The New Concept of Natural Resource and Its Derivations

Luis Antonio Bittar Venturi

Full Professor at the Department of Geography

University of São Paulo – São Paulo - Brazil

e-mail: luisgeo@usp.br

Abstract

As the real world changes faster than the theoretical concepts formulated to explain it, after a certain elapsed time these concepts lose accuracy. They start gradually lagging behind the facts they once explained until they became rather narrowed and imprecise. Considering that, concepts have to be reviewed periodically to incorporate new facts and perspectives in order to converge their meanings to the new realities. This research aimed to reveal faults and inaccuracies concerning the concept of natural resources and its derivations. Additionally, we intended to update and expand them in order to recover their weakened explanatory power. Methodologically, this research undertook a conceptual revision based on authors of various backgrounds. Then, these concepts were confronted to new facts to corroborate their current inaccuracy. Thus, we drew some conclusions that allowed us to present a new definition of natural resources. To replace the dualist definition of renewable X non renewable resource, we proposed a new classification considering durable and exhaustible resources, being the first divided in four subcategories: renewable, reproducible, naturally recyclable and inexhaustible. The exhaustible resources, by their turn, were divided in two subcategories: finite and renewable badly used.

Keywords: Natural resource, Renewable, Reproducible, Durable, Exhaustible, inexhaustible, naturally recyclable.

1. INTRODUCTION

Initially, natural resource notion as "any nature's element that may be exploited by mankind" can be useful for us as a conceptual base. However, analysing it more carefully, some new questions may arise.[1] Is natural resource something material or could it carry non-material nature's aspects? Can a natural element be considered a resource even though there is not demand for it? If there is demand for a resource, but there is no access to it, will it be considered as such? Should natural resource purposes be made explicit in the definition? If so, can natural resources meet either social or cultural wishes, beyond necessities? Finally, should the definition be limited to an economic system or should it have a universal

[1] Concept is the shared idea of something; definition explains it and starts to exist through the written speech.

character? These issues of social and physical characters arise from the fact that natural resources matters lie on the interface between society and nature. The word 'resource' itself indicates its social and historical character because we only search for something that has demand. On the other hand, the word 'natural' indicates the physical-chemical resources essence, which determines its occurrence and distribution on Earth. Therefore, it is essential for the concept to integrate these two dimensions.

2. METHODS AND MATERIALS

As a theoretical research, our methodological proceedings were basically the analysis of a number of concepts from different authors, including some geographical and environmental dictionaries. This analysis revealed inaccuracies and raised some variables that based our study, such as: materiality, historicity, finality and universality. By confronting some conceptual derivations, we revealed the false antagonism between renewable x exhaustible resources, the difference between renewable and reproducible resources, reordering all definitions based on the ballast of empirical examples of the reality. Have done that, we drew a new conceptual proposal systematised in a table.

3. DEVELOPMENT

The first issue to be settled, then, is related to the materiality of a natural resource. The word *element* of the initial definition conveys the idea that resource must be something material of immediate utilisation. This idea is widely shared throughout different definitions. This is the case of the IBGE[2] definition that describes natural resource as "Name applied to all raw materials, renewable or non-renewable, which are acquired directly from nature, and exploited by mankind". (IBGE, 2004, p.266). Guerra (1980) also reinforces the idea when he defines natural resources as "all life-giving goods supplied by nature" (p.11). British authors also emphasise this material essence of natural resources, as Mayhew (2009), who defines them as "any property of the physical environment, such as minerals, or natural vegetation, which is exploited by humans" (p. 342); or Saunier and Meganck (2009) who describes them as "anything that is provided by nature, such as minerals deposits, forests, water, wildlife, etc." (p.211).

Nonetheless, a number of natural resources is non-material and of indirect use, and perhaps the best example is nature itself. The Conservation Unities National System (SNUC, in Portuguese) establishes the *indirect use of natural resources* in National Parks for education purposes, recreation and contemplation, not allowing the extraction of any element for transformation and use.

In the real estate market, properties with the same standard of building may be more or less expensive according to their proximity to certain landscape aspects, as overlooking the sea, for example. The material essence takes place in these properties' price variations. The possibility is real, once we look from the cultural perspective; some landscape aspects are more valued than others are.

[2] Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics). See www.ibge.gov.br

Figure 1 – Appropriation of the landscape as a natural resource. Although it is non material and indirect use, the landscape will be accounted in the price of the property.

The topography is another landscape aspect, which is exploited in a non-material way. In the process of mechanised agriculture, planed surfaces make possible the direct and material use of soil resources. In the process of generating hydropower, irregular topography enables the material and direct use of the water resource.

Figure 2ab – Indirect and non-material use of landforms making viable the direct and material use of *arable soils* and *water* for hydropower, respectively.

In some cases, topography, itself, can be exploited by tourism industry as a landscape aspect of prominence.

Figure 3 – Landforms may be indirect appropriated for tourism purposes. Note that for non material uses, the natural resource is not displaced, i.e., the demand has to move towards it.

Therefore, to include immaterial resources in the concept it was necessary to add the word *aspect* to the initial definition. Nevertheless, by doing so, it becomes relevant to explain the possibility of *indirect use* related to the aspect, besides the direct use related to the element. The matter can be solved adding, between commas, either directly or indirectly to the concept, as follows:

"Any nature element or nature *aspect* can be explored, directly or *indirectly*, by mankind."

Historical perspective is the next issue to be included in the concept. Natural goods can be demanded in a certain historical context, and no longer be in another one. Or yet, a natural element that has never constituted a natural resource may become one when emerges demand and means for its appropriation. Zimmerman (1966) stated that "resources are not: they become", what makes clear the difference between natural element and natural resource. Only when demand exists a natural element becomes a natural resource. And demand changes historically. Godard (2002) reinforces the historicity of the concept when he claims:

> [...] resources cannot be fixed once and for all; the contents of what we call resources change historically and they depend either on the evolution of the environment or on the evolution of the technical possibilities, as well as the social necessities and economic conditions. (p. 207)

The idea had already been stated by Oliveira when he asserted that "the majority (of resources) is found in limited quantities and acquire utility, i.e. become valuable at the moment mankind explore it"[3]. The importance of demand is also present in foreign authors' works, as Park (2011) who defines natural resources as "any feature of the natural environment that is of value in *meeting human needs* [...]"(p.299); or Thomas and Goudie (2003) who define them as "components of the natural environment that *have utility* to human kind [...]"(p.332).

[3] Inaugural class given by Professor Oscar de Oliveira about "Natural Resources and Development" at University of Brazil (RJ) on March 09, 1962. (Apud GUERRA, 1980, p.11)

Thus, just by including the word *demand* in the initial definition we included the historical perspective to it. Even though the word *resource* already fulfils this function, once it designates something that is needed (Cunha , 1982).

Yet, another question remains open: utility for what? The most probable answer would be to fulfil the necessities of humankind, as the notion of materiality lingers strongly. However, many resources, either by their nature or by their form of appropriation have no relation with necessity and survival, but with wishes. Living in a place, which overlooks the sea is more a cultural wish than a necessity. Therefore, the inclusion of the expression *material and cultural necessities* embraces the social and natural dimensions of natural resources.

According to GODARD (*op cit*):

> Natural resource is a concept located in the interface between social and natural processes: it is the result of humankind's view of the biophysical environment, a look cast by their necessities, their knowledge and savoir-faire. (p.205)

Bringing now the issue of the universality, in the Social Sciences, natural resource has been related to labour, by which society appropriates nature, incorporates it into the productive system and reproduces itself. According to Leff (2007), "The natural resource and the labour force are not natural beings existing independently of the social, but they are the biologic determined of production and reproduction conditions of a given social structure" (p.121). Nevertheless, when we lock the concept in an economic system, such as capitalism or any other, the concept loses its universality. Natural resources in any society or system, either feudal or socialist, or even in the indigenous primitive societies in which labour does not exist in the sense we understand it. For this reason, the insertion of the expression *in any time or space* widened the concept, which became universal again. By doing so, we can now draw a new concept of natural resources that incorporates all those initial questions: materiality, historicity, finality and universality, which are expressed, respectively, by the bold words of the following definition:

> *Natural resource can be defined as any element or* ***aspect*** *of nature which is in* ***demand****, or being used by mankind, either directly or* ***indirectly****, as a way of to satisfy their* ***material and cultural*** *necessities at* ***any time and space****.*

By incorporating social and physical elements, the geographical perspective has been reinforced as well as the explaining potential of the concept.

3.1. Some supplementary question

A definition establishes a limit of the concept coverage, the boundary between what is and what is not comprise by it. In most cases the boundary is loose and not very precise. In the case of natural resources definition, it happens due to the fact that it is a very wide universe of elements and aspects, and mainly because they may present different levels of change in their natural condition. For example: up to what level of change or processing of a resource can it be still considered natural? Oil is a natural resource while gasoline is not. Yet, there are different stages of refining between oil and gasoline. Which of them marks the limit

between natural and non natural resource? Clay is a natural resource while porcelain is not. But there are levels of kaolin processing that are in the middle of these two products. Similarly, iron ore is a natural resource while steel is not. However, during iron ore processing thin residues are left, which are then transformed in iron pellets used in the steel industry. Materially speaking, these pellets are natural, but structurally they are not, in the sense that these "iron pellets" are not found in the nature. Even the non-material resources can be in this condition. A natural park can be subject to landscape infrastructure interventions. What is the level of transformation that establishes the boundary between a natural park and a planned park? The conceptual accuracy will always be limited if we want to keep the concept universality. From a "certain level" of change, a resource will no longer be natural, but a manufactured product; and each case must be analysed separately. The issue is important not only scientifically, but in the public administration scope as well, once the natural and produced elements are subject to rather different taxes.

In the geographic analysis, the territorial mobility of a natural resource is also a question to be considered. In order to understand how the mobility takes place, we shall resort to the *local value* concept. A high local value resource presents low sale price, high utility, it involves large quantities and it is, generally, irreplaceable, for instance raw materials (sand and gravel) for the building sector. These combined characteristics limit these resources to the place they occur, once transport costs make them not viable economically. On the other hand, the high price of some resources increases their territorial mobility, as petroleum and aluminium. An interesting variation of mobility refers to indirect uses of natural resource. For instance, a landscape of high cultural and aesthetic value is a natural resource that does not move. Moving is, in this case, a prerogative of the demand. Additionally, some natural resources of direct and material use do not move, as is the case of arable soils for growing crops (although there are some experiences of transferring fertile soils form one place to another, such is the case of the polders of Netherlands). It is important to notice that, depending on the use, the same resource can be found in one class or another, for instance soils that are used for landfill and sanitary landfill can be considered inexhaustible, but for agricultural purposes they may be exhaustible.

Another issued related to natural resources is the impact while drastic change of state, and this can happen during the process of exploitation, appropriation, use or disposal. Considering the wide range of natural resource, it is not possible to add this issue to the concept. Therefore, impacts must be analysed either separately or in groups. For example, the agriculture activities beget specific impacts, as deforestation, soil erosion, siltation of rivers etc.; mining activities will impact differently, as shale gas exploitation, rivers impoundment and so on. Thus, impacts may be local, regional (when the atmosphere or the hydrographical network are affected), seasonal (for instance the use of fertilizers in agriculture) or irreversible (as it normally occurs in mining areas). It is also worthy of attention that impacts can have positive sides (socially and environmentally). Considering social impacts, when we analyse natural resources in relation to the GDPs (Gross domestic product) and the HDIs (Human Development Index) of countries, it becomes clear that there is not necessarily a correspondence of these three aspects. On the contrary, in many cases countries rich in natural resources present a low GDP and HDI (like Democratic Republic of Congo, Venezuela etc), while countries poor in natural resources show high GDP and HDI (such as Japan, South Korea etc). Hence, natural resources are not synonymous of natural richness. The conversion of the first in richness is not somehow assured, but highly

dependent on social policies, regardless the natural availability. Guerra (1980) points in this direction when he claims:

> It is important to highlight the fact that natural resources constitute potential wealth, and only mankind is able to transform this wealth into power. Thus, a nation's main wealth is humankind, because only through them it is that resources may lead to social development. (p.19)

Another issue we forwarded refers to the vital natural elements to humankind's survival. Can the air we breathe be considered a natural resource? In this case, the use of air is not historical, yet physiologically automatic, and therefore it does not fit the definition. Nevertheless, we may think of aspects related to air as freshness, purity as in climatic resorts, for therapeutic and recreational purposes. In this case, the element air is reintroduced to the definition.

Finally, the individual use of any element or nature feature has little meaning. When an individual collects seashells from the beach for their own purposes, we are not talking about natural resource. However, if a community collect them to make utensils or handicrafts to sell to tourists, then seashells become a natural resource. In the geographical analysis, the appropriation and use of natural resources is meaningful only through a collective perspective, socially shared.

3.2 Renewable resources X exhaustible resources: only an apparent antagonism

Concepts are formulated in order to define objects and facts. Thus, they must present conformity with the real world. Yet, concepts lose accuracy related to the object or the fact that they designate insofar as the world develops. This section and the next sections aim at the precision of some definitions related to natural resources, which will create a conceptual base to help the study of any natural resource.

The division of natural resources between renewable and not renewable is highly accepted, being the latter synonymous with exhaustible and, normally, referring to minerals. Guerra's definition is (1980): "we must highlight that some (natural resources) are renewable, as soils, vegetation; while others are non renewable as minerals" (p.11).

Here, we will show that these two categories are not opposite, as well as non-renewable is different from exhaustible.

There is a wide variety of natural and social factors that may increase or diminish the renewability of a resource. Arable soils, for example may be more or less renewable depending on natural conditions: under tropical weather, the high humidity and heat intensify the weathering process. Therefore, soils may renew itself faster than in areas with little water, less heat, or both.

On the other hand, if we consider the same soil subject to the same weather conditions, even though renewability may be wider or more constricted depending on social factors, such as different ways of handling it. The alternation of crops and fallow techniques may increase the renewability of soil, while intensive plantations may enfeeble it. In any case, we realise that the concept of renewability lies on the notion of time. However, there are two times to be taken in account. Considering that all resources on Earth renew themselves continuously (even within different speeds), in principle, all resources would be renewable. Nevertheless, in a social perspective, only the resources whose renewing speed happens within a human

time scale are those that are considered renewable. Because of this, oil is not a renewable resource. Still, being naturally renewable within a human time scale is not enough to be classified as renewable conclusively, because the rhythm of exploitation can be superior to rhythm of natural recover, so becoming exhaustible, such is the case of soils, forests, and fish among others. Park (2011, p 378) defines renewable resource as:

> A natural resource (such as fresh water, a forest, or renewable energy) that is replaced at a rate which is at least as fast as it is used, which has the ability to renew itself and be harvested indefinitely under the right conditions, but which can be converted into a non-renewable resource if subject to overexploitation […].

With the expression 'right conditions' the author links renewability to the resource handling (besides its natural dynamic) and points to the possibility of a renewable resource becomes exhaustible when used under wrong conditions. Hence, the same resource can be either renewable or exhaustible, which it nullifies the opposition between these two categories. In Mayhew's definition of renewable resource (2009, p425), the notion of natural time and rhythm of use are also present:

> [...] a recurrent resource which is not diminished when used but which will be restored, such as wind-energy. Renewable resources may be consumed without endangering future consumption as long as use does not outstrip production of new resources, as in fishing. In principle, wood is a renewable resource, but in the absence of well-planned management, short-term exploitation can induce environmental impacts or conversion other uses yielding results better likened to mining than sustainable use […].

This definition encompasses the main elements, as the notion of time, when it refers to the speed of use in relation to the natural renewal, and articulates the social and natural perspectives. The author uses the expression "In principle..." to refer to nature's dynamic, and then, to incorporate handling and use planning.

Subtly different from *rhythm*, resource exploitation *continuity* may jeopardize its renewability, because sometimes the threat is not in the speed of exploitation, but in its continuous exploitation, without truces, so that the natural recovering is no longer assured. Besides the notion of time (rhythm, speed and continuity), *spatial dimension* is essential to better understand the renewability of resources. Let us have a rainforest as an example: It is a naturally renewable resource in the human time scale, and so it will be if its use happens in a rhythm equal or inferior to its renovation. Yet, there is a spatial determinant. Depending on the deforestation scale, a rainforest cannot renew itself anymore

Figure 4ab - Different scales mean different possibilities of renewing.

The chances of a forest to recover are inversely proportional to the deforested area extension, once that renewing conditions as soil fertility and humidity stem mainly from the forest itself, besides the necessary genetic material to its regeneration.

Being the natural rhythms more permanent, the renewability of a resource depends mainly on social aspects, once humankind is who determines the rhythm of use. Yet, there are cases in which renewability depends on other factors, besides rhythm and extension of use. Recent studies on the Brazilian Caatinga biome have shown that this kind of vegetation renews itself with more limitations than others, because deforestation increases the soil temperature, and impairs the natural seeds germination on the soil. (Souza and others)[4].

If renewable resource is not synonymous with inexhaustible resource, because the first can be exhausted if the time and scale determinants are not favourable to its renewing, neither their opposites are synonymous. That is, non-renewable resource is not necessarily exhaustible. Some non-renewable resources occur in so large quantities that they happen to be inexhaustible. This is the case of raw materials (construction industry) that are the base of the Earth's material, or aluminium, the most abundant metal on the planet. And also, there are minerals which, besides existing in large quantities, as evaporites (salts) opposing the idea that every mineral is exhaustible or non-renewable. Finally, water, as one of the most abundant resources on the planet is inexhaustible.

3.3 Renewable or inexhaustible resources?

Wind and solar energy are imprecisely considered renewable. In the previous definitions, Park (2011) and Mayhew (2009) added renewable energy or wind-energy to their definitions of renewable resource. Yet, these definitions allude to *rhythm of use* and *stocks recovering*, issues that make no sense to solar and wind energy. Would the rhythm of the use of solar energy be equal or inferior to the rhythm of its natural renewing? Would the recovering of wind stocks be guaranteed by the adequate rhythm of wind-energy exploitation? The 'right conditions' mentioned in the previous definitions is a nonsense notion here, given that under *any condition*, much as humankind commits mistakes and whatever it is the rhythm and the speed of the imposed use, these sources will be emanating energy indefinitely. These sources of energy must be defined simply as *inexhaustible*. Otherwise, they would be in the same category of forests and species of animals, making the concept of renewable resources lose accuracy.

[4] Souza, B. I.; Macedo, M. L. A.; Silva, G. J. F. Temperatura dos solos e suas influências na regeneração da Caatinga nos Cariris velhos – PB. RA'EGA, 2015. (Temperature of soils and its influence on the regeneration of the Caatinga biome in Cariris velhos)

Figure 5ab – Wind and Solar energy: not renewable but ***inexhaustible*** resources.

We can include in this category of *inexhaustible resources* the geothermal energy, coming from the Earth's internal heat, the energy of tides and any other energy ruled by universal laws and that will never be extinguished, howsoever may be its handling and howsoever may be the rhythm of its use. That is, they are sources of energy that exist independently of mankind, and nothing mankind does may affect them.

David Thomas and Andrew Goudie, resorting to Rees (1990) focus on the difference between renewable and inexhaustible resources forming two categories, as in the definition below:

> Two categories of flow resources can be discerned: those where flows are dependent on human activity, and whose future availability may be compromised by excessive use […] and those where human usage has no impact on future availability. To this effect, Rees (1990) gave solar energy, air, water (at the global scale), wind and tidal energy as examples of the latter, termed non-critical zone flow resources, and fish, forests, soil and water in aquifers as examples of those in danger of losing their renewability through human actions. These can be termed critical zone flow resources, and in effect they can become stock resources if their ability to regenerate is compromised. (THOMAS; GOUDIE, 2000, p.205)

Then, according to the authors, the renewable natural resources lie on a *critical zone* where they can be exhausted by mismanagement; and in a *non-critical zone*, when they are independent from mankind and whose use does not reduce stocks. Those latter we classify just as *inexhaustible*.

3.4 The difference between renewable resource and naturally recyclable resource

Water is mistakenly defined as a renewable resource. Because this concept refers to *stock recovering* it is inadequate for define water, once its quantities have been stable on the planet for at least two billion years (Christopherson, 2012, p.1177). What happens to water is not renewing, but a continuous change of state and place due to the hydrological cycle. Water molecules can be in the ocean, then in the atmosphere, in glaciers, in the underground, in rivers and lakes. In addition, while passing from a state and from a place to another, it only performs a part of the cycle. Fragmenting this cycle results, inevitably, in a fragmented analysis. Considering only freshwater and defining it as a renewable resource (by atmospheric discharge), it is logically equivalent to accept that freshwater is being destroyed when rivers reach the ocean. In other words, water must be understood within the water

cycle. Doing so, it becomes easy to conceive water as a *naturally recyclable* and an *inexhaustible resource*, owning to its enormous quantity.

3.5 The difference between *renewable resource* and *reproducible resource*

Considering all organic resources as renewable, indistinctively, is unanimity. Park (*op cit*, p.378) includes forests and cultivation in this category: "[…] which has the ability to renew itself and be harvested indefinitely […]". Here, forest, reforesting, animals or livestock are in the same category in which, once again, the concept loses accuracy. It is incumbent on us to adopt a new category, because, differently from forests and animals that occur naturally, agriculture, reforestation and livestock have an important social component: the use of techniques that accelerates the natural processes. Godard (2002, p.207) alert to the difference, and he refers to the reproducible character of some resources, in order to differentiate them from renewable ones through natural processes.

Figure 6ab- Forests and crops are conceptually different, being respectively renewable and reproducible.

Reproducible resources are those whose rhythm of production is accelerated by techniques, as it occurs in agriculture and livestock. A sugar cane plantation, for instance, does not *renew by itself*, so it cannot be considered a renewable resource. Even fresh water, when desalinated by processes that accelerate the hydrological cycle, can also be defined as a reproducible resource.

4. RESULTS AND CONCLUSION

There is a wide variety of elements and aspects that occur in nature and that react differently to the different means of exploitation and use. Because of this, the natural resources analysis must always combine natural and social aspects in a contextualised way.

A fixed list of resources from one kind or another can be only an initial reference. Nevertheless we must take into consideration that the renewability of resources can be related sometimes to their natural proprieties and sometimes to the conditions of handling or both, which make renewability a flexible notion. Restricting the wide universe of natural resources to only two categories – renewable and non-renewable – means neglecting all possible variations, as inexhaustible resources, reproducible resources and naturally recyclable ones.

Here, we propose a division between *durable* and *exhaustible* natural resources. The first last for many reasons: either because they are renewable, reproducible, naturally recyclable or simply by being inexhaustible. The exhaustible resources are so, because their stocks are finite, or because are renewable subject to mismanagement. Hence, this is the proposal presented in the table below:

Table 1 – New classification of natural resources

NATURAL RESOURCES	
DURABLE	**Renewable** (forests, animals, soils in specific conditions, river stream energy, firewood, biogas, etc)
	Reproducible (agriculture, forestry, livestock, salt, freshwater, etc)
	Naturally recyclable (water, nitrogen, etc)
	Inexhaustible (solar, wind and geothermal energy, tidal, wave energy, aluminium, sand, rocks, salt, water, etc)
EXHAUSTIBLE	**Finite** (oil, coal, arable soils under specific conditions, etc).
	Renewable subject to mismanagement or overexploitation.

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