4 THEORETICAL – METHODICAL PART

4.1 Evaluation of methodical literature

Many applied methodical approaches have been developed to solve a complex of socio-economic and landscape ecological problems at the territorial and regional level. Within the framework of comprehensive ecological research the necessity to elaborate new theoretical and methodical approaches in the individual scientific disciplines that participate in the interdisciplinary comprehensive research of the ecological characteristics of landscapes seems to be urgent (Ružička, 1985). Methodical approaches are different with respect to the complexity and heterogeneity of the landscape object itself as well as of the target like optimization of its utilization. However, the goal of most methods developed so far is based on rational utilization, protection and development of the territory, its environment and natural resources. Among the many research methodics, the following applied methodical approaches have been used in territorial/regional, environmental and landscape ecological planning, especially in Europe and America:

- The Metropolitan Landscape Planning (METLAND) model,
- Environmental Planning through Environmental Impact Assessment (EIA),
- Landscape-ecological Planning (LANDEP).

4.1.1 The METLAND approach

This is a comprehensive approach to regional landscape planning. It is designed to show the potential cause/effect relationships of alternative land use in various landscape-ecological and public service resources. The model was developed at the Department of Landscape Architecture and Regional Planning, University of Massachusetts and is guided by sound environmental/landscape planning principles. From the landscape/landuse point of view, at least five principles or norms have been discussed in the METLAND model (Fabos, 1979). The principles of this approach are:

- ”Development should be discouraged in areas of significant resource value.” This principle stresses the fact that much of the local or regional scarcities (i. e. resources) can be avoided by preserving the biological, physical and aesthetic resources within the region and by acting to prevent their needless elimination, degradation or obliteration.
- ”Development should be discouraged in areas of natural and human-caused hazards.” The losses and hardship that result from such natural hazards such as floods and human-caused hazards such as air/water pollution occur not only to the people and properties immediately affected, but also to the wider society that is called on to provide relief to the victim. Keeping away from such hazards will not only reduce the hazard, but provide additional options as essential attributes of increased diversity.
- ”Development should be encouraged in areas best suited for it.” This principle suggests that almost all prospects regarding resource abundance, physical charac-

ter, attractiveness of the site, number of people benefiting etc. should be analyzed first.

"The ecological carrying capacity of the regional environment should not be exceeded." It emphasizes that any developmental activities of the region should be in accordance with natural regulations and principles.

"The public service resources (e. g. infrastructure, recreation, education, etc.) holding capacity should not be exceeded without appropriate expansion of such resources." The simplified framework of the METLAND model suggests that any development and landscape alternation should be a three phase procedure; namely, assessment, plan formulation and plan evaluation. In this approach the assessment of the resources starts with an analysis of the various components of a landscape resources: a hazard, an ecological factor, a development suitability or a given public resource. Their location, quality and distribution is mapped, and most importantly, values are attached to each landscape characteristic. These assessed values constitute the primary input for the plan formation and plan evaluation procedures. During these procedures, two basic approaches – cost benefit analysis and a goal-oriented approach – are used for obtaining the target goals.

4.1.2 Environmental Planning through Environmental Impact Assessment (EIA)

The planning history suggests that most of the planning activities such as engineering, technical, industrial etc. focused on maximizing economic benefits but neglected the environmental consequences of their development. The consequences of much development, however, led to the deterioration of the environment in a rapid manner. In order to overcome these difficulties environmental impact assessment has grown in response to public awareness of the frequently harmful environmental effects of development. The orderly logical process by which the potential consequences of the proposed developmental projects or policies are examined is an environmental impact assessment (Folk, 1982). Numerous methodologies for accessing EIA have been developed in response to the need for considering unquantified environmental amenities and values during the decision-making process. Moreover, many new methodologies developed for EIA have been used since 1973 and more especially since 1976. All methodologies incorporate means of collecting, classifying information for analysis. They usually attempt to identify, measure and describe as many potential impacts as possible. Some also incorporate means of comparing and evaluating the impacts of alternative projects or sites. These methods also quantify, weight and often aggregate impacts.

Most of the methods commonly used in EIA include: ad-hoc method, checklists, matrices, overlays, networks, quantitative or index methods and models. However, the use of any method depends upon numerous factors such as type and complexity of the problem, objective, structure of the research, time, budget, manpower etc. The most important methodologies followed by many researchers are the overlays methodology and the Leopold matrix method. The overlays methodology was in use for several years in the field of planning and landscape architecture, but was extended to EIA by Ian Mc Harg in

1968. It employs a series of maps, each containing data on environmental, social and economical variables. The Leopold method, probably the best-known and most widely used methodology (especially in the USA), was developed by Luna Leopold and others at the U.S. Geological Survey. The matrix itself is actually only a late step in a comprehensive action program for the entire planning process. The planning process involves the following steps (Leopold, 1971):

- Analysis of technological possibilities of achieving objectives;
- Identification of alternative actions for achieving objectives;
- Analysis of existing environment prior to proposed action;
- Development of engineering plans and cost/benefit analysis;
- Identification of impacts for each alternative and analysis of magnitude and importance of impacts and
- Assessment of impacts for each plan of action.

Moreover, to identify environmental impacts, Leopold proposed a matrix to determine linkages between proposed actions. The proposed actions considered for impact assessment are divided into the following broad categories such as:

- Modification of regime, e. g. exotic flora, fauna, modification of habitat;
- Land transformation and construction, e. g. urbanization, canals, roads etc.;
- Resource extraction, e. g. blasting, surface excavation etc.;
- Processing, e. g. farming, chemical industries, food etc.;
- Land alternation, e. g. erosion control, landscaping etc.;
- Resource renewal, e. g. reforestation, waste recycling etc.;
- Waste employment and treatment, e. g. dumping. land fill etc.;
- Chemical treatment, e. g. fertilization, weed control and
- Accidents, e. g. explosion, operation failure etc.

As a matter of fact, all the categories mentioned above can be expanded to include additional elements necessary for a particular project. The environmental characteristics and conditions which may be affected by means of man's action can also be considered a list of impact indicators. This list should be grouped as:

- Physical and chemical characteristics, e. g. soil, water, land form, floods etc.;
- Biological conditions, e. g. flora, fauna, endangered species of flora and fauna etc.;
- Cultural factors, e. g. land use, recreation, landscape design and
- Ecological relationships, e. g. food chain, eutrophication etc.

Within the framework of environmental policies, several methodologies of EIA have been developed in the USA, Europe and some parts of Asia in the recent years. However, EIA, a summary of the analysis consisting of text, statistics, matrices, overlays or a combination of these, failed to consider alternatives adequately and more direct observation, modeling and experimental studies are still needed to predict long-term system level changes.

4.1.3 Landscape-Ecological Planning (LANDEP)

Landscape-ecological methods are directed towards preservation of natural resources and optimal ecological and environmental conditions for future generations of mankind on the basis of application of ecological points of view to landscape utilization. It is a special Slovak attempt and a widely used method. It is a complex system of applied scientific activities which includes ecological, biological, geographical and other research methods. These methods are united by the combined methodologies of LANDEP which is directed towards a landscape optimization (Ružička and Miklós, 1979, 1980, 1981, 1982, Žigrai, 1982a). LANDEP results in the proposition of localization of social activities in the landscape, which is expressed on a map. The proposition is developed from ecological data which provide a clear-cut standpoint as to the what, where and why of the ecological proposal. This methodology starts with the analysis, synthesis, interpretation, evaluation, proposal, protection and creation of the environment. The simplified method of LANDEP, which is also known as Ecological Evaluation of Territory (EET), was elaborated in cooperation with planners for practical needs and use in territorial planning. Analysis starts with the re-evaluation and homogenization of existing data such as geology, soil, relief, climate, vegetation, land use etc. The second methodological step is the synthesis of the ecological data. The purpose of synthesis is to create homogenous spatial landscape unit-types and -regions. In these units, the properties of analysed indices have similar values in the whole area and in all places of their occurrence. Furthermore, this step is effected by partial landscape-ecological and the complex landscape-ecological typification. Both processes result into the formation of units called landscape-ecological units (LET) which play a significant role in the ecological evaluation of the territory (Ružička, Miklós, 1982). The most important step of landscape-ecological planning is the evaluation of the territory. The purpose of evaluation is first of all to determine the potential of the landscape (Finke, 1971), its functional suitability, the degree of risk to the stability and resistance of the landscape to these factors etc. (Ružička, edit., 1979). The final methodological step is the proposition, protection and creation of the landscape. This step tries to answer questions such as what activity is the most suitable for a given area from the standpoint of ecological as well as economic principles, what would be the danger of threatening the landscape by localization of certain activities and what would be the most suitable measures connected with such a activity from the standpoint of threatening a given area. Detailed methodological steps of LANDEP are described in the next chapter.

4.2 Selection of the research method

It is believed that the particular environmental, ecological and socio-economic problems of Kathmandu could be solved with the help of the applied method called ”Landscape-ecological planning method” (LANDEP). This is a component of spatial planning and, through it, of ecological planning. It follows a programs of landscape optimization which means a proposition (plan) for the most suitable relocation of social activities from the viewpoint of landscape ecological supposition (Ružička, Ružičková, Žigrai, 1975 and Miklós, 1977, 1981, 1982 and Žigrai, 1982a, 1985, 1986, 1989, 1990,). Its main concern

are the localization of objects, their size and spatial inter-dependence according to natural and landscape characteristics and functions of the territory. This planning method was successful in solving the landscape and environmental problems of Mexico City (Cervantes, Žigrai, 1982; Zigrai, Cervantes, 1981, Žigrai, 1982b). It is a complex system of applied scientific activities which includes biological, ecological, geographical, agricultural, silvicultural and other research methods. The goal of this method is the optimization and proposition of the most suitable allocation of planned social activities in the landscape from the standpoint of landscape-ecological regularities. Because the landscape optimization should not in any case retard the economic development of the landscape, the optimization means choosing at the same time the least evil, i.e. choosing a location where a given activity will be in the least conflict with the natural conditions.

This applied method has been adopted for the:

- rational utilization of natural sources,
- creation of ecologically optimal landscape structure and ecological bases for territorial planning,
- creation of favorable living conditions for the inhabitants of settlements, as well as harmonization of the urbanization process with ecological conditions,
- transformation of nature in agreement with the needs of the development of different branches of national economy employing the ecological conditions,
- keeping the natural genofund of the living nature and nature conservation.

4.3 Methodical steps

The content and essence of LANDEP is constituted of two parts: ecological data about the given landscape and ecological optimization of the landscape utilization.

A. Landscape-ecological data on the territory:

The data represents basic landscape-ecological information, which will be used in the process of planning and decision making. It consists of analytical and synthetic parts.

Analytical parts (elaboration of the landscape-ecological analyses):

The selection and quantity of the landscape-ecological analysis depend on the aim of the landscape-ecological plan, character of the investigated territory, cartographic scale and disposition of the background materials. These materials could be described, evaluated and homogenized, with particular emphasis on the interpretation and evaluation. The interpretation means the change or transformation of the analytical background materials or data in such a way as to make the application of landscape properties to the synthesis and decisions processes possible. The evaluation means the determination of the suitability of the landscape potential for the particular human activities or demands. The selected landscape-ecological analytical data could be shown or expressed in the same cartographic scale, which is very important for the cartographic landscape-ecological synthesis by the overlaying of the particular maps.

Synthetic part (elaboration of the landscape-ecological synthesis and its interpretation):

Synthesis is a multi-stage process based on the parametric typification, i. e. the superposition or overlay of the analytical and partly synthetic maps with particular indices. By means of the overlay procedure these maps are marked up for new boundaries for partial synthesis and complex synthesis. The aim of the landscape-ecological synthesis in the first methodical step is forming or building of homogeneous spatial landscape units called landscape-ecological types (LET) on the topical level, i. e. types of abiotic, biotic, socio-economic complexes. These types (LET) have the properties of analysed indices with similar values in the whole area and in all places of their occurrence. The landscape-ecological complexes are here meant, in a broad sense, i. e. inclusive of the economical properties and features, because human activity is considered an important landscape-ecological factor. The types of landscape-ecological complexes, therefore, serve as the operative spatial units with or without interpreted landscape-ecological properties for their evaluation, i. e. the suitability for a particular individual and societal demand or need in the framework of the landscape-ecological optimization of land use. Synthesis of landscape properties in types and further manipulation with types makes the decision making process possible. Therefore, all landscape-ecological properties can be taken into consideration. The second methodical step of the synthesis is creation of the landscape-ecological heterogenous spatial landscape units on the choric level, i. e. regions with types of abiotic, biotic, economic and landscape-ecological complexes. The regions have a characteristic composition of homogeneous types. Such types or units are put together and codified. The regions serve for global characterization of the planned or investigated territory.

B. Ecological optimization of the landscape utilization:
Evaluation of ecological data on the territory:

This is the most significant part of the whole methodical process of elaboration of the landscape-ecological background data. The aim of optimization is to suggest a land use to benefit the ecologically optimal given goal. The suggestions for optimal use of the territory are based on the assessment of analytical and synthetic landscape-ecological data. The basic principle of evaluation lies in determining the relative adequacy or capability of the individual areas (types) to the selected activities, or in determining the relative differences, respectively, in the capability of areas for activities. The evaluation is divided into several closely connected parts. The selection of indices of ecological properties of the landscape based on analysis and synthesis, which are expressed in the types of landscape-ecological complexes. It is a direct consequence interpretation.

The selection of social activities:

The social activities, which are to be developed in future in each territory studied, are determined beforehand by the plans of higher levels. They are obligatory for the lower level planning. The role of this methodical step consists of an arrangement and classification of these given activities according to their character, e. g. agricultural and industrial production, dwelling, recreation, nature protection etc. and according to their social significance. The social activities expressed in the map are considered functional elements of the landscape.

The assessment of functional values of indices of ecological properties of the landscape, i.e. the assessment of suitability of types of landscape-ecological complexes for functional elements:

This is the most important part of evaluation. This process is comparatively complicated and is realized according to the previously determined decisive principles. The most frequently used method in LANDEP is the so-called method of decision in table. The most important and first step of this part is to fix the ”limit” values of properties of landscape-ecological types for the activities, i.e. values which eliminate the possibility to perform individual activities in the areas of given types of landscape-ecological complexes.

The assessment of the convenience of contemporary utilization of the types of the landscape-ecological complexes:

This step tries to answer the question of the contemporary quality of the landscape. The answer is developed from the intensity and mode of anthropic influence on the landscape, from a harmony of this influence with natural conditions and from a simple determination of the level of stability and balance of the landscape etc.

Propositions of the land use (use of the territory) or landscape utilization:

Propositions are aimed at the harmonization of ecological properties (potential) of the landscape with its utilization for the purpose of development of man and society. Propositions consist of the following parts: (i) Primary and (ii) secondary proposition:

(i) The primary proposition:
is usually a projection of results of decisions from a table into a map, where for each type of landscape-ecological complex the functions are given in an order of convenience. They provide a material for alternative solutions to the proposals for utilization of individual areas. With other words, the primary proposition takes into consideration the evaluation of ecological data on the territory for the landscape utilization and ends in a determination of the most suitable activity for each type of landscape-ecological complex from functional as well as ecological points of view. The results obtained are projected in space by the typification map.

(ii) The secondary proposition:
corrects the mosaic pattern of the very atomized proposal for utilization of areas as a result of mechanical transmission of decision processes on the typification map according to requirements of activities for the size of areas, according to the relationships of adjacent areas, etc. Such an arranged proposition represents a basic result of ”LANDEP” called a functional division of territory. Because individually proposed functional elements, i. e. social activities projected in space re-occur several times in the territory, as is the similar case of type of landscape-ecological complex, the functional division of territory has a character of functional typification of territory.

Tertiary proposition:
possesses a character of regionalization, because it delineates parts of territory with a distinctive grouping of functional elements; such groupings with prevailing function cre-

ate functional regions of the investigated territory with certain combinations of functions. The number of stages of propositions is not obligatory and it can be changed according to aim and character of the territory, and the problems under study. Secondary and tertiary propositions result in the proposal of an ecologically optimal landscape structure, which serves as one of the starting points for urbanistic solutions for the territory.

C. Protection and creation of landscape environment:

The protection and creation of environment presents a further stage of propositions in which the proposal of an ecologically optimal landscape structure or landscape utilization is confronted with valid or proposed documents of territorial planning for the development or urbanization, industrialization, agriculture, tourism or another complex of social activity. This part of the LANDEP method is divided as follows:

Analysis of the environmental problems:

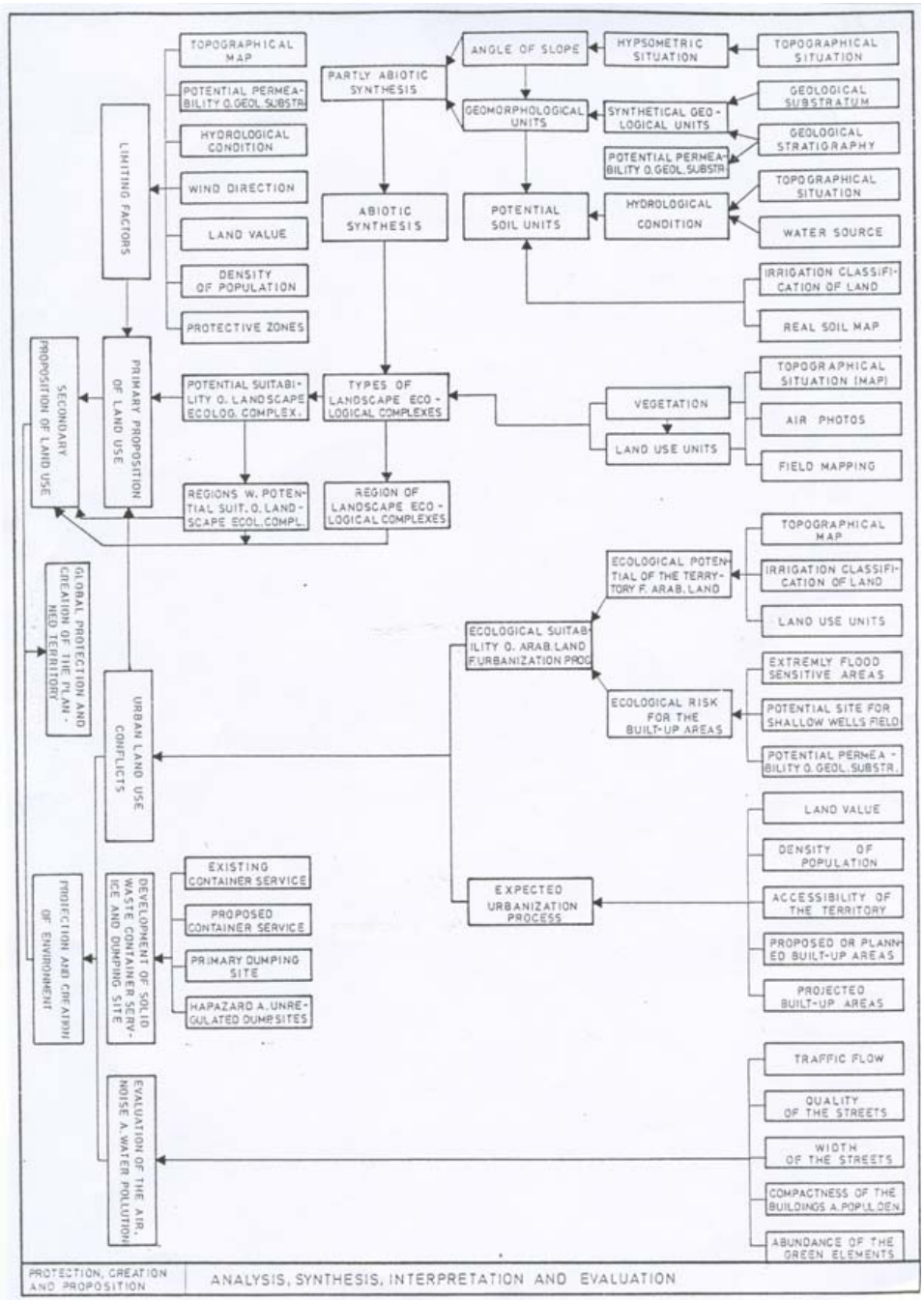
Elaboration of the map with environmental problems; Investigation or determination of landscape-ecological land use conflicts by the confrontation of the landscape-ecological proposal of land use with the present-day land use; Investigation or determination of landscape-ecological urban conflicts by the confrontation of the landscape-ecological proposal with urbane propositions. Such a ”problem” map is worked out to indicate in which areas these propositions do and do not harmonize, or where some problems are arising. The problems are then analysed, the degree of disharmony of propositions determined and the problems classified according to their nature. Determination of the nature of the problems is considered a basic starting point for both creation and protection of environment already at the level of territorial planning. The choice of measures for elimination or lowering of the unfavourable consequences of planned interferences on the quality of the environment is realized on the basis of collective expertise using the data available in this field. In general, the measures for elimination of unfavourable phenomena can be divided into abiotic (e. g. fixation of slopes, ameliorations, etc.), biotic (e. g. planting various greenery) and combined ones.

The proposition of measures:

Represents an integral part of the environmental and urbane proposition of territorial utilization. For each problem in each area concrete measures or a set of measures is proposed, according to the ecological conditions of the planned territory. In this way it warrants the acceptance and use of ecological data and conceptions of the territorial utilization during the stage of planning and projecting. The proposed measures are contained in the map for environmental planning as well as in the catalogue with particular planned measures.

The cartographic overlay of particular methodical steps of the problem-oriented landscape-ecological planning for the Kathmandu Metropolitan area is presented on the Fig. 4.

Fig. 4


TOPOGRAPHICAL MAP
POTENTIAL PERMEA-BILITY O. GEOL. SUBSTR.
HYDROLOGICAL CONDITION
WIND DIRECTION
LAND VALUE
DENSITY OF POPULATION
PROTECTIVE ZONES
LIMITING FACTORS
PARTLY ABIOTIC SYNTHESIS
ANGLE OF SLOPE
HYPSOMETRIC SITUATION
TOPOGRAPHICAL SITUATION
GEOMORPHOLOGICAL UNITS
SYNTHETICAL GEO-LOGICAL UNITS
GEOLOGICAL SUBSTRATUM
GEOLOGICAL STRATIGRAPHY
POTENTIAL PERMEA-BILITY O. GEOL. SUBSTR.
ABIOTIC SYNTHESIS
POTENTIAL SOIL UNITS
HYDROLOGICAL CONDITION
TOPOGRAPHICAL SITUATION
WATER SOURCE
IRRIGATION CLASSIFI-CATION OF LAND
REAL SOIL MAP
SECONDARY PROPOSITION OF LAND USE
PRIMARY PROPOSITION OF LAND USE
POTENTIAL SUITABI-LITY O. LANDSCAPE ECOLOG. COMPLEX.
TYPES OF LANDSCAPE ECO-LOGICAL COMPLEXES
VEGETATION
LAND USE UNITS
TOPOGRAPHICAL SITUATION (MAP)
AIR PHOTOS
FIELD MAPPING
REGIONS W. POTEN-TIAL SUIT. O. LAND-SCAPE ECOL. COMPL.
REGION OF LANDSCAPE ECO-LOGICAL COMPLEXES
TOPOGRAPHICAL MAP
ECOLOGICAL POTEN-TIAL OF THE TERRY-TORY F. ARAB. LAND
IRRIGATION CLASSIFI-CATION OF LAND
LAND USE UNITS
GLOBAL PROTECTION AND CREATION OF THE PLAN-NED TERRITORY
ECOLOGICAL SUITAB-ILITY O. ARAB. LAND F. URBANIZATION PROC.
EXTREMLY FLOOD SENSITIVE AREAS
ECOLOGICAL RISK FOR THE BUILT-UP AREAS
POTENTIAL SITE FOR SHALLOW WELLS FIELD
POTENTIAL PERMEA-BILITY O. GEOL. SUBSTR.
URBAN LAND USE CONFLICTS
LAND VALUE
DENSITY OF POPULATION
EXISTING CONTAINER SERVICE
PROPOSED CONTAINER SERVICE
PRIMARY DUMPING SITE
HAPAZARD A. UNRE-GULATED DUMPSITES
DEVELOPMENT OF SOLID WASTE CONTAINER SERV-ICE AND DUMPING SITE
PROTECTION AND CREATION OF ENVIRONMENT
EXPECTED URBANIZATION PROCESS
ACCESSIBILITY OF THE TERRITORY
PROPOSED OR PLANN-ED BUILT-UP AREAS
PROJECTED BUILT-UP AREAS
TRAFFIC FLOW
QUALITY OF THE STREETS
WIDTH OF THE STREETS
COMPACTNESS OF THE BUILDINGS A. POPUL. DEN.
ABUNDANCE OF THE GREEN ELEMENTS
EVALUATION OF THE AIR, NOISE A. WATER POLLUTION
PROTECTION, CREATION AND PROPOSITION
ANALYSIS, SYNTHESIS, INTERPRETATION AND EVALUATION

4.4 Working procedure

We undertook the following activities in the different phases of this study:

Preparation Phase:
(Vienna, October 2, 1985 – June 27, 1986)
- Review and approval of the completed reports from the regional territory;
- Preparation of the catalogs from different sources and selection of the methodological know-how of LANDEP from different Institutes;
- Selection of the available regional materials (i. e. texts, maps, reports etc.) for landscape-ecological planning and
- Preparation of the proposal for the intended study (i.e. landscape-ecological planning for Kathmandu).

Field Work:
(Kathmandu, July 3, 1986 – September 28, 1986)
- Collection, selection and preparation of the appropriate landscape-ecological data from the research territory;
- Preparation of legends for land use, landscape and environment;
- In-depth study of the aerial photographs and transformation of aerial photo information for landscape-ecological planning purposes;
- Intensive field checking, survey and mapping in Kathmandu at the scale 1:10,000 and
- Consultation with different specialists, planners and politicians regarding the interpretation and evaluation of each landscape-ecological parameter.

Final Phase:
(Vienna, October 4, 1986 – June 30, 1987)
- Working out of problem-oriented landscape-ecological analysis and interpretation;
- Preparation of the draft of regional materials for abiotic, biotic and socio-economic components;
- Disaggregation, reduction and enlargement of different cartographic data needed for each step of landscape-ecological methodology;
- Preparation of different analytical maps (scale 1:10,000) needed for the cartographic overlay procedures and
- Preparation of the final maps and reports.