Sustainable Holistic Approach and Know-how Tailored to India The *SHAKTI* - Project

1 The Context

Global changes do not longer concern individual countries or regions but the world as a whole. The trend towards urbanization and the increasing number and size of metropolises and "mega-cities" in all parts of the world but especially in the developing and newly industrializing countries is a remarkable example of global change. The growth, restructuring and migration of people in urban regions is happening at a speed that puts the innovativeness and strategic expertise of politicians, economists and civil societies to the test. Metropolises and mega-cities are focal points of sustainable development because they give rise to massive problems in all three dimensions of sustainability through the intertwining and compression of fluxes of people, resources, goods and capital. At the same time, however, opportunities arise for innovative strategies and for the support of efficient, compact and sustainable economic systems and lifestyles.
Viewed from this perspective, such cities are more and more becoming arenas of decision about global sustainable development. The "mega-cities of tomorrow" – rapidly growing metropolises are about to approach or pass the threshold of becoming a mega-city (10 million inhabitants acc. to the definition of the UN) within a few years – are of particular political interest because they offer the chance for precautionary intervention and targeted urban development in order to prevent economic, social and ecological crises and to preserve or create scope for action. To answer the question if the fast development can be managed in a sustainable way a lot of expertise from all concerned stakeholders is required and decision makers will need a solid foundation of knowledge from research.

1.1 The Research Program

In 2004 the German Federal Ministry of Education and Research (BMBF) started a research program on "Research for the Sustainable Development of the Mega-cities of Tomorrow" [1]. The task of the researchers funded by the BMBF within this program is to work together with research institutions in the selected countries and regions and in close co-operation with local institutions responsible for urban development in order to devise solutions and strategies for a sustainable configuration of the mega-urban regions of the future. The generated ideas should be implemented in form of pilot studies. Relevant interest groups from politics, economics and society have to be included from the outset so that the research issues address real, local needs. Projects will be funded in four stages; the first stage (two years) will be a preliminary phase in which the concepts described in the submitted project outlines are defined together with the local partners and prepared for implementation in the three phases to follow (each of three years duration).

1.2 Hyderabad – A Mega-city of tomorrow

Hyderabad, the state capital of Andhra Pradesh in Southern India, an urban agglomeration with a population of approximately 7 million (2001 census) is India's sixth largest city and one of the fastest growing metropolitan areas of the country. Hyderabad metropolitan region is expecting continuous economic growth that is mostly based on the growing potential of the biotech industries and the IT sector.
Hyderabad has emerged as a knowledge hub including central research and training institutions, universities and professional colleges. It has made rapid strides in information technology, biotechnology and tourism. With the formation of Cyberabad - an IT hub - and the new international airport development area, Hyderabad is experiencing a big boost in real estate activity. A huge movie studio, several industry and tertiary sector parks, and other research and recreational facilities are continuously coming up on the outskirts.

urban agglomeration population 2005 approx.	7.0 million
estimated population in 2010	9.4 million
estimated population in 2025	13.2 million
slum population in 1994	1.3 million
Hindu	55 %
Moslem	41 %
others	4 %
city area	260.0 sq.km
metropolitan area	778.0 sq.km
population density	14.192 inh./ sq.km

Fig. 1: Hyderabad Facts
Source: [2]

Aiming at a sustainable development in Hyderabad is calling for the simultaneous consideration of the existing city, particularly the old town and the new development areas in the outskirts. The existing city requires sensitive solutions for the renewal of housing and upgrading the technical urban infrastructure, preserving the cultural heritage and the possibility for a large part of the population to keep earning their livelihood. New areas have to be developed in an integrated regional concept regarding long-term perspectives. Coping with such tremendous growth along with huge accumulated needs will be a major challenge with respect to limited resources.

The German consortium's field trips and discussions on site have clearly revealed an urgent need for Hyderabad to adapt to population pressure by the integration of projects for suitable infrastructures into long-term adaptable strategies. These projects cannot be run separately; they have to fall within the scope of a holistic approach looking for a sustainable development. So far, the city of Hyderabad has done only limited reflection on strategies and instruments to define such a holistic approach. Given the imperative demand for social sensitivity in implementing change processes, information and participation of citizens in the decision-making process are of special importance. The team's field trips have also revealed that NGOs play a crucial role. Discussions with decision-makers confirmed that NGOs are being considered as mediators, helpful partners, evaluators and early warning systems. Therefore, close cooperation is indispensable for the success of the proposed project.

1.3 The Challenges

The vision of the Municipal Corporation of Hyderabad (MCH) is to develop Hyderabad as a 'First City' – "A smart and globally competitive city with opportunities for all its people in a safe, stable, livable, prosperous and people friendly environment". In 2003 Hyderabad has executed a "City Development Strategy – CDS" [3] (established by the "Cities Alliance" together with the UN-HABITAT and facilitated by the Administrative Staff College of India, ASCI). The question "Can Hyderabad be a global city?" was discussed there by many stakeholders. The main focus areas were "health" and "eco-growth" in close relation to a "high quality and civic infrastructure". First constraints were identified and first action plans generated. However, the implementation is a big challenge for local politicians and administration as the city faces severe budget constraints to cope with the implementation of infrastructure, environmental and social and demands.

The demographic growth in Hyderabad is basically showing three trends which will steadily aggravate the existing lack of basic urban infrastructure:

1. influx of well educated people in the outskirts leading to spatial growth and sub urbanization processes through new development areas with high quality housing, industry and tertiary sector development
2. an increasing population density in the inner city
3. the immigration of poor, low level or not educated people will create new informal settlements

While public authorities tend to tolerate these informal settlements at least on a short term, sustainable urban development demands legal dwelling opportunities for all citizens by providing affordable housing including access to safe water, sewerage, energy and public transport infrastructure that respect the resources regionally available.
In their regional development strategies, the city strives for attracting highly qualified people, but also takes the continuing immigration of the rural population into consideration.
Today the city has to face many challenges concerning sustainable infrastructure systems such as

- lack of effective public transport system
- poor infrastructure maintenance
- water supply restricted to 2 hours a day on alternate day
- sewerage overflows on roads
- unbalanced spatial development – neglect of inner city
- unreliable electricity supply
- high pollution – water, air, noise

To ensure sufficient infrastructure will also be crucial for the future economic development of the city.

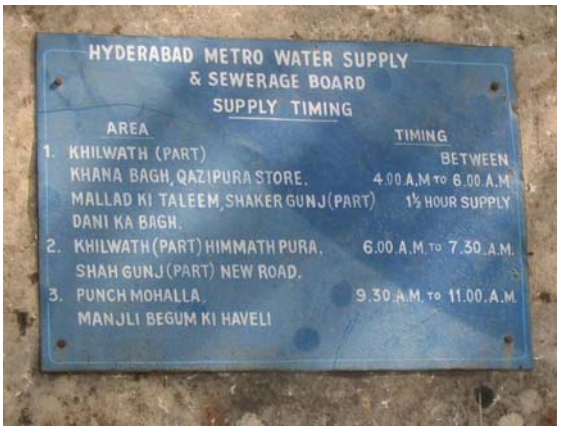

Fig. 2: Water supply in Hyderabad
Source: Poyac

2 The SHAKTI-Project Goals

First targets for future development are already set in Hyderabad's Master plan [4] designed by the Hyderabad Urban Development Authority (HUDA) the and in the "City Development Strategy". The overall goals of SHAKTI [5] will address the current and future needs of Hyderabad by simultaneously providing applicable solutions with associated strategies, action plans for implementation or business models integrated in a long-term sustainable development perspective. The main areas pointed out from the city authorities and the Indian research partners lead to three overall goals:

1. **Concepts, strategies and instruments to cope with growth**
   We have to jointly elaborate implement strategies and concepts for urban growth on regional and municipal scale, both for new development areas as well as for the existing city in terms of a higher population density and a lack of infrastructure and affordable housing. In parallel it is necessary to identify precautionary actions to reduce urban sprawl and avoid over-exploitation of natural resources.

2. **Sustainable solutions for technical urban infrastructure**
   The selected sectors are water, sewerage and sanitation systems, energy and transportation. To develop integrated concepts for the future infrastructure systems by

optimizing the existing infrastructure; focusing on integration (e.g. energy use for water supply). Assessing environmental, economic, social and cultural impacts within a holistic approach and taking into account the spatial concepts will be a big challenge for the German-Indian team.

3. **Integration of a collaborative learning and planning processes**
   The reflection and adaptation of international state of the art planning and technical standards to the Indian cultural context will be a basis to develop the future strategies. Public participation needs to be fostered in the development process and a continuous communication process will ensure the feed back. An integration of monitoring and evaluation procedures in the decision making process and the implementation have to ensure the consideration of selected sustainable criteria. Early warning systems showing fundamental changes have to be identified and established.

The proposed solutions will implicate a long term regional, national and global perspective based on an integrated, holistic approach. Each technical urban infrastructure system of the city has to be explored in its interrelation to others, impacts on the urban development and the three dimensions of sustainability. One big challenge of the project will be to merge all partners in a process of learning with different starting conditions and contexts towards a collaborative process to develop solutions.
In phase one the integration of all stakeholders concerned will be supported by international workshops and bilateral working groups to ensure the collaboration. The prioritization of the problems to solve will be primarily based on on-site knowledge of the Indian partners. Methods and actions of problem solving will be worked out jointly.

3 The Project Structure

Within the SHAKTI-project there are basically 4 working groups focusing on technical urban infrastructure: energy, water, sewage/waste and mobility. Besides focusing on their specific sector these working groups have also to identify the implications on the other infrastructure systems.

Then we have the horizontal, integrative working groups which are urban planning and monitoring. While the urban planning group has to deal with the spatial growth patterns on one hand - the spatial implications of different technical infrastructure solutions on the other hand have to be addressed together with the respecting infrastructure group.

Economic experts are assessing the potential of financing concepts – public private partnerships (PPP's) for example are very common and far developed in India for the implementation of infrastructure projects – but there is also the question in which case it becomes crucial to ensure for affordable basic services like water and energy supply for everybody.
Within the monitoring process all teams have to be involved to evaluate all planned projects with regard to sustainable indicators. Therefore additional experts from social sciences, environmental assessment and economics are in the team as well as experts in future studies.

Additionally we have the technical support working groups like the experts for geographical information systems (GIS) and remote sensing. Both have to identify the supporting tasks together with all other groups to assist them in data collection and data management. A common GIS database is a basic element for a holistic evaluation (see chapter 5). Finally, communication experts will assist the teams in the participation and dissemination procedures.

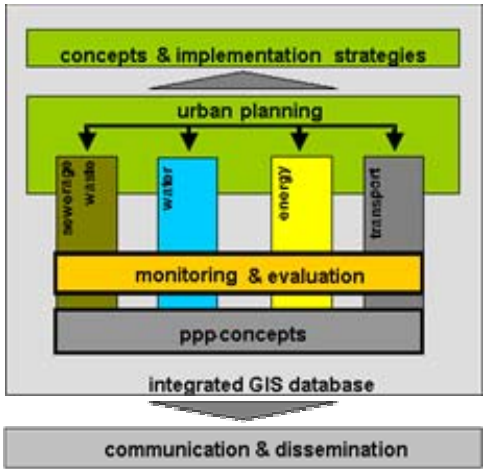

Fig. 3: project structure
Source: Schwaiger

4 The Approach

4.1 Key Questions

Some key questions have to be answered first for each of the disciplines and in a next step we have to come to a common understanding in an integrated way. It is necessary to identify differences and similarities between the disciplines. The different disciplinary approaches have to be evaluated regarding their usefulness for other disciplines. Here are some of those key questions:

- What are the respective definitions of growth – country wise and in different disciplines?
- How does a city grow?
- What are the existing concepts to cope with growth?
- What are the push and pull factors?
- What is the basic element, module of the cities' growth?
- What relevance does the performance of a module have for the performance of the whole?
- What can be understood - or not by looking at the elements from a partial or holistic point of view?

Within the complexity of an integrated approach addressing a fast growing and rapidly transforming city, it is necessary to develop an approach to reduce the complexity and to identify scales which can be handled and the impact of interventions can be detected soon. Starting to discuss about the growth process we came to the point that it is necessary to look at it on different levels (regional & local). Having in mind, that *„Large impacts often stem from changes in peoples' (and politicians') everyday small decisions -- how they decide to travel to work and to the shops, how they choose to organize their neighborhoods and buildings, what they choose to recycle, how they use water. The combination of these small, everyday decisions, both conscious and unconscious, with large, planned decisions, is shaping how environmental benefits, and environmental burdens and risks, are differently experienced by different social groups and in different areas."* [6], we distinguish the outer growth on one hand and the inner transformation process on the other hand. This leads us to a parallel Top-down and Bottom-up approach for different issues.

4.2 Top-down and Bottom-up

The chosen approach analyzes the "outer growth' in the metro region and the "inner transformation" based on the unit of a typical quarter or neighborhood which can be seen as an element or module of the whole city.

The neighborhoods will be clustered according to their
- physical structure – building and infrastructure (building types, age, use etc)
- social structure and capacity

Representative neighborhood-types will be analyzed regarding
- fluxes – water, energy, materials
- mobility and consumption patterns
- dynamic and character of transformation

The neighborhood types will be defined and selected by urban planners together with social scientists and supported by remote sensing data. The results stemming from the neighborhood analyses made by all disciplines are the basis for scenario calculations of the whole metro region. All data will be organized in a common GIS data base.

This approach is useful for the analyses as well as the intervention strategies. The levels are also characteristic for different actor groups to be addressed. The bottom-up level directly addresses the population – the inhabitants in the different neighborhoods, companies, welfare committees etc. The targets are demand side management, awareness raising campaigns for changing consumption and mobility patterns. The intervention measures will be shaped along the social capacity profiles. The top-down level addresses the administration, political decision makers and utilities on city or state level. The implementation and Interventions on this level will take longer, as it will address standards, institutional structures etc.

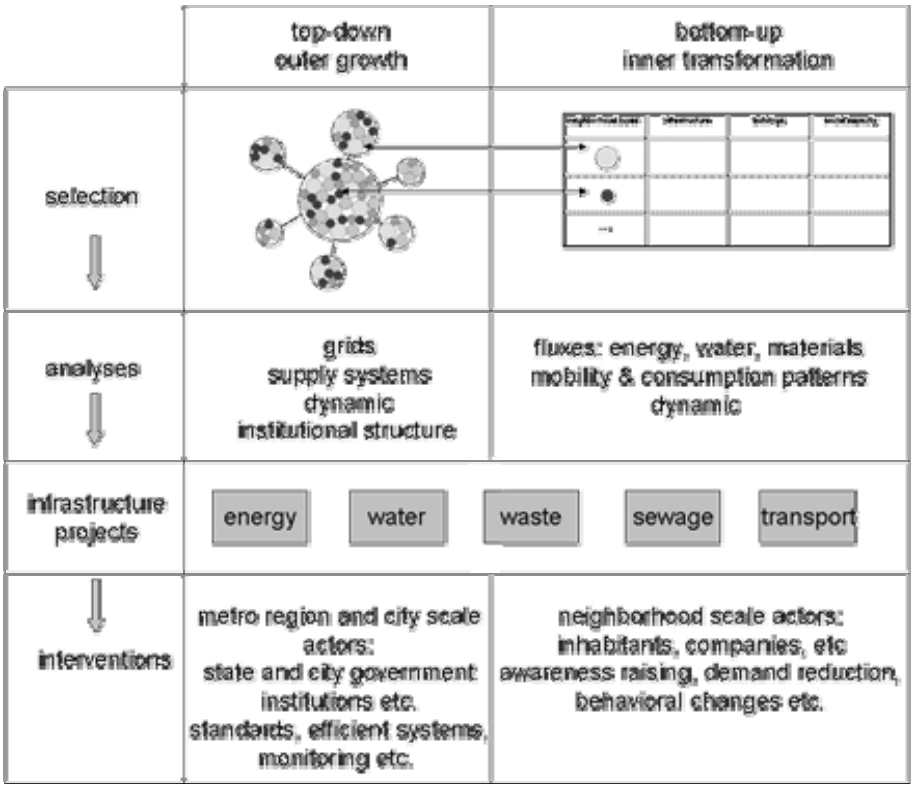

Fig. 4: intervention strategies
Source: Schwaiger

For the implementation strategies necessary initiatives will be defined for various actors along the top-down and bottom-up approach e.g. national, provincial and municipal agencies, private sector, research institutions, NGO's and the population. Along different intervention levels (e.g. for energy: reduce demand, optimize supply systems and increase the use of renewable energy sources) the characteristics of the buildings and inhabitants within neighborhood modules will be the basis of the intervention measures and instruments. Beside the physical structures it is very important to adopt the measures to the social capacity and choose the right dissemination procedures and means.
These initiatives will be organized along the following areas:

- planning
- research and demonstration
- awareness & education
- legislation & enforcement
- financial & fiscal instruments

Within the next step, catalyst projects, set in place by key actors, will be identified and implemented. Catalyst projects will be chosen carefully for those areas and actors were the potential of acceptance and dissemination is very high. Within these projects different issues should be addressed at the same time.

An adaptive management system helping to structure the planning and monitoring will be developed and introduced. Firstly, an evaluation is necessary to identify the right scale for those processes. The monitoring will take into account sustainable indicators as well as effects on different target groups and other urban sub systems. Feedback loops for adjustment are necessary to be integrated.

5 First Results

5.1 Top-down Spatial Analyses using Remote Sensing

In the situation where the real growth is quick and informal settlements as well as legal and illegal developments are not shown up-to-date in maps, data analyses coming from remote sensing can bring basic information about the urban structure and can help to detect the growth process by comparing datasets from different years. The small-scale analysis based on a highly detailed analysis of the urban structure can identify e.g. the densification through illegal construction and informal settlements. Urban structures reflect the distribution of the population, the level of prosperity, industry and production units, green space as well as infrastructure. A comparison to identify similar structures together with other data sources will be the basis to select the neighborhood types for further examination.

The different perspectives on the city are supported through the different data types. The large-scale Landsat data mark the overview level focusing on the extension of the city and its growth patterns over time. The capabilities of the Quickbird data with its high geometric resolution allow highly detailed analysis of the urban structure and the neighborhoods.
The classification is necessary to show the urban structure in detail. This will be complemented for selected neighborhoods by field surveys evaluating the existing infrastructure, social structure, mobility patterns, energy and water flows. The different remote sensing data contribute to a multi-level perspective within an interdisciplinary GIS database to support the information basis.

To assess the usefulness of the approach a first case study has been carried out. The goal of this study was to identify the urban built-up areas to measure the changes of the urban extension over a time interval and classify the urban structure. For that purpose the classification methodology is based on an object-oriented hierarchical approach. The object-

oriented methodology was used to combine spectral features with shape, neighborhood and texture features.

The results show the spatial expansion of the urban built-up areas of Hyderabad between 1989 and 2001 (figure 5), in particular the urban sprawl in the periphery and densification processes in central Hyderabad. The spatial growth in a northward direction of the metropolitan area is also visible.

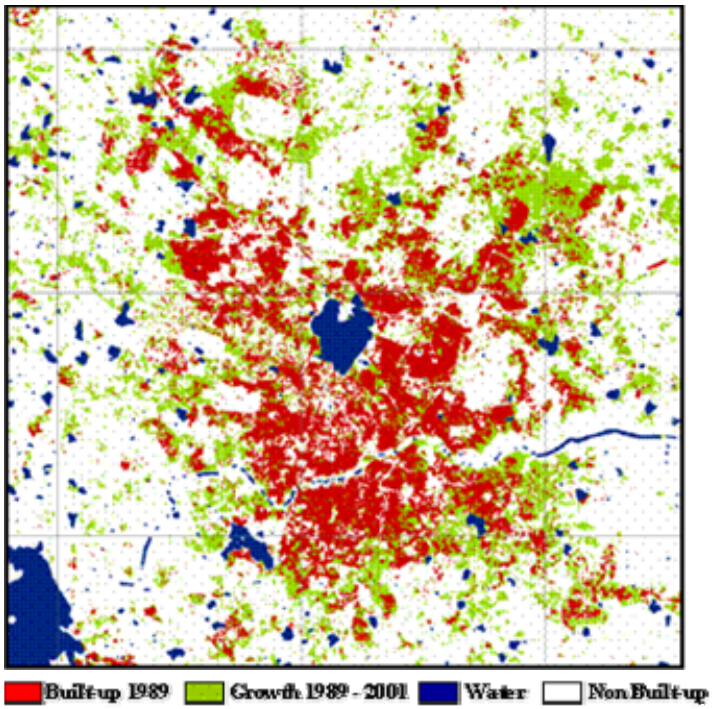

Fig. 5: Urban growth in Hyderabad between 1989 and 2001
Source: DLR

Through the change detection an increase of urbanized areas to a tilled urban area of about 2.2 times as large as in 1989 was measured. In addition, built-up densities in the administrative borders were calculated. The result shows that even in the already very dense built-up areas in the historic centre of Hyderabad a further densification process has taking place. The combination with ward wise population data specifies the densification.

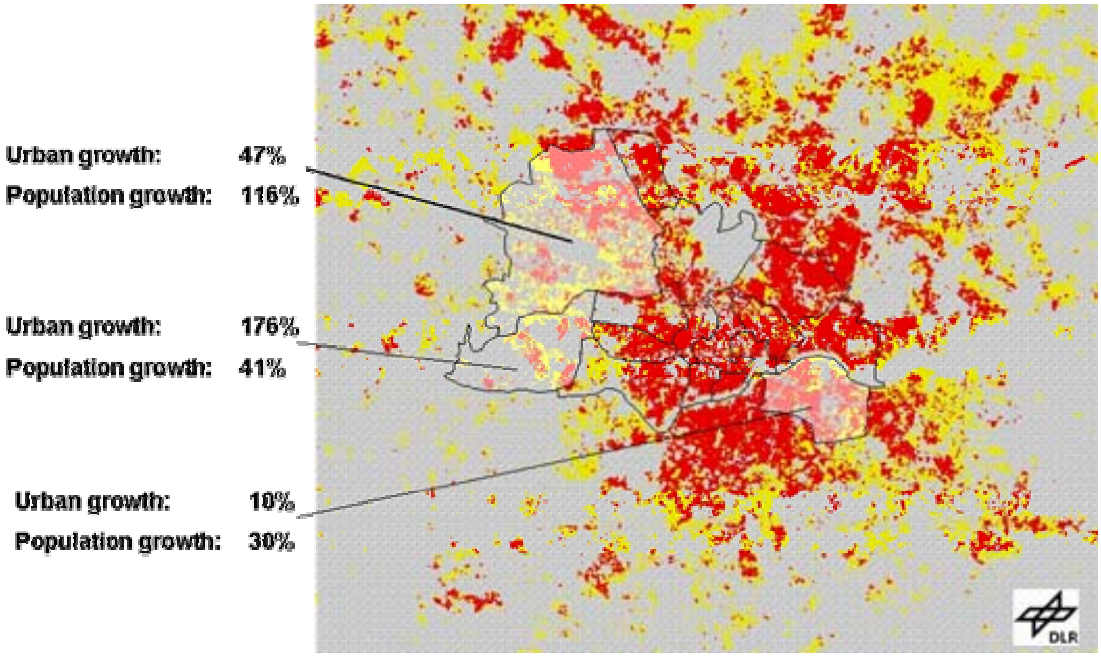

Fig. 6: spatial growth combined with population figures per ward
Source: DLR

High resolution satellite images support a detailed analysis of the small-scale urban morphology. An automated object-oriented classification approach was implemented for an extraction of detached houses, of main street infrastructure, of vegetation areas, of bare soil and of water areas. The methodology presented by [7] was applied to the Quickbird data of Hyderabad. The methodical framework was inherited, with adjustments on the spectral peculiarity of the particular scene.
To validate the classification results an accuracy assessment has been carried out. This show an average of more than 78 % of houses has been classified correctly.

This analysis of the current status of the built-up environment provides useful spatial information for a sustainable urban management. It further enables the calculation of the built-up density and provides necessary information for the analysis of the location and the carrying capacity of the street infrastructure as well as the analysis of accessibilities (see 5.3). The study clearly shows that the results coming from the analyses using remote sensing data can deliver useful basic information about the growth pattern with a reasonable effort.

Remote sensing proved to be a very useful basis for a more detailed analysis of the spatial distribution of industry and commerce in an emerging mega-city which is a prerequisite for a reasonable planning of technical infrastructure. The intersection with field work data enables value-added spatial information through interdisciplinary collaboration. Thus, different perspectives can be highlighted for a broader understanding of urban workflows and its dynamics. This multilayer spatial information allows analyzing and anticipating developments to support future planning strategies.

5.2 Analyses Bottom-up: Neighborhood structures and Master-plan regulations

To understand the inner transformation process, detailed field surveys in different types of neighborhoods need to be carried out. A second pilot study [8] addressed the neighborhood level not only to analyze the status quo, but to evaluate the potential for future transformation too. By analyzing the city, 5 typical residential neighborhood types have been identified and chosen for this study: Noor Khan Bazar, Baghlingampalli, Vijay Nagar Colony, Himayatnagar

and Rasool Pura. The characteristics of each neighborhood were explored, evaluated and reasons for the course and the direction of development have to be shown. The development in the different neighborhoods will be compared and verified with the existing regulations and legal policies.

Five basic questions were guiding the survey:

- How does the growth on neighborhood level look like?
- Does it differ from place to place?
- Is the development sustainable; what are the changes to quality of life?
- What are the policies to control and regulate the growth; are they sufficient to direct the development?
- How are the processes on neighborhood level being reflected in the remaining city?

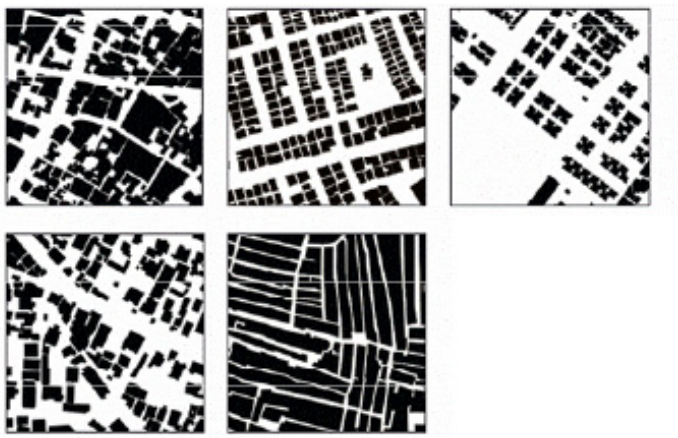

Fig. 7: urban structures selected neighborhood patterns
Source: Brauch

The rapid development stresses the importance of a steering instrument. Uncontrolled building activities are taking place not only on the green field but also in existing neighborhoods while the authorities are trying to cope up with a framework of regulations regarding the spatial development and building regulations. The HUDA has set up a master plan for greater Hyderabad until the year 2020 and the states government of Andhra Pradesh formulated the Vision 2020 for the next two decades. Some of the outcomes of the pilot neighborhood study and conclusions may differ from quarter to quarter but in general it can be stated that the local authorities are concentrating on the steering of the spatial growth process on the outskirts of the city promoting a low rise density. The consequences are urban sprawl, insufficient infrastructure while land prices are skyrocketing due to speculation.

The evaluation of each neighborhood and the description of yesterday's, today's and tomorrow's situation show how the location, the predominant building typologies and social factors influence the direction and force of development.
This knowledge implies that the universally valid building regulations of the Master Plan are not eligible to govern the present conditions and the displayed development in all these individual areas. Moreover, the regulations restrict the density to a very low level and this encourages a spatial expansion of the city rather than using the growth potential of the inner-city. The low-density prescriptions together with a lack of control lead to an illegal development and decrease of the inner-city qualities.

Neighborhood Development Plan
Using the example of Vijay Nagar Colony, a Neighborhood Development Plan was proposed in this study. The plan is developed out of a detailed investigation of the residential quarter, which includes all the relevant factors: density, building typologies, open space, traffic, infrastructure and inhabitants questionnaires.

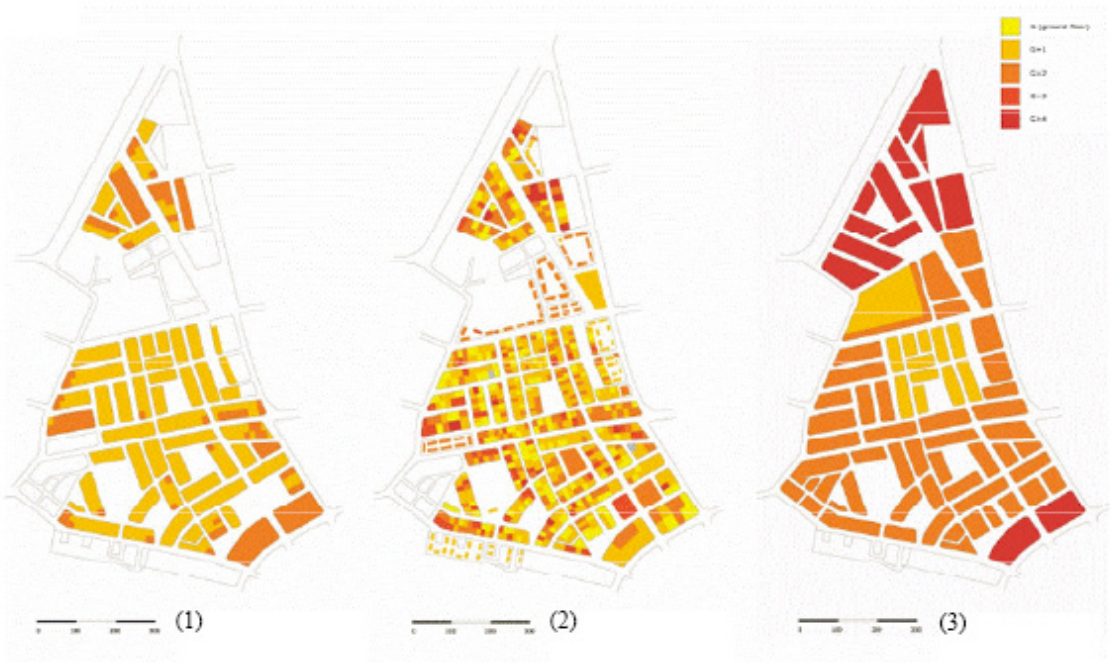

Fig. 8: Vijaya Nagar Colony – floor area ratio (far)
(1) Master plan (2) today (3) future development due to Neigh. Dev. Plan Brauch
Source: Brauch

The Neighborhood Development Plan refers to all these factors and gives suggestions for the improvement of spatial use. The over all objectives are to develop a density concept:
- that on the one hand restricts the spatial growth of the city by making use of existing growth potentials in order to create dwellings for all sections of the growing population - and on the other hand to regulate this growth and preserve typical building structures and existing neighborhood qualities by adjusting existing building regulations to secure a controlled and planned neighborhood development with a long term perspective.

5.3 Integrating Infrastructure

Another race in the fast growing Metropolis can be seen: keeping the pace for the growing need of infrastructure. What happens mostly is the planning of each discipline on its own which is mainly driven by the trial satisfying the already existing demand. The vision of a sustainable and holistic development of the technical infrastructure in the city is therefore a necessary objective. Nowadays, the planning of the technical infrastructure is not integrated and networked.

A third pilot study [9] is addressing the issue of integrated infrastructure planning focusing on the needs of industrial areas as well as mixed used areas with small service industries. Looking for a starting point the idea leads to the creation of an integrated tool for planning purposes, bringing together all involved bodies that comprise all essential data and analysis possibilities for reducing parallel work and uncoordinated decision making. An enterprises inventory for further technical infrastructure planning could offer the chance as one part therein. The strength lies in the usefulness and serviceability, both for the own use of the intended infrastructure planning concerning industry and the possibility to connect the

inventory with data made available by the disciplines of urban planning, energy, transport, water and waste. To set up such a tool threats because all is wedged in a grown up political system with a broad range of responsible bodies. The considerations led to the necessity using a Geographic Information System (GIS) as database system for the inventory as a state of the art and flexible, expandable instrument which is the second part.

The pilot project was accomplished on-site in Hyderabad with intensive contacts to partners of the different local bodies such as Governmental bodies for industries, different industrial associations, NGOs, educational and research institutions and also single enterprises were of particular interest.

Two case studies were done in the residential area Vijaya Nagar Colony a neighborhood in the inner part of the city and in four industrial development areas located in the eastern part of Hyderabad. Within the studies water consumption and enterprises distribution were analyzed by using the GIS tool feature.

The results demonstrated that GIS has proved to be a flexible tool to implement an enterprises inventory. The capabilities of displaying, combining and processing data are sufficient and connecting the inventory with other data and with the work of other disciplines is possible as well. For example: the enterprises with their spatial locations can be directly connected to additional attribute tables to give an interchange to other disciplines.

There is a high potential of improving the efficiency of processes, plans and units by improving the use of resources and connecting the Governmental organizations, municipalities, industrial associations as well as private partners need to be involved more intensively and co-operation is necessary. Some of them need to be convinced of their benefits. Another important outcome is that only these local organizations are able to provide the necessary data. Second to obtain an understanding of the Indian economy therefore field studies should be considered as much as possible for getting to know enterprises and industrial areas and the infrastructure situation on-site. Creating awareness for integrated planning and also considering environmental issues in all hierarchy levels is an essential need.

6 Conclusions

To that stage it came out, that the chosen parallel top-down and bottom-up approach is reasonable to analyze the growth patterns on one hand and the potential for future development on the other. The application of technical tools like remote sensing and GIS databases along with field surveys lead to useful information with an adequate effort.
The first results clearly show, that the master plan as the steering instrument failed in preventing and guiding the inner-city in the already built up areas to cope with the transformation process and the control to follow the set regulations is lacking.

A promising approach to cope up with a sustainable development and motivation for planning in the existing city is certainly a bottom up strategy with participatory planning tools and has to start with the neighborhoods. The neighborhoods are the clusters a city consists of and they can be seen as manageable portions to bridge the gap of planning from top down and feasible building activities on the bottom. The aim is to foster the discussion between planners in the government and the inhabitants, the social responsibility, implementation by government and local partners. It also lays a foundation stone to develop growth scenarios on common senses and accepted building rules by the community on a marketable basis to guide a compliant re-densification by preventing the urban characteristics of a quarter. Therefore the general regulations of the master plan have to be adapted to local needs inside the quarters to strengthen and guide the urban growth process to become a sustainable base for the next decades.

7 References

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