European Journal of Sustainable Development (2022), **11**, 2, 133-141 ISSN: 2239-5938
Doi: 10.14207/ejsd.2022.v11n2p133

A Country of Bricks – How to Transform Waste into Viable Products for Construction

By Constantin-Iulian Tănaşcu[1], Robert-Andrei Costache[1], Lorian Ovidiu Vintilă[1]

Abstract
We live in complex times, in a world where the difference between rich and poor people is enormous. The distance between the two social categories increases from year to year, especially when in a certain year, events appear that can be included in the category of natural disasters and that have a very big impact on the security and well-being of the population. The study we propose considers two elements: an analysis of poor people, who do not have a stable shelter and who suffer greatly from it, but also a product we are working on and which could have a positive impact, both on them, as well as on the environment. The study we propose is based on data provided by EUROSTAT and the National Institute of Statistics (NSI), in order to determine the number and distribution of people who do not have a house or have a disused building in which they live. Based on the values obtained in the period 2000-2019 we can determine, equally, the dynamics of declining population security (lack of housing or improper housing), as well as the positive impact on the environment, if this product will be implemented nationally. Attention must be focused on how to make the future product, brick. This attention is necessary because we use, in the construction of future bricks, raw material that may contain various bacteria that can, in turn, endanger the lives of the population, if the construction process is not checked at any time and if certain are not used. substances intended to destroy bacteria before the actual composition of the product and its assembly. On the one hand, the realization of this product will offer an extra chance in the fight against poverty by ensuring an optimal living environment. Building a house for people in the social category of poor people is a chance for them to start a new life. Every individual needs the security of a place to consider at home. On the other hand, the realization of this product has certain benefits for the environment. Based on the principle of the circular economy, the waste that currently pollutes most surfaces in Romania can be transformed into bricks and used to build houses or sell them to our neighbors. In this way, the quantities of waste stored in landfills can be reduced by up to 60-70%. At the end of the analysis and description of the product, we formulated certain courses of action in order to streamline the selective collection and increase the number of bricks, as well as certain courses of action that may be the basis of a future regional development strategy.

Keywords: Social Security, Circular economy, Ecology, Regional development

1. Introduction

The success of an individual is strongly favored by the existence of three elements: sustained preparation, the desire to succeed and the security of life. The first two elements were discussed by researchers, entrepreneurs and people in the field of human resources and we know, at the moment, what the desire to succeed and the sustained training in a field mean. When we talk about the security of life, the field is very wide, very common and very little analyzed. For specialists such as Feldstein and Liebman (2002) the activities

[1]Academy of Economic Studies, Doctoral School of Management, Bucharest, Romania

that fit the sphere of social security place in the foreground objectives of social protection of the elderly and people close to retirement age, which are in the category of poor people and who presents all the elements for a rapid decrease in living standards when they reach retirement age. What the two researchers failed to capture at the time is young people and their families. There are strong signals, not only in Romania, but worldwide, that security analysis and proposals to increase security must start at an early age. Diamond (1977) captures much better what social security should be. While most countries focus only on the elderly and helpless, the United States focuses its policy on the conventional framework needed to examine each family's income and income taxes. In other words, the United States has understood since 1977 that the security of an individual means what is due to him after his work, after paying income taxes.

Maslow (2013) understood that the security perceived by an individual, in addition to the income he has from providing a service or selling a good, also means a roof over his head. Thus, even if he divided the needs of an individual on seven levels within the Pyramid of Needs, Maslow placed the security of the individual on the 2nd place, and the need for a living space, on the first place, along with the basic needs.

People, who live and feel all the economic events that happen every day, can define the security of an individual as ensuring a living space and an income high enough to cover taxes and food expenses. The question is, what do we do with those who can't afford a roof over their heads, but only a small amount of money to get something to eat? The answer can be found in the circular economy.

People with a certain social status and a sufficiently large amount of money do not want to allocate sums of money to the less fortunate. It is human nature to position oneself (or try to position oneself) on a higher level in relation to one's peers Headey (1966) and it is also understandable. Every human being ensures the life he wants and works for. However, the population considered rich tends to make more waste than the poor population in relation to the money available to meet the needs. All these satisfied needs produce a high level of waste.

In order to understand the correlation between the level of waste and the rich, it is enough to look at certain information related to GDP and the level of waste generated by certain countries. These things can be seen below:

Table 1: The ranking of countries based on their GDP

Country (place based on GDP)	GDP (million dollars)
United States of America (1)	20.494.050
China (2)	13.407.398
Japan (3)	4.971.929
Germany (4)	4.000.386
India (7)	2.716.746
Brazil (9)	1.868.184

Source: Made by authors based on the statistics provided by World Economic Forum (2019)[1]

[1] World Economic Forum (2019). The top of countries based on their GDP. Link: https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases, accessed on 13.02.2021

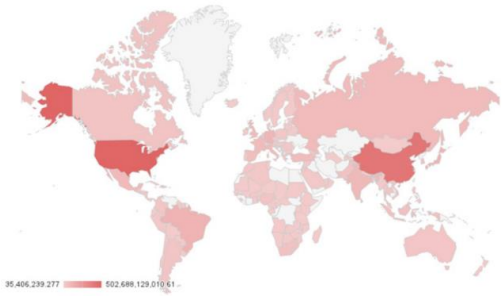

Figure 2: The quantity of garbage generated by every country.
Source: Made by authors based on graphics provided by MotherJones (2012)[2]

The GDP of the countries we will study has changed over time, but the position in the ranking has remained almost the same. Thus, the position in the ranking of GDPs in the country remained the same as in 2012.
The reason why we chose GDP as an element of the analysis is that this indicator shows us the level of wealth of a country, the degree of development and the situation of the population. A country with a low GDP is considered a poor or developing country. Looking at figure 2 we can see the countries that produce the most waste. We find that the countries in the first two positions also generate the most waste from all over the world. Currently, according to the analysis conducted by Mother Jones (2012), 228,015,499,809 kg (228,015,499 tons) of waste are produced worldwide, most of which are produced by the United States and China. Of these, annually, starting with 2010, a little over 60 million tons of waste are recycled, according to figure 3. The other tons remain in landfills, oceans, fields or forests all over the world.

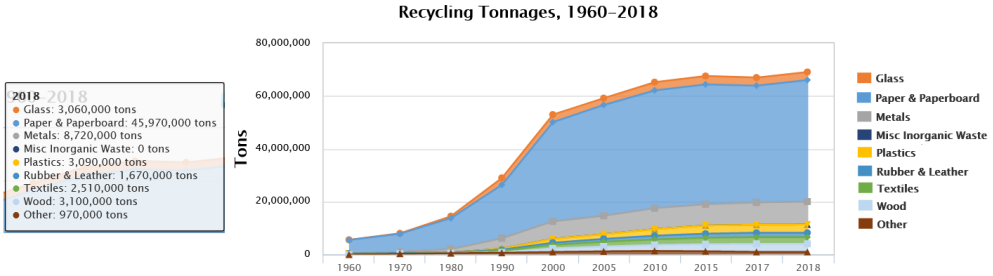

Figure 3: Dynamic of the processed waste
Source: Made by authors based on statistics provided by Unites States Environmental Protection Agency (2019)[3]

[2] Mother Jones (2012). The most pollutant countries in the world based on their collected garbages. Link: https://www.motherjones.com/environment/2012/07/trash-charts-world-bank-report-economy/, accessed on 10.03.2021

[3] Unites States Environmental Protection Agency (2019). Facts and figures about materials waste and recycling. Link: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#recycling, accessed at 15.02.2021

The question we raise in our study is: how can we use unrecycled waste to reduce social disparities? The answer to this question may consist in the transformation of waste (glass, paper, plastic, tests and inorganic waste) into construction bricks.

2. Results of the Research

To be able to see the efficiency of transforming waste into bricks and the actual construction of houses using this building material, we must observe the number of people who do not have a house and the product we will use in the construction of houses.
In terms of the number of homeless people, according to a report by the Homeless World Cup Foundation (2015), there are over 100 million homeless people worldwide and over 1.6 billion homeless people for a minimum standard of living according to Habitat for Humanity (2015). Adding the two categories, we add up to 1.7 billion people in need of housing. The number presented represents the number of families in this situation. This means that 20.38% of all people on the planet suffer from poverty in an advanced form and cannot afford to have at least the minimum life expectancy. To cover the total housing needs, 1.7 billion houses would be needed, each designed to be approximately 50 square meters in size, exactly as shown below:

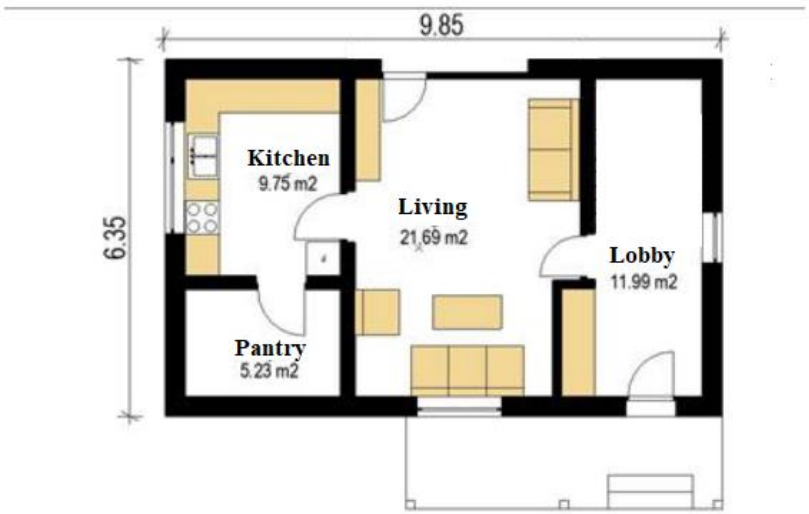

Figure 4: A house of 50 sm
Source: Project simulated provided by Constructonline.com

For a house like the one in figure 4, you need a number of 2,750 pieces of bricks with the size of a single brick of 240/290/238. Thus, at a simple calculation, in order to be able to build all those houses we need 4,675,000,000,000 ecological bricks. To this are added windows and doors, elements that can also be made from recycled and transformed waste. Regarding the realization of the bricks that we propose, the process is very simple and very efficient. It can be followed by going through figure 5:

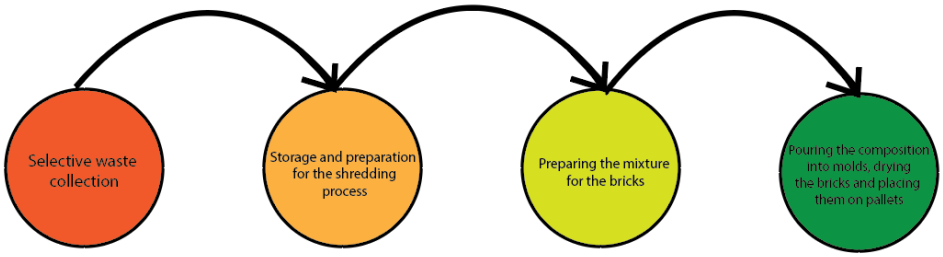

Figure 5: The steps for development of bricks
Source: Made by authors based on production cycle

The first stage in making bricks is the selective collection of waste. This is because each category of waste is processed differently and requires special attention. As soon as the amount of waste is sorted, it is safely stored so as not to pollute the environment and the waste is prepared for crushing.
The crushing process is performed for each type of waste and consists of a successive crushing until the waste actually reaches a powder or is ground until it is very small.
The process of making the bricks includes mixing the powder with sand, earth or cement. It is preferable to add 10 kilograms of composite to a composition of 100 kilograms of powder obtained from the waste to develop a resistant mixture. In the mixing process it is necessary to add any drug to eliminate colic. Colic drugs eliminate bacteria that may exist in the powder obtained by crushing the waste. The composition is mixed until it is observed that the inserted elements thicken for about 10 minutes. The resulting composition is taken with a trowel and added to special forms where they are kept for 10 minutes to dry. The obtained composition is resistant, much lighter than a normal brick and efficient in constructions. It is very important to mention that for a quantity of 100 kilograms of powder, 80 kilograms of waste are required, regardless of the structure of the waste.

Figure 6: Ecological Brick
Source: Made by the authors based on their experiments

For a composition made of 100 kilograms of waste powder, a number of 384 bricks can be made. For the construction of a house we need to repeat the process 8 times. In those 8 cycles, 800 kilograms of powder are obtained from 640 kilograms of waste.

In order to cover the number of people who need a house in Romania, it is necessary to build 15,000 houses according to the European Federation of National Organizations Working with the Homeless (2012). Of course, since then the number of people has increased, but these are the only data available for poor, homeless people in Romania. As a result, taking this example, we have to build 15,000 houses. For a house, 640 kilograms of waste are eliminated from nature. For 15,000 houses it is necessary to collect a number of 9,600,000 kilograms of waste (9,600 tons).

According to the director of Rom Waste Solutions, Lazar (2017), the largest waste processing company in Bucharest, the capital alone generates 575 tons of waste per day and 700,000 tons per year, of which 210,000 tons only packaging waste. In this way, the need for the raw material of the bricks could be easily covered.

Thus, with the 9,600,000 wastes collected, the total number for covering the raw material for bricks would be obtained, and the selective collection and recycling of waste in the capital would be complete.

The time to complete a cycle that results in 384 bricks is 3 hours. For 8 cycles, respectively for building a house, it takes 24 hours (one day). To build the total number of houses it is necessary to have 360,000 hours (15,000 days). Both can achieve a single production line, but for two such lines, the time is halved, and it decreases in direct proportion to the increase in the number of processing centers and production lines.

For the construction of all the bricks we need 12,174,479 production cycles that total 36.5 billion hours of production. For these, 973,958,320 kilograms of waste (973,958.32 tons) would be used. The impact on the environment, following the collection of 973,958.32 tons of waste would be particularly important and would mean a revitalization of ecosystems by cleaning them of the main elements that pollute them for years.

Of course, these bricks can also be used for larger constructions such as blocks or for ordinary constructions of people who can afford them. By switching from normal bricks to ecological bricks, the impact on the environment would be extremely positive. We say this by analyzing the market. In 2017, according to the Romanian Ministry of Finance, many ceramic blocks (bricks) were sold. Their number can be seen below, by distributors:

Table 2: The total number of bricks sold by producers from Romania

Producers	Quantity in euro (mil. euro)	Quantity in lei	Quantity of bricks (in pieces – 2 lei / brick)
Wienerberger	42.4	205.574.942	102.787.471
Soceram	33.1	160.484.212	80.242.106
Cemacon	20.2	97.939.005	48.969.502
Siceram	17.3	83.878.455	41.939.227
Brikston	16.9	81.939.069	40.969.534
Macofil	7.1	34.424.105	17.212.052
Helios	5.7	27.636.254	13.818.127
Euro Caramida	5.3	25.696.867	12.848.433
Ceramus	2.1	10.181.777	5.090.888
Prefab Construct	1.4	6.787.851	3.393.925
TOTAL			367.271.265

Source: Made by the authors based on statistics provided by Ministry of Public Finances (2021)

According to Table 2, in 2017, 367.2 million bricks were sold from brick producers in Romania. Replacing them with ecological bricks means 956,436 production cycles and a reduction of natural waste of 76,514,880 kilograms of waste (76,514.8 tons). Let's imagine what it would mean that, globally, all brick producers use waste as a raw material for bricks. Let's imagine what it would be like for everyone who builds houses, blocks of flats or entire cities to use brick made from waste. The amount of waste on the planet would be greatly reduced.
In Romania alone, during 2017, 367,271,265 bricks were made. This means 76,514 tons of waste disposed of and turned into bricks. Looking objectively at the situation in Romania through the study conducted by Stiftung (2018) and completed for 2018, 2019 and 2020 with data from the National Institute of Statistics looks like this:

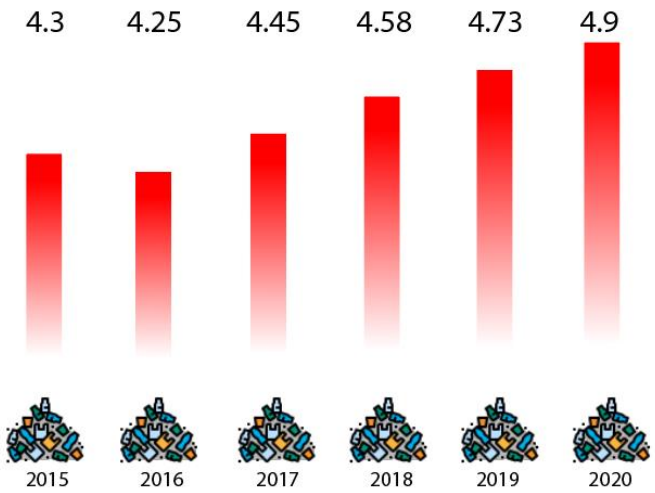

Figure 7: The situation of waste production in million tones
Source: Made by authors based on statistics provided by Stiftung (2020)[4]

There is a general increase in garbage in all years of analysis. Garbage can be used as an indicator of quality of life. The more garbage there is, the better people's lives are, the higher their income and the richer their consumption basket. Returning to the graph, there is a strong growth in 2020. This is generated by nervous consumerism because 2020 is the year of the pandemic, a year in which people stayed at home for a long time and consumed all kinds of products or bought all kinds of assets to occupy their time.
If we take the amount of garbage generated in 2020, respectively 4.9 million tons of garbage, and compare with how much the brick producers produced, in pieces, it would mean a visible decrease in garbage. The recycling rate in Romania is 13%, according to Green Report (2020), which means that out of the 4.9 million, only 637,000 tons were recycled. With all the waste that brick producers could use, Romania would reach a waste recycling of 713,514 tons, which means a percentage of 14.56%. Up to 30% can be added

[4] Stiftung, F.E. (2020). The growing of sanitation inside the city. Link: https://monitorsocial.ro/indicator/salubritatea-marilor-orase-o-problema-in-crestere/, accessed on 10.03.2021

to this amount if each town hall would open waste processing centers and transform them into bricks. Romania can reach a recycling threshold of 44.56% only from what we already recycle, from the transformation of waste into bricks by producers and from what every town hall in the country could recycle. Indeed, all 55.44% percent left unrecycled could be used for compost, clothing or paper.

3. Conclusions

As we have demonstrated, there is a real opportunity to solve two problems that have worsened over time: the safety of the individual transposed by owning a home and the reduction of waste levels around the World, which endangers the daily health of people. It is easy to imagine a city made only of bricks, but it is difficult to imagine what the world would look like with less and less waste, where it is efficiently used in construction and not thrown away.

Through the present research, as well as the tests we have carried out over time, we have come to the conclusion that waste dumped in nature, which pollutes and endangers the health of the individual, could be processed to obtain construction materials - bricks, and then use these bricks to build sustainable homes for the less fortunate. The process is not only based on chemical principles, but also on a healthy principle of the times in which we live - the circular economy. This circular economy, given the growth of the global population, is an important element in reducing poverty and protecting the environment, only if it is implemented as part of a national strategy.

The bricks obtained by waste processing have important similarities compared with the classic ones, widely used in every country in the World. The main common elements of waste and classic bricks are: strength, thermal properties and safety of constructions. The main strengths of the bricks made from waste are the low costs of construction and inexhaustible raw material (waste generated by the population). Basically, by replacing the classic bricks with those made from waste, there will be a substantial reduction in variable production costs, a much larger amount of bricks available on the market and the possibility of building houses for the homeless, with extremely low costs. All this while using bricks made by waste that have the same properties as the classic ones, but different color.

Thus, the transition from classic bricks to waste bricks is not just an alternative when it comes to building materials, but could be an effective way of life, which could lead to waste reduction, supporting homeless people to have a house and would lead, slowly but surely, to future "green homes", built through the circular economy, which can lead to the cities of the future.

Also, the research we have done on waste bricks is just another page in an increasingly voluminous literature in the field of circular economy and the transformation of waste into useful things, written by researchers such as Qi and Qiuyan (2013), Romanova (2016), Kunanbayeva and Gorovoy (2018) etc. All the data we add to international research (in the field of waste transformation into useful objects/materials) can be used as a starting point in scaling up the production processes of these new bricks, for a cleaner world and a green future.

References

Diamond, P.A. (1977). A framework for social security analysis. Journal of Public Economics 8 (1977) 275-298. link: https:/sciencedirect.com/article/pii/0047272777900020, accessed on 25.02.2021

Feldstein, M., Liebman, J.B. (2002). Social security. Handbook of Public Economics, Volume 4. Elsevier Science B. V. Link: http://www.sciencedirect.com/science/article/pii/S157344200280, accessed on 14.03.2021

Green Report (2020). The Minister of Environment warns that Romania can't recycle 50% of it's garbage. Link: https://www.green-report.ro/ministrul-mediului-avertizeaza-romania-va-rata-tinta-de-50-pentru-reciclarea-deseurilor-la-finele-anului-si-vom-plati-penalizari/, accessed on 14.03.2021

Habitat for Humanity (2018). The number of homeless people worldwide and Romania. Link: https://www.habitat.org/volunteer/build-events/world-habitat-day, accessed on 03.02.2021

Headey, B. (1988). The sense of relative superiority — Central to well-being. Soc Indic Res 20, 497–516. Link: https://doi.org/10.1007/BF03359554, accessed on 11.03.2021

Lazar, C. (2017). The statistics about garbage in Bucharest, the capital of Romania. Link: https://www.zf.ro/companii/retail-agrobusiness/bucurestenii-genereaza-aproape-600-de-tone-de-deseuri-de-ambalaje-pe-zi-romania-este-tara-cu-cel-mai-scazut-nivel-al-reciclarii-din-uniunea-europeana-16283259, accessed on 11.03.2021

Maslow, A.H. (2013). Motivation and personality. Addisson-Wesley Educational Publishers INC, ISBN: 978-973-707-905-3.

Ministry of Public Finances (2021). Statistics on the sale of construction materials in 2020-2021. Link: https://mfinante.gov.ro/informatii-statistice-generale.ro, accessed on 09.03.2021

Mother Jones (2012). The most pollutant countries in the world based on their collected garbages. Link: https://www.motherjones.com/environment/2012/07/trash-charts-world-bank-report economy/, accessed on 10.03.2021

Stiftung, F.E. (2020). The growing of sanitation inside the city. Link: https://monitorsocial.ro/indicator/salubritatea-marilor-orase-o-problema-in-crestere/, accessed on 10.03.2021

Unites States Environmental Protection Agency (2019). Facts and figures about materials waste and recycling. Link: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#recycling, accessed at 15.02.2021

World Economic Forum (2019). The top of countries based on their GDP. Link: https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases, accessed on 13.02.2021

Romanova, E. (2016). Research of Ecological Motivation of the Heads and Specialists Getting an Education in the Field of Production and Application of Construction Materials. International Conference „Topical Problems of Arhitecture, Civil Engineering, Energy Efficiency and Ecology. DOI: 10.1051/matecconf/20167307010

Qi, G., Quiyan, L (2013). Ecological Development of Building Materials. International Materials Research. DOI: 10.4028/www.scientific.net/AMR.712-715.887

Kunanbayeva, K. Gorovoy, A. (2018). Ecological-and-economical aspects of assessment of management of the city-forming organizations in the contruction industry. International Scientific Conference Environmental Science for Construction Industry –ESCI. DOI: 10.1051/matecconf/201819305048