TẠP CHÍ
KHÍ TƯỢNG THỦY VĂN

Research paper

An Integrated Framework for Assessing Climate Risks to Population Sustainability: a case study in Ho Chi Minh City, Vietnam

Minh Hoa Nguyen Thi[1*], Phu Bao Nguyen[2], Hong Nhat Pham[2], Tuan Anh Ha[3], That Lang Ton[4]

[1] Faculty of Human Resources Management, University of Labor and Social Affairs (ULSA); 43 Tran Duy Hung, Trung Hoa, Cau Giay, Ha Noi 100000, Vietnam; nguyenthiminhhoa1212@yahoo.com
[2] Institute for Tropicalization and Environment; 57A Truong Quoc Dung, Ward 10, Phu Nhuan, Ho Chi Minh City 700000, Vietnam; nguyenphubaohien@yahoo.com
[3] National Economic University, Institute for Population and Social Studies; 207 Giai Phong, Hai Ba Trung, Ha Noi 100000, Vietnam;phamhongnhat@hotmail.com
[4] Ho Chi Minh University of Natural Resources and Environment; 236B Le Van Sy, Ward 1, Tan Binh, Ho Chi Minh City 700000, Vietnam; ttlang@hcmunre.edu.vn

*Corresponding author: ttlang@hcmunre.edu.vn; Tel.: +84-903983932
Received: 5 February 2022; Accepted: 28 March 2022; Published: 25 April 2022

Abstract: Global warming is a serious and urgent issue facing the world today to achieving sustainable development, and it threatens to reverse millions of people into poverty. In this work, a simple and pragmatic framework for assessing the impact of climate change on sustainable development at local scale was reported according to the three–pillar conception of social, economic and environmental sustainability. In detail, the research has assessed the climate effects on sustainable development of population in the south of Ho Chi Minh City (HCMC), which is subdivided into five district–level subdivisions (District 7, District 8, Binh Tan District, Binh Chanh District, and Nha Be District) and each district possesses its own unique properties of natural resources and society. The average population growth rate of all five districts from 2005 to 2014 was approximately 5.17%, which was around two times higher than that of HCMC, at 2.97%. To the south of HCMC is a lowland area with an elevation of 0.8–1.5 m, as compared to that of HCMC. Also, the population growth rate in five districts was unsustainable under the influence of climate risks, with the sustainable development index of 0.280 ÷ 0.305. In conclusion, the negative impacts of population growth affected by climate fluctuations in the southern part of HCMC may lead to potential consequences of population size and structure such as migration, poverty and family disruption.

Keywords: Sustainable development assessment; Population sustainability; Sustainable development index; Climate change; Ho Chi Minh City.

1. Introduction

The concept of sustainable development of a country has been widely displayed by its sustainable development index (SDI), which consists of three pillars of sustainability (environment, economy, and society) [1], his concept has also unified the three components of sustainable development in society including economic, ecological and social dimensions [1]. The SDI has been generally used individually or simultaneously with different indexes so as to assess its practical applications [2]. However, there is still no agreement about how to establish a set of indicators or at least an appropriate indicator to assess the sustainable development at a local level [3]. Some indicators have been frequently used for local sustainability assessment such as Barometer of Sustainability Index (*BSI*) reported by the International Union for Conversation of Nature and Natural Resources (*IUCN*) in 1994, and Local Sustainability Index (*LoSI*) proposed by Nath and Talay in 1998 [4–5]. Moreover, depending on the locality characteristics, appropriate indicators can be applied for different purposes, for instance, a community development assessment identified through Human Development Index (*HDI*) and Human Poverty Index (*HPI*) [6]. Nevertheless, local indicators based on sustainable development models typically focus on economic and social indicators and ignore the most pressing ecological and environmental issues. To estimate the differential impacts of climate change on economic and social development, the Livelihood Vulnerability Index (*LVI*) was developed to integrate the three pillars of sustainable development for community assessment [7].

In terms of sustainable development evaluation, no matter what kind of indexes (*SDI or LoSI*) are considered to be used, the selection of indicators plays a critical role in the formation of their sub–indicators, followed by the generation of a composite index or an integrated approach [8]. In this context, the main procedure for developing a sustainability index includes choosing appropriate sustainability indicators, weighting the chosen indicators, and then aggregating those into a composite index [9]. Previous reports have usually used a large number of indicators/indices for calculating indexes in the evaluation of sustainability [10]. For instance, the United Nations Sustainable Development utilized 134 indicators in 1996, slightly dropped to 58 in 2001, and finally reduced to 50 core indicators at 2005 for measuring sustainable development [11]. On the other hand, at local/regional levels, some methods have also applied a variety of indicators, such as 15 sets of criteria for the LoSI calculation, and 05 indicators when assessing sustainable development. For example, Land Use indicators were employed to achieve a suitable sustainable development index in Mexico, whereas 10 environmental indicators and 06 socio–economic indicators were carried out to assess the urban sustainability in Helsinki [12]. Additionally, the LoSI based on 12 classes of sustainable criteria (R–Resources consumption; C–Loading; I–Indoor environmental quality, S–Quality of service, E–Economics, G–Management, T–Commuting transport, P–Participation, M–Regional marketing and branding, K–Cultural topics, L–Local development, A–Virtuous circles) was also used to determine the sustainability performance in European cities at local scales [13].

However, these are still no unified indicators for assessing the sustainability of different aspects of economy, society and environment. The number of indicators used depends on the country, locality, specific conditions and different purposes of assessment in which a set of indicators is likely synthesized for each different aspect. Regarding the Sustainable Society Index, eight policy categories and three Wellbeing dimensions (Humans, Environment, Economy) were calculated for 151 countries accounting for 99% of the world population [14]. Furthermore, two crucial factors are commonly taken into consideration in sustainability assessment are society and economy, in this regard the effect of society was determined and the economy one was compared with SDI, particularly an assessment of the influences of social information on the sustainability and a comparison among social, economic and ecological dimensions with GDP [15]. In recent years, the ecological factor has been highlighted and determined among the three pillars of sustainability, specifically under conditions of climate change affecting the sustainability performance via an influence on social and economic aspects. Unfortunately, there is no specific or uniform strategy in relation to the detection of indicator sets for sustainable development assessment, except recommendations with the orientation of indicators introduced by United Nations, caused by the purposes of assessment, conditions of implementation, data sources and mainly the three pillars of sustainability.

In this report, the assessment of local sustainability in the south of Ho Chi Minh City (*HCMC*) under the effect of climate extremes was based on the Poverty Sustainability Index (*PoSI*) by preparation of indicator sets in regards to economy, society, and environment in place of climate change, which was suitably modified with environmental conditions of the city. These conditions were suggested by the World Bank [7] including six criteria and the Asian Development Bank containing 04 criteria [1]. The Population Sustainability Index (*PoSDI*) was developed according to the formula of the HPI [16] .

2. Research areas

The southern part of HCMC consists of five administrative divisions: District 7 (established in 1997), District 8 (the inner–city district has been established for hundreds of years), Binh Tan District (established in 2003), Binh Chanh District (established in 2003), and Nha Be District (established in 1997) (Figure 1). This is a newly developed land selected for investigating sustainable development in the context of climate change. Although the total area of all five districts is relatively large (969.86 km2), accounting for 46.3% of the natural area of HCMC, the population size is extremely small (2,098,484 people in 2014), at approximately 26.0%, indicating the potential growth scenario of the populations in these areas [17, 18].

As illustrated in Table 1, it is apparently that the population growth rate of all five districts have fluctuated between 2005 and 2014. The growth rate in District 7 was 11.93% in 2005, which later significantly reduced to 0.41% in 2006, went up dramatically to 19.50% in 2007, and then remained fluctuating from 2008 (11.49%) to 2014 (11.27%). In terms of District 8, its population slowly grew from 1.37% in 2005 to 4.42% in 2007, followed by a double decrease to 2.21% in 2008 and an insubstantial increase to 3.85% in 2009. The figures later showed some fluctuations from 2009 (3.85%) until 2014 (only 0.08%). Similarly, Binh Tan, Binh Chanh and Nha Be have also displayed a serious of fluctuations in population size since 2005. In particular, the highest population growth rate in Binh Tan (12.80%) and Binh Chanh (16.84%) was recorded in 2007, while that of Nha Be occurred in 2006, at 12.65%. Moreover, the average population growth rate of 5.17% in the south of HCMC for 10 years was two times higher than that of HCMC, at 2.97%. In this regard, District 7 had the highest average rate of 7.32%, followed by Binh Chanh (6.39%), Nha Be (6.27%), Binh Tan (5.79%), and District 8 (1.84%). This can be attributed to natural and socio–economic characteristics of these areas, which leads to the increase of their mechanical populations.

To the south of HCMC (Nha Be–District 7–South Binh Chanh) is a lowland area with an elevation varying between 0.8 and 1.5 m, in which case South Binh Chanh at an elevation of 0.3–2.0 m is a floodplain, except residential zone at an elevation of up to 3.0 m. All of these data indicated that approximately 99.9% of Nha Be–South Binh Chanh belongs to lowland regions with elevations less than 2.0 m. Additionally, the southernmost suburbs of HCMC, including District 7, a part of District 8, Nha Be and a part of Binh Chanh, have the lowest elevation, as compared to that of HCMC and are regularly flooded by high tides (139.5 km^2)[19]. Particularly, community groups in such areas usually account for a large proportion of the population, such as children (18.9–23.0%), poverty (8–30%), individuals with less physical ability (26.0%) and immigrants (15%)[6, 20]. In comparison with criteria regarding potential impacts (both natural and socio–economic factors) of climate variability on European infrastructure development [16], the southern area of HCMC is a climate–sensitive zone, and therefore it is necessary to assess the potential effects of local environmental changes on sustainability in the south of HCMC.

3. Method

3.1 Data collection

In order to select an appropriate scale for the survey and interview families affected by environmental conditions in the southern region of HCMC, a number of investigations over a recent five–years period have been collected. From 2009 to 2011, approximately 5000 households (roughly equivalent to 217 votes/district), except Can Gio district, were selected and interviewed about the negative effects of flooding on environment in HCMC [21]. Meanwhile, 100 families in poverty, one of the most sensitive objects with climate change, were surveyed in District 8 [22]. Accordingly, a scale of 900 votes, equivalent to 180 votes/district, was conducted in 58 wards in which around 16 wards were selected to be interviewed by a simple random sampling method. A household consists of one or more individuals who live in the same dwelling, regardless of residence time.

In this work, each survey contained 41 groups of detailed questions (ITE 2016), which were interviewed based on the unified criteria [1, 7] comprising 10 indicator sets. However, because urban areas in the south of HCMC are considered as non–flooded and non–expanded areas, relevant questions were eliminated. Only 08 sets of indicators (household characteristics, incomes, health, drainage situations, floods, traffics, energy and water supply) from the survey data were collected and represented as socioeconomic factors in this report.

According to the findings of a multi–year monitoring of meteorological parameters at hydro–meteorological stations and environmental parameters at environmental monitoring stations in HCMC, multivariable regression equations were applied, which results indicated a linear correlation between climate change and environmental factors [15]. At a national scale, a set of environmental indicators were promulgated with 05 indicator sets corresponding to 36 indicators and 93 sub–indicators [4]. Unfortunately, such indicator sets based on Driving Forces–Pressures–State–Impacts–Responses (DPSIR) framework have typically focused on environmental management issues. In this work, a set of climate change indicators was selected to replace the set of environmental indicators. Climate change parameters were collected from three meteorological stations (Binh Chanh, Nha Be and Tan Son Hoa) in HCMC for 10 years (2006–2015) [23] in which relevant data on hydrometeorology were published [24], climate change scenarios of HCMC [25].

3.2 Calculations

To select core–indicators and sub–indicators for the survey, different categories of indicators were chosen via different approaches. Recently, there has not been a selected set of indicators in local sustainable development planning since the introduction of some innovative approaches in a United Nations initiative called Agenda 21 (1992). In 2013 S. Mattia and co–workers suggested that the indicator set for assessing sustainability at the local level usually consists of 12 core–indicators without mentioning of environmental factors and their influences. As a result, climate change indicators [26], the correlation between climate change and environment, and recommendations for setting of indicators regarding the influence of climate on socio–economic development [1, 7] were considered and applied, shown as follows:

Climate change indicator: the standard deviation of monthly mean temperature, the standard deviation of monthly total rainfall, the difference between monthly maximum and minimum temperature, the number of days with temperatures higher than 35^{o}C, the number of days with precipitation above 50 nm, and the annual number of flooded areas.

Socio–economic indicators [1, 7] household characteristics–population (07 sub–indicators), incomes–GDP (05 sub–indicators), energy consumption (05 sub–indicators), costs of water supply (05 sub–indicators), health (07 sub–indicators), drainage issues (05 sub–indicators), flooding problems (05 sub–indicators), traffic impacts (05 sub–indicators).

Data standardization using vector–based techniques (Brauers et al. 2008; Lý 2014)is expressed as follows:

$$x_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^{2}}}$$

Where: j = 1, 2, …, n as the number of alternatives; i = 1, 2, …, m as the number of objectives;x_{ij}as the response of alternative j on an objective i;x_{ij}^{*} as a dimensionless number representing the normalized response of alternative j on objective i. These normalized responses belong to the interval [0; 1].

Expert discussions about weights: 30 experts who possess a master's degree or higher in education (ITE 2015)were selected and consulted. They have applied multiple–criteria to assess climate change risks according to a maximum score of 100 and later these results were used to form weights of the indicators (rank reciprocal weights). In this context, the consultation results were scored by determining the weights via inverse method – dividing the sum of the inverse numbers by the scores of individual criteria, in other words (Table 2) [27].

$$w_i = \frac{\frac{1}{i}}{\sum_{j=1}^{n} \frac{1}{j}}$$

where: i (rank) = 1, 2, 3 …n; j (attributes/criteria) = 1, 2, 3…m

In general, different techniques of standardization will yield different results [20]; accordingly, some combination methods should be used. In that case, multiplying the standardized numbers by the weights will get the evaluation scores.

$$X_i = x_{ij}^{*} \text{ x } w_i$$

Calculation of PoSDI: the formula for arithmetic average was used to calculate the HPI:

$$\text{PoSDI} = [(\frac{\text{PoSDI}_{cc}{}^{3} + \text{PoSDi}_{ec}{}^{3} + \text{PoSDI}_{sc}{}^{3}}{3})]^{1/3}$$

Where: PoSDI_{cc} = climate change sustainability index; PoSDI_{ec}= economic sustainability index; PoSDI_{sc}= social sustainability index;

The sustainability assessment of population growth was based on the LoSI reported by Nath and Talay in 1998, as following (Hòe 2006):

0.00 ÷ < 0.20: unsustainability
0.20 ÷ < 0.40: weak sustainability
0.40 ÷ < 0.60: sustainability
0.60 ÷ < 0.80: quite sustainability
0.80 ÷ < 1.00: strong sustainability

4. Results

4.1 Descriptive statistics for survey data

The vast majority of respondents to the survey are young with a median age of 40 and a mean education level of 11.56 years. They have been well–educated with 79% a high education level (higher education or university), which indicated that they possess at least a certain knowledge in the field of climate crisis and sustainable development.

Regarding the negative impacts of flooding stress on the lives of the individuals involved in the south of HCMC, some suburban areas situated in low topographic positions like Binh Chanh and Nha Be have nearly 28.7% of households that are frequently influenced by flooding. On the other hand, the affected households in two new urban districts, District 7 and Binh Tan, was approximately 57.8%, with the lowest water level of 3 cm and the highest water level of 135 cm when compared with actual floor levels. In addition, around 37% flood–affected households were reported in District 8, of which the lowest water level was 1 cm and the highest one was 115 cm. The statistics of this research also revealed other harmful impacts of flooding such as potentially increase the growth of indoor mold and resulting in adverse health effects, especially infectious diseases in the elderly (29.4%) and children (40.7%) in District 8. All of these figures demonstrated that the negative influences and consequences of flooding was significant and this was dramatically higher than that of in 2011 data.

4.2 Population sustainability indexes (PoSDIs)

According to the expert questionnaire survey results, the weights of the indicators were determined, as presented in Table 2 below. Among presented factors, household characteristics with the weighted average (WA) of 0.32 (*economic indicators*) and traffic issues with the WA of 0.32 (social indicators) were found to be the major factors affecting the PoSDIs at the local level, followed by health problems (0.28), GDP (0.23), floods (0.23), energy consumptions (0.22), costs of water supply (0.17) and drainage issues (0.17). These findings are suited with actual conditions in the southern region of HCMC because household properties play a crucial role in livelihoods and incomes, whereas traffic is a major urban transport problem of residents in the city, particularly when they are ought to be going to work or school.

Based on the PoSDIs are shown in Table 3, it is seen that there was noticeable difference in the PoSDIs among 05 districts, 0.400 for Binh Chanh, 0.377 for District 7 and 8, 0.370 for Binh Tan and 0.368 for Nha Be. Binh Tan has the highest number of PoSDIcc, at 0.224, followed by District 8 (0.220), Binh Chanh (0.212), District 7 (0.199), and Nha Be (0.191). The maximum difference of PoSDIcc between Binh Tan and Nha Be was approximately 14.6%. By contrast, the difference between PoSDIec and PoSDIsc was negligible, at around 7.3% ÷ 7.9%. When considering individual PoSDIs, only PoSDIsc (0.368 ÷ 0.400) can be regarded as sustainable and others belonging weak sustainability.

According to the data in the Table 3, climate change is likely to have a dramatic impact on the economy of HCMC and contribute to making PoSDIec small, between 0.210 and 0.226. Similarly, a small number of PoSDIcc (0.191 ÷ 0.224) was largely because the weather in the southern part of HCMC has changed significantly. In general, PoSDIs in the south of HCMC tend to decrease, thanks to economic and social consequences of climate change. For example, the local sustainability indexes in the south were relatively smaller than those in Davao Province, Philippines, at 0.34 ÷ 0.60, and dramatically smaller than those in developed countries. This can be attributed to the breakdown of family structure in the south where traditional family members tend to live with or in close proximity to extended family members, the relocation to higher ground, and the effect of moving bottlenecks on traffic flow, economy, and study, especially children studying in primary and secondary schools.

5. Conclusion

In this study, a simple framework for evaluating the effect of climate change on residential sustainable development was reported, according to the three–pillar conception of sustainability (society, economy and environment). The report introduced a modified index that can be used to minimize missing data. Moreover, different weights were selected and later determined to optimally develop the modified index that is simple and practical for framework development process, a key tool in quantitative measurement.

Additionally, the report provided evidence on the use of indexes, which were applied as an essential tool for determining the level of influence of climate change on residents. The PoSDIs of 05 districts (District 7, District 8, Binh Tan, Binh Chanh and Nha Be) in the south of HCMC were only 0.280 ÷ 0.305 and this result can be interpreted as a sign of weak sustainability. As a result, the harmful effects of climate change and variability on residents in the city can easily result in potential issues of population size and structure such as migration, livelihoods, health, and education.

However, there were some limitations used for calculating the PoSDIs, according to the human poverty index, the selection of secondary factors, and the relationship between sub–factors and main factors. In other words, this is inconsistency of criteria for assessing the residential sustainability.

Acknowledgements: This research was funded by the Department of Science and Technology of Ho Chi Minh City. Data and climate change scenarios in the city were supported by Prof. Dr. Nguyen Ky Phung, Vice President of People committee Department of of Thu Duc City.

Competing interest statement: The authors declare no conflict of interest.

References

1. Bank, A.D.; Committe, H.P.; Donre. Ho Chi Minh City Adaptation to Climate Change. ICEM– International Centrem for Environmental Management*,* **2009**, pp. 2.
2. Böhringer, C.; Jochem, P.E. Measuring the immeasurable-A survey of sustainability indices. *Ecol. Econ.* **2007***, 63(1)*, 1–8.
3. Brauers, W.; Zavadskas, E.; Peldschus, F.; Turskis, Z. Multi–Objective Optimization of Road Design Alternatives with an Application of the Moora Method, 2008.
4. BTNMT, Thông tư số 43/2015/TT–BTNMT về báo cáo hiện trạng môi trường, bộ chỉ báo môi trường và quản lý số liệu quan trắc môi trường. Hà Nội, 2015.
5. Čiegis, R. Darnaus vystymosi vertinimas. Taikomoji ekonomika: sisteminiai tyrimai. **2009**, *3(1)*, 105–121.
6. CPHCSC. The 2009 Vietnam Population and Housing Census: Completed Results Statistical Publishing House, 2010.
7. Dasgupta, S.; Laplante, B.; Meisner, C.; Wheeler, D.; Yan, J. The impact of sea level rise on developing countries: a comparative analysis: The World Bank, 2007.
8. Hahn, M.B.; Riederer, A.M.; Foster, S.O. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change—A case study in Mozambique. *Global Environ. Change*. **2009***, 19(1)*, 74–88.
9. Hák, T.; Moldan, B.; Dahl, A.L. Sustainability indicators: a scientific assessment. Island Press, 2012, pp. 67.
10. (17). Lý, C.Đ. Giáo trình Phân tích hệ thống môi trường. Đại học Quốc gia thành phố Hồ Chí Minh: Viện Môi trường và Tài nguyên, 2014.
11. L. Hens, R.J.; Borden, S.; Suzuki Cara vello, G. (Eds) Research in Human Ecology: An Interdisciplinary Overview, **1998**, 247–258.
12. Silfverberg, K.; Starck, A.; Manninen, A. The Core Indicators for Sustainable Development in Helsinki. Helsinki City Urban Facts Office, **2002**, *4(1)*, 7–101.
13. Mattia, S.; Oppio, A.; Pandolfi, A. Developing the Green Building Challenge (GBC) evaluation model: a multidimensional framework for the assessment of regional and urban regeneration interventions. *Aestimum* **2012**, 499–510.
14. Saisana, M.; Philippas, D. Sustainable Society Index (SSI): Taking societies' pulse along social, environmental and economic issues. *Environ. Impact Assess. Rev*. **2012***, 32*, 94–106.

15. (17). Lý, C.Đ. Giáo trình Phân tích hệ thống môi trường. Đại học Quốc gia thành phố Hồ Chí Minh: Viện Môi trường và Tài nguyên, 2014.
16. Programme, U.N.D. Human Development Report 1997. Oxford University Press, 1997.
17. Nhật, P.H. Nghiên cứu ảnh hưởng do hệ thống chống ngập úng đến môi trường khu vực Tp. Hồ Chí Minh và đề xuất biện pháp phát huy và giảm thiểu, 2012.
18. Programme, U.N.D. Human Development Report 1997. Oxford University Press, 1997.
19. Nations, U. Indicators of Sustainable Development: Guidelines and Methodologies – Third Edition.UN DESA–United Nations Department of Economic and Social Affairs, 2007.
20. Medineckienė, M.; Turskis, Z.; Zavadskas, E.K.; Tamošaitienė, J. Multi–criteria selection of the one flat dwelling house, taking into account the construction impact on environment, 2010.
21. Nations, U. Indicators of Sustainable Development: Guidelines and Methodologies – Third Edition.UN DESA–United Nations Department of Economic and Social Affairs, 2007
22. Triangle, T.c.đ.k.q.t.T.G.H.; HIDS, V.N.c.p.t.T.H. Nghiên cứu nghèo đô thị: Các chính sách công về giảm nghèo từ nghiên cứu trường hợp ở quận 8, thành phố Hồ Chí Minh, 2012.
23. SRHC, S.R.H.C. Số liệu thống kê về nhiệt độ, lượng mưa tại các trạm khí tượng các năm 2006–2015, 2016.
24. Phùng, N.K.; Tâm, L.V. Xây dựng mô hình tính toán một số thông số dưới tác động của Biến đổi khí hậu phục vụ quy hoạch sử dụng đất, giao thông, tài nguyên nước và hạ tầng cơ sở cho TP. Hồ Chí Minh. Đề tài nghiên cứu khoa học thành phố Hồ Chí Minh, 2011.
25. Phùng, N.K. Xây dựng kịch bản biến đổi khí hậu, nước biển dâng cho Tp. Hồ Chí Minh 2016. Đề tài nghiên cứu khoa học thành phố Hồ Chí Minh, 2016.
26. Stocker, T.; Qin, D.; Plattner, G.; Tignor, M.; Allen, S.; Boschung, J. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge Univ. Press, Cambridge, UK, and New York, 2013, pp. 1535.
27. Sandanayake, Y.; Fernando, N.; Karunasena, G. The 3RD World Construction Symposium 2014. Theme – Sustainability and Development in Built Environment: The Way Forward. In D.o.B.E.U.o. Moratu (Ed.): Building Economics and Management Research Unit BEMRU, 2014.