

SUSTAINABLE DEVELOPMENT: UNDERSTANDING THE LEAST RESOURCE BASE

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ABSTRACT. In the paper, the least resource base required to ensure isolated human habitat sustainability over a historically long period of time is discussed. Territory and energy are proposed as such basic resources. The analysis of isolated societies of Tasmania, the Chatham Islands, and North Sentinel Island concludes that habitat can exist long and sustainably in a local area of at least 30 square kilometres in a mode of inherent safety, without the use of artificial technologies. This conclusion demonstrates the possibility of sustainable development of human civilization as a sum of local communities in the context of the isolationism paradigm, an alternative to globalism's currently dominant concept. The significance of identifying the least resource base of sustainable development of isolated communities in the context of the establishment of scientific bases and settlements in remote areas of the globe, on the Moon and other planets of the solar system, and developing strategies to combat pandemics such as COVID-19, is highlighted.

KEY WORDS: Sustainable Development, isolationism, resource base, habitats

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INTRODUCTION

Sustainable development is the 'Holy Grail', fundamental worldview paradigm of modern civilization and one of the five most important priorities of the UN. This versatile and holistic term could be defined as «development that meets the needs of the present without compromising the ability of future generations to meet their own needs» (World Commission 1987), or «development that promotes prosperity and economic opportunity, greater social well-being, and protection of the environment» (UN.org 2017).

The vital importance of sustainability for societies, cities and humankind in general is obvious and hardly requires any elaboration. However, until now sustainable development has been more a declaration of intentions rather than established policy (Braun, Whatmore 2010). The entire history of civilization, especially modern history, looks more like a chain of severe crises rather than sustainable growth. The most recent significant global crisis is a pandemic caused by the COVID-19 virus (WHO.int 2019), which has spread throughout the world since the end of 2019. This has led to many thousands of deaths (Gisanddata.maps.arcgis.com 2020) and huge financial losses, it devastated world economy and severely impacted global sustainable development; this crisis is far from being overcome at the time of preparing this article.

There are numerous technological, political, etc. obstacles to sustainable development, but lack of understanding of the nature of biological and social processes should be considered as the most serious one. There are no satisfactory models and even comprehensive definitions of the key biological, social, or environmental concepts, systems and processes, including the definition of life itself (Pross 2011; Chodasewicz 2014). There are no theoretical models that would allow to identify possible threats and risks to sustainable development, forecast them and quantify risk factors in advance, although we live in a risk society (Beck 1992). There is no methodology to predict new types of challenges except the extrapolation of crises of the past, which inevitably leads to biased forecasting and planning. The contradiction between the obvious existence of threats and risks to sustainable development, on the one hand, and the impossibility of their scientific description, on the other hand, becomes a major factor of insufficient decision making. Demarcation of the boundaries between science and common sense (Gieryn 1999) is still an issue, which is ought to be resolved. These problems are well recognized, there are attempts to describe and categorize a wide range of possible risks and threats facing humanity, some of them are thought-provoking (Wells 2009), but inevitably speculative. The existing definitions of the term «sustainable development» are also vague, controversial and leave a lot of room for interpretation.

Inconsistency of sustainable development concept compels us to consider its premises, defaults and prerequisites, which are usually not mentioned in the definitions, but are integral and inherent parts of the whole paradigm. One of the most fundamental defaults is the concept of globalism, that could be described as a «network of connections that span multi-continental distances» (Nye 2002). Sustainable development is usually coterminous with globalism, assuming that the response to global and, therefore, universal challenges to sustainability should be universal and global as well. The intrinsic relations between the concepts of globalism and sustainable development are manifested many times – for example, from the perspective of forecasting environmental aspects of global sustainable development (Krapivin, Varotsos 2007).

Globalism as a representation of global interconnectivity and transboundary processes of commons (Middleton, Ito 2020) requires a unification of economics and cultures throughout the world. An alternative approach for ensuring sustainable development is isolationism. Possibly, effective governance should flexibly combine both approaches. Indeed, globalism implies progress of the civilization by the means of free exchange of products and sharing of the best practices for the benefit of all humankind. Instead, isolationism is focused on defending civilization through the proliferation of cultural models and, especially, preventing the spread of local crises to the rest of the world. (Heinonen et al. 2017). The vital importance of the isolation is clearly demonstrated by the fact that the global response to the severe COVID-19 crisis (Filetti 2020) and other epidemic threats (Brown, Labonté et al. 2011) leads to temporal fragmentation of the world with severe limitation of world trade and free movement of people as an ultimate remedy. In general, this isolation could be extremely long.

Therefore, it seems necessary to study the question of what is the least resource base for maintaining the sustainable development of human culture for a historically long time without the risk of its degradation. Solving this problem is important in both academic and applied aspects. Also, this research agenda matches with the Sustainable Development Goal #11 «Sustainable Cities and Communities» (sustainabledevelopment.un.org 2015).

From an academic point of view, the answer to this question will allow us to assess the lower limit for the autonomy of the human community in terms of various basic resources that are necessary to support its existence for a historically long time with the natural, risk-free processes. This data could also be valuable for designing isolated scientific bases and habitats, forecasting measures to eliminate the consequences of natural and man-made disasters, planning scientific exploration of other planets, etc.

Of particular importance in this regard is the question of the resistance of isolated settlements to factors that we cannot estimate even roughly, such as their ability to resist the combined impact of biological and societal processes: emergences of new infectious diseases, vulnerability to genetic degeneration in closed populations, sustaining cultural models, etc.

A special aspect and area of application of the results of the study is the design of habitable bases in remote areas of the Earth (in the Arctic and Antarctic, on the ocean floor, in mountainous areas), in space, on other planets, etc. Currently, the possibility and feasibility of creating long-term habitable scientific stations on the Moon and on Mars – and, potentially, on other bodies of the Solar system – is widely discussed (Cohen 2015); there is even futuristic concept design of floatable space stations for deploying in Venus atmosphere (Linaraki, Oungrinis 2013). Such stations will have to ensure the life of the teams for

a long time and in conditions of complete isolation from the overseas bases. They should be resilient to a wide spectrum of external impacts, including physical ones (meteorites, radiation, etc.). Moreover, such stations may be isolated from the Earth due to numerous technical factors. There are studies of resilience aspects of long-term manned space missions (Schwendner et al. 2017; Oluwafemi et al. 2018). Nevertheless, it is necessary to consider the possibility of assuring sustainability of distant habitats in case of long-term isolation.

MATERIALS AND METHODS

Today, sustainable development is often understood in the context of technological development. Technology is thought of as an implicit background of society. This approach, however, is methodically controversial since the time horizon of technological development of mankind is quite small and its benefits are questionable to say the least. It is difficult to conclude about the long-term consequences of technological development. In this scope is reasonable to study the concept of sustainable development in the broadest possible context regardless of the technological perfection of the investigated cultures. Therefore, comparative indicators are required.

The main objective of the study is to empirically assess the lower threshold of the resource base used by an isolated community, which is sufficient to ensure its long-term sustainable development. The context of the study includes an attempt to determine which of the two possible alternatives for sustainable development – globalization or fragmentation – is the most effective strategy of ensuring the security and sustainable development of humanity in the scope of unpredictable threats, risks and challenges, as well as forecasts of the long-term consequences of the humankind development within the current technological and urban paradigm. One of the conditions for setting this task is to verify that sustainable development on a limited resource base is possible and to roughly estimate the «quantum» of the least resource base.

There are many obstacles to solving this task. The term «resource base» needs to be clarified and defined. It should be acknowledged that there is currently no comprehensive, exhaustive and scientifically substantiated list of resources required for sustainable development. It is not easy to determine the size of this resource base in the scope of trade relations with other societies. Non-intrusive study of other cultures, especially those radically different from the world's dominant ones, also poses a major challenge. Finally, any study of sustainable development requires confirmation on a significant time horizon, which exceeds that of modern science. Under these conditions, it becomes necessary to involve additional retrospective material, which becomes extremely problematic in case of isolation of the community under research.

In addition, a fully theoretical, model-based approach to solving the problem of estimation of the least possible resource base for sustainable development seems unachievable at the current level of science due to a lack of understanding of the nature of biological, social and even geographical entities and structures – especially considering the whole variety of interactions between them. (Girard 2020). Current models are hypothetical and controversial to say the least. There is no clear vision of biological and environmental factors of risks, as it was clearly unveiled by the COVID-19 and other virus pandemics and their long-term consequences for humankind.

In this situation, it seems reasonable to propose a conservative approach based on a combination of non-intrusion empirical, observational, forensic and comparative methods to roughly estimate a few vital parameters required for long-term sustainable development of existed human

societies in real Earth conditions, and subsequently improve this estimate recursively.

The proposed methodology is based on the concept of inherent, or 'passive', safety as an approach for supporting sustainability only with natural resources, without any potentially vulnerable technological systems; systems should return to normal state only by the means of natural laws, without any intentional actions that involve application of external power or forces. This vision of the inherent safety concept became very popular in the modern nuclear industry as a response to the Chernobyl and Fukushima nuclear incidents. Reliance of system must be «placed on natural laws, properties of materials and internally stored energy» (www-pub.iaea.org 1991).

The use of this heterogeneous methodology requires vast interdisciplinary approach and aggregation of volumes of data that describe different aspects of human societies in a situation of complete isolation by studying in situ societies that survived isolation for a very long time.

This task is also a great challenge since it is necessary to find a culture, regardless of its technological maturity, that was sufficiently isolated socially and geospatially for long (from a historical point of view) time, but at the same time that has been sufficiently studied to prove that it is or it was isolated. Of course, both requirements contradict each other. In addition, this study can only be carried out based on modern, approved and verified data, since the reliability of historical information about isolated cultures, especially ancient ones, raises reasonable doubts.

Moreover, at present isolation is a relic, as all societies are increasingly and even definitively involved into the world governing infrastructure and interconnected as networked localities (Ito 1999) with each other by world trade, unification of the economics, migration, information exchange, adopting universal social standards and other factors.

Another challenge is identifying a set of vital measurable parameters relevant to sustainability issues. Such parameters can hardly be considered due to the difficulties of accurately measuring them in closed, isolated communities. At the same time, the assessment of community resilience to biological, medical, and genetic threats is of particular interest and is of paramount importance, since until now our understanding of the dangers of epidemics and how to counter them is formed ad hoc, based on available empirical data (Bardosh et al. 2017).

As a mandatory condition, it should be specified that a sustainable society that exists in a limited area should not use any non-renewable resources and/or materials, such as crude oil, coal, metals, etc. Also, trade, migration, etc. should be excluded.

Under these conditions, it seems reasonable to try to determine the general physical and geospatial factors that limit the effect of other factors, which could be measured empirically and using remote sensing methods. These factors should be

a part of a framework and encapsulate the effect of all other factors that affect the functioning and sustainability of societies. Others factors, like cultural ones, related to maintaining a balance between natural resources and human practices (Rappaport 1984) require further research, but also deserve proper attention and relevance, especially in the context of isolated human settlements.

Therefore, it makes sense to choose two factors – one geospatial and one physical. The geospatial factor can be the area of the habitat that supplies natural resources for its existence. For the physical factor is reasonable to choose the mean amount of energy that is dissipated in this area and provides society with renewable resources. From a methodological point of view, it is possible to obtain the values of these two parameters. It is possible to determine the area, for example, using remote sensing data. The amount of energy dissipated within a given area, in the absence of significant thermal energy flows, is completely determined by the integral flow of solar energy, which depends on latitude and the season and varies slightly from year to year. The use of non-renewable energy sources in this study is excluded since it contradicts the considered paradigm of sustainable development. Nevertheless, when the analysis focuses on the human settlements on the Moon/Mars and other celestial bodies, some changes must be taken into account. Many studies related to the human exploration of space foresee the use of nuclear power to supply the necessary level of energy to the human settlements and guarantee a long period of the permanence on the celestial body. The use of such kind of energy source does not necessarily contradict with the concept of development in space. Furthermore, some energy sources which can be considered not acceptable for sustainable development on Earth may emerge as adequate for the sustainable development in space. For example, on Mars, the use of carbon dioxide, which is available in the atmosphere of the red planet and causes pollution on Earth, is essential for the production of oxygen, necessary for the life of the humans and for the process of «terraforming», which will provide Mars of an «earth-like» environment.

The list of isolated cultures that currently exist or have existed on a limited land base in the recent, well-documented past, is very short. According to some rough estimations, there are nearly 100 isolated indigenous societies in the world today (BBC.co.uk 2008). Half of them, circa 50 tribes, are situated in lowland South America (Walker, Hill 2015) and include 28 isolated settlements with a total population of about 1700 in the Amazon basin in four Brazilian states, which were unveiled by the means of remote sensing data (Kesler, Walker 2015). At least two Indian officially scheduled tribes (Tribal.nic.in 2018), Jarawas and Sentinelese, both on Andaman archipelago, remain a high degree of isolation up to now.

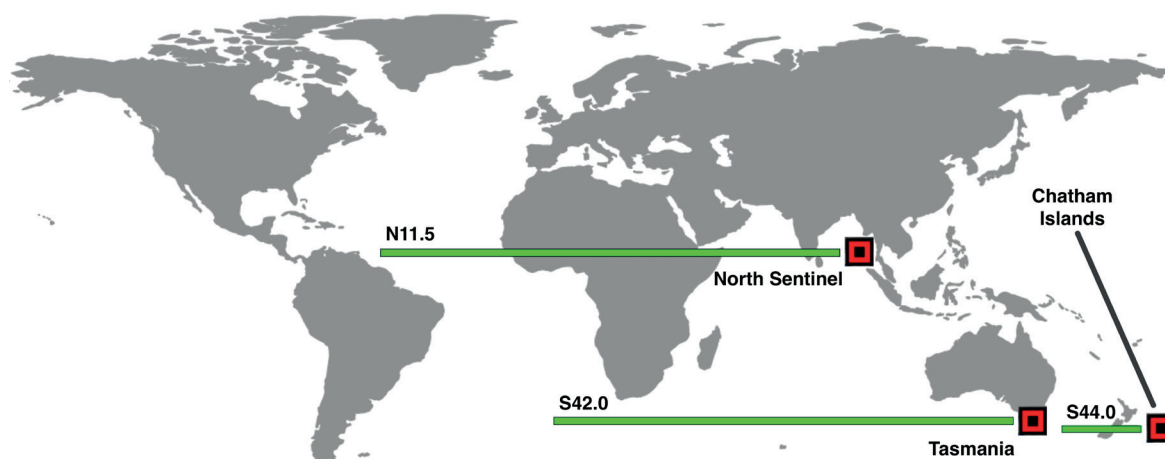


Fig. 1. Location of Tasmania, Chatham Islands and North Sentinel and their latitudes

Several presumably isolated tribes have survived in the west part of Papua New Guinea Island (Regnskog.no).

The assessment of the resource base of isolated societies living on the continental territory is extremely difficult because it is impossible to clearly identify its boundaries. In these circumstances, it makes sense to select communities existed on island territories, the area of which is easy to determine.

The study of the islands and its ecology in a non-intrusive way is currently being carried out using remote sensing methods, mainly by the space-based sensors. Currently, there is a significant and constantly growing library of data on the islands with different spatial, spectral and temporal resolutions. At present, the highest spatial resolution is provided by Maxar satellites (USA) – about 0.3 m (Maxar.com). The energy resolution of hyper-spectral imaging can reach 100 angstrom and above, imaging with a spatial resolution of half a meter can be carried out with a frequency of up to twelve images per day (Planet.com). Active radar sounding with a resolution of about 1 meter is also possible. However, these data do not allow us to sustainably observe traces of traditional culture development or, for example, to assess the population of an island.

As research objects for our purposes we have chosen the cultures that existed in not-so-distant past on the island of Tasmania (Australia), the Chatham Islands archipelago (New Zealand) and currently exist on the North Sentinel Island (India) (Fig. 1). This allows to better account for the scale factor as the areas of the respective island territories differ by about two orders of magnitude (Fig. 2).

Tasmania Island

Tasmania Island (in fact, it is an archipelago of more than three hundred islands) is located to the south of Australia mainland (S42, E147) and is separated by the 200 km wide Bass Strait. Area of Tasmania is approximately 65 thousand sq. km, it is 26th largest island in the world. There are mountains (the highest point is 1617 m), rivers, and lakes. There are no active volcanos on Tasmania today.

Tasmania has a cool temperate climate with four distinctly separated seasons, which significantly varies across the island. The lowest recorded temperature was -14.2C, the highest temperature was +42.2C. Nevertheless, the temperature in the coastal regions rarely drops below freezing, and daily temperature variations are also quite small. There are indicators that Tasmania’s climate during last 1000 years has changed repeatedly with the minimum

(characterized by the average temperature of 2C lower than at present) circa 1050AD (Saunders et al. 2013). Significant biodiversity of the island is supported by the mountain region in the West and high variability in precipitation patterns. There is extremely diverse vegetation, some plants are unique. The island is well-known as a home for many endemic mammals, some of which are partly extinct by now.

The island was populated by Australian aboriginal people around 40 thousand years ago via a natural bridge, that connected Australia and Tasmania at that time. Later, once the sea level rose, the bridge was destroyed, and the local population was completely isolated from the continent for approximately 8,000 years, until the period of European exploration, British colonization and penetration of modern western culture at the turn of the 18th and 19th centuries, which broke the isolation and destroyed the unique culture of the local aboriginal society that sustained all that time. The population of Tasmania island during isolation epoch is roughly estimated at the level of 3,000 – 5,000 with the mean value of 4,000. There were 9 tribes on the island, which consisted of 50 to 85 different ‘bands’; each band occupied territory 500-800 square kilometers and each tribe occupied territory 2,500-8,000 square kilometers (Jones 1974).

Chatham Islands archipelago

Small and dense, the Chatham Islands archipelago is located in the southern part of Pacific, 800 km to the East from Northern Island of New Zealand (S44, W176). The archipelago consists of dozen islands including two relatively big and populated. The total area is near 1,000 square kilometers. The last signs of volcanic activity on the islands date back to the Cretaceous period. The highest point of the main island is about 300 m; there are streams and many big lakes.

The Chatham Islands are characterized by an oceanic, cool and windy climate with small temperature variations and frequent rainfall. The record high temperature was 23.8C, the daily mean temperature is 11.5C. Snowfall is extremely rare but was registered in 2015. Regardless of harsh conditions, the ecosystem of the archipelago is quite diverse – there are dozens of endemic plants, many endemic birds (partly extinct). Chatham Rise acts as a source of food for fish and marine mammals.

The Chatham Islands is well known as a location of sustained aboriginal Moriori tribe that developed a unique culture based on the fundamental idea of pacifism and

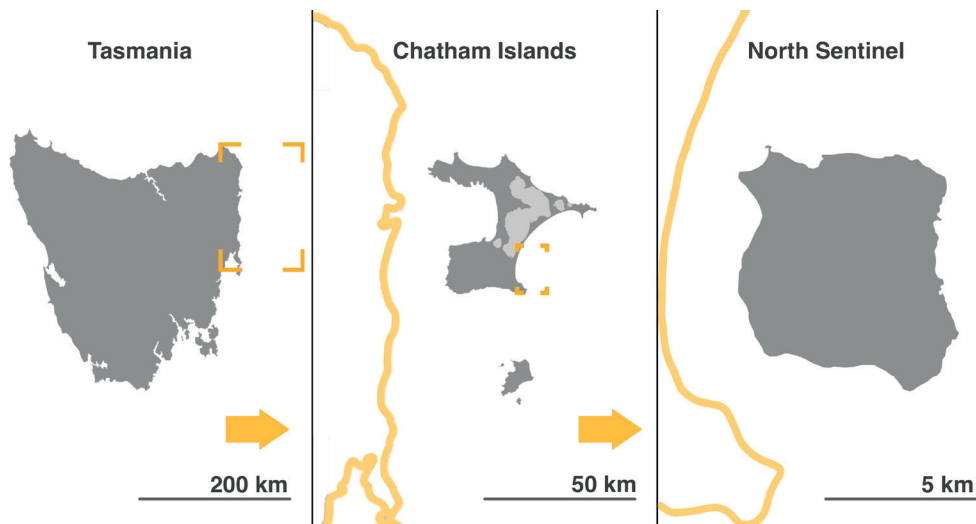


Fig. 2. Comparing of areas (left to right): Tasmania, Chatham Islands and North Sentinel

rejection of violence; in the 19th century, Moriori culture was destroyed as a result of the genocide (Brett 2015). The origin of Moriori remains debatable. According to some studies, ancestral Moriori were Polynesians and arrived to the Chatham Islands between 1200 and 1500 AD. Therefore, Moriori culture existed in isolation for more than 300 years and sustained at least for dozens of generations. Isolation was enhanced by the remoteness of the archipelago and the severity of conditions atypical for the area of settlement of Polynesians. The population of Moriori people on the Chatham Islands during their isolation is estimated as 2,000 people (Blank 2007).

North Sentinel Island

One of the rare and most impressive examples of a tiny local culture, which at the beginning of the 21st century is still isolated from the outer world and has survived successfully, is a culture of North Sentinel Island in the Andaman archipelago (Bay of Bengal, Indian Ocean). The area of this small, square-shaped island, bordered by a coral reef, is less than 50 sq. km, length of the coastline is less than 30 km. North Sentinel Island is clearly visible on satellite images (Fig. 3 a, b), provided by Proba satellite (Esa.int 2005), and EO-1 satellite (NASA). The island is located in a tropical region, N11.5, E92.2, and is completely covered by dense wet evergreen forest. There are no lakes, no rivers, no mountains (the elevation of the two highest points – Northern Hill and Southern Hill is both roughly estimated at 122 m) and no signs of volcanic or thermal activities on the island. Distance to the closest island in the Andaman archipelago is quite small – North Sentinel Island is located less than 30 km to the west from the southern part of South Andaman. Despite the tiny size of the island, it is inhabited (Venkateswar 1999). The local population, called ‘Sentinelese’, is still largely unknown (ncst.nic.in 2017).

Cultures of the aboriginal people of the Andaman Islands are isolated, according to some estimations, for around 60 thousand years (Jobling 2012), although a few unsuccessful documented contact attempts, and even military expedition to the island in 1880, were made (Hamilton 2018). The population of North Sentinel Island is unknown too; there are estimations of the current population ranging from 100 to 150 (and even up to 500), which periodically decreases down to 50. Nevertheless, society has developed its own sustainable and unique culture. At least core concept of that culture – hostility to aliens – is inherited and sustained for a long time. At the same time, Sentinelese society shows the ability for innovations (Hamilton 2018).

North Sentinel Island is vulnerable to a wide spectrum of natural threats – for example, forest fires. Island was severely impacted by the 2004 «Christmas» tsunami. Lifting of the tectonic plate by 1-2 meters has changed the coastline, subsequently increasing the area of the island, dried coral reef around the island and vanished the shallow lagoons. Due to the limited population and dependence on the environment, island inhabitants are critically vulnerable to various biogenic risks such as diseases, infections, genetic degradation risks, etc. However, the long-term sustainable existence of the population indicates that these risks can be overcome for a community that exists on a resource base of the North Sentinel Island.

RESULTS

The data in the form of population/area and specific population density/area graphs for the three selected examples are shown in Fig. 4 (a, b).

Surprisingly, the data indicates that the smaller area (in case of the Chatham Islands and especially North Sentinel Island) supports the stable existence of a much more

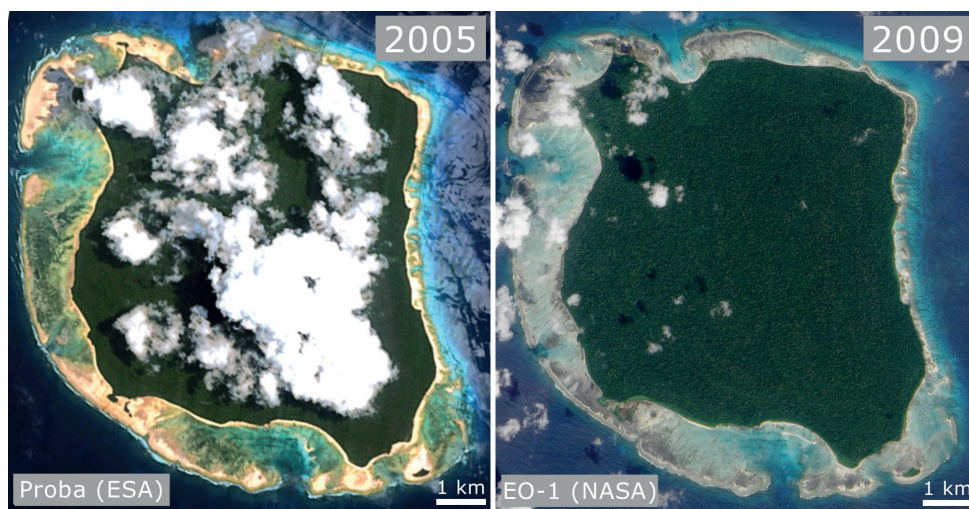


Fig. 3. (a, b). (Left to right) Satellite images of North Sentinel Island: a) Made on April, 23, 2005 by Proba satellite (ESA) after the 2004 «Christmas» tsunami; made on December, 31, 2009 by EO-1 satellite (NASA)

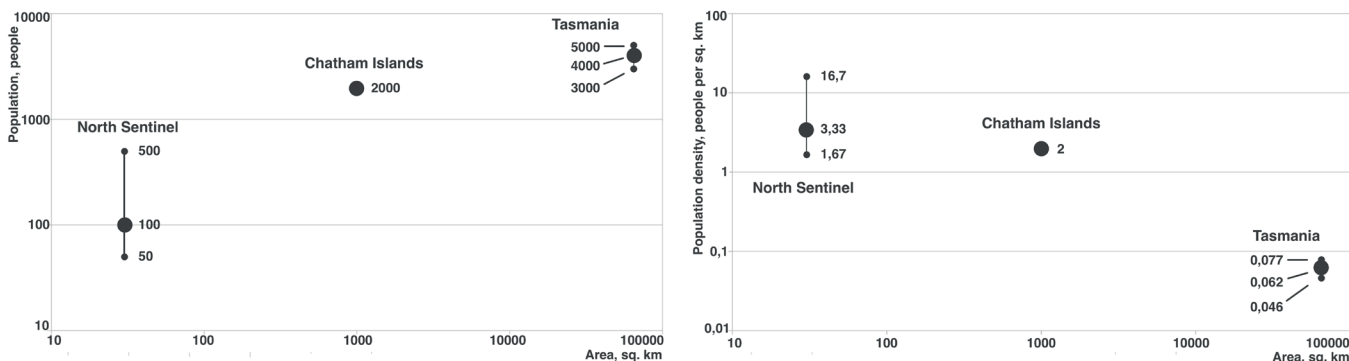


Fig. 4. (a, b). Population/area (a, left) and population density/area (b, right) graphs for isolated sustained societies in Tasmania, the Chatham Islands and North Sentinel Island. Both axes on both figures are logarithmic

densely populated society. This may be due to errors in population estimates or their interpretation. However, it is more likely that this effect is related to the availability of marine resources, which are particularly effective in ensuring the sustainable existence of societies; their relative importance increases as the size of the island decreases causing a relative increase in the length of a coastline section per unit area. When taking into account the water area necessary for the sustainable existence of communities, it can be assumed that it is approximately equal to the share of the world's oceans that falls on the area of the washed island multiplied roughly by a factor of three.

Therefore, we could assume that a resource base with a land area of about 30 square kilometres and a water area of about 90 square kilometres, located in tropics, at 11 degrees latitude, could provide sustainable reproduction of renewable resources, sufficient to ensure the long-term existence of the human community on a historical timescale.

By knowing the average density of solar energy per unit surface area and time, and assuming that this parameter is constant, we can determine the amount of energy needed to maintain biodiversity and ensure sustainable development of society in an isolated area at 11 degrees latitude. According to current measurements, the solar constant – or, more accurately, total solar irradiance (TSI) – is 1361W/m² and varies over time by less than 1 percent (Kopp et al. 2005). Assuming Earth's albedo is around 0.3 (Rosenbaum et al. 2018), the energy flow of 120 GW is enough for assuring long-term sustainable development of a closed society (Table 1). The population of society in this case could be estimated as 100 people (Fig. 5).

DISCUSSION

Assessment of the least resource base for sustainable development of isolated communities is complicated by the methodological and technical difficulties that were already mentioned above briefly.

From the methodological point of view, it is necessary to consider the applicability of the idea of a «resource base» and its suitability in the context of the research. The idea that the biosphere can be separated into fragments to support independent evolution of several isolated communities is only an assumption. It is quite obvious that this idea is an implementation of a broader methodological concept of «close-range interaction», or the dominance of local factors over global ones. This vision is widely accepted, for example, in epidemiology. Nevertheless, the prevalence of the local specific factors over the global non-specific ones is discussable and should be critically considered.

Another methodological problem is the identification of the pivotal factors of the sustainability of a social system. In this study, space (area) and energy are proposed as essential ones. This assumption fits well with the current worldview, but it also needs to be verified, critically analysed and possibly refined. In any case, both factors are framework only and the future research should investigate such factors as the spectrum of electromagnetic radiation, magnetic field, mineral composition, etc.

Technical difficulties include the need to use a retrospective approach and, therefore, to use the assumption of stability of measured parameters over long time horizons. The stability of territories in space seems to be quite obvious. At the same time, the long-term stability of the solar energy flow is a conclusion that follows from

Table 1. Least resource base required for sustainable development of isolated society

Parameter	Value	Units
Total Area	120	Square kilometers
Land Area	30	Square kilometers
Water Area	90	Square kilometers
Energy Flow	120	GW
Population	100	People
Population Density	3.3	People per square kilometer

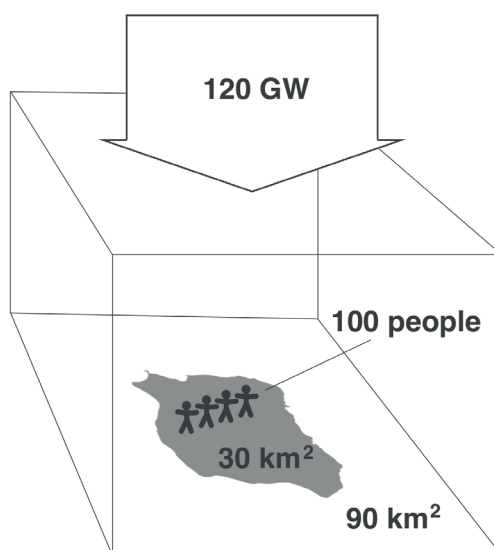


Fig. 5. Visual representation of least framework parameters required for sustainable development of an isolated society

the assumption that the sun is an absolutely black body. In this case, its luminosity, in accordance with the law of Stefan-Boltzmann, depends on the temperature and surface.

Despite the satisfactory accuracy of the proposed estimates of the area and energy density required to maintain sustainable community development in a limited area, this system is not closed. It is submerged in the environment of the ocean and atmosphere, from which it receives a significant and possibly vital part of the resources. Therefore, in further studies of this kind, it is necessary to quantify these factors.

Comparing the universalism-isolationism as two scenarios for sustainable development of humankind is also a challenge. The concept of globalism undoubtedly dominates today, but the vulnerability of global society, primarily to biological and social threats, is evident. This vulnerability was demonstrated by the 2020 COVID-19 pandemic. On the other hand, it is not quite clear whether the sum of isolated societies will be a more successful and more resilient alternative to universalism.

Presumably, the most striking example of the importance of the proposed approach is the deployment of isolated settlements in an unfavourable environment, primarily on other planets. Under these circumstances, providing the minimum territory and energy required for sustainable development of a society becomes the most important and universal factor. The most actively discussed option for such settlements are settlements on the Moon and Mars. In this case, it is possible to consider the settlement on Moon/Mars as an insulated system and the «area – energy density» parameters can be a good starting point for the analysis of the sustainable development. In conditions of physical isolation from the Earth and radically different environment, ensuring the minimum resources necessary for the sustainable development of a settlement when transport links with the Earth are terminated is seen as a critical task. Another aspect of the study of the smallest resource base for sustainable development is the theoretical aspect. The study of management experience and practical approaches to ensuring sustainable development, practiced in ultra-compact communities, is an important source of knowledge about the nature of the biological and social factors.

It must be taken into account that this assessment is a part of a much broader interpretation of the meaning of

the «sustainable development» concept than the currently dominant one. The validity of such an interpretation needs to be critically considered. Nevertheless, the intensifying signs of growing instability of the human community in the context of epidemic threats like COVID-19, caused by globalization, and the constant need for a regime of isolation to prevent such threats indicate that an expanded interpretation of the term «sustainable development» is feasible.

CONCLUSIONS

The work assessed the least resource base in terms of minimum area and energy flow required to maintain long-term sustainable development of an isolated society. For this purpose, the available empirical material on three cultures was analysed: the Tasmanian and Chatham Islands aboriginal tribes, which existed in isolation until the beginning of 19th century, and the North Sentinel Island society, which exists in complete isolation today and is one of the last cultures of that kind in our era of dominant globalization. The analysis showed that an island area of 30 square kilometres, receiving 120 GW of solar energy, is sufficient for sustainable development of an isolated community with an estimated population of 100 people for at least many centuries. At the same time, an isolated community in these circumstances turns out to be capable of technological development, ensuring sustainable maintenance of basic cultural attitudes and reliable protection from various threats and risks of natural origin – from natural disasters to epidemic and somatic diseases and genetic degradation – within the concept of inherent safety. Therefore, a sufficient level of resilience could be achieved on the relatively modest resource base. This assessment is crude, preliminary and purely empirical. However, it already allows to assess the minimum requirements for maintaining a long (for many generations) existence of a community in complete isolation when there is no contact with human civilization, for example, in the case of settlement on another planet. In addition, this assessment raises the question of the feasibility of searching for theoretically possible alternatives to globalism due to the revealed vulnerability of the global community to threats and risks spreading across the planet, especially biological threats. ■

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