SOCIO-ECONOMIC FACTORS SHAPING MIXED USE DEVELOPMENTS IN INDIAN CONTEXT: A METHODOLOGY FOR PLANNED DEVELOPMENT

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ABSTRACT

Mixed use developments (MXDs) have been in existence even before any definition emerged to delineate what constitutes it. This could be the reason why till date, it is one of the most evasive terms in the planning vocabulary. The context of strategies or policies that aid to frame the developmental pattern of MXDs remains a challenge to the planners. Various planning organizations and institutes have come up with varying methods to consolidate the issues that jeopardize the growth and developments of the mixed land use. Several attempts have also been made to make them efficiently planned areas. However, these methods are case-specific and cannot be optimized to address the sensitive socioeconomic disposition of any particular identified mixed land use. Adoption of any of these methods to address any mixed land use, particularly, in an Indian context, where socioeconomic composition is highly heterogeneous, would not be feasible. Here, the requirements would be to derive a correlation pattern between the plethora of socioeconomic issues of Indian MXDs with respect to the influence factors for relating them to a quantifiable module of assessment in order to resolve them. This study aims to conglomerate the identified influence factors and their contribution to a case-specific area/zone. It also develops a methodology that better addresses the identified influence factors to ensure socio-economic sustainability of the MXD. Finally, the study analyses the scope for possible adoption of the methodology for inclusion of a planned mixed land use pattern in a long term planning process of any identified mixed use zone.

Key words: Mixed Land use, Influence Factors, Correlation, Socio-economic Sustainability, Framework

Introduction

A mixed use has been defined in more than any other possible term of the urban vocabulary. Over time it has been defined by various urban theorists and planners in the following ways:

- *"Mixed-use development is an ambiguous, multi-faceted concept" (Rowley, 1996);* [1]
- *"The terms 'mixed use' or 'mixed use development' are widely used, but seldom defined" (Coupland, 1997);* [1]
- *"Although the term appears frequently in the planning literature it is rarely defined" (Grant, 2002).* [1]
- *"The term mixed-use development has frequently appeared in the planning literature...however this term is hardly defined" (Hoppenbrouwer, 2005);* [1]
- *"The definition of mixed-use is not as precise as for a single property type" (Rabianski, 2009)* [1]

However, in the year 1976, ULI was the first organization to address the concept in-depth with the publication of their first book on the topic titled *Mixed-Use Developments: New Ways of Land Use.* The second edition of their *Mixed-Use Development Handbook* characterizes mixed-use development as consisting of:

- *Three or more significant revenue-producing uses (such as retail/ entertainment, office, residential, hotel, and/ or civic/ cultural/ recreation) that in well planned projects are mutually supporting;*
- *Significant physical and functional integration of proct components (and thus a relatively close-knit and intensive use of land), including uninterrupted pedestrian connections; and*
- *Development in conformance with a coherent plan (that frequently stipulates the type and scale of uses, permitted densities, and related items.* [2]

Based on the above definitions emerged the development of MXDs that got defined primarily in terms of the nature (predominance factor) and the type (block, cluster, neighborhood, etc.) as factors deciding growth and axis of development of the demarcated MXD zones.

In conformance with the same definition, the conceptualization of the MXD as part of planning strategies commenced. The typologies of models developed promoted a panoptic insight across different levels of planning (cluster, neighborhood, sector, city, etc.). The initial typologies of models defining formation of MXD were developed by Alan Rowley (1996) and Eric Hoppenbrouwer & Erik Louw (2005).

<u>MXDs in Indian Context</u>

Some salient features of MXDs as observed in Indian context were as follows:

Formerly, till the Delhi Development Authority's Guidelines on MXD came into being in the 2021 Master Plan, there was a pronounced unapprehendable growth of the MXD in the country. Also there was lack of policy framework backing the issue of MXD.

After the DDA's Master Plan 2021, major planning bodies of major urban agglomerations started taking note. However, it transpired in the best possible manner as PPP models or joint venture models. These models are practiced largely till date but still lack policy framing and policy structuring.

Nonetheless, DDA's Master Plan 2021 was successful in addressing the MXDs of the region for which it was planned. The other parts of the country continued witnessing the unplanned and uncontrolled growth of the MXDs. Recently: Certain draft plans started inclusion of policy recognition for Mixed Use Developments.

One significant example is the UTTIPEC publication of Street Design Guidelines (2010), for Delhi Development Authority (DDA) that encourages mixed use developments. It came after the DDA's master plan for 2021 and promoted MXDs largely.

Another recent example is the draft of State Urban Housing and Habitat Policy, 2013 - UP Housing and Development Board (UPHDB). The draft allocates specific percentage for each facility-35% for residential, 25% for offices/institutional use, 20% for retail (commercial), 10 for industrial (non-manufacturing and non-polluting) and the remaining 10% for community and recreation facilities. Other regulations include permitting mixed land use on 18 m and wider roads.

The lack of any pre-set percentage split-up for any defined nature of MXD - irrevocably results in jeopardizing the planned growth of the mixed-use, thus, eliminating all chances of its long term sustainability.

Certain differences exist in the expected outcomes versus ground reality scenario of the MXDs in the Indian context. Hence, the ways in which the types, nature and influence factors of these MXDs get shaped differ and the elements constituting the influence factors also differ. These basic have been enlisted in Figure 1.

Figure 1 : MXD in Indian context: Expected Outcomes vs. Ground Reality

The predominance factor plays an important role in determining the nature of mixed use. As a result, it indirectly implies the direct relation of changes in economic and social domains affecting the overall development of the mixed land use. Say for example, if two areas are selected, where one has a commercial predominance and the second has a residential predominance, the former shall generate more economy as compared to the later. Also differing would be the social parameters as the later zone would experience more of a neighborhood-based clustering as per social cohesion theories whereas the commercial might experience more of a CBD type of clustering based on economic agglomeration theories.

The percentage split-up of the different land uses helped determine the predominance factor in a MXD and this would help determine orientation of the different indicators towards them which could involve slight modification of the elements constituting the indicators. This would be effective while ascertaining the nature of predominance – i.e. single or shared. Single predominance would mean percentage split-up of the particular land use being the highest for the selected zone whereas shared predominance would imply percentage split-up of two or three land uses being closest to each other and constituting the greatest share of the land use. Based on then the predominance factor,

the indicators comprised of elements derived from survey outputs would be aligned along the predominant land-use's characteristics.

The major factors influencing the growth and development of mixed-use were attributed to the type of mix, nature of mix and the level at which the development manifested itself. These factors could be broadly classified under the associated functions of: [3]

- Density
- Transportation
- Social
- Economic

Literature Review

The overall literature studies confirmed the following:

- Need to address MXD for future planning principle: benefits and drawbacks. [4] [5] [6]
- Percentage of mix: dependent on dominance of land use, size of plots, setbacks and FAR with the first one being the most important role-player in the Multi Criteria Analysis (MCA) decision-making model. [1] [7]
- Identification of study area and demarcation of mixed-use zones. [3] [8] [9]
- Existing Models/method for MXD planning: advantages-disadvantages and their impact. [10] [11]
- Current trends in research-based modelling and methods for planning MXDs: best approaches to minimization and elimination of identified issues. [12] [13]
- Identification of indicator base and the relative datasets from survey outputs that corroborates to the individual indicators. [14] [15]
- Best method to approach the statistical evaluation of datasets to derive the proposals. [16]

However, the major contribution of literature survey as mentioned above could be classified broadly in terms of:

- Shaping framework of the study
- Shaping methodology of survey procedure
- Delineating models and methods adopted for the analysis and post-analysis stage

Shaping Framework of the Study

The methodology initially adopted to achieve the desired objectives was a 'goal-based approach' that incorporated three stages wherein the indicators and models & methods instrumentally shaped up in the form of objectives. However, due to lack of existing

pattern of indicators at micro-planning level– as supported by the literature survey—
the need to essentially establish social and economic indicators itself molded the prime
methodology to an 'objective-based approach.

<u>Shaping Methodology of Survey Procedure</u>

The basic methodology of survey procedure, prior to visiting the study areas, was a
basic delineation of the primary and secondary surveys and their respective types as
required for the proposed study. For primary surveys, respondent groups, survey types
and nature of data required as output from these surveys were estimated and accordingly
surveys were designed keeping in mind a base sample size corresponding to the 90
percent confidence level and $\pm$ 10 confidence interval for deriving optimum data from
the surveys. For the secondary survey, time-series based data (inclusive of nature of
data, form of data availability and tentative sources of data were estimated) that were
relative to the indicator base / influence factors were considered prior to commencing
data collection.

Though this was a basic framework defined by the literature surveys alone, a definite
pathway for extraction of necessary datasets for analysis phase could be certainly
assessed and estimated for the proposed study by developing a methodology based on
case-study of a selected area, as has been discussed in section 3 of this paper in detail.

<u>Delineating Models & Methods Adopted for the Analysis and Post-Analysis Stage</u>

The initial models adopted were linear regression models and subsequent
Geographically Weighted Regression (GWR) models - based on literature surveys [16].
However, when these failed to materialize into the exact desired nature of the outcomes,
then the alternatives in the form of Principal Component Analysis (PCA) were
suggested by further probation into the literature base that had already been assembled
for the proposed study.

<u>Developing a Methodology: In General</u>

The model that was adopted for this purpose was a case-study based on Nagpur Urban
Agglomeration, Maharashtra, India. A MXD model could be developed only when the
following prerequisites are fulfilled:
  • Selection of Study Area for the Case-Study.
  • Designing Survey Methodology for the Selected Area
  • Developing Models with respect to the Nature of Data from Survey Outputs

<u>Selection of Study Area for the Case-Study</u>

The city considered in context of the proposed study was Nagpur, Maharashtra, India. Nagpur city (named after the Nag river) is located at the geographic center of the Indian subcontinent witnesses' cross-cultural imprints on its day-to-day walks of life - whether it be in terms of regional linkages, economic stratifications or social bearings. Major rail and road networks running North to South (NH) and East to West (NH) intersect at this city, making it a major intersection junction. This in turn catalyzes a chain of related migration that triggers socioeconomic amalgamation of the highest order (Figure 2i).

POPULATION DENSITY MAP

EMPLOYMENT GENERATION MAP

PEAK HOUR TRIP GENERATION MAP
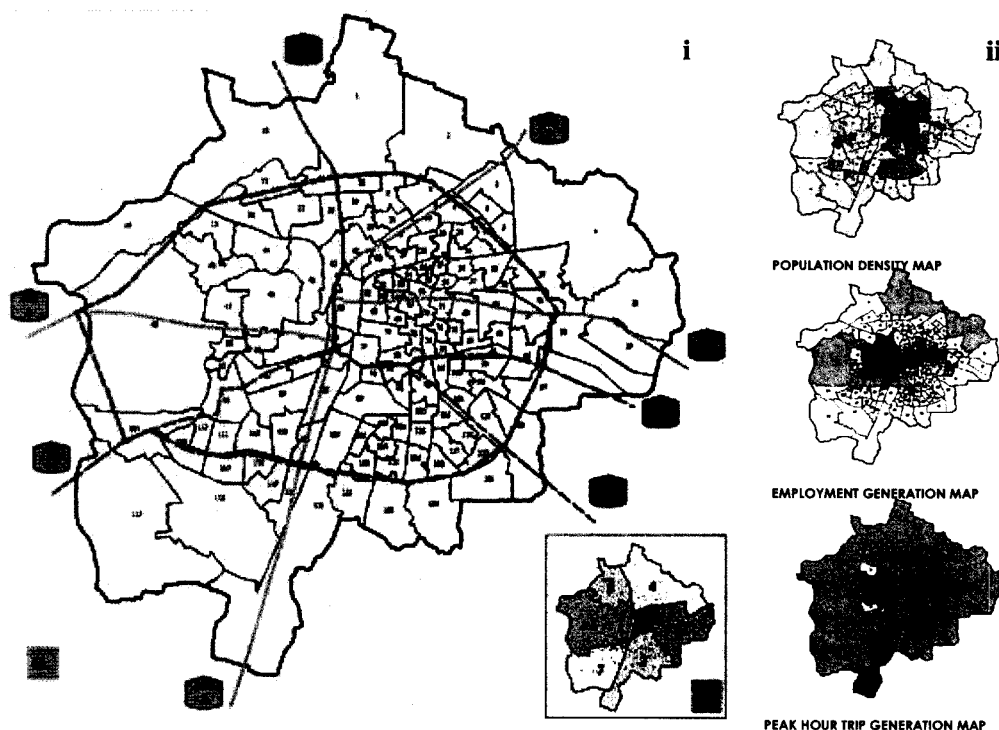
Figure 2 : (i) Selection of Study Area at Nagpur Urban Agglomeration, (a) Regional Linkage, (b) Planning Units; (ii) Criteria for Identification of Study Zones. (Note: Darker shades represent maximum & lighter shades represent minimum)

However, in context of MXD, the zones selected within the urban agglomeration were based on three major criteria of (Figure 2ii):
- Optimal population density
- Maximum propensity of employment generation
- Highest rate of peak hour trip generation

Based on the above criteria, three basic zones portraying MXDs were identified and selected for in-depth analysis and modelling. They were: ZONE-1 (Sitabuldi– Lendra Park), ZONE-2 (Dharampeth– Ramnagar) and ZONE-3 (Gaddi Godam– Sadar)

Designing Survey Methodology for the Selected Area

The basic methodology of survey procedure, prior to visiting the study areas, was a basic delineation of the primary and secondary surveys and their respective types as required for the proposed study (as has been discussed in previously in sub-section 2.2). The base sample size was divided into different types of surveys, based on the percentage split-up of the current (existing) land use pattern for the particular activity. The different types of surveys helped assimilate the different elements constituting the indicators and in turn could be classified under the four basic influence parameters (as already identified in sub-section 1.1.3)

Developing Models with respect to the Nature of Data from Survey Outputs

The general input-output models and econometric models faced certain hindrances while analyzing this kind of data derived from the surveys. This was because they could ideally evaluate datasets with same range of data or data as per rating systems (five-point or ten-point). Right at this point, rating data was improbable as it could mean loss of significance in values of the datasets. Hence there was a need for formulation of a new model to explain the MXDs under study, which could be an amalgamation of two or more existing models or a different approach that assimilates both existing models and qualitative inputs based on literary and case-study based evidences.

Developing a Methodology: For Analysis of Collected Data

As per the sample case-study of the Nagpur Urban Agglomeration, the basic methodology for data collection and analysis was accomplished in two basic stages and this entire process was divided into objectives-based activity constituted by three major objectives. Together, these objectives aimed to ascertain socio-economic sustainability of evolving MXDs in commercial predominant zones of Nagpur Urban Agglomeration, forming an indicator base for the study area and establishing extent of impact of elements of influence factors on indicator base.

Objective-1: Developing an Indicator System - Based on the Social and Economic Elements of the MXD

By means of literature study, inclusion of MXD indicators were included in surveys to derive outputs in the form of datasets, and analysis of existing datasets and by formulation of correlation matrix - a relational pattern of certain indicators was identified to be pertinent to the proposed study.

Objective-2: Allocation of Numeric Values to the Indicator System Based on Rating System for Equivalence

By analysis of derived datasets from a new perspective method—use of Principal Component Analysis (PCA) for the formulation of a series of matrices.

As all MXDs involved in the process were found to be commercial predominant, taking commercial land use as the 'epi-center' of all other land uses, the threshold for the medium sized (considering the middle range in terms of income-expenditure pattern and nature of commerce) commercial units were found to be 200 meters on an average. Considering this as the area of basic influence of commercial activities in the zone, the 200 meters by 200 meters grids were developed. The cumulative inputs from all types of surveys, corresponding to each identified indicator (12 indicators were identified for the given study area) from each individual grid were combined and averaged to develop a set of twelve matrices for a given land use.
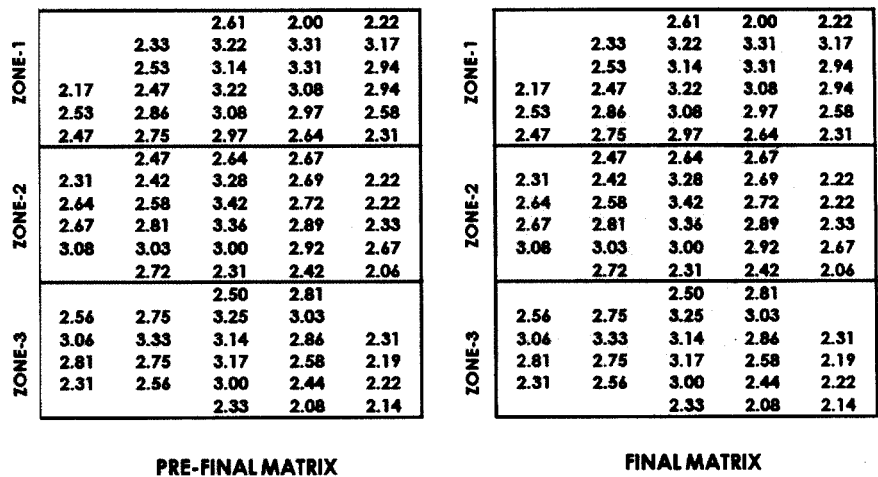
This delineated 3 sets (depending on three typologies addressed primarily– commercial, offices and residential) and 12 datasets (corresponding to the 12 identified indicators) for each such set—obtaining about 36 such matrices—named as unit or initial matrices.

This was then solved for different typologies of surveys which when solved step-wise rendered the desired outcomes.

Objective-3: Determining the Influence Domain & Degree of Influence of Identified Indicators on the MXD

Solving the unit/ initial matrices w.r.t. the amalgamation of the same indicators for different typologies - as derived using PCA in objective-2 - the derived outcomes were in the form of intermediate matrices. On solving these matrices, the pre-final and final matrices deduced helped ascertain the approximate degree of influence (from the percentage of explained variance). The final and pre-final matrices are given in Figure 3.

It also ensured the base for identified pockets within a mixed use that could be said to be socially and economically productive and sustainable in the long-run - hence, prompting selection of appropriate zones within a mixed-use for which the derived percentage split-ups of different typologies (as derived in the next step) could be applied. The same is evident from Figure 4.

PRE-FINAL MATRIX

ZONE-1

		2.61	2.00	2.22
	2.33	3.22	3.31	3.17
	2.53	3.14	3.31	2.94
2.17	2.47	3.22	3.08	2.94
2.53	2.86	3.08	2.97	2.58
2.47	2.75	2.97	2.64	2.31

ZONE-2

	2.47	2.64	2.67	
2.31	2.42	3.28	2.69	2.22
2.64	2.58	3.42	2.72	2.22
2.67	2.81	3.36	2.89	2.33
3.08	3.03	3.00	2.92	2.67
	2.72	2.31	2.42	2.06

ZONE-3

		2.50	2.81	
2.56	2.75	3.25	3.03	
3.06	3.33	3.14	2.86	2.31
2.81	2.75	3.17	2.58	2.19
2.31	2.56	3.00	2.44	2.22
		2.33	2.08	2.14

FINAL MATRIX

ZONE-1

		2.61	2.00	2.22
	2.33	3.22	3.31	3.17
	2.53	3.14	3.31	2.94
2.17	2.47	3.22	3.08	2.94
2.53	2.86	3.08	2.97	2.58
2.47	2.75	2.97	2.64	2.31

ZONE-2

	2.47	2.64	2.67	
2.31	2.42	3.28	2.69	2.22
2.64	2.58	3.42	2.72	2.22
2.67	2.81	3.36	2.89	2.33
3.08	3.03	3.00	2.92	2.67
	2.72	2.31	2.42	2.06

ZONE-3

		2.50	2.81	
2.56	2.75	3.25	3.03	
3.06	3.33	3.14	2.86	2.31
2.81	2.75	3.17	2.58	2.19
2.31	2.56	3.00	2.44	2.22
		2.33	2.08	2.14

Figure 3 : Corroborating all intermediate matrices – to obtain the pre-final and final matrix

ZONE-1   ZONE-2   ZONE-3
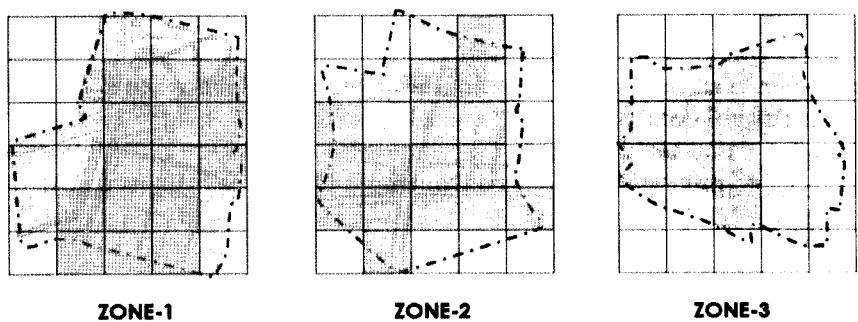
Figure 4 : Using final matrix to obtain a spatial probability of identified MXDs

Objective-4: Formulation of Intermediate and Combination Matrices for Deriving Desired Outputs

As observed in previous objective (objective-3, sub-section 4.3), intermediate matrices helped in estimating the degree of influence of the indicators on the said MXD. Also it helped in determining the most sustainable and potent pockets within the identified MXD for the growth and development of the same in social and economic terms.

Similarly, on solving the initial matrices w.r.t. all indicators for the different typologies, three sets of matrices - termed as the combination matrices were derived. On further solving these matrices, normalized values of the percentage of explained variance and computed sets of maxima-minima values - together helped estimate the range for the percentage split-up of different typologies within a given MXD - for its social and economic sustainability in the long term planning process.

Conclusion

The desired outcomes from the study had been successful to an extent of satisfactorily rendering the two basic outputs: the identification of most sustainable pockets of a MXD and the percentage split-ups for identified typologies within the MXD. Apart from this, the area selected for study was a non-primate city, thus eliminating plenty of complex socio-economic parameters existing there. With respect to the same, the limitations imposed for the topic that hoped to explore only two (intrinsic influence factors) of the four identified influence factors, imparted a diminishingly fragmented view of the outcomes in the initial stages of the analysis. At the later stage, the datasets were sufficient to materialize into the intentioned results.

Thus, it could be concluded that the topic could be further explored in terms of the domains of the identified extrinsic influence factors and their inclusion in mainstream dataset analysis. However, considering larger cities might result in a colossal dataset with possibilities arising for using other modelling techniques on it. In short, to achieve complacency of the topic by such a method, though is exhaustive, yet might prove to be cumbersome in terms of linking too many datasets of qualitative outputs to a numeric platform. Nonetheless, it might prove to be an optimum method for delineation of qualitative aspects on a quantitative model for assessment, analysis and relevant development along the identified lines.

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