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Renewable Material Resources: A New Opportunity for the South

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Definition of the Renewable Material Resources- To come to a common background, let us define the renewable material resources (RMR). RMR are those resources of biological origin, sometimes called biomaterials [7]. The essential characteristic of these resources consists in that they are-or were-alive, i.e., a form of natural life and, hence, an ecosystem of its own right and a part of a larger ecosystem. This means that RMR carry, though in a miniature form, the genetic code of our "mother" nature and the cyclicity of life and death. A second important characteristic of these resources consists in that they are totally produced using the renewable energy of the sun via the photosynthesis process [14]. Here we are talking about the RMR of plant origin, which, are actually a manifestation of the great process of renewal of natural structures (micro and macro). The RMR of animal origin are-or were-those forms of organic life relying totally or basically on materials, produced by sun energy, i.e., RMR of plant origin.

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Renewable Material Resources: A New Opportunity for the South

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"The world has enough for everyone's need, but not for everybody's greed".
Mahatma Gandhi

I. Definition of the Renewable Material Resources

To come to a common background, let us define the renewable material resources (RMR). RMR are those resources of biological origin, sometimes called biomaterials [7]. The essential characteristic of these resources consists in that they are-or were-alive, i.e., a form of natural life and, hence, an ecosystem of its own right and a part of a larger ecosystem. This means that RMR carry, though in a miniature form, the genetic code of our "mother" nature and the cyclicity of life and death. A second important characteristic of these resources consists in that they are totally produced using the renewable energy of the sun via the photosynthesis process [14]. Here we are talking about the RMR of plant origin, which, are actually a manifestation of the great process of renewal of natural structures (micro and macro). The RMR of animal origin are-or were-those forms of organic life relying totally or basically on materials, produced by sun energy, i.e., RMR of plant origin.

The third important characteristic of RMR is that they are renewable. "Renewable" can be described as "being part of a relatively short ecosystem cycle", i.e. cycle which acts on a human or biological time scale [26]. But we should stress here that renewability is just a potentiality; the theoretical potentiality to be renewed into exactly the same form in the same place [31]. Therefore, actual renewal is conditional in the sense that it depends on (human) influences upon ecosystems. Over exploitation will lead to exhaustion or extinction of RMR. One also can talk about partial renewal, i.e., renewal in terms of the carbon cycle, but not in terms of nutrient cycles [31]. Here again renewal can be realized by the human intervention as in the case of use of fertilizers, the tissue culture or genetic engineering! Therefore, it may be necessary to differentiate between "natural renewal" and cultural renewal". Natural renewal occurs within totally natural eco-cycles without leading to their disturbance, i.e. preserving the resilience of the ecosystem [31], which is unrecoverable [23]. Therefore, proceeding from the precautionary principle including a sound skepticism regarding human intervention in nature: the natural renewal of RMR should be given a high priority as compared with cultural renewal. This gives a productive meaning to the concept of natural capital [23], which means that the preservation of the ecosystems is the guarantee of actual renewal of RMR, and hence their sustainable availability.

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II. Classification of Renewable Material Resources

Fig. 1 [13], illustrates a simple classification of RMR. This figure demonstrates the wide variety of these resources world wide. Here we have wide variety in species, as well as in the chemical composition and the physical and mechanical properties, depending on the specific ecological condition of each region in the world, the different practices of silviculture, the age of the resource, etc. Besides, this figure reveals the dispersedly character of distribution of these resources. This means that, apart from urban areas, there is no local community in India, Egypt, Germany or USA, without its own share of RMR. The combination of both characteristics: wide variety and dispersedly distribution provides a strong base for sustainable development, because it shows that each local community can find its own authentic role in the process of sustainable development. This figure also reveals a priority area: the economic use of the secondary products of RMR. The industrial market rationality made emphasis on the primary products of these resources, [13]. This short sighted vision has led to the neglect of use of most of the secondary products of these resources, leading to serious environmental effects, e.g., infestation by insects, burning in the field of agricultural crop residues, etc. But within the framework of sustainable development this represents a challenge. Proceeding from the concept of whole crop use [12], a quite new vision for the economic use of RMR could be developed making full use of the resource potential [31], of each component of the RMR.

III. Significance of the Renewable Material Resources within the Perspective of RIO

Let us view in the following paragraphs in which ways are RMR associated with Rio perspective? In Agenda 21, Chapter 3 is devoted to combating poverty

[15]. The objective here is to 'enable all people to achieve sustainable livelihood' [15]. To, fulfill this objective policies should address 'simultaneously issues of development, sustainable resource management and poverty eradication' [15]. When coming to specific cross-cutting measures of alleviation of poverty the necessity of empowering local communities was stressed, as well as the adoption of a community-driven approach to sustainability and within the framework of this approach: the establishment of 'a network of community-based learning centers for capacity building and sustainable development' [15]. Here, RMR were not mentioned "by name". But it is evident that RMR are those resources on earth within the reach of people everywhere. They need not to be excavated and thus they can be obtained locally without, necessarily, the interference of the government or big companies. Over and above, they can be reproduced locally by the efforts of local or indigenous people. It is not just the matter of material availability of RMR, but also the familiarity with- and the knowledge and technical heritage locally accumulated about-these resources. This is very relevant to the capacity building and technical development of local communities. It is much easier to transfer the technical ability of turning on a machine to a peasant in Upper Egypt or a Bedouin in the oases on a palm midrib his grandfather used in roofing, fencing and in crate manufacture than on steel he –and his fathers- has (have) never seen before in his (their) life. Therefore, RMR are intimately associated with capacity building, and I would add, empowerment of local communities. Empowerment in the above context extends beyond the political sphere to the sphere of knowledge, technical ability and economic power. These dimensions of empowerment, I believe, are more convenient to begin with in the conditions of many countries in the South, especially where democracy is absent. *To cut it short this means: to empower people begins via what they have more and know better about.*

Let us now turn to Chapter 4 of Agenda 21 devoted to changing consumption patterns [16]. Here special attention is given to 'the unsustainable pattern of consumption and production particularly in industrialized countries, which increases the demand on the natural resources' [16]. Within the framework of 'a multipronged strategy, it is suggested to reduce the use of the finite resources in the production processes and the wastage of these processes' [16]. This includes the increase of the efficiency (eco-efficiency) of use of non-renewable resources and their substitution, when possible, by the sustainable use of RMR. Meanwhile, the focus of attention on the fact that the basic consumer needs of a large section of humanity are not being met [16], shows that there is a great opportunity for innovation coming from the countries of the South, usually referred to as leapfrogging [21], especially if they follow the warning from emulating the production and consumption patterns that have been developed in industrial societies [16], and respond to the call to break with conventional Western values [21], in order to attain sustainability.

Within the suggested activities in Chapter 4 stress has been made on the reduction of the amount of energy and materials used per unit in the production of goods and services. Within this area of activity it was suggested to 'encourage the environmentally sound and sustainable use of renewable natural resources' [16]. Really, if we compare the Net Energy Requirements (NER) values in GJ/ton for a material derived from a non-renewable resource, such as aluminum, with that derived from RMR, such as wood or chipboard the values are: 198.4 for aluminum, 3.1 for sawn wood and 11.8 for chipboard [22]. This means that the sustainable use of RMR as substitute, where ever possible, for non-RMR could lead to a drastic shift in energy consumption. Over and above, it is suggested in Chapter 4 to develop effective ways of dealing with the problem of disposing of mounting levels of waste and materials' [16]. Here, RMR represent a clear advantage as compared with non-RMR. They are biodegradable, i.e., they could not represent waste problem if properly recycled or composted or effectively used as a fuel, in the case of which they will be CO_2-neutral [7].

Let us conclude. In Agenda 21, Chapter 3 an environmental policy focusing mainly on the conservation and protection of resources was considered inadequate, equally as a development policy focusing mainly on increasing the production of goods for the alleviation of poverty without addressing the sustainability of the resources on which production is based [15]. Therefore, the sustainable use of RMR could service within the perspective of Rio as an integrated approach: both for the conservation and protection of resources and the development of people in the local community viewed as a socio-cultural ecological system of its own right.

IV. Renewable Material Resources as a New Challenge for Engineering

Before the industrial revolution RMR played a dominant role in the social and economic life of all societies in the world. Before the appearance of the bourgeois class and the development of trade RMR were essential for the realization of self-sufficiency of local communities in satisfying their basic needs in shelter, clothes, food, etc. It wasn't until the First and then Second Industrial Revolutions that a drastic shift occurred in the dependence of man on RMR [13]. The shift to steam power, then electricity, the invention of the internal combustion engine and the revolution in industrial chemistry and in steel manufacture were the main factors behind the shift to reliance on non-RMR, [13]. Still 'around 1900, natural materials were practically the only alternative for the production of all types of

objects and technical products. Textiles, rope, canvas and paper were manufactured from domestic natural fibres such as flax, hemp, etc.' [2]. The rise to predominance of synthetic organic materials and of fibers, started in the 1920s [2].

Let me first point to the fact that the shift, from RMR to non-RMR gave quite a different "image" of the material and, hence, the product. A material from RMR expresses to some extent the identity of the natural resource. Sometimes it even reveals a part of the history of genesis of the resource, like the annual rings of trees in wood and the fibro-vascular bundles in bamboo, and transcends to you the message of finiteness of resources. This, I think, may have an influence on the behavior of the user/consumer of the product, I mean the value of frugality. In contrast, the image of a material from a non-RMR, like nylon or plastic is abstract. It does not have any imprint of nature. Therefore, a material from non-RMR transcends to you the message of infiniteness of the resource and, hence, the value of limitless consumption.

But the shift from RMR to non-RMR has had deeper implications. It was accompanied with a shift of many productive activities: from the South to the North and, in both, from rural to urban areas, where, new non-RMR industries were destined to flourish. The past 200 years model of industrialization relying on the exploitation of cheap raw materials without paying for the ecological consequences (ecological rucksack*) of extraction of resources, together with the growth of labor productivity from 50 to 100 times [4], has created a state of abundance of material goods and caused a tremendous rush in the pace of consumption. The present prevailing model of consumption is not a clear expression of the satisfaction of basic needs. From the behavioral point of view it is rather a process of conversion of people to purchase and possess as an alternative to self expression and innovation: in art and home production. You can buy and possess beauty, art and product, in a ready-made form. Consumption for consumption is intended to fill the gaps in your life leaving little for your free choice [4], for your search for the meaning of life and self-realization, and even more, for togetherness and communication with others**.

Now, why RMR represent a challenge for engineering? RMR are much less known in the world of engineering both scientifically and technologically. These resources are totally absent in present engineering curricula, which were tuned to non-RMR, such as steel and concrete [13]. A great rush of creativity and engineering effort is needed to compensate almost 200 hundred years of engineering negligence of these resources. It is clear that a qualitative shift in utilization of RMR needs an equal qualitative shift in knowledge, especially technical knowledge. We are not talking about traditional science and technology: what we need is a new vision for the role of science and technology to rediscover RMR [11], which means to find different-from traditional-forms of utilization of these resources that meet our needs at present without compromising the ability of future generations to meet their needs, i.e., forms of utilization consonant with sustainable development, [19]. This means that we need a new engineering mode of operation. Elsewhere [13], I talked in detail about what I called an engineering approach to RMR. But here I will just mention the general aspects of what I called now engineering mode of operation.

a) *If the shift to non-RMR meant the dislocation of industry from rural areas, the trend of rediscovery of RMR means the relocation and reintegration of industry in rural areas.* But this means the creation of new models for this process of reintegration. I will give several examples. In our experience on the industrial use of palm midrib we developed several concepts like: a) learning from local and indigenous people before teaching them, and really we learned a lot from them about the traditional uses and techniques of processing of palm midribs, which was invaluable to our further engineering work; b) tailoring of industry to the morphology of the local community [10], and we really found that the selection of the house as a site for industry was most appropriate, especially for women; this has had of course a great influence on the techniques we innovated and the machines we developed; c) we defined the appropriate technology[1] not just in technical terms, but also as a catalyst in development of people themselves [11].

Another example is associated with the use of agricultural residues in USA in composite panels. In an attempt to market this new trend the chosen heading was "it's dawn again in the grain forest [5]. In his article some motives behind the industrial use of agricultural resides are 'to solve the ills of small town North America suffering a slow steady decline due to low agricultural prices, lack of good employment for children growing up in those communities due to greater mechanization of steadily larger farming operations conspiring to consign many of these small towns to failure' [5]. Therefore, the use of agricultural residues in panels is not just for

* The total amount of natural materials disturbed and utilized in order to make a product available as a service delivery machine [4].

** The proportion of man-man communication in human communication in the West has dropped from 90% to 10% in 50 years [17].

1. Appropriate technology includes those technical inputs (tools, machines, techniques, training courses, knowledge, etc.) whether endogenously initiated or introduced from elsewhere that could be assimilated by the recipient community so that they may lead to the building up or strengthening of its endogenous technical capabilities [11].

solving the problem of burning of these residues or the technical quality of the product, but also 'a story of the "salt of the earth" values we associated with the agricultural community. It is people being allowed to live and prosper in their home communities' [5]. The third example is associated with the new vision of growing of crops for industry in EU. One of the main objectives of this trend consists in the revitalization of rural economy, where traditional agriculture and forestry no longer form the backbone of rural economics throughout the EU and where employment in agriculture is declining in both relative and absolute terms' [7]. The use of RMR systems as a basis for socio-economic process strategies for local and regional sustainable industrial development has been considered as a way to stimulate de-urbanization offering the farmer an attractive alternative' [31]. Therefore, there is a need to develop quite new concepts for the relocation of RMR-based industries in rural areas, like for example Bioregionalism[1]. This concept reveals a vision of industrialization quite different from that of early Industrial Revolution, because it searches for harmony with the rural community meaning with both society and ecology.

b) A wide variety of techniques and machines specific to each (or group of) resource(s) should be innovated. This means that a wide area of local innovation is opened all over the world, because need for development of unique-to-each-resource-techniques and machines would be better locally satisfied. Hereafter several examples.

i. As a monocotyledon the palm midrib has no radial rays like wood (di-cotyledon). The specificity in the anatomical structure of the palm midrib was the spring board for the design of a new machine, we called skinning machine [9], which could convert the date palm into a square-or rectangular-cross section strip using much more simple and safe tools than the disc saws, traditionally used for the cutting of lumber into strips. The aforementioned design suits very much home-based industry in villages.

ii. In order to manufacture oriented strand board from wheat straw it was necessary to prepare the straw avoiding chopping the strands of straw into very short lengths. In order to obtain long strands from straw a straw splitter [1], was designed to split individual straws longitudinally. Thus strands of straw of length up to 100 could be obtained, which guarantees high mechanical properties of oriented straw strand boards [1].

iii. During the investigation of the process of manufacture of composites from cotton stalks, it was found that the outer layer (bark) hinders the effective gluing of these stalks. Therefore, it was decided to design a machine for the removal of the outer layer of the cotton stalk. The first prototype of this machine has been accomplished.

c) The allocation of stages of processing and/or manufacture of RMR in rural areas may provide better advantages than urban areas: Either because of the bulkiness of these resources or perishability or that the country side provides better logistics and/or economic advantages than urban areas. Hereafter are several examples.

- Storage * Air drying.
- Bundling (tying into bundles). * Mat making.
- Baling (making of bales). * Threshing (in green or dry).

d) Innovation of new products from RMR making use of the unique properties of these resources. The relative ease of processing of RMR and the uniformity of their anatomical structure (e.g., the even distribution of fibro-vascular bundles in the palm midrib) could help realize good conformity between the functions needed and the design of the material/product to satisfy these functions. For example, composites could be made from strips from the outside layer of the palm midrib (having high tensile strength ~ 25 N/mm^2) and inner layers of less strength to satisfy both criteria of high strength and toughness. In our[2] methodology after evaluating the physical and mechanical properties of palm midrib as compared with beech and spruce woods our activity took the trend of development of new product lines for palm midrib, such as palm midrib-core block-board (as a substitute for spruce), Mashrabiah items (as a substitute for beech) and lumber like products (as a substitute for spruce and red pine [31]. Then we directed our research activity to determine the optimum process parameters for manufacturing the product. One of the supporters of our work[3], called our methodology: development and research, D & R and not R & D, claiming that it is more appropriate for the conditions of the

[1] Bioregionalism is the dominant political paradigm that allows social and economic growth within the carrying capacity of the land while being supplemented by inter-Bioregional trade. Nation states have given way to region states that have situated themselves with the necessary critical mass to be self-reliant and prudent regional traders. Bioregionalism is not utter self-sufficiency or the end of trade, but self-reliance in basic provisions for reasons including community security, ecological sustainability and personal fulfillment. While not abjuring material comfort, most Bio-regionalists advocate some level of voluntary simplicity; viewing modern consumerism as evidence of a spiritual world left by the shattering of human communities and their connection with nature. Restoration of community life within the greater community of nature is the core goal of Bioregionalism" [7].

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countries of the South, where the financial resources are limited. Therefore, it is more appropriate to proceed by opening a new avenue (or product) for the material utilization and testing the marketability of the product before making research.

V. The Role of Renewable Material Resources in Sustainable Development: Guide lines

a) *A holistic approach is needed. Such an approach should include the following measures*

i. The environmental consequences of the suggested form of utilization should be considered: both in the short and long runs. This is consonant with the sustainable development. Let us discuss the aforementioned measure on one of the recent technical "green" developments: bio-plastics. Bio-plastics, meaning biodegradable plastics could be manufactured from RMR, such as: whey, a by-product of cheese industry [29], agricultural waste (apple pulp, sugar beat pulp, skin of banana, potato-peels, etc.), agricultural residues (straw, jute, flax, hemp, etc.) [32], or even from fresh corn [7], which is very teasing for many countries in the South suffering from poverty and hunger. Suggested markets for bio-plastics include many disposables: from packages to cutlery, stationary items, medical ware to disposable green houses [29]. This technical development may be a good response to the increase of cost of 'taking back' packaging materials or the cost of incineration [29]. But if we all go 'green' and "Believe in bio-plastics" [3], the rebound effect [4] on the long run will surely upset the environmental gains of use of biodegradable plastics. More than that: what behavioral message does "Believe in bio-plastics" transfer to consumers? The message is as follows: "In order to go "green", you do not need to change yourself: consume and throw as you like: we have taken care of your waste. We will compost it properly'.

ii. *We should aim at the complete or integrated use of the resource potential [31].* The resource potential of a plant consists of levels of its different potential uses. The character of its resource potential depends on the number, variety, complexity, combinations and uniqueness of the plant and its parts. The possibility of use of the resource potential depends on the observer's reference framework, value systems, knowledge and experience [31]. The resource potential of the plant begins with its function as a natural material system performing certain ecological services. Some researchers [6], point to the need to evaluate 'the capital value of the ecological services provided by RMR as long as they are preserved in a viable state [6]. The integrated use of the resource potential includes, as well, the use of all its constituent parts. This means a change of the perspective from the product value to the system value meaning 'the whole use from harvesting to final product and waste after consumption' [31]. There may be different blueprints for applying the above mentioned rule depending on the specificity of socio-cultural context: from the level of a household feeding goats on palm leaflets manufacturing Mashrabiah items from palm midribs (thus substituting imported beech wood) and using the palm midrib residues for cooking in a house oven, to the level of a bioregion including a set of industries scattered around RMR and making full use of its parts [7].

iii. *It is most convenient that the cycle of production of RMR, their processing or manufacture and the consumption of their products be closed on the local level.* In Fig. 2, the interaction between production of RMR and their manufacture on the local level will mean less transportation costs and will stimulate the actual renewal of RMR. The interaction between the manufacture of RMR, probably in micro-or small-scale industrial establishments and consumers will guarantee harmony between the real basic needs of people and the design and manufacture of products, made to satisfy their needs. The interaction between the production of RMR and consumers will make them more ecologically conscious and will help set rules for using ecologically safe means of production of RMR and their fulfillment of the ecological services to the local community.

b) *Biodiversity and cultural diversity are two sides of the same coin.* Therefore, the preservation of the ecosystem vitality and resilience and the conservation of natural resources world-wide is intimately associated with the flourishing of different cultures in the would. As far as RMR are concerned, different cultures of the world evolved hand in hand with certain elements of the flora in each region. For example, papyrus was pivotal in ancient Egypt. It was used, not only for food and making of writing paper, but also in making sailing boats. Columns in the ancient temples in Egypt were made in the form of bundles of papyrus stems, symbolizing the significance of papyrus in the life of ancient Egypt. In Asia bamboo, rattan and rice were essential ingredients of the way of life there. In Europe wood played a dominant role in all the walks of life [13]. It is not by chance that the Weihnacht Baum (spruce tree) has such a spiritual value in Europe and the "berioska" (birch) tree in Russia. Therefore, giving the cultural dimensions due care means the tapping of the culturally accumulated experience on the growing and utilization of RMR, as well as the

participatory soul of people, for the preservation of the biodiversity and the ecosystem at large.

The dimension of culture, when viewing the culture as a set of subcultures, could work as well, on the local level. Therefore, it is necessary to give due care to this dimension within any policy aiming at preserving the natural resources. This has been clearly stated in Agenda 21, Chapter 3: 'an environmental policy that focuses mainly on the conservation and protection of resources must take due account of those who depend on the resources for their livelihoods' [15], i.e. their value systems should be respected and their endogenously formed patterns of social organization should be taken into consideration. I would like to give an example on the natural reserves. There is gathering evidence of the change of the management of natural reserves from absolute protection to a combination of protection and sustainable exploitation, thus reducing the contradiction between nature conservation and economic development [33]. The approach here is to turn reserve residents into a reliable force for conservation [33] by giving them an economic incentive. The introduction of new patterns of resource use and the improvement of traditional ones may serve as means for community development and thus reducing the pressure on the environment [33].

c) *Action research is needed to reveal and inactivate the wealth of experience and spirit of endogenous creativity of local community in sustainable use of RMR.* Imagination, creative thinking and selective inputs of science and technology may help in innovating modern patterns of sustainable use of RMR within the framework of development of the local community. Priority areas for the conduction of such a research should be selected to represent the different regions/cultures of the world, the most important RMR and the important technical heritage on use of RMR that is most in danger due to the present forces of globalization.

d) *There is a need to reread the cultural history with the purpose of rediscovery of historical experience, associated with the growing and use of RMR.* I am grateful to Weenen, H.V. for this idea and for encouraging me to study the ancient history of Egypt as a source of sustainable technologies. As he expressed to me: 'the idea is to assess technologies of the past, to learn from them, to build upon them and to add 21st century knowledge, in sight and technological experience' [30]. As an encouraging example, he pointed to a papyrus text of 600 B.C., written by Cleopatra, explaining how papyrus was recycled into card-board to be used as a replacement of wood, which at that time was very rare in Egypt [30]. The interesting point is that wood is still rare in Egypt even now! The significance of recalling the history of growing and use of RMR was implicitly mentioned in an EU report on 'Crops for Sustainable Enterprise [7], in talking about hemp as 'an old industrial crop that is currently being rediscovered having 25000 known uses and maize, which has 3500 uses [7]. The historical study on RMR is also important as a process of valorization of many RMR and local styles of life based on them, which were long condemned as inferior or backward as compared with synthetic materials and Western style of life associated with them. In our work with the palm midrib one of the obstacles we met was the dominant feelings of scorn and disrespect our artisans and professionals have to this material, especially because palm midribs, and many other RMR are associated with the poor as producer and as consumer [11].

VI. Renewable Material Resources: New Opportunities for the South

There is recently a surge in interest in use of RMR against the dominance of fossil-based materials and products that have been produced by the industrial world during the 20th Century [7]. A report was presented last year to the EU within the series of 'Design for Sustainable Development' [7], devoted to give a new vision of RMR as a feed stock for industrial production processes. Meanwhile, 'encouraging and positive shift is taking place in industry from continuing to exploit fossil-based resources to developing renewable resources' [7], as industrial materials. The strategic considerations behind this shift is the recognition that non-renewable fossil fuel-based materials contribute significantly to global warming and to air, land and water contamination' as well as to 'explore new production and exploitation methods that would enable us to fulfil our material needs even after fossil resources are exhausted' [7]. The same trend is strong in USA, though expressed differently. The United States of America gained global supremacy in the 20th century .. when the discovery and use of hydrocarbons radically transformed the world, that is why the 20th century can be referred to as "the Age of Hydrocarbons" [27]. The argument continues: 'Will the American economy and the American dream run 'dry' as the oil wells run dry? The vision proposes to have America lead the development of this hydrocarbon replacement: Carbohydrates' [27].

But why am I devoting this section for the opportunities RMR may create for the countries of the South?

- If the shift to non-RMR meant a shift of industrial activity from the South to the North, then the shift in use of RMR will mean a corresponding shift-or return-of industries to the South. There are already some writings foreseeing future competition between the North and the South in the production of long fibre crops for industry and

emphasizing the necessity of technological edge of the North to gain this competition [7].

- The shift of RMR-based industries from urban to rural areas may lead to higher developmental gains in the countries of the South, because a higher portion of the population still lives in rural areas: the percentage of rural population is 72% in India [20], 55% in Egypt [25] as opposed to 5.5% in EU [7].
- The traditions of growing and use of RMR are much better preserved in the countries of the South as compared with the developed world. It is not a matter of cultural or national pride, but rather a necessity of survival, since the modern, Western-styled non-RMR-based industry is until now incapable of satisfying the basic needs of rural population, as well as the poor in cities.
- It is foreseen that the global population in 2050 will be 9.5 billions, 8 of them in the developing countries!.

Let us now return to the main theme of the present section: *Why RMR represent new opportunities for the South?*

a) The North has made heavy investments in the use of non-RMR to develop their infrastructures and shape their life styles. They have over-industrialized their life using: concrete, steel, aluminum and plastics in all the walks of life. This, I think, represents some inertia in case of change, i.e., it is a little bit more difficult to "return" to RMR. In the developing countries: we have a different situation. I use here "developing" in the positive sense that we did not go that far along the way of unsustainable development, and we should feel less guilt concerning the environmental degradation world-wide. Most of the developing countries did not yet heavily industrialize; they did not yet develop non-RMR-material intensive infrastructures and cities. They did not yet even satisfy the basic needs of most of their population. They are, in rural areas, still living with-and near-RMR. Therefore, they don't have to "return" that much to be "green" or to be again with RMR and as an empty page challenges the creativity of an engineer, the lag in development may provide a bigger room far change and better chances for innovation.

b) As contrasted with non-RMR, RMR are easily locally available for people everywhere. This provides the potentiality for people, on the local community level to interact intensively with these resources. This, in turn, provides the possibility of development of micro-and small-scale industrial projects, based on RMR. Whatever the end-product is, *at least we have: from the field to the factory a wide spectrum of processes to be locally made on RMR.* This not only gives great potentialities for entrepreneurship on the local level, but also provides better conditions for the countries of the South to choose a pattern of sustainable development more in harmony with their cultures. I should add here that in most of these countries, the ecological conditions in arid zones call for much less material intensity for the satisfaction of basic needs: in shelter, clothes and food. This gives a better chance for use of RMR.

c) The rich biodiversity could provide within the framework of sustainable development important comparative advantages for many countries in the South. *The unique strategic advantage of each ecosystem may be exploited* to harvest plants which grow exclusively, or best, in that ecosystem. I will give an example from Egypt. 'The desert plants have developed over millennia adaptation mechanisms including the production of a host of secondary metabolites to protect them selves from physical and biotic aggressions. Such secondary metabolites like: falconoids, alkaloids, volatile oils and anthrquinons having multi-functions like antifungal, antiviral and antibacterial activities could protect the plant in its naturally hard conditions] [18]. 'A lot of research is now directed to the use of the desert plant extracts against different plant diseases, caused by microorganisms. For example, Asphodels fistulosus, a plant growing in North and South Sinai, gives very promising results in fighting different bacteria and fungal strains in concentrations ranging from 5 to 10 ppm. This supports the traditional medical practices performed by the Bedouins in using this plant as a healer for external ulcer and inflamed areas [18]. Therefore, considering the plant as the 'nature's green pharmacy' and that there is a growing trend world-wide to return back to the green nature believing that herbal remedies are safer and less damaging to human body than synthetic drugs [18], the desert plants may represent a comparative advantage for many desert regions in the countries of the South.

To generalize, the Non-Traditional Natural Products (NTNP) are commercial products elaborated locally from locally available plants but not including traditional commodity-type agricultural products, such as wheat, rice, etc. The concept of NTNP covers both concepts of Non Timber Forest Products (NTFP) used in the Natural Resource Management literature and the concept of Non Traditional Crops used in agriculture. The NTNP concept covers, as well desert areas, therefore it is much more versatile.

The area of NTNP is a vast area including dried medicinal plants; dried algae; vegetable oils obtained by mechanical extraction (argan oil, neem oil, shea butter):, essential oils obtained by steam extraction (eucalyptus, rosemary, lemon grass); coloring agents (indigo,

carmine); alcoholic extracts (ipecac); waxes, resins and gums. The significance of the area of NTNP is that it can be developed with both the objectives of conservation of biodiversity and the development of local communities. Besides, the livelihood of so many local communities still depends on NTNP. For example, in Rajasthan [24], 60% of NTFP is consumed by 50 millions tribal people and it constitutes 20-60% of tribal household earnings [24]. In addition, there is the wealthy technical culturally rooted heritage, associated with the collection and use of these resources. This heritage is of course a great edge in the development of new uses of these resources.

d) The concept of the value chain could be of great value for the countries of the South trying to improve the management-and increase their economic effectiveness of use-of RMR. The value chain concept 'describes the full range of activities that are required to bring a product from its conception through its design, its sourced materials and intermediate inputs, its marketing, its distribution and its support to the final consumer. In other words the chain can be seen as incorporating production, exchange, distribution and consumption from the cradle to the grave of a given product or service' [28]. This concept may have great significance for RMR, because many of RMR, especially the NTNR, are buyer-driven commodities, sold mostly in their raw state by the local traders and middlemen, who used to exploit this situation by paying to the producers little more than procurement prices [24]. There is a need to reconstruct producer-driven commodity chains with the purpose of adding value to these resources through their local processing. Besides, what has been called in chapter 4 the rediscovery of RMR means the innovation of quite new ideas of products and product designs to be made from RMR. This represents great chances for value addition via the creative efforts of local artisans and engineers. Our experience with the Mashrabiah project on use of palm midrib supports very much the concept of value chain as an important tool for the improvement of economic effectiveness of use of RMR.

e) The countries of the South have a great opportunity to have a considerable share in the "green" market. There are now widening strata of environmentally sensitive and socially aware consumers [21], who prefer "socially just" and organically grown produce [21]. The success of fair trade outlets [21] inspires us to extend the sphere of "green" products to those made from natural-fibre textiles, as well as to totally organic products from products of pruning of palms (from palm midribs, leaflets and coir), as well as products of pruning of fruit trees. The General Preferential System of the EU [8], giving preference to products from countries of the South produced in more environment-friendly way, is very encouraging in this concern. Returning again to the concept of "green" market: those environmentally sensitive and socially aware consumers, overwhelmed by over mechanization and over standardization of present industrial model need products:

- Expressing the identity of the resource they were made from and carrying the imprint of our "mother" nature,
- Carrying the touch of human hand, who made the product, a sense of handicraft;
- Expressing some culture, or, I would say, products with high cultural expressiveness could be better accepted.

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