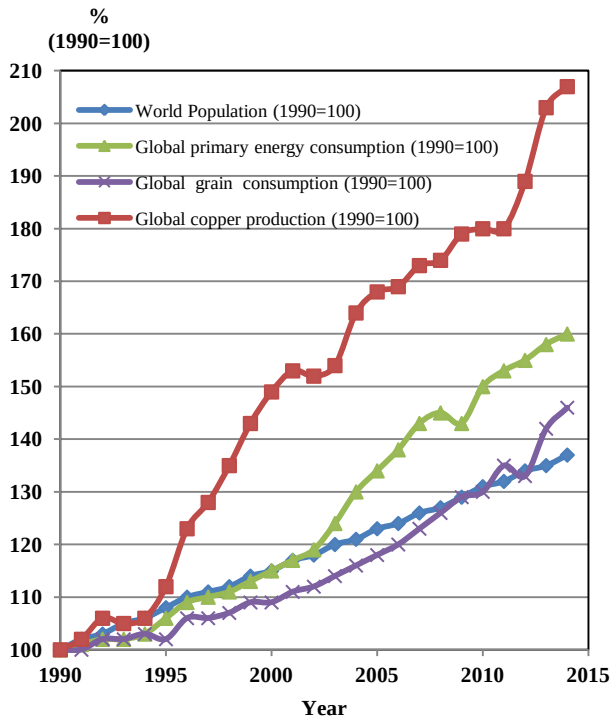

Fig.2. Data on population and selected natural resources within 1990-2014 (1990=100)
Source: data computed from [8, 21, 25, 26].

Table 2. The framework of saferational management of natural resources.

Safety	**Rationality**
Accessibility of water • water exploitation • quality of water	***Affordability of water*** • water price • consumption of water as a % of the household expenditure
Accessibility of food • food supply • quality of food	***Affordability of food*** • food price • consumption of food as a % of the household expenditure
Accessibility of fuels • fuel proven reserves • quality of infrastructure	***Affordability of utilities*** • fuel price • consumption of fuel as a % of the household expenditure
Accessibility of minerals • mineral proven reserves • mineral production	***Affordability of minerals*** • price of mineral • mineral productivity

This is to be accompanied by rational dimension in consumption which relies on affordability of the same resources presented above, relaying on their prices.

The model identifies key indicators which may contribute to a better awareness of politicians and general public of the present and future constraints, as the consequences of a given action about natural resources seemed not to be fully grasped. This will lead to a better safeguarding of the existence of present and future generations, by setting a milestone for politicians whom should better incorporate safety and rationality in the management of resources by enforcing a new legislation meant for a sustainable global course.

4 Conclusion

Natural resources are the base foundation of life on earth. The present paper tackled only a selection of main resources, with the aim to emphasise the need of a proper sustainable management of natural resources.

The sustainable management of natural resources involves a proper setup and the first step in to tackle the topic from a saferational perspective, which has in view the accessibility and affordability of natural resources. The accessibility component contains the reserves of a given resource and its quality, while the affordability component contains the price of a given resource and the burden of this price on the household expenditure.

The findings of this paper constitute the starting point of a research that will ascertain an index of sustainable management of natural resources (ISMR) which will be employed on a cross-country analysis to determine the specific responses needed for specific national circumstances. The specific measures will cover the need for better management of agriculture and/or industry and/or municipalities, with a focus set on resources efficiency and waste management, depending on the negative aspects revealed by the ISMR.

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