EVALUATION OF INDIA'S URBAN SOCIAL SUSTAINABLE DEVELOPMENT USING A COMPOSITE INDEX

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Abstract
India has experienced phenomenal growth in urbanization in the last few decades putting massive pressure on basic infrastructure and services. The objective of this paper is to create a composite social sustainable index for India which will help us to understand the dynamics of social sustainable development .The index will enable prioritization of resource allocation between the various sectors of the social dimension. Secondly the paper attempts to analyse the impact of macro-economic factors like economic prosperity, population, population density, income inequality, and environment and migrant influx on social sustainability. It examines all four facets of urban sustainability: social, economic, environmental and institutional, in an integrated manner. The three-tiered hierarchical model is tested in the state of Odisha, in Eastern India. Using this framework we go on to obtain a composite index for urban social sustainability that can be applied to all Indian cities with contextual changes. This research shows that in India education is fundamental to improving the social sustainability and urban policies should focus strongly on the critical zones of education, health and access to basic services.

Keywords: *Urban social sustainability; composite index; hierarchical model; sustainability indicators; integrated framework; correlation analysis*

INTRODUCTION

Background
India has experienced phenomenal growth of its cities. The rate of urbanization has grown rapidly from 26 per cent in the 1990-2000 decade, to 30 per cent in the 2000-2010 decade. Projecting this growth rate forward, the urban population will be 40 per cent of the total projected population of 1470 million by 2030. Urbanization at this scale will put massive pressure on a city's natural resources and the ability of the Indian cities to provide basic infrastructure and services.

A look at the background of the sustainability issues reveals that a lot of research has been done on this topic on a global scale, starting with the Brundtland commission report in 1987, which sparked global efforts to construct sustainable development indicators. In1992, governments of 178 countries worldwide met at Rio de Janeiro for the UN conference of Environment and Development (also known as the Earth Summit) in order to address the urgent problems of environment protection and socio-economic development. India was however not a member state. In fact, in India, till 2008, no city had registered an indicator development initiative (Nathan and Reddy, 2008) though now the Indira Gandhi Institute of Developmental Research, Mumbai is attempting to measure the sustainable development for mega-cities like Mumbai and Bangalore (Reddy and Balachandra, 2013).

Need for forming an urban sustainability index

Urban Sustainability, as defined by United Nations Commission on Sustainable Development (UNCSD), has four components namely Economic, Environmental, Social and Institutional. The UNCSD framework for determining the Urban Sustainability is a 3 tiered hierarchical model with several themes under each dimension, and several indicators under each theme. Tracking sustainability indicators over a period of time may shed light on distance and direction from the target. An urban sustainability index obtained by an aggregation of all the indicators could define the progress towards full urban sustainability in a quantitative and measurable way, which is easily understood by policy makers.

India has not yet developed or published a comprehensive and consistent sustainable strategy (von Hauff et al., 2013). It has developed a series of projects and programs, starting with the tenth five-year plan that can be classified as important elements of National Sustainable Strategy. These five-year plans provide medium-term strategies for overall development. The ministry of urban development has recently framed a report on the development of sustainable habitat parameters on Urban Development (Town and Country Planning Organisation, 2011).

Although a number of global initiatives have been launched by the World Bank, UN Habitat, Asian Development Bank etc. which measure the urban sustainability across countries, there is no single global initiative which takes into account the unique needs and inclusive growth policies of India. Globalization – in the sense of the increasing exchange of products, services and concepts –does contribute to a convergence of solutions and problems, but there is also a country specific explanation for the constraints encountered in the development of implementation of a sustainable strategy in India. (Von Hauff et al., 2013). Hence it is important to develop a custom made sustainability framework for India, to address the problems which are typical to India like demographic control, gender and caste disparity in education etc. which is not addressed by the global initiatives. This has been dealt in detail in the later section, framing the urban social sustainability framework, by taking into account India's potential weak zones.

Definition of sustainable urban development

Probably the most comprehensive definition of sustainable development is given by Brundtland Commission, as "Development which meets the needs of the present without compromising the ability of future generations to meet their own needs."(Brundtland, 1987)

'Sustainable Urban Development' (SUD) has often been used interchangeably with 'urban sustainability' (Richardson, 1994; McLaren,1996). They may be differentiated, however, because sustainability implies a desirable state or set of conditions whereas SUD implies a process by which sustainability can be attained (McLaren, 1996). More formally, SUD has been defined as "development that improves the long-term social and ecological health of cities and towns" (Wheeler, 1998).

Urban sustainability is defined as the challenge to "solve both the problems experienced within cities and the problems caused by cities" (European Commission, 2006), recognizing that cities themselves provide many potential solutions. The dimensions of Urban Sustainability are established as "Sustainable urbanization refers to the well-balanced relationship between the social, economic and environmental agents in society, so as to accomplish sustainable urban development" (Drakakis-Smith, 2000).

Research question

Despite rapid economic growth in India, the urban quality of life remains low and hence there is need to develop an integrated social sustainable framework which is tailored to address its typical problems. The aim of this paper is to develop a Composite Index (Urban Social Sustainability Index) to assess social sustainable development for urban India, which will inform National Policy and Planning.

Since the focus of this paper is to assess social sustainable development, it is important to understand that a social sustainability framework cannot be developed in isolation but has to be obtained in conjunction with a comprehensive sustainability framework under the four dimensions of Social, Economic, Environmental and Institutional development. Each of these three dimensions is an equally important component of sustainable growth and must be integrated from the outset while developing a sustainability framework (von Hauff et al, 2013). Once the integrated sustainability model has been developed, the Social dimensional model will be developed with indicators under each theme.

METHODOLOGY

The study was conducted with the following objectives

To form a hierarchal framework of urban social sustainability after studying the urban sustainability as a composite framework encompassing social, economic, environmental and institutional dimension and then focusing on the social dimension. The framework is to be to be tailor made for India by

a. Mapping theoretical definitions and global practices to Indian policy regulations
b. Making a gap analysis of India's performance vis-a-vis the global aggregate performance based on sustainability indicators.

To form a composite index for social sustainability and understand the dynamics of social sustainable development by

a. Finding the correlation between the dimensional index and thematic index
b. Understanding the macro-economic factors impacting urban social sustainability

The research methodology used was as follows:

i. Developing a thematic comprehensive framework of urban sustainability within the four dimensions of economic, social, environmental, and institutional sustainability.
ii. Obtaining a model for urban social sustainability with indicators under each theme.
iii. Sampling the state and cities on which the model will be tested
iv. Data collection from secondary sources for the cities
v. Creation of a composite urban social sustainability index by:
    a. Normalisation of indicator values
    b. Allocating weights to indicators using expert surveys and confirming the results with weights obtained from factor analysis.
    c. Linear aggregation of indicators under each theme to obtain theme index.
    d. Determining the directionality of the scores
    e. Linear aggregation of thematic index to obtain composite dimension index value.
vi. Testing the model through multivariate analysis
vii. Analysis of the results

Establishing a framework for urban sustainability

As discussed earlier the four dimensions of Social, Economic, Environmental and Institutional need to be discussed in tandem for integrated sustainable development. In this section we try to map practice, policy, and theoretical definitions to obtain the conceptual framework for Indian urban sustainability. In the absence of a nationally defined sustainable strategy, the report of the sub-committee on Development of Sustainable Habitat Parameters in the Field of Urban Planning by Town and Country Planning Organization, Government of India, Ministry of Urban Development (Town and Country Planning Organisation, 2011), formed the basis of sustainable urban policy guidelines. The global initiatives taken were Social Progress Index (Stern et al,2014) , Global Urban Indicator database (UN-Habitat,2000), Report on Monitoring the Habitat Agenda and the Millennium Development Goals- Slums Target (UN-Habitat,2009), City Data Book

(Westfall and de Villa ,2001), Global City Indicator(World Bank,2008), FEEM Sustainability Index (Carraro et al. ,2009), International Urban Sustainability Indicators List (Shin L-Y et al. ,2011). In Table 1, after mapping the themes for each of the dimensions (Social, Economic, Environmental and Institutional) under global practices and India's Sustainability Strategy, the resultant framework obtained gives the common themes that can be applicable for India.

Table 1: The urban sustainability framework for India (Source: Authors).

SOCIAL DIMENSION									
Themes	S P I	GUID	MDG	C D B (ADB)	Global City Indicator	FEEM SI	IUSIL	Policy Relevance with NSS	Common themes
Health	√	√	√	√	√	√	√	√	√
Access to basic needs	√	√		√	√		√	√	√
Housing	√	√		√	√		√	√	√
Personal Safety	√	√		√	√		√	√	√
Education	√	√	√	√	√	√	√	√	√
Equity	√	√	√	√	√		√	√	√
Demography				√		√	√	√	√
Poverty			√	√	√	√	√	√	√
Culture							√		
Recreation							√		
Pedestrian public space							√		
Access to credit							√		
ECONOMIC DIMENSION									
Themes	S P I	GUID	MDG	C D B (ADB)	Global City Indicator	FEEM SI	IUSIL	Policy Relevance with NSS	Common themes
Infrastructure for economic development	√			√	√	√	√	√	√
Transport efficiency		√		√	√		√	√	√
Income and Distribution	√	√		√	√	√	√	√	√
Stability of growth							√	√	√
ENVIRONMENTAL DIMENSION									
Themes	S P I	GUID	MDG	C D B (ADB)	Global City Indicator	FEEM SI	IUSIL	Policy Relevance with NSS	Common themes
Soil Pollution	√	√	√	√	√		√	√	√
Air Pollution	√		√		√	√	√	√	√
Water Pollution	√	√	√	√	√		√	√	√
Green spaces					√		√	√	√
Energy Consumption					√	√	√	√	√
Land Use Patterns		√		√	√		√	√	√
Disaster Mitigation					√		√		
Noise pollution							√		

Geographically balanced settlement							√		
Freshwater							√		
Biodiversity							√		
INSTITUTIONAL DIMENSION									
Themes	S P I	GUID	MDG	C D B (ADB)	Global City Indicator	FEEM SI	IUSIL	Policy Relevance with NSS	Common themes
Personal Rights and Choice	√						√		
Governance And Participation		√		√	√		√	√	√
Local Government		√		√	√		√	√	√

Source: Social Progress Index (Stern et al, 2014), Global Urban Indicator database version 2(UN-Habitat, 2000), Report on Monitoring the Habitat Agenda and the Millennium Development Goals- Slums Target (UN-Habitat, 2009), Urban Indicators for managing Cities: Asian Development Bank, 2001(Westfall and de Villa, 2001), Global City Indicators Program Report (World Bank, 2008), FEEM Sustainability Index (Carraro et al., 2009), International Urban Sustainability Indicators List (Shin L-Y et al, 2011), Report of the Sub Committee on Development of Sustainable Habitat Parameters (Town and Country Planning Organisation,2011)

Establishing a framework for urban social sustainability

To form the conceptual Urban Social Sustainability model, a mapping was done for each indicator between theory, policy and practice, and a gap analysis was done on the resultant common indicators to understand the potential weak zones where India falls behind the world aggregates. The theoretical basis for the model was obtained from relevant literature review. If there was mapping on three or more areas, the indicator was included in the resultant framework. The criteria for selection of indicators was that it should follow the Bellagio practices of being policy relevant, simple, understandable and valid (Hass et al., 2004) and that there should be availability of time series data which is cost effective i.e. good quality affordable data. All data used for comparison were as of 2011. The resultant framework started with 44 indicators (as seen in Table 2) but after factor analysis they were narrowed down to 26 collinear, consistent and comprehensive indicators (as seen in Table 5). It was important that the framework was not indicator rich and information poor .The framework included only the outcome indicators as there is lack of consensus on how the input leads to outcomes.

Table 2: The Indian urban social sustainability framework – Mapping practice, policy and theory (Source: Authors).

Indicators of Demography									Gap Analysis	
INDICATORS	SPI	GUID	MDG	CDB	Global City Indicator	Policy relevance with National sustainable strategy	Theoretical base	Resultant framework	Urban India Average	Urban World Average
Population net density (persons/sqkm)		√		√		√	√	√	12,100	4400
Age pyramid (Dependency ratio) (per cent)				√		√	√	√	55.6	54
Population growth rate (per cent)				√		√	√	√	1.64	1.21
Average household size (no)				√		√	√	√	5.3	4.44
Household formation rate (per cent)				√		√	√	√	46.8	26.9

Informal settlements (slum formation) (per cent)			√				√	√	38.1	45.4

Source for Theoretical base- Population expansion putting pressure on infrastructure (Dixon, 2011) demographic change (Colantonio et al, 2009) *Source for data*: UN-Habitat Report 2011 (UN-Habitat, 2011), World Development Indicators 2011 (World Bank, 2011), India Human Development Report, 2011(Gandhi et al, 2011)

Indicators of Education									Gap Analysis	
Adult literacy rate (per cent)		√	√	√		√	√	√	62.8	80.9
School enrolment rate (primary) (per cent)		√	√	√	√	√	√	√	116.9	106.9
School enrolment rate (secondary) (per cent)			√	√	√	√	√	√	60	68.4
School dropout rate (primary and secondary) (per cent)						√		√	34.2	18
Access to advanced education (no)	√			√				√	25	*
School children/classroom				√					*	*
Student/teacher ratio (primary and secondary)(no)					√			√	40.7	23.05

Source for Theoretical base- enrolment rate, literacy (World Bank, 2008), basic education (Mahadevia, 2001) social mixing and cohesion (Colantonio, 2009) *Source for data*: India Human Development Report, 2011(Gandhi et al, 2011)

Indicators of Health									Gap Analysis	
Birth rate (no per 1000)	√			√		√	√	√	18.3	19.5
Death Rate (no per 1000)	√			√		√	√	√	5.8	7.89
Infant mortality rate (no)			√			√	√	√	50	44
Child Mortality rate(no)		√	√	√	√	√	√	√	66	61
Maternal Mortality Ratio (no)	√	√	√	√	√	√	√	√	254	273
Family Planning rate (per cent)			√	√		√	√	√	46	61
Male female ratio at birth (males per 100 females)						√		√	108.5	108.5
No of persons per hospital bed					√	√		√	268	290
Child Immunization (per cent)							√		70	83

*Source for theoretical base***-** Mortality, Healthcare delivery, nutritional status, health status and risks, adequate provision and access to adequate public health facilities (Mahadevia, 2001) *Source for data*: World Development Indicators 2011(World Bank, 2011), India Human Development Report, 2011(Gandhi et al, 2011), data unavailable-*

Indicators of Equity									Gap Analysis	
INDICATORS	SPI	GUID	MDG	CDB	Global City Indicator	Policy relevance with National sustainable strategy	Theoretical base	Resultant framework	Urban India Average	Urban World Average
Income inequality –share of poorest in national income		√	√	√	√	√	√		8.1	6.35

Child labour (per cent)		√	√	√	√	√	1.6percent	9.3percent in Asia
Employment rate by gender (no)	√	√	√	√	√	√	35.7	56.8
Ratio of boys to girls in primary, secondary and tertiary education(no)	√	√		√	√	√	100 boys to 92 girls (sec)77 ,5 girls(tert)	100 boys to 96 girls
Proportion of women councillors (per cent)	√	√		√	√	√	11	19

Source for theoretical base – gender equity in employment, promote social integration and support disadvantaged groups (Kaufmann et al., 2005), Empowering people, participation, Human rights and gender (Colantonio, 2009) *Source for data*: World Development Indicators 2011(World Bank, 2011), India Human Development Report, 2011(Gandhi et al, 2011)

Indicators of Housing								Gap Analysis	
Land price/income ratio (no)		√		√		√	√	*	*
Housing price/income (no)		√		√	√	√	√	*	*
Percentage unauthorized housing and land (per cent)		√		√		√	√	*	*
Percentage of population in durable houses (per cent)		√			√	√	√	81	78.43
Percentage of population in self owned houses (per cent)		√	√	√		√	√	67	57.1
Distribution of urban poor housing in HIG and MIG schemes				√		√	√	*	*
No of homeless people (per cent)				√			√	0.24	1.4
Housing shortage (per cent)	√			√		√	√	37.7	*
Overcrowding		√				√		*	*
Evictions		√						*	*
Secure tenure		√	√	√		√		*	*
Housing finance		√					√	*	*
Housing rent to income					√		√	*	*

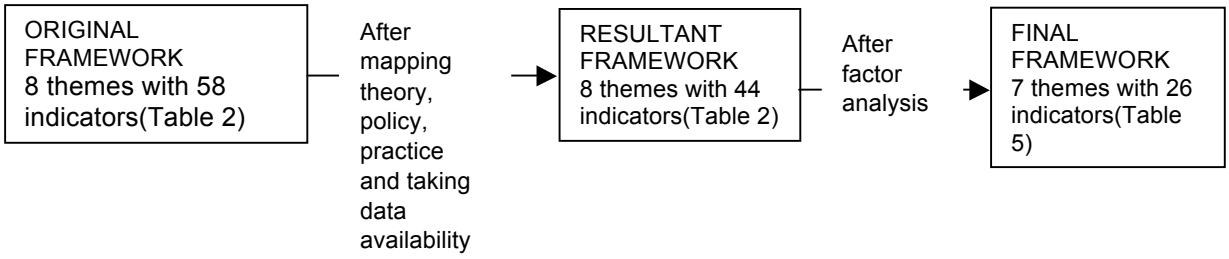
Source for theoretical base- access to water and sanitation facilities (World Bank, 2008), authorized electrical connections and interruptions, nutrition (Stern et al., 2004) quality of service (Kaufmann et al, 2005) provision and access to civic amenities and a clean safe and healthy living environment for all, safe and sufficient drinking water (Mahadevia, 2001) *Source for data*: World Development Indicators 2011(World Bank, 2011)

Indicators of Poverty								Gap Analysis	
Above poverty line households(percent)		√	√	√	√	√	√	73.5	78.4
Expenditure on poverty reduction				√		√	√	*	*
Average MPCE (Rs)			√		√		√	1052	*

Source for theoretical base – Combating poverty, sustainable livelihoods (Mahadevia, 2001) social capital (Colantonio, 2009) Source for data: India Human Development Report, 2011(Gandhi et al, 2011), Level and Pattern of Consumer Expenditure2011-12 NSS 68th Round (National Sample Survey Office, 2014), data unavailable-*

Indicators of Safety									Gap Analysis	
INDICATORS	SPI	GUID	MDG	CDB	Global City Indicator	Policy relevance with National sustainable strategy	Theoretical base	Resultant framework	Urban India Average	Urban World Average
No of police officers per 1 lac population (no)					√	√		√	173	*
Crime rate per 1 lac population (no)	√	√			√	√		√	581.1	3300
No of fire-fighters per 1 lac population					√	√			*	*
Accident rate per 1 lac population (no)	√			√	√	√		√	14.7	27.2
Urban violence	√	√			√				*	*
Source for theoretical base – homicides, crime rate, fire and emergency response, law enforcement, freedom from violence and intimidation based on social identity (Mahadevia, 2001) *Source for data*: UN-Habitat Report 2011										
Indicators of Access to Basic Services									Gap Analysis	
Percentage households with piped water connections (per cent)	√	√	√	√	√	√	√	√	52 per cent network coverage 62 per cent treated supply	63 per cent network coverage 91 per cent treated supply
Percentage households with electricity connections (per cent)	√	√		√		√	√	√	92.68	76.7
Percentage households with sewerage network (per cent)	√	√	√	√		√	√	√	32.68	61
Percentage households with telephone connections (per cent)	√	√		√		√	√	√	64	81
Government expenditure per capita on each service				√		√			*	*
Water consumption				√	√	√			*	*
Price of water						√			*	*
Price of electricity						√			*	*
Quality of electrical supply							√		*	*
Percentage households with toilet connections (per cent)	√			√		√	√	√	74	80
Percentage households with solid waste collections (per cent)	√			√		√	√	√	38.23	*
Source for theoretical base- access to water and sanitation facilities(Global City Indicators,2008), authorized electrical connections and interruptions ,nutrition(Stern 2014)quality of service(Kaufmann)provision and access to civic amenities and a clean safe and healthy living environment for all(Mahadevia,2001)safe and sufficient drinking water(Mahadevia,2001) -- *Source for data*: World Development Indicators 2011, India Human Development Report,2011, World Health Organization 2011, Service Level Benchmarking 2011, data unavailable-*										

While referring to Table 2, the following discussion will be limited to the final 26 indicators chosen (as also seen in Table 5 which gives the final indicator list for calculating the USSI) after factor analysis on the 44 indicators.



Demography

Demographic growth is the single most important criterion putting pressure on infrastructure resources. Except City Data Book (by Asian Development Bank), demographic growth as a theme is absent in most of the global initiatives relating to sustainable development. India is the second most populous country in the world with more than one sixth of the world's population. Though the world population has increased by 15 per cent between 2000 and 2011, India's population has increased by 18 per cent in the same period. Referring to Table 2, the final indicators under the demography framework were:

1. Population growth rate: Exponential rate of growth of population was 1.64 per annum during 2001-2011,higher than world growth rates of 1.21
2. Household formation rate: This rate has gone up in the recent years 2001 onwards because of the rise of nuclear families and is almost double the world aggregate.
3. Informal settlements: The rise in population and migration has lead to the rise in slum population and this is significant because India houses 15 per cent of the world's slums. It magnifies the urban divide.

Education

Educational attainment is a proxy for human capital development and in India there is a lot of gender disparity and caste disparity in educational benchmarks. Referring to Table 2 the final indicators under the housing theme were:

1. School enrolment rate (primary and secondary): It is higher than the world average at the primary school level but lower than the world average in the secondary school level.
2. School drop-out rate (primary and secondary): The drop-out rate is much higher than the world aggregate at primary and secondary level.
3. Student/teacher ratio (primary and secondary): India is performing better than the world average.

Health

There has been positive trend in the development of health infrastructure in terms of hospitals, dispensaries and public health centres (SRS Statistical Report, 2011). In spite of government expenditure on healthcare a substantial increase, the indicators on mortality rates, though constantly falling, show much scope for improvement.

But the positive trend is that the though the world birth rate has fallen by 4 per cent in the period between 2000 and 2011, India's birth rate has fallen by 16 per cent. Referring to Table 2 the final indicators under the health theme were:

1. Birth rate: Birth rate in urban India is lower compared to world average of 19.5 per thousand.
2. Infant mortality rate: The Infant mortality rate in India is much higher compared to world average of 44 per thousand.
3. Child mortality rate: The Indian under five mortality rate is higher than the world average (there is a large variation in the developed economies and developing economies)

4. Maternal mortality ratio (MMR): Though the MMR has come down from 301 per thousand in 2001 to 254 in 2004 it is still very high compared to world standards.
5. Death rate: Death rate in urban India was lower than world aggregate of 7.89 per thousand.

Equity

Although there have been significant improvements in per capita GDP over the past decades, there is still a massive gap between the poorest and richest sections of society. Income inequity is an important indicator of government failure in achieving inclusive growth. There are a number of regional and group specific disparities. Sex ratio at birth is indicative of favour towards male child. The 2011 census reveals 914 females to 1000 males. India has gender inequality rank of 112 out of 187 countries in the world. Referring to Table 2 the final indicators under Equity theme were:

1. Child labour: The child labour has declined from 20 per cent of children under the age of 14 engaged in full-time labour (1993-94) to 4.2 per cent (2005) and in 2011 it was at 1.6 per cent
2. Sex ratio for work participation rate: Percentage of females in the labour force is very low compared to the world average.
3. Proportion of female councillors: Proportion of female councillors in India is 9.2 per cent compared to 16.2 per cent of the world, in spite of the 33 per cent reservation for women in parliament which significantly demonstrates gender inequality.

Housing

The demand for affordable housing, along with high levels of urban poverty, has led to the emergence of slums in India. It is important to achieve significant improvements in housing facilities for slum dwellers. Referring to Table 2 the final indicators under the housing theme were:

1. Land price per income ratio: For affordability, the housing to income ratio should not be greater than 4 in EWS (economically weaker sections) and LIG (low income Groups) and for this land cost is a prime constituent.
2. Percentage of housing on unauthorised land has increased due to rising slum population
3. Percentage households in self-owned houses are higher than the world average.
4. Housing shortage is very acute in urban India in the affordable housing category.

Poverty

The national poverty gap ratio at 4.8 is one of the highest in the world though it has consistently fallen over the years. Referring to Table 2 the final indicators under poverty theme were:

1. Above poverty line households: 28.6 per cent of people in the country live below the national poverty line out of which 25.7 per cent are in urban areas. This does not compare well with the world average.
2. Average Monthly Per Capita Consumption Expenditure.

Safety

Global studies show that 60 per cent of all urban residents in developing countries have been victims of crime at least once over the past five years. Urbanization, particularly in the developing world, has been accompanied by increased levels of crime, violence, and lawlessness (UN-Habitat, 2011). Referring to Table 2 the final indicators under the safety theme were:

1. Crime rate per a hundred thousand populations: Crime rate in India is much lower than the world average.
2. Accident rate per a hundred thousand populations: Road accident fatality in million plus cities is lower than world average.

Access to basic services

Access to reliable supplies of safe drinking water and sanitary disposal of sewage are two of the most important means of improving human health. Referring to Table 2 the final indicators under the Access to basic services theme were:

1. Network coverage (water supply) and households with tap water from treated source: Both are lower than world average and needs improvement.
2. Percentage households with toilet facilities and improved sanitation: also much lower than world average.
3. Percentage households with sewerage network: also lower compared to the world
4. Percentage households with electrical connections: It has risen from 89 per cent in 2000 to 93 percent in 2011 which is a positive trend and is higher compared to the world.
5. Percentage households with landline and mobile telephone connections: The percentage of Population with telephone connections has gone up from 0.60 per cent in '91 to 64 percent in 2011 which is huge jump in connectivity.

State of Odisha for testing the framework

The state of Odisha has been intentionally chosen for testing the framework. Almost half of Odisha is below the poverty line. It has lagged behind the national average in terms of literacy rate, life expectancy rate, infant mortality rate and child mortality rate.(Government of Odisha,2004). This high incidence of poverty and relatively low level of human development feed into each other creating unsustainable conditions. Although it has always been one of the least urbanized states in India, since 2011, Odisha has seen rapid rates of urbanisation, as seen by the decadal growth rate of 30.28, almost in line with national average of 32.60. The population of the state has grown by 14 per cent between 2001 and 2011, but the urban population has grown by double the rate. This provides the best context for the sustainability impact to be studied in terms of whether the infrastructure services match the growth in population.

The sampling universe consists of mid-sized cities (population between one to ten lakhs) in India because they constitute two-third of the total number of cities having a Municipal Corporation. These mid-sized cities are unable to prove their credit-worthiness for international loans and hence the constraints to their economic sustainability are very severe. Out of the five cities of Odisha having municipal corporations, four cities of different levels of maturity have been studied. Bhubaneswar, being the capital is a new and planned city, while Cuttack is a heritage city with a 1000-year-old history. Berhampur and Sambalpur are almost two hundred years old.

Creation of a composite urban social sustainability index

Most of the data for the cities has been obtained from the relevant municipalities (Comprehensive Development Plans), NUIS (National Urban Information System) and Census data as of 2011. Other sources of data are Government reports like District Census Handbook, District Information system for education, Annual Health Survey, Odisha Economic Survey etc. (Refer Table 5).

Normalization of indicator values

In real-life situations, indicator values have different measurement units (income in local currencies, electricity in KWh, etc.). For developing composite indicators, it is essential to transform the values of all these indicators into some standard form. Thus, for each of the indicators included in the analysis, a relative indicator is estimated using the actual, minimum and maximum sustainability threshold values. For comparing best case and worst-case scenario, the four cities (Siliguri, Asansol, Raipur and Amritsar) of comparable population, character and regional setting have been taken. The relative indicator is developed using a scaling technique where the minimum value is set to 0 and the maximum to 1. The equation used for this is:

$$\text{Relative indicator} = \frac{\text{Actual value} - \text{Minimum threshold value}}{\text{Maximum threshold value} - \text{Minimum threshold value}}$$

Source: (OECD, 2008)

Giving weights to indicators

Weights to the indicators were obtained by doing expert survey with a questionnaire using constant sum rating scale. The weights so obtained almost matched with the weights obtained from factor analysis confirming the validity of the expert survey and choice of indicators.

Linear aggregation of indicators

The composite thematic value can be found by

$$Ti = {}^{l}\Sigma_{k=1} w_k \, x_{ik} = w_1 \, s_{i1} + w_2 \, s_{i2} + \; + \ldots\ldots \, w_m \, s_{il} \qquad (1)$$

Where *Ti* the overall score of theme *i* and x_{ik} the Relative indicator value *i* for criterion *j* of which *wj* is the weight.

Testing the model through multivariate analysis

Cronbach Alpha showing the coefficient of reliability based on the correlation between individual indicators, is the most common estimate of internal consistency (OECD,2008). The acceptable threshold is 0.6. Majority of the themes have a very high internal consistency among indicators under it (value greater than 0.7) (Refer Table 3 A). Since one (Equity) of the 8 themes is less than 0.6 it is dropped from the final dimensional index calculation. Testing the themes under the Social Sustainability dimension also reveals a strong alpha value of 0.726. (Refer Table 3 C).

Table 3: Statistical analysis (Source: Authors).

Table 3 A Cronbach α for Themes

Theme	Cronbach Alpha Value
Demography	0.718
Education	0.709
Health	0.893
Equity	0.364
Housing	0.764
Poverty	0.840
Safety	0.703
Access to basic needs	0.686

Table 3 B KMO,Barlett value for themes

Theme	KMO Value	Bartllett's significance value
Demography	0.618	0.016
Education	0.548	0.018
Health	0.625	0.000
Housing	0.566	0.038
Poverty	0.500	0.018
Safety	0.500	0.005
Access to basic needs	0.550	0.005

Table 3 C Cronbach α for Dimension

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.726	0.726	7

Factor Analysis was conducted to investigate the overall structure of the indicators under each theme and assess the suitability of the dataset by means of suitable multivariate methods like principal components analysis. It also provides the weights for each of the individual indicators under each theme. Themes under the social dimension were matched with the weights given by the expert survey and verified the expert opinion. The sample adequacy was tested by Kaiser-Meyer-Olkin test (value to be greater than 0.500) and the Bartlett's test of sphericity (significance level should be less than 0.05). (Refer Table 3B). Majority of the themes satisfies this test.

Obtaining the directionality of the scores

Value judgements are necessary in deciding the vector qualities (i.e., the direction) of the indicator scores (Voogd, 1983). That is, to judge whether a particular theme is contributing positively or negatively to sustainability. For some themes, a higher criterion score implies a better sustainability, whereas for other themes, a higher criterion score might imply lower sustainability. The first kind of criteria is referred to as 'benefit criteria' while the second type is denoted as 'cost criteria'. Of the eight themes under social sustainability, four themes are categorised as benefit criteria, namely education, access to basic services, equity and poverty alleviation. The remaining four themes fall under the umbrella of cost criteria, namely demography, health, safety, and housing. For the scores to be formulated according to higher the better, the following transformation will be made:

Directed Standardised score = Standardised score(for Benefit Criteria)
Directed Standardised score = 1- Standardised score (for Cost Criteria)

The benefit and cost criterion were decided after expert consultation.

Linear aggregation of the thematic index to obtain the dimensional index

The overall score of dimension value for Urban Social Sustainability is obtained by multiplying the score of each criterion (cost and benefit) by the weight of that criterion, and then adding all those weighted scores together.

$$USSI = {}^{m}\Sigma_{j=1} w_j \, x_{ij} = w_1 \, s_{i1} + w_2 \, s_{i2} + \; + \ldots\ldots \, w_m \, s_{im} \qquad (2)$$

Where, USSI is the overall score of dimension (urban social sustainability index) and *xij* the score of option *i* for criterion *j* of which *wj* is the weight. The inputs in the model are both weights and scores. This linear aggregation is the summation of weight x standardised score for benefit criterion themes, and weight x (1- standardised score) for cost criterion themes. The weights are obtained from factor analysis by using the shared covariance value. The final USSI scores for the 4 cities are given in Table 4. As seen from the table Cuttack leads in social sustainability, followed by Berhampur , Bhubaneswar and Sambalpur.

Table 4: USSI scores for four cities of Odisha (Source: Authors).

Theme	Weights from factor Analysis	Bhubaneswar Directed Standardised score	Cuttack Directed Standardised score	Berhampur Directed Standardised score	Sambalpur Directed Standardised score
DEMOGRAPHY	0.25	0.33	0.54	0.88	0.45
HEALTH	0.15	0.19	0.48	0.15	0.41
SAFETY	0.15	0.71	0.85	0.71	0.44
EDUCATION	0.15	0.56	0.7	0.51	0.72
HOUSING	0.15	0.45	0.3	0.08	0.33
ACCESS TO BASIC SERVICES	0.15	0.59	0.62	0.22	0
POVERTY	0.15	0.32	0.52	0.51	0.26
USSI		0.5055	0.6555	0.5470	0.4365

Data Source: Census India(2011), District Census Handbook (2011), District Information system for education(2011), Annual Health Survey Bulletin :2011-12(Office of Registrar General and Census Commissioner , India,2011), Odisha Economic Survey(Government of Odisha ,2011), National Sample Survey Office (2014), National Crime Record Bureau (2011), Service Level Benchmarks(Ministry of Urban Development,2011), National Urban Information System (2011)

The final indicator list for calculating the USSI with the true and relative indicator value are shown in Table 5.

Table 5: Comparative true and relative indicator values for themes under urban social sustainability for the four sample cities (Source: Authors).

Theme	No	Indicator	Unit	Bhubaneswar		Cuttack		Berhampur		Sambalpur	
				True Value	Rel. Value	True Value	Rel. Value	True Value	Rel. Value	True Value	Rel. Value
DEMOGRAPHY	1	Population growth rate(decadal 2001-11)	%	37.5	0.75	22.9	0.38	15.6	0.19	19	0.28
	2	Household formation rate	%	41.4	0.59	20.5	0.04	27	0.21	37	0.47
	3	Informal settlements	%	34	0.61	36.3	0.73	22	0.00	39.8	0.91
		DEMOGRAPHY INDEX VALUE (DIRECTED STANDARDISED)			**0.33**		**0.54**		**0.88**		**0.45**
EDUCATION	1	School enrolment rate(primary)	%	88.53	0.13	88.06	0.12	101.8	0.27	108.5	0.35
	2	School enrolment rate (secondary)	%	101.0	0.47	139.9	1	97.51	0.42	106.4	0.55
	3	School drop-out rate(primary and secondary)	%	4.84 9.63	0.18	7.07 16.64	0.29	3.81 10.47	0.17	0 9.7	0.1
	4	Student/teacher ratio(primary)	no	32.85	0.58	28.32	0.38	32.04	0.55	27.23	0.33
	5	Student/teacher ratio(secondary)	no	39.18	0.78	21.87	0	43.21	0.96	27.91	0.27
		EDUCATION INDEX VALUE (DIRECTED STANDARDISED)			**0.56**		**0.7**		**0.51**		**0.72**
HEALTH	1	Birth rate	%	18.3	0.60	20	0.75	17.1	0.50	19.1	0.67
	2	Infant mortality rate	no	69	1.00	37	0.32	67	0.96	43	0.45
	3	Child mortality rate	no	83	0.89	48	0.32	90	1.00	54	0.42
	4	Maternal mortality ratio	nos	276	0.70	276	0.70	311	0.88	253	0.58
	5	Death rate	%	7.3	0.84	5.4	0.50	7.2	0.82	7.6	0.89
		HEALTH INDEX VALUE (DIRECTED STANDARDISED)			**0.19**		**0.48**		**0.14**		**0.4**
HOUSING	1	Land price per income ratio	no	0.28	1.00	0.27	0.96	0.03	0.07	0.01	0.00

	2	Percentage of housing on unauthorised land	%	20.7	0.46	8.12	0.10	4.8	0.00	32.4	0.80
	3	Percentage households in self owned houses	%	53.81	0.00	54.2	0.01	56.85	0.10	64.49	0.36
	4	Housing shortage	%	18.5	0.23	7.63	0.00	15.45	0.16	17.96	0.22
		HOUSING INDEX VALUE (DIRECTED STANDARDISED)			**0.45**		**0.3**		**0.08**		**0.33**
POVERTY	1	Above poverty line households	%	75	0.58	74.1	0.55	54.7	0.04	53.1	0.00
	2	Average MPCE per household	Rs	809	0.59	832	0.68	758	0.40	652	0.00
		POVERTY INDEX VALUE (DIRECTED STANDARDISED)			**0.59**		**0.62**		**0.22**		**0**
SAFETY	1	Crime rate per 1 lac population	No	194	0.12	120	0.00	152	0.05	279	0.26
	2	Accident rate per 1 lac population	No	84.2	0.46	59.27	0.30	94.08	0.52	149.1	0.86
		SAFETY INDEX VALUE (DIRECTED STANDARDISED)			**0.71**		**0.85**		**0.71**		**0.44**
ACCESS TO BASIC SERVICES	1a	a.coverage connections-water supply	%	51.7	0.72	49.4	0.68	34.7	0.40	42	0.53
	1b	b.Percentage households with tap water from treated source	%	47	0.00	68	0.56	64	0.45	76	0.78
	2	Percentage households with toilet facilities	%	75	0.31	84	0.61	85	0.64	65.63	0.00
	3	Percentage households with sewerage connections	%	34.5	0.46	2	0.03	0	0.00	0	0.00
	4	Percentage households with electrical connections	%	86.22	0.00	94.36	0.65	94.4	0.66	95.08	0.71
	5a	a. Percentage households with landline telephone connections	%	4.78	0.46	4.91	0.50	4.29	0.32	4.22	0.30
	5b	b. Percentage households with mobile telephone connections	%	64.78	0.53	66.39	0.64	71.7	1.00	59.31	0.15
		BASIC SERVICES INDEX VALUE (DIRECTED STANDARDISED)			**0.32**		**0.52**		**0.51**		**0.26**

Data Source: Census India (2011), District Census Handbook (2011), District Information system for education (2011), Annual Health Survey Bulletin: 2011-12(Office of Registrar General and Census Commissioner, India, 2011), Odisha Economic Survey (Government of Odisha, 2011), National Sample Survey Office (2014), National Crime Record Bureau (2011), Service Level Benchmarks (Ministry of Urban Development, 2011), National Urban Information System (2011)

RESULTS ANALYSIS AND DISCUSSION

This paper will not attempt to diagnose the problem areas for the individual cities but limit itself to understanding the dynamics of Social sustainable development in general for India. For this reason the scope of analysis will be limited to

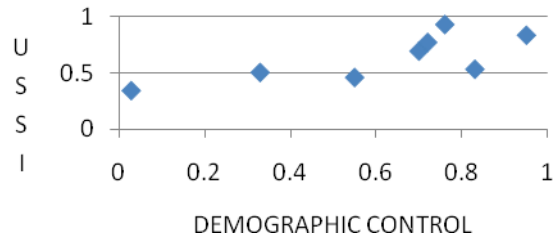
Finding the correlation between the dimensional index and thematic index.
Understanding the macro-economic factors impacting Urban Social Sustainability.

Correlation between social sustainability index and its constituent themes

To understand the importance of the various constituent themes of Urban Social Sustainability, a correlation analysis is conducted between the social sustainability level of the sample cities and the constituent themes (like demography, education, health, housing, poverty, safety and access to basic services) which could help the policy makers to make decisions regarding financial planning and prioritization of resource allocation among the themes.

Figure 1 shows strong positive correlation between all the thematic indices and social sustainability index but the strength differs in its intensity as indicated by the correlation coefficient (r value seen in table below). Conducting a scatter plot analysis between USSI (Urban Social Sustainability Index) and the thematic indices shows that education is fundamental to improving the social sustainability. As can be seen in the table, there is very high correlation (r = 0.826) between educational index and social sustainability index. This is followed by correlation of safety index(r = 0.801), access to basic services index (r = 0.793) and health (r = 0.769) with USSI. This is indicative of the huge role played by these themes on Social Sustainability. The urban policies should focus strongly on these critical zones of education, health, safety and access to basic services.

Fig 1a ROLE OF DEMOGRAPHIC CONTROL IN URBAN SOCIAL SUSTAINABILITY



Thematic Index	Correlation Coefficient r Value
Demographic Control	0.764
Health	0.769
Safety	0. 801
Education	0. 826
Housing	0.685
Access to Basic Services	0.793
Poverty	0.685

Fig 1b ROLE OF HEALTH IN URBAN SOCIAL SUSTAINABILITY

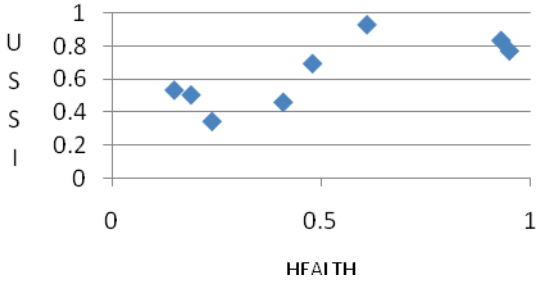
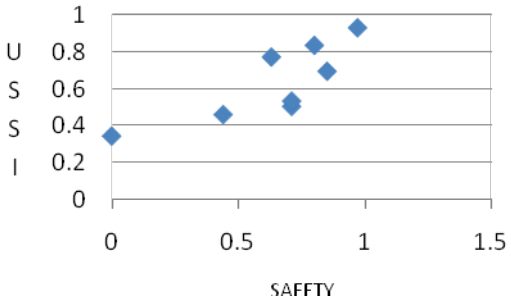


Fig 1c ROLE OF SAFETY IN URBAN SOCIAL SUSTAINABILITY



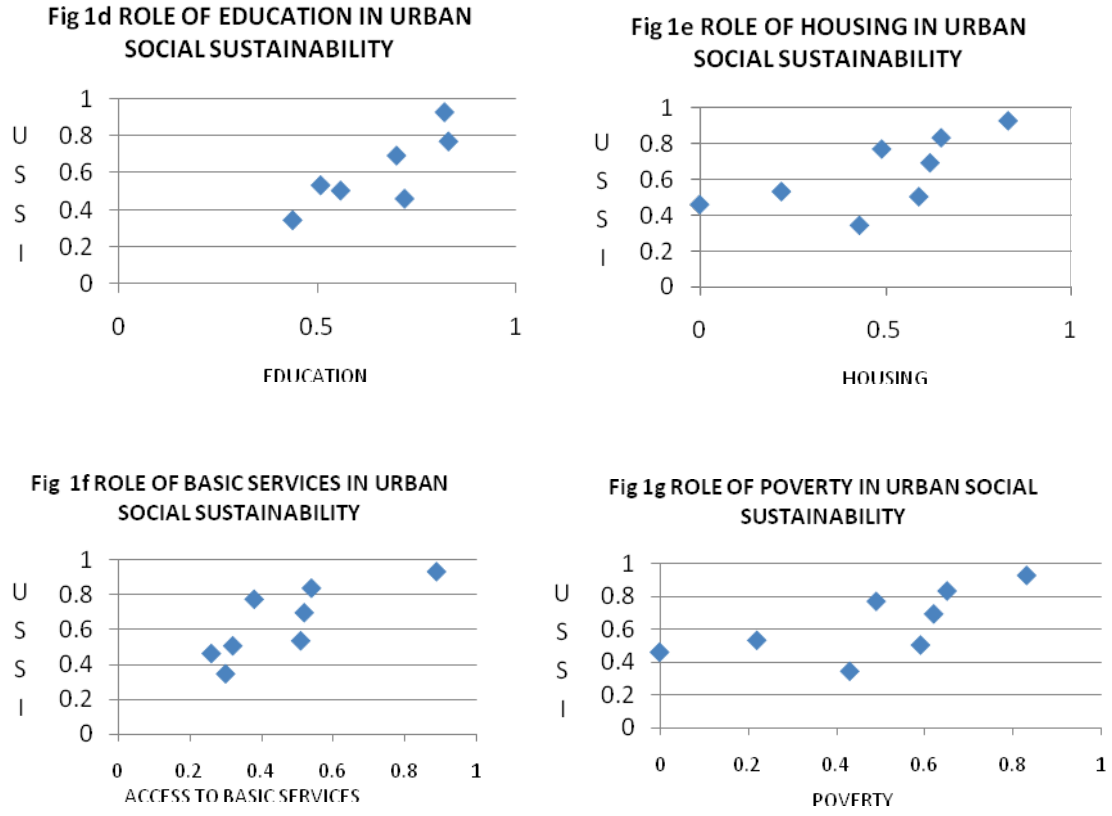


Figure 1: Correlation analysis between USSI and its constituent thematic indices (Data Source: Table 5 – Source: Authors).

For India to achieve sustainable growth, human development, which is a function of social policies and economic growth, is very essential because it enhances the power of the citizens to participate in the development process. The synergies in the social sector mainly work through feedback loops between education, basic infrastructure services and health. For instance, higher education has a positive impact on health status and in turn health is an input for higher education. The impact of education is most powerful because it affects all human development outcomes like health (in terms of family size and nutritional status) and basic services (for healthy living conditions).

India has a very large percentage of persons in the working age group but without a healthy population it will be difficult to realize the demographic dividend. Health and sanitation do not respect boundaries. Poor health conditions are brought about by unsafe drinking water, poor sewage networks, lack of public toilets and waste collection strategies. So as seen in Figure 2 the sectors of education, access to basic services and health work synergistically to produce sustainable social development and urban policies should focus on these core sectors.

Hence in a developing nation like India where resources are in short supply, the resource allocation amongst the various sectors could be in the order of their importance to the social sustainability. The dimensional and thematic indices thus evaluated help the policy makers to make well informed judgements.

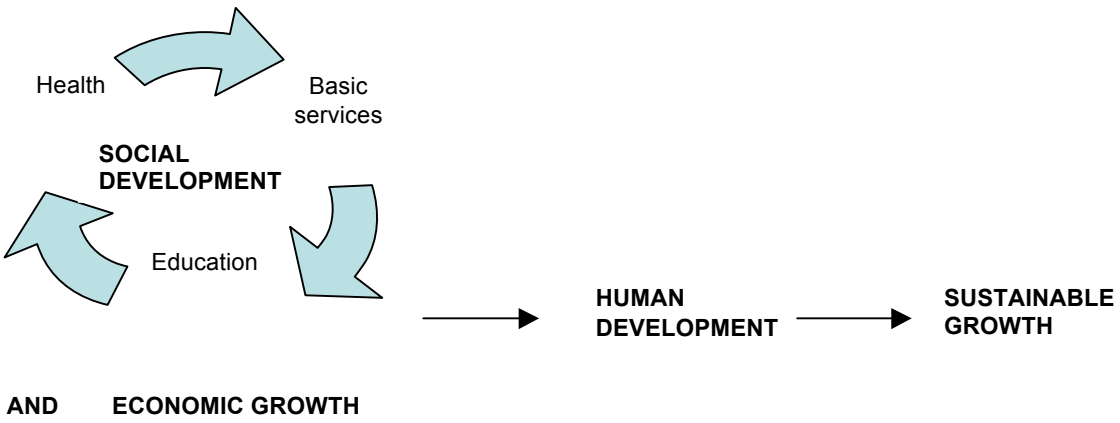


Figure 2: Synergies of education, health and access to basic services producing sustainable social development (Source: Authors).

Macro-economic factors impacting urban social sustainability

The next objective is to understand the drivers of urban social sustainability. Hence a correlation analysis is conducted between the social sustainability level of the sample cities and various macro-economic factors like economic prosperity, population, population density, and income inequality, environment and migrant influx. The purpose of this analysis is to predict the optimum balance of a city in terms of parameters like economic prosperity, size, density, income inequality, ecological balance and migrant influx that may ensure a socially sustainable city.

Population

Looking at Figure 3a, the scatter plot between population and USSI brought forth a very interesting observation -With increase in population there is increase in the social sustainability level but only up to a critical population level of 5 lakhs, after which there is a downtrend. This implied that after the critical turning point of inflection, the social sustainability growth model needs to be revised. This shows 5 lakhs population is the sustainability bottleneck.

Economic Prosperity

The sample cities are in various stages of development- some are very mature cities like Cuttack (thousand years old) and some are new cities like Bhubaneswar. But irrespective of the stage of development there is very little correlation between economic wealth and social sustainability. Here economic wealth is being represented by per capita GDP (which is the most commonly accepted measure). Barring two outliers, the scatter plot is clustered in a single vertical straight line in Figure 3b.

Population density

The scatter plot shows a very important observation. There is a fairly strong positive correlation between a city's population density and USSI .The distribution of the scatter plot in Figure 3c shows an upward trend which flattens out at the critical point of 8000 persons per sq km. Any economic advantage due to increase in density (because of economy of scale) is not felt beyond this point. This shows a density of 8000 persons per sq km is the sustainability bottleneck.

Income Inequality

Looking at Figure 3d, the scatter plot shows a strong negative correlation between income inequality and social sustainability. GINI Coefficient is a common measure of income inequality. It is a coefficient ranging from 0 to 1 where 0 is a state of perfect equality and 1 is the state of

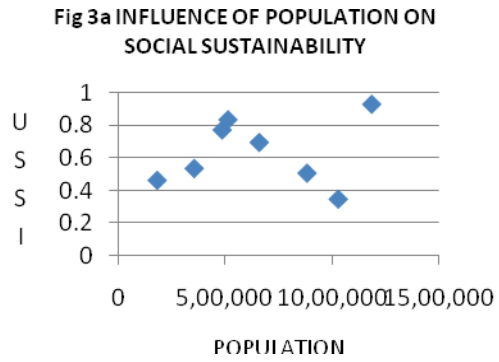
perfect inequality. As the income inequality increases the Social sustainability decreases. This shows equal distribution of wealth contributes strongly to the social sustainability.

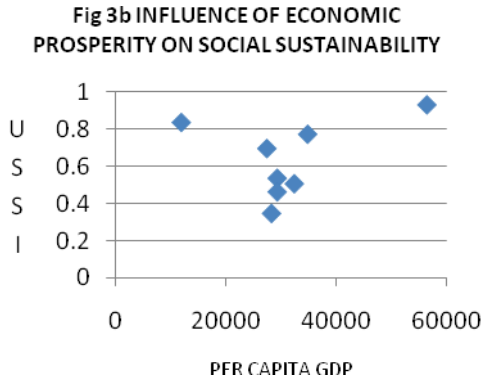
Environment

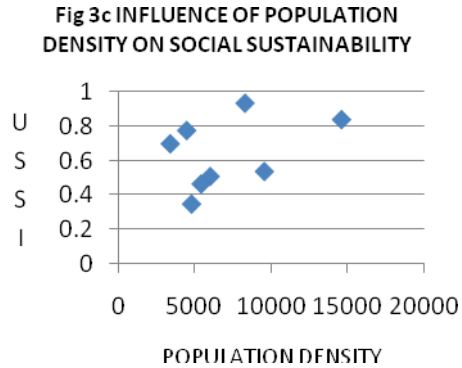
Figure 3e shows a weak positive correlation between the environment's impact (symbolically measured by the percentage of PM_{10} exceeding the acceptable range in a 24 hour period) and urban social sustainability index. Percentage of PM_{10} exceeding the acceptable range in a 24 hour period is a commonly acceptable measure of air pollution used by global initiatives. There is no distinct pattern observed. The weak positive correlation can be explained by the fact that the higher is the air pollution, the higher is the impact on health, which in turn impacts the social sustainability.

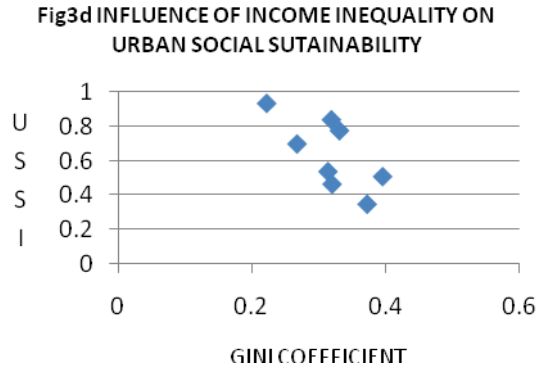
Migrant Influx

Figure 3f shows a strong negative correlation between migrant's influx and social sustainability. The downward trend is indicative of the inverse relationship between the two variables. With increase in the number of migrants, the social sustainability levels decrease. The migrant population in this case has been represented by percentage of slum population. With increase in the influx of migrants to cities there is an infrastructure crunch in terms of education, health, housing, access to basic services and increase in security and safety concerns too.









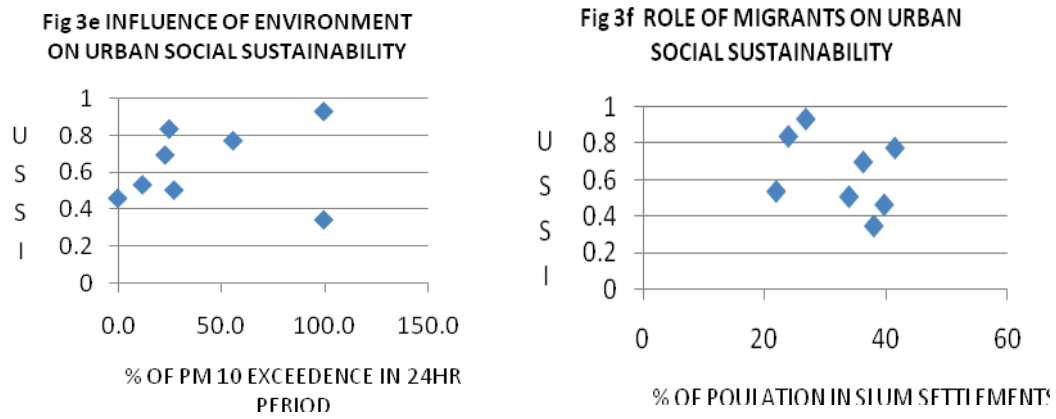


Figure 3: Macro-economic factors impacting Urban Social Sustainability (Source: Authors).
Data Source: Economic Survey Report (2011), Census of India (2011), National Sample Survey Office (2014). Ministry of Environment and Forests (2012).

The sustainability of mid-sized cities is positively correlated to population size and density. (Refer figure 4). However there are turning points beyond which the city's sustainability slows down. This is especially so when the population is greater than five lakhs and density greater than 8000 persons per sq.km. Sustainability is negatively correlated to migrant influx and income inequality. It is important to leverage on the economies of scale that a large population with a major percentage of people in the working age group brings. Increasing density so that it makes the infrastructure costs sustainable and equitable distribution of income are other methods, which brings rich dividends in terms of sustainability. The migrant influx from rural areas could be diverted to the smaller urban centres and turn it into their economic advantage instead of making the mega and midsized cities untenable in terms of infrastructure and services. Beyond the turning points the urban focus and financial flow should be diverted to smaller urban centres which should be developed to have a strong economic base.

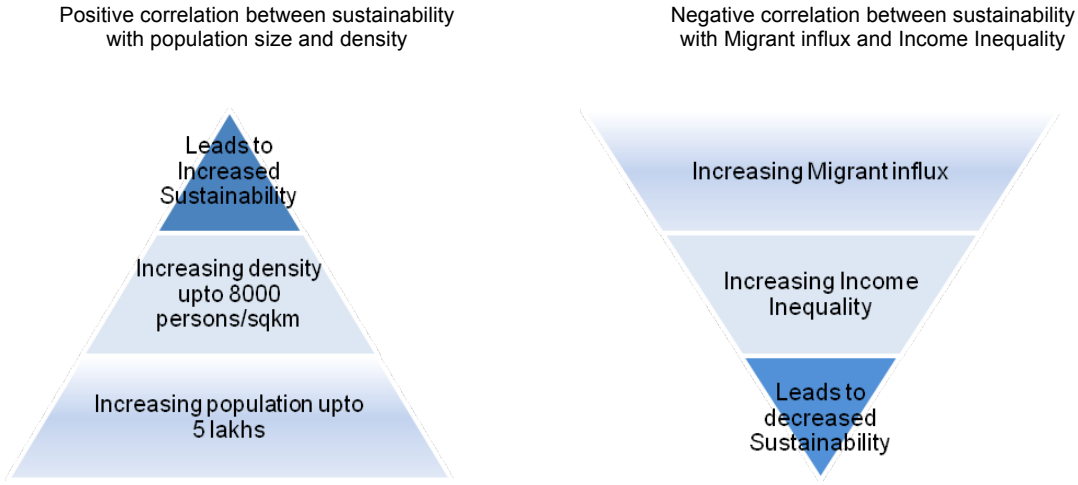


Figure 4: Macroeconomic factors affecting social sustainability for mid-sized cities (Source: Authors).

CONCLUSION

The objective of the research was to create an output based measure of urban India's social sustainability. The theoretical construct is custom made for India by mapping Indian sustainability policies with global initiatives and theoretical definitions, and doing a gap analysis to identify India's weak sectors in comparison with world sustainability. It is tested in the state of Odisha which is at the bottom of the urban ladder but growing at a tremendous speed and hence an appropriate test site because the infrastructure is not growing at the same relative speed. The same framework with contextual additions or deletions would work elsewhere in India. The indicators are limited in number and easily available from Census and NUIS (National Urban Information System) data. The trends can be seen in a 10 yearly time-series data to map the progress. However one size cannot fit all. India being a vast country context plays a very important role and the generic framework may be improved on a case to case basis .The weights to the indicators may vary as per local conditions.

One of the main purposes of forming a composite social sustainability index is the allocation of resources amongst the various sectors of Social dimension. The correlation analysis between the thematic index and dimensional index gives a scientific basis for prioritization of resource allocation amongst the various social sectors. In India there are so many cross currents between urban growth and policy reality that these indicators not only help to inform and empower policy makers, citizens, researchers and activists to measure and monitor sustainable development but also for policy making and for prioritization of budget allocation between various sectors. This research shows conclusively that in India education is fundamental to improving the social sustainability and urban policies should focus strongly on the critical zones of education, health and access to basic services.

To achieve faster economic growth, there is need to enhance human capabilities. Investments in health, education and basic services can enhance human development in midsized cities and towns that are at the centre of India's development trajectory. The challenge of urbanisation in India is to ensure planning for these basic services delivery at the minimum standards. In the context of Odisha, public policy for promoting human development has to contend with the fact that a low level of human development is accompanied by a very high poverty ratio and a poor growth performance. In such a scenario, it may be suggested that the optimal policy objective should be to forge strong links between growth and human development so that both become mutually reinforcing. The high incidence of poverty, and low participation in school and higher education, feed into each other. Establishing publicly funded educational institutions and pro-active policies alone can break this vicious cycle. A functional public health system will be critical to stabilizing the total population and reducing the total fertility rate. For economic growth to effectively reduce poverty on a sustainable basis, policy interventions for the enhancement of health and educational status and basic services are urgently required.

The second objective of creating the social sustainability index is to predict the parameters of a city in terms of economic prosperity, size, density, ecological balance etc., which may ensure a socially sustainable city. Economic prosperity and environment have a very weak positive impact on urban social sustainability but there is a distinct impact of population, density of population, migrant influx and income inequality on urban social sustainability. However blindly following the model of pursuing economic growth through population expansion and density will prevent sustainable growth. Beyond the turning points where the sustainability slows down there should be change in the existing models of development. The focus should be on the conversion of these mid sized cities into smart and low carbon cities which will strengthen their carrying capacity. Secondly the financial flows should be diverted to the smaller urban centres so that the imbalance between economic growth and social development which occurs in the mid sized cities could be offset by a cluster of growing small urban centres.

There is strong inter-relationship between the themes under the Social dimension. The vicious cycle begins with unplanned demographic growth as seen in the case of Bhubaneswar where the slum population makes up more than a third of the total population growing at a rate of 19.5 per cent per annum compared with the 5.75 per cent per annum growth of city population. This rapid growth does not come with the corresponding urban infrastructure growth and this widens the urban divide. Because of the inequitable distribution (in terms of income, housing, health, basic services, education divide) the cascading effect on each of the themes continues. India's policy measures are rightly geared towards inclusive growth and slum prevalence wherein through a multi-pronged approach of skill building, increasing provision of basic services, community development and security of tenure, the slums prevalence has fallen from 41.5 per cent in 2000 to 28.5 per cent in 2011, making it the second most successful country in the world after China in slum improvement. (UNDP, 2011).

It would be worthwhile to mention in this context that recently Bhubaneswar has been ranked the premier city of India from among the 28 smart cities; however its sustainability in the social sector as seen by the research leaves much to be desired. Sustainability scorecard of the cities is a realistic measure of the city's sustainability and can be used to make politically informed judgments. It encourages public accountability and an integrated framework across all the dimensions and would go a long way in evaluating our cities.

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