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ENERGY AND RESOURCE SECURITY: SOME INSIGHTS



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ABSTRACT

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The import-export paradox emerges when countries, despite being rich in resources, are not willing to use their resources and in turn import them from other countries thus, depleting the other countries' resources. As a case study, the mining sector in India provides evidence of the import-export paradox as despite being rich in minerals, India imports three times its own production of the same. The growing global demand of energy only puts more stress on this issue and thus it is crucial to address this paradox in order to achieve energy and resource security. One of the ways for doing this could be by establishing a resource bank that treats resources as capital and by doing so it ensures that the resources being used are also being replenished. Steps can also be taken at G20 level to develop a cooperative framework to address the same. At the Indian level, initiatives such as the International Solar Alliance can be strengthened by increased allocation of finances in order to build greater capacities.

Contribution/Originality: This study is one of the few studies to have investigated the import-export paradox by drawing evidence from the Indian mining sector. This study's primary contribution is finding a solution to the issue of the paradox by proposing the development of a resource bank along with other initiatives.

1. INTRODUCTION

Energy security and resource security are important for augmenting growth a development in the developing world as much as enduring economic growth in the developed world. By way a context, certain stylized facts need to be placed upfront: (i.) When countries cannot meet their increasing energy demands domestically; their dependence on imports from other countries could have implications for national security. (ii) The implications of import dependence assume a new meaning in terms of reliance on its own resources at an affordable price for an energy-importing country. (iii) What is more, energy and resource security have important implications for inter-country economic relations too.

Against this backdrop, the paper focuses on some conceptual aspects of import-export paradox building on an earlier paper by [Das and Sharma \(2018\)](#). Thus, Section 1 provides an understanding on the concept of the import-export paradox that exists. In order to understand the issue at a deeper level the Section 2 defines and explains natural capital. Taking reference from the previous section, Section 3 attempts to understand the relation between natural capital and economic growth. Drawing from the above, Section 4 provides the dynamics of the energy and resource markets along with the global and Indian scenarios of the same. Section 5 builds on the preceding one and takes the case of mining in India to provide an evidence of import-export paradox. In the light of the above, Section 6 highlights the need to secure resources in a country by addressing the import-export paradox. The paper

summarizes the main findings by way of concluding observations in Section 7 and provides certain policy suggestions in Section 8.

2. IMPORT-EXPORT PARADOX: ANALYTICAL INSIGHTS

The concept of import-export paradox brings forth an interesting problem wherein countries tend to conserve their own resources for future use by importing them from other countries. This holds true in both resource-abundant and resource-deficient countries, as the latter are in anyway import reliant. Due to this, the other countries' resources are exploited and depleted.

This is a major issue because if all countries functioned like this, then no country will be willing to export and hence, no other country will be able to import resources. This will lead to an import-export paradox.

This issue has been explained further in the paper with the help of an example from India, where despite being resource-abundant in minerals, India still remains import dependent. The import-export paradox needs to be addressed in order to achieve resource and energy security. One way of addressing this could be by developing a Resource Bank that can monetize resources in a way that it ensures the resources that are being borrowed or lent are also being replenished.

The next section describes and explains the concept of natural capital.

3. UNDERSTANDING NATURAL CAPITAL

Today we are amidst of the fourth industrial revolution, which is exemplified by digital world, robotics, 5G networks, genetics, and others. All this has propelled the economic productivity, efficiency, and growth to a new level. This revolution has a major impact on our natural capital, as it tends to increase the burden on natural capital. On different fronts, including digital, material science, nanoscience, bioinformatics, biological advances, robotics, artificial intelligence, and so on, the dimensions of technology and their interactions with natural capital will be explored to fulfill the surge in demand. With this context, there is a need to ensure resource security in order to avoid any dire consequences caused by the ever-increasing demand for natural resources.

In this light, it is important to know the meaning of natural capital. Natural capital is defined and described in various ways, at core of which lies human well-being. [Daly \(1994\)](#) describes natural capital as “stock that yields a flow of natural services and tangible natural resources”. Likewise, [OECD \(2005\)](#) defines it as “the natural assets in their role of providing natural resource inputs and environmental services for economic production”. Whereas [UNEP \(2012\)](#) focuses on the components i.e., “Natural capital includes land, minerals and fossil fuels, solar energy, water, living organisms, and the services provided by the interactions of all these elements in ecological systems”. Natural capital is described to refer to all environmental assets by the System of Environmental Economic Accounting (SEEA) framework, shown in [Figure 1](#). Thus, natural capital comprises of ecosystem assets and natural resources implying that natural capital includes natural resources such as minerals and energy and has a broader scope than the ecosystem assets. Natural capital comprises of the building blocks that help in attaining economic growth and productivity and thus, holds immense significance. The recent report by [UNEP \(2021\)](#) elucidates how the SEEA framework is working on expanding and including natural capital and ecosystems into economic reporting. This is an integral step in recognizing the value of nature and providing a more holistic view in understanding the relationship that exists between the environment and the economy.

But increased demand for the resources may lead to scarcity or shortage in supply of these resources is critical towards the human well-being. Thus, resource-security holds great magnitude in meeting our needs. Inter-country trade and commerce and investment take on new meaning in this scenario as no country has capita in entirety—resources, financial resources, and human resources. For long-term growth, all countries, developed and developing, require various resources, which in turn will lead to growing competition for energy and other resources like better

technologies etc. When unable to meet these demands domestically, countries will depend on other countries, which will have consequences for national security.

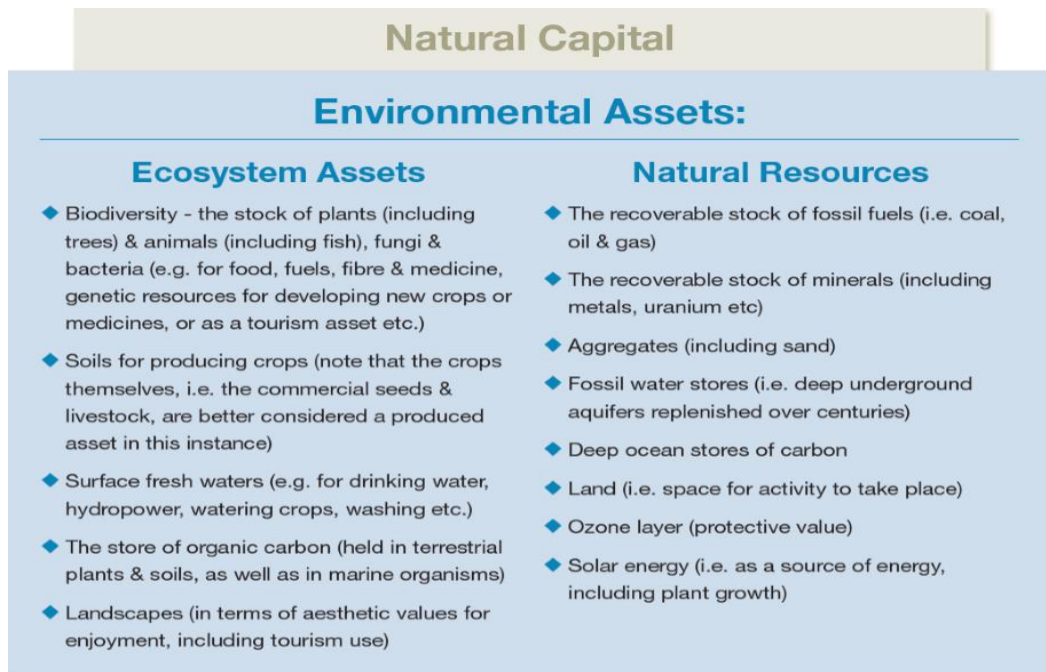


Figure-1. Natural capital: examples of ecosystem assets and natural resources.

Source: Towards a Global Map of Natural Capital: Key Ecosystem Assets, UNEP (2014).

There exists a strong link between natural capital and socioeconomic development of a nation. And depending on other countries for resources as mentioned hampers the national security. National security is defined by US (US Legal) is:

“The term national security encompasses within it economic security, monetary security, energy security, environmental security, military security, political security and security of energy and natural resources.”

The above gain highlights the significance of resource-security, not just in terms of availability but also affordability. One key issue with natural resources is how they are distributed. The degree to which a country is endangered by energy instability is determined by its disproportionate resource endowment and consumption pattern, which in effect creates a power hierarchy, where country with abundant resources is at the top of this hierarchy and the ones who are resource deficient are the bottom of this hierarchy and the transit ones are in the middle, which leads to clash of interests among countries as the former suggest that countries will try and conserve their own resources for a sustainable future and to be high up in the hierarchy ladder. Not just this, countries try and exploit other countries to meet with their current needs, via imports or foreign direct investment (FDI) or acquisition. This tendency to employ other countries resources and conserve its own is unsustainable as no country will be willing to export, subsequently leading to import-export paradox (Das & Sharma, 2018).

The next builds on this one and provides literature on the linkages that exist between natural capital and economic growth.

4. NATURAL CAPITAL: A FUEL TO ENGINE OF ECONOMIC GROWTH?

There has been extensive research on the role natural capital plays in economic growth of a nation. Auty (1993); Sachs and Warner (1997); Gylfason, Herbertsson, and Zoega (1999); Gylfason (2001) found an inverse relationship between the two. The resource curse also known as the paradox of natural resources, where resource-rich economies fail to benefit from the natural wealth. Cameron (2017) studied about Angola, which being a resource-

rich economy experienced this curse. Whereas Papyrakis and Gerlagh (2004) concluded that if natural capital is well managed, they enhance the economic growth.

In principle, with higher endowment of natural capital, economic growth and investment should increase but the literature suggests this is not necessarily true. This happens due to some associated problems with natural resources, like Dutch disease, which refers to the crisis in Netherlands due to discovery of large deposits of natural gases (Taguchi & Lar, 2016). In contrast, Botswana and Norway, resource-rich economies, have defied the Dutch disease theory (Stevens, 2003; Torvik, 2009). As per Vandycke (2013), if the resource-rich economies employ resource earnings for development of other form of capital (like human and physical) then only resource-rich economies can realize positive effect on economic growth.

It is also found that natural resources have negative effect on economic growth if they are coupled with weak institutions (Acemoglu, Johnson, & Robinson, 2001; Collier & Hoeffler, 2005; Isham, Woodcock, Pritchett, & Busby, 2003). In contrast to the situation when the institutions are strong, which employ revenues from resources for development and thus impact economic growth in a positive manner.

Thus, it's not just the quantity of resource or the resource endowment that plays an important role but also the institutions and management that helps an economy to reach new level of growth and development.

The next section talks about the energy market and the demand and supply scenarios that exist at the global and the national levels.

5. DYNAMICS OF ENERGY/RESOURCE MARKET

Humans derive numerous benefits through ecosystem services such as food, freshwater, regulation of weather and climate, recreation amongst others; and thus, depend entirely on nature for survival and economic prosperity (Dasgupta, 2021). It is estimated that around US\$ 44 trillion is moderately or highly dependent on nature and the services it provides (WEF, 2020). A collapse in some of the ecosystem services could lead to a reduction in global GDP of US\$ 2.7 trillion in 2030 (World Bank, 2021). Currently, humans are demanding 1.56 times more than the earth can regenerate (WWF, 2020).

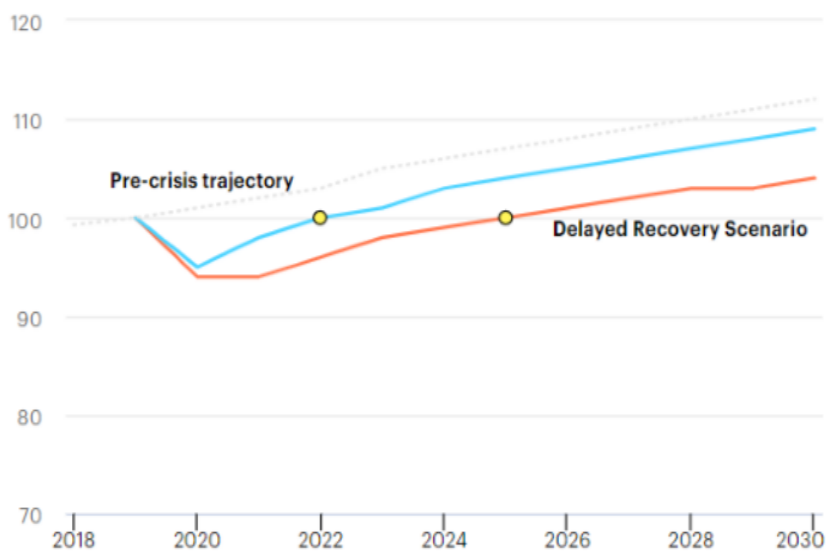
Given the nature of growth and development over the last century and especially in the past few decades, the importance of resource availability cannot be over-emphasized. As described before, growth of an economy is highly dependent on its resource use as well as consumption and on its institutions. With an increase in GDP, each nation needs added resources to sustain economic growth and growth rates. This holds true for both developed and developing countries. As we discussed earlier, every country does not have access to necessary quantity of resources, resultant, they import the same from the resource abundant economies. This is a cause of concern when viewed in the light of the import-export paradox. With growing demand and consumption patterns, this concern gets deeper.

5.1. Global Scenario

With the advent of Covid-19 pandemic, there is increased uncertainty in the energy sector. Extended restrictions have toned down the global energy demand but there is a ray of hope emerging in the dark with rollout of vaccines. As per IEA (2020), there seems to be an expected falls in 2020 of 5% in global energy demand, 7% in energy-related CO₂ emissions and 18% in energy investment. Also, oil consumption is projected to decline by 8% in 2020 and coal use by 7%. IEA projects the energy demand under two scenarios: Stated Policies Scenario (STEPS- wherein the assumption is pandemic is brought under control in 2021 and is based on the then present policy settings) and Delayed Recovery Scenario (DRS- where the pandemic has deeper and prolonged economic and social impacts) depicted in Figure 2.

Prior to the occurrence of Covid-19 pandemic, the global energy demand was increasing. According to IEA (2021a), global energy demand is expected to increase by 4.6% in 2021, compensating for the 4% contraction in

2020 and pushing demand above 2019 levels by 0.5% and 70% of this projected increase is expected to be in emerging and developing economies. Similarly, it is expected that in 2021 fossil fuel demand will rise, coal demand is projected to increase by 60% more than all combined renewables. Coal demand in 2021 is on the path to rise 4.5%, with around 80% growth in Asia. According to McKinsey and Company (2021), the global energy landscape is changing and transitioning and predicts that the demand for oil and gas are expected to peak in 2029 and 2037 respectively while the demand for coal is expected to decline steadily, as shown in Figure 3.



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- Pre-crisis trajectory
- Stated Policies Scenario
- Delayed Recovery Scenario
- Reaching 2019 levels

Figure-2. Energy Demand by Scenario, 2018-2030.

Source: World Energy Outlook, IEA (2020).

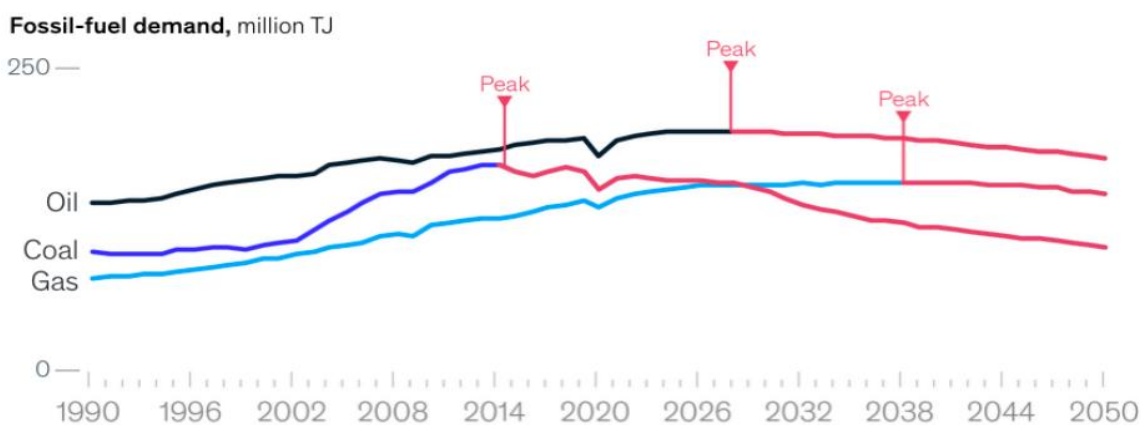


Figure-3. Fossil Fuel Demand.

Source: Global Energy Perspective, McKinsey and Company (2021).

However, it is evident that resources are limited and the predicted rise in supply would be unable to meet the potential needs of this rising demand. Non-renewable resources, take millions of years to form implying they are limited in stock, suggesting an unavoidable resource crisis if this escalating pattern for demand persists. Therefore, resource security is an important issue of concern in the future and for the future.

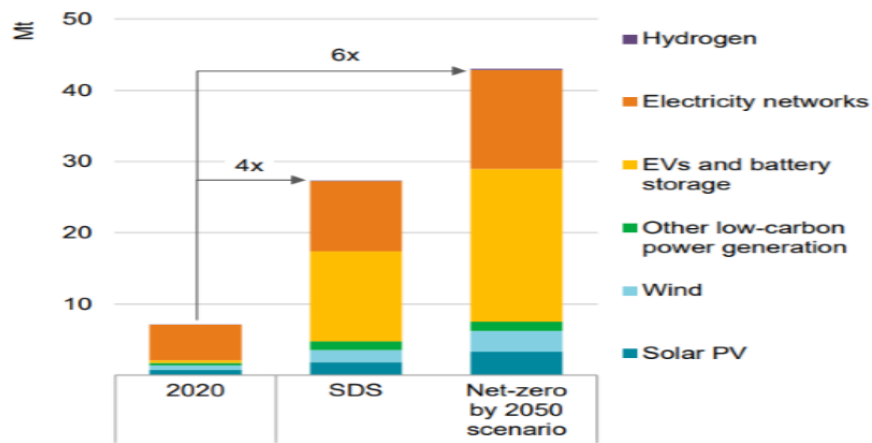


Figure-4. Mineral demand for clean energy technologies- Growth to 2040 by sector. Source: The Role of Critical World Energy Outlook Special Report Minerals in Clean Energy Transitions, IEA (2021c).

Similarly, the demand for minerals tends to increase over the years, especially with transition to the clean energy technologies. This is due to requirement of more minerals than fossil fuels in clean energy technology i.e., in building photovoltaic plants, electric vehicles, wind farms and others. With this transition in pace, clean energy technology is fitting to be the fastest-growing section of demand and this demand is expected to increase in future as well Figure 4. Growing significance of minerals in a decarbonizing energy system necessitates that energy policymakers broaden their perspectives and consider probable new vulnerabilities, which presents a unique set of challenges faced by minerals. Also, the price concerns along with apprehensions related to supply security persists in an electrified, renewables-rich energy system. As per the IEA estimates, in a scenario that meets the Paris Agreement goals, the share of total demand for clean energy technologies rises significantly over the next two decades, reaching more than 40% for copper and rare earth elements, 60-70 percent for nickel and cobalt, and nearly 90% for lithium. EVs and battery storage have already surpassed consumer electronics as the largest consumer of lithium, and they are on track to surpass stainless steel as the largest end user of nickel by 2040. These estimates further emphasize the alarming situation, which needs to be timely addressed for sustained global growth and development.

5.2. India's Scenario

Resource production and demand scenarios in India too pose an analogous picture as that of the world. India's energy demand is increasing at a fast pace as is the case with global demand. Prior to emergence of global pandemic Covid-19, the energy demand was anticipated to increase by 50% over the period of 2019 to 2030, but these estimates are now revised to be 35% under the STEPS and 25% in DRS. The key energy and economy indicators of India are well below the global average, although they have been steadily rising Figure 5, Appendix 1.

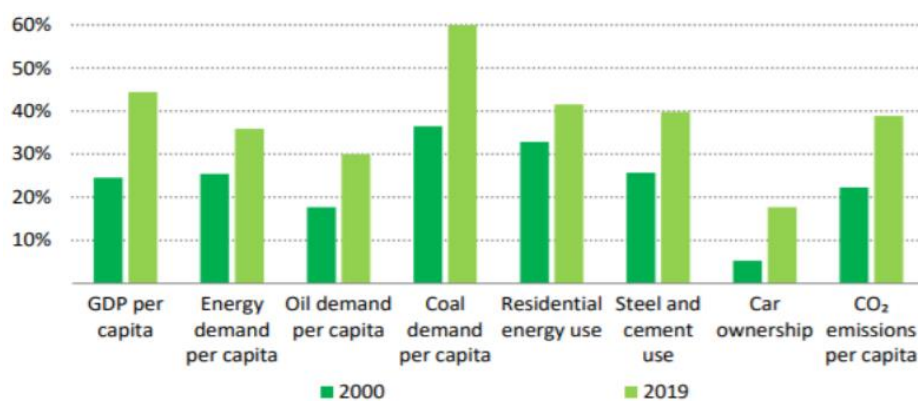


Figure-5. Key indicators in India as a percentage of global averages. Source: India Energy Outlook, IEA (2021b).

More than 10% of increase in the global energy demand is due to India, since 2000 and in per capita terms, the rise is more than 60% in energy demand since 2000. It is estimated that almost 80% of India's energy requirements are fulfilled by coal, oil and solid biomass (primarily fuel wood) where coal has the largest share in the mix (IEA, 2021a). India's domestic production Appendix 2 has been unable to meet its growing demands in case of fossil fuels resulting in high import reliance, especially over the past two decades Figure 6. This is cause of concern, as the resources globally are also limited. Even with the higher production (as given in Appendix 2), we will be unable to meet the increasing demand. This mismatch and the gap would imply increasing import of resources from resource-rich countries, thus making India import-dependent. To combat this, India is trying to boost its domestic supply by increasing the investment in the sector, but the complexity lies at the comparatively smaller domestic resource base. At the same time, it also important to note that the recent Indian initiatives of alternative sources of energies, such as the International Solar Alliance, biofuels, wind energy amongst other has the capacity to changes the energy mix in the coming years which can help in addressing the issue of the import-export paradox.

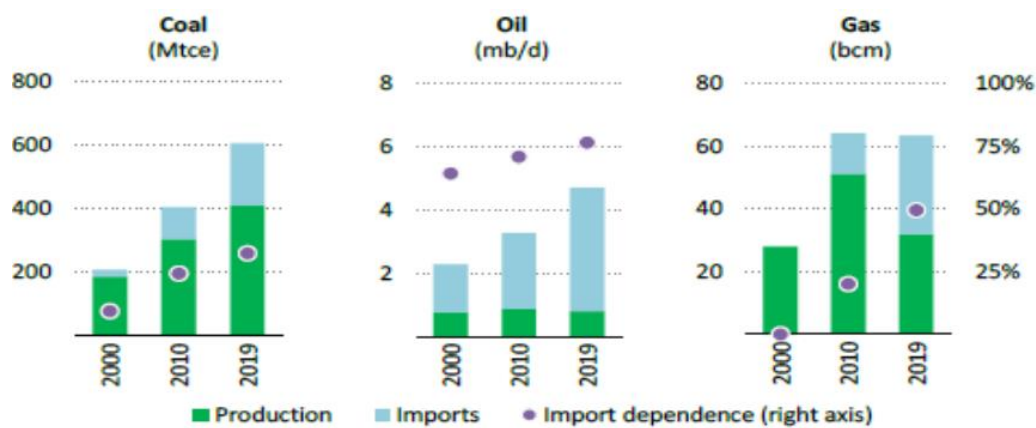


Figure-6. India's production and trade.

Source: India Energy Outlook, IEA (2021b).

Note: Mtce = million tones of coal equivalent; mb/d = million barrels per day; bcm = billion cubic metres.

The issue of import-export paradox is explained further with the help of an Indian case of mining in the next section.

6. IMPORT-EXPORT PARADOX: THE INDIAN CASE

Due to importance in the manufacturing sector, minerals play a role of valuable resource for any country. India is endowed with immense resources of minerals. As per Ministry of Mines, India produces around 95 minerals, including 4 fuel, 10 metallic, 23 non-metallic, 3 atomic and 55 minor minerals. Odisha, Rajasthan, Andhra Pradesh, Chhattisgarh are some of the top states in terms of value of mineral production in 2019-20 accounting to Rs 32841 crore, Rs 22776 crore, Rs 17906 crore and Rs 12032 crore respectively (Ministry of Mines, 2021).

With increase in clean energy technology, the demand for minerals has risen, not just globally but also domestically. With this increase in demand, India is importing around thrice its own production¹. India as a nation is rich in many minerals as discussed and is a major mining hub due to its richness in resources but is still import-dependent harming its current account balance. This is due to the various problems faced by the mining sector like acquiring land for new mines, procedural delays like delays in approvals by the government, illegal mining and many others. The sector shrunk by 0.6% during 2011-12 and 2012-13.²

Mining contributes to 2.7% in 2018-19 to gross value added (MoSPI), down from 3.2% in 2011-12, implying much of the wealth of the country remains underground and untapped. This can be attributed to constraints in exploration activities. There were blanket bans, clearance delays, land acquisition for new mines, delay in government approvals, environmental degradation produced by illegal mining which affected the mining sector per

¹ https://www.business-standard.com/article/economy-policy/mineral-rich-india-still-imports-thrice-the-value-of-its-local-production-118062200930_1.html

² <https://www.businesstoday.in/magazine/features/story/india-mining-rules-problems-government-policies-43026-2013-12-05>

se. Also, exploration in India is still a state sponsored activity. As a result, despite having fifth largest bauxite reserves, there has not been any large bauxite mine opening in the last 35 years and most of the other bauxite mines are unexplored and unutilized. India is also rich in gold and copper reserves but there has not been much investment in the same.

Import-dependency despite being resource-rich is due to non-utilization of resources. Thus, simplification of procedures and policies, efficient functioning is required, for India to capitalize its resources in an effective way. Thus, we can say that natural resource exploration and development is required to eradicate poverty and unemployment, which can be attained via investment in the exploration and development.

In light of the above discussions, the next section reiterates the importance for resource security and suggests the development of a resource bank in order to address the import-export paradox.

7. COOPERATION FOR RESOURCE SECURITY

Resources have a double-edge effect on growth, i.e., increased intensity of use increases the output and hence growth but at the same time, it increases its depletion rate. As described in the previous sections, there is anticipation of global demand and supply gap and hence it is vital to confront the issue of resource and energy insecurity. One of the possible solutions, that we are using constantly is trade, wherein, resource-deficient nations can import from the resource-rich countries and vice-versa, with benefit accruing to both. But all countries have a tendency of conserving their own resources for future use and exploiting others, which has been explained earlier and was referred to as the import-export paradox. This tendency is flawed and unsustainable. Not just this, trading the resources as a measure to treat resource-crisis also has another limitation, i.e., the resources are treated like products when traded instead of natural capital.

As mentioned previously, energy/ resource security is vital as it is affecting the power play globally and affects in the growth and development of the countries. It is not just the quantity that needs to be ensured but also the affordability needs to be taken care of. With time passing by, even the resource-rich countries by exporting the resources and meeting the growing demands of limited resources, will tend to become resource-deficient. Thus, there is an issue of sustainability. One of the possible solutions to this issue is monetizing the resources via resource bank (Das & Sharma, 2018). Resources need to be treated as capital by the banks, i.e., the concept of 'buying of resources' need to be replaced by the concept of 'borrowing of resources'. By borrowing the resources, the exhaustible nature of resources is made inexhaustible just like capital. This is under the assumption that total resources remain constant. The theoretical underpinning of the above-mentioned solution dates to 1930s. According to Hotelling's rule, the most profitable social and economic mining route for non-renewable resources is the route in which the price of resources (determined by the marginal net income from resource sales), increments at the pace of interest (Hotelling, 1931). As per the basic version of the model, with time resource rent should increment at a pace equal to interest rate. Higher rate would not work, as it would lead to faster price rise and lower depletion of the deposits. We are aware that, capital either on spending or with inflation gets depleted. Conversely, it grows and does not deplete with lending or investing. Based on rule, resources can be lent in manner that they are not depleted. Not just this, Daly (1990) mentioned that to achieve sustainable development in case of non-renewable resources, one must invest in every period, a portion of his income from extraction in renewable alternatives. Therefore, when non-renewable resources are economically depleted, a renewable alternative has been established whose production capacity is the same as the production capacity of non-renewable resources at the beginning of mining. This is also known as one of the operational principles of Daly. In meeting the sustainable use of the resources, we must keep in mind the weak and strong sustainability approach. The former approach considers renewables and non-renewables as substitutes of each other. The approach states that the total resource (renewable + non-renewable) should be non-declining. In contrast to this, the latter approach, it is necessary to maintain a non-decreasing stock of non-renewable resources.

Adopting the above theoretical basis ensures that we create an additional supply (using the interest received by treating resources as capital and using this to replenish the depleting resources and thus creating an additional supply) and promoting a conservation behavior amongst the users (as they now pay, interest which can be treated as a penalty for depleting the resource, which will inculcate conservation behavior to avoid the financial burden). Some concluding observations have been highlighted in the next section followed by some policy suggestions.

8. CONCLUDING OBSERVATIONS

Natural capital plays an important role in economic prosperity as the humanity depends on nature and ecosystem services for its survival. However, the abundance of natural capital does not necessarily ensure economic growth without effective management and institutional support. On one hand, while, with the help of resources countries can achieve economic growth, on the other hand, the continuous use of resources depletes its reserves.

Furthermore, there exists an import-export paradox wherein despite being resource-abundant, countries tend to import from other countries to preserve their own resources. This is an unsustainable practice. This has been explained by taking the case of mining in India, as despite being rich in minerals, India remains import-reliant by importing three times of the minerals it produces. This can also be due to non-utilisation of resources and can be curbed through efficient functioning and simplifying policies.

Globally, the energy scenario has been changing and it is expected to be increasing in the future. The global energy demand is projected to increase by 4.6% in 2021 from 4% in 2020. Similarly, with increasing clean energy technologies, the demand for minerals is also projected to rise in future. This will put more pressure on the world's resources. In India, the energy demand has been growing at a rapid pace contributing to more than 10% increase in global energy demand and most of its energy demand is fulfilled by coal, oil and biomass. Due to low domestic production of fossil fuels, India remains dependent on imports. However, the recent initiatives of alternative sources of energies in terms of International Solar Alliance, wind energy, ethanol and biofuels has the potential to alter the energy mix and thus, address the import-export paradox.

Resources play an integral role in the growth and development of an economy. It is integral to ensure energy efficiency and resource security and overcoming the import-export paradox. One way of doing so could be by developing a resource bank that monetizes the resources where they can be treated as capital. The lending and borrowing of resources will ensure the replenishment of the resources.

9. POLICY SUGGESTIONS

Based on the study and its primary conclusions the following policy steps are suggested:

1. Creation of an International Resource Bank
2. The concept of resource bank could be worked upon through forming a coalition of UNEP, IEA, OECD, World Bank etc.
3. At the G20, the issue of energy and resource security including creation of a resource bank but not limited to needs to be deliberated upon more comprehensively and in a cooperative framework
4. The Indian initiative for the International Solar Alliance needs to be strengthened by commitment of greater allocation of financial resources and augmentation of capacities especially in the developing world

A study maybe launched to further explore how initiatives such as International Solar Alliance and the concept of Resource Bank could be blended.

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Appendix-1. Energy Demand by scenario.

	2000	2019	STEPS		SDS		IVC	
			2030	2040	2030	2040	2030	2040
Primary energy demand (Mtoe)	441	929	1237	1573	994	1147	1153	1526
Total final consumption (Mtoe)	315	621	853	1123	703	843	783	1075
Electricity demand (TWh)	369	1207	1959	3146	1922	2980	2087	3433
CO2 emissions (Gt)	0.9	2.5	3.2	3.8	2.4	1.8	3	3.4
Coal demand (Mtce)	208	590	712	772	454	298	660	712
Power generation	147	397	453	444	232	60	371	362
Industry	37	141	198	255	169	185	193	240
Natural gas demand (bcm)	28	63	131	201	144	210	159	260
Power generation	11	17	25	33	49	61	62	95
Industry	4.3	24	61	106	50	84	60	107
Buildings	0.3	3.9	7.3	11	5.2	7	9	15
Transport	0.1	4.1	9.2	12.1	9.6	11.9	10.9	15.6
Low-carbon gases (bcm)	0	0	6.4	21	20	47	10	31
Oil demand (mb/d)	2.3	5	7.1	8.7	6.2	5.8	7	8.3
Road transport	0.6	1.9	2.9	3.8	2.4	2.1	3	3.8
Aviation and shipping	0.1	0.2	0.4	0.6	0.3	0.4	0.4	0.6
Industry and petrochemicals	0.6	0.9	1.5	1.8	1.2	1.3	1.4	1.7
Buildings	0.4	1	1.3	1.4	1.4	1.1	1.4	1.5
Biofuels (Mboe/d)	0	0	0.1	0.2	0.2	0.2	0.1	0.2

Appendix-2. Fuel supply and production by scenario.

	2000	2019	STEPS		SDS		IVC	
			2030	2040	2030	2040	2030	2040
Coal production (Mtce)	187	409	519	560	304	161	472	515
Steam coal	163	369	474	512	270	133	428	470
Coking coal	16	25	23	24	23	23	23	24
Lignite and peat	7.9	14	22	23	11	5.2	21	21
Coal trade (Mtce)	-20	-196	-193	-212	-151	-137	-188	-197
Natural gas production (bcm)	28	32	55	78	52	66	65	101
Conventional gas	28	30	47	53	47	55	48	62
Coalbed methane	0	1.3	5.7	12	4.7	11	5.9	16
Other production	0	0.3	2	13	0.4	0.2	12	22
LNG imports (bcm)	0	30	76	124	92	144	93	159
Oil production (Mb/d)	0.8	0.8	0.6	0.6	0.5	0.4	0.7	0.6
Conventional crude oil	0.6	0.6	0.5	0.4	0.4	0.2	0.5	0.4
Natural gas liquids and other	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.3
Refining capacity (Mb/d)	0	5.2	6.4	7.7	5.8	5.7	6.4	7.7
Refinery runs	0	5.1	5.9	7.2	5	4.6	5.8	6.8
Other fuels (Mtoe)								
Traditional use of solid biomass	113	113	85	63	0	0	0	0
Modern solid biomass	35	67	93	112	95	117	98	116
Biofuels	0.1	1	5	10	9	14	5	10
Biogas, biomethane, low-carbon hydrogen	0	0	6	19	18	48	10	31

Notes: Nuclear fuels not included. Other natural gas production includes shale and tight gas.

Source: India Energy Outlook, IEA (2021b).

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