

Spatial planning guidance for achieving sustainable urban development

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Abstract

Sustainable planning guides are being developed to direct spatial planning both at the local and regional levels towards sustainability. However, due to the multifaceted nature of spatial planning, different guides do focus on different aspects of planning and tend to overlook or lay little emphasis on other aspects. The goal of achieving sustainability through spatial planning requires that integrated sustainable planning guidance which will incorporate all aspects should be developed. The paper discusses current framework of sustainable spatial planning in Saudi Arabia. It highlights the need for better planning guidance and proposes general guidelines in view of current international practices. The guidelines are very pertinent at this time that Municipal Master Plans are being reviewed in the Kingdom.

Keywords: Sustainable planning; Planning guidance, Sustainability; Saudi Arabia

Introduction

Sustainable development has become a global issue since about fifteen years ago when the World Commission on Environment and Development introduced the concept. The concept emerged to foster a balance consideration of social, economic and environmental consequences of development activities. Despite the pervasiveness of the principles of sustainability, only few communities have been able to develop strategies of fostering sustainability and these few communities and regions are mainly in the developed countries. This is due to the difficulties in operationalizing sustainability principles and the institutional contexts of implementing these principles. Different approaches and frameworks have been developed to move communities towards sustainability. Most of the approaches (ICLEI, 2002; OECD, 2000; CSD, 2002) are developed on a framework of impact assessment, monitoring, indicators and targets/benchmarking. In addition, cities

and spatial planning are given special attention by these approaches. The city has attracted attention because of the environmental problems that result from rapid urbanization and continued increase in urban population. That is, sizeable number of people is affected by urban environmental problems. Spatial planning has a stake in promoting sustainability as plans, policies and programs that determines land uses and environmental impacts are products of the planning process.

The focus on spatial planning for the achievement of sustainable communities has been on the two major aspects of planning; the planning process and the outcome of planning (Berke and Conroy, 2000; George, 2001; Kessler, 2002; Partidario, 2002). It has been widely recognized that the planning system and the development plan would play crucial role in delivering sustainable development. Thus, sustainable planning guides are being developed to direct spatial planning both at the local and regional levels towards sustainability (LGMB, 1993; DETR, 1998). However, due to the multifaceted nature of spatial planning, different guides do focus on different aspects of planning and tend to overlook or lay little emphasis on other aspects. The goal of achieving sustainability through spatial planning requires that integrated sustainable planning guidance which will incorporate all aspects should be developed. In essence, a sustainable planning guide should provide guidance on integrating sustainability principles into the planning process, assessing the effectiveness of integrated sustainable planning process, incorporating sustainability principles into the development plan and evaluating the development plan for sustainability. Also, the sustainable planning guidance should be a general framework that could be applied (with little or no modification) in different local contexts.

In Saudi Arabia, efforts have been made to incorporate environmental considerations into National Development Plans and local Master Plans. An environmental institution (MEPA: Meteorology and Environmental Protection Administration) has been created and the General Environmental Code has been established to ensure that environmental considerations are taken into account at all levels of planning. Considerable improvements have also been achieved in integrating an environmental section in the Development Plan (Ministry of Planning, 2000). However, the achievements still fall short of the required framework for fostering sustainable planning and development (Al-Gilani and Filor, 1997). An assessment study by Alshuwaikhat and Al-Hussain (2001) showed that the Master Plan (Jubail Industrial City, Saudi Arabia) addresses economic issues more than social and environmental matters. There is the need to develop a comprehensive strategy of enshrining the principles of sustainability in land use planning in the Kingdom especially now that Municipal Master Plans are being reviewed. The paper discusses current framework of sustainable spatial planning in Saudi Arabia. It highlights the need for better planning guidance and proposes general guidelines in view of current international practices.

Overview of Sustainable Spatial Planning in Saudi Arabia

Sustainable spatial planning in Saudi Arabia has been limited to examining possible environmental issues in development activities in the traditional planning process. Unlike the practice in UK and North America, there is no formal sustainability planning guideline for both the planning process and the plan documents. Contemporary planning

in Saudi Arabia evolved in the 1970s with the adoption of the comprehensive planning approach whereby development/master plans are developed for the country and different municipalities. The Ministry of Planning (MOP) and the Ministry of Municipal and Rural Affairs (MOMRA) are government agencies that are in charge of national and municipal planning. The Ministry of Planning has the mandate of preparing the sectoral plans at the national level while the Ministry of Municipal and Rural Affairs coordinates the planning process at the Municipal level. Although the ministries consult other governmental agencies to produce the plans that are approved by the Council of Ministers, the process is characterized by top-down and centralized approach to planning. The planning process is guided by the General Environmental Code and other environmental standards that are developed by Meteorology and Environmental Protection Administration (MEPA). The process virtually encourages and at times ensures project-level environmental assessment with little coverage of the assessment of plans and programs (Al-Gilani and Filor, 1997).

The adequacy of the current level of integration of sustainability in the spatial planning in the Kingdom is evident in the planning documents. The Five-Year Development Plan at the national level and the Master Plans at the municipality level indicate the depth of coverage of sustainability issues in the planning process. For instance, the Seventh Development Plan highlights the protection of the environment against pollution and the preservation of natural resources as one of the general objectives (Ministry of Planning, 2000). The Seventh Plan also indicated some environmental targets to be achieved such as reducing the level of pollution, approving the General Environmental Code, controlling desertification, creating environmental information network, adopting coastal

management plan and conserving national wildlife. However, in the planning and methodology section of the document, emphasis is placed on mainly the economic, social and institutional dimensions of development at the detriment of the environmental dimension which is a very crucial issue in sustainability. The inadequacies in the integration of sustainability principles in the planning process have been due to lack of formal and legal framework of sustainable planning guidance. International experiences have shown that sustainable spatial planning could be enhanced in an institutional context with formal guidelines.

Guidelines of Sustainable Planning

Having highlighted the need for improvement on the current practice of sustainable planning in Saudi Arabia, it is imperative to develop guiding principles that will further promote sustainable planning. The guidelines are in two forms: the guidelines on integration of sustainability with planning process and guidelines for evaluating the development plan. That is, both the planning process and the plan should be guided and evaluated for sustainability. The guideline on integration of sustainability with the planning process is based on the extension of the SEA (Strategic Environmental Assessment) from environmental appraisal to sustainability appraisal.

1. Guidelines on integration of sustainability with planning process

The integration of SEA with the planning process involves about five forms of which at least three have been widely discussed in literature (Kessler, 2002; Partidario, 2002; Elling, 2000). Practitioners have made efforts to develop principles that should guide

good practice of integrating SEA into the planning process. The principles are highlighted in Table 1. The procedural aspect of the integration of SEA into planning process has attracted the highest attention due to attempts to practically link the SEA process with the planning process and the development of procedural steps as an overarching framework for integration of other aspects. SEA process has shifted from being environmental-led to objectives-led integration which is centered on its links with the planning process. George (2001) noted that sustainability appraisal in the United Kingdom developed as a shift from the traditional EIA to objectives-based approach. The objective-based appraisal requires that the objectives of development plans be appraised based on the objectives of sustainable development. The appraisal is based on three working definitions (James, 2001; DETR, 1999):

- Objective – statement of what is intended for a policy or series of related policies and of what way that intention is to be pursued.
- Target – objective that seeks a specified desired end state, usually, although not necessarily, within a specified time-scale.
- Indicator – piece of information which is used to measure and track the status and progress of a complex system.

In addition to providing the working definitions of sustainability appraisal, the UK Government highlighted about four stages that can be used to integrate sustainable development into development planning process (DETR, 1998). The stages are:

- clarifying issues and objectives – identify strategic issues and objectives for the region or sub-region;

- identifying indicators and targets – select key economic, social and environmental objectives where indicators are needed, use existing data where possible to define indicators and involve local community in deciding thresholds;
- strategic options – select key decision areas for strategy development, develop options and clarify the likely effects of the options in relation to the key objectives;
- policies and proposals – develop policies that help to implement the overall strategy and clarify the likely impacts of the policies and proposals on the key local objectives.

Apart from the having a framework for integrating sustainability into the planning process, there is also the need to assess the effectiveness of the planning process in promoting sustainability. Therivel and Minas (2002) identified three tasks that should be accomplished by an effective Environmental Assessment process. One, the process should identify the sustainability or environmental ramifications of implementing the strategic action and suggest possible changes. Two, the changes recommended by the process have to make strategic actions and plans more sustainable. Three, the changes should be incorporated in strategic actions and plans. In order to make the criteria more comprehensive, the factors highlighted by George (2001) could be added to complement the criteria. The sets of criteria are based on the twin principles of inter- and intra-generational equity (Table 2).

2. Guidelines for evaluating the development plan

Evaluation of master plan is necessary to know the status of our progress towards sustainability. As Walsh and Brand (1998) noted, that “no more than ever environmental appraisal must take place as an essential part of plan-making process for it is an effective means of ensuring that land use plans are environmentally sustainable”. The task of monitoring and evaluating the plans for sustainable development has not been fully investigated. Baer (1997) noted that the planning profession has developed relatively few criteria for evaluating the quality of general plans. To date, there has only been sporadic empirically based investigation exploring the linkages between sustainable development and land use planning (Hales, 2000). The intricacies of evaluating master plan for sustainable development are in the quantification of qualitative concepts of sustainable development. Although some indicators of sustainability have been developed, the gap of objectivity and quantitative measurement still exist. The ability to determine the best sets of indicators and to quantify the relationship between the indicators and master plan elements is very crucial to sustainability appraisal of master plans.

Different attempts have been made to develop a quantitative and systematic approach for evaluating sustainable development principles in master plans. Counsell (1999) investigated the attempts to operationalize some themes and principles of sustainable development in UK structure plans. The study investigated resource protection (environmental capacity, environmental capital and the precautionary principle) and socio-economic (social equity, policy integration and participation) themes. Relative ranking approach was used to rank the plans based on the relative operationalization of

the different themes of sustainability. Bruff and Wood (2000) used content analysis approach to assess the strengths and weaknesses of development plans in terms of sustainable development. The approach is mainly qualitative as plans are graded on the extent to which a set of identified policies are covered and fulfilled. In an attempt to make the evaluation more quantitative, Berke and Conroy (2000) highlighted about seven plan elements which are assessed on the principles of sustainable development. The plan elements are housing, transportation, environment, energy, land use, economic development and public facilities. An effective and comparable assessment of the master plan can be achieved if the approach is objective and quantitative. The selected sustainability indicators should be measurable on all the master plans that are considered and a measurable relationship between the indicators and the plan elements should be established.

3. Guidance for sustainable development plans

Having highlighted the guiding principles for evaluating the development plan and integration of sustainability in the planning process, it is very important to elaborate on the components of a sustainable development plan and how these components could be explored to promote sustainability. As it has been recognized that there is a linkage between the planning process and the actual plan, the planning process must be guided by the principles of integration of sustainability for the development plan to be sustainable. These guidelines, as highlighted above, include early integration, systematic and multidisciplinary approach, separate documentation of assessment and interlinking environmental assessment with the planning process. It is also relevant that the process

should be supported by adequate institutional and legal frameworks that are embedded with community participation and institutional capacity building.

The institutional framework should effectively link planning and administration at the national, regional and local level thereby promoting coherence in policy and decision-making. The framework needs to enhance institutional arrangement for full implementation of Agenda 21 by encouraging sustainable planning at the local level. The framework should be capable of promoting good governance, transparency and inclusive community participation. The legal framework should provide legislative directive to support the integration of environmental assessment into the planning process. The directive should specify the roles and responsibilities of different government and private sectors and enjoin public participation. The capacity of different government and private agencies to effectively discharge their responsibilities should be enhanced through adequate training and sharing of information and knowledge on good practice. Also, the level of environmental awareness of the populace should be improved to promote effective public participation and consultation.

The guidelines of sustainability integrated planning process could be complemented by the guidance for the development plan. The procedural guideline for preparing a sustainable development plan has been highlighted in literature (Counsell, 1998; English Nature, 1994; Quaid, 2002; ICLEI, 2002). The steps are similar to the stages of planning process highlighted by DETR (1998) but they are more detailed. The two approaches could be synthesized for practical application. The modified steps included in the

procedure are (Fig. 1): inventory of resources and establishment of information base; formulation of goals, targets and indicators; development of a strategic sustainability action plan; strategic environmental assessment of the plan; and implementation and monitoring.

- Inventory of resources and establishment of information base – This step involves the collection of data on the quality of the environment. The baseline profile of natural, social and economic resources is established and information base on the current state of the environment is developed. The inventory will include the following areas: water, air, land, health, economy, housing, waste, safety, energy, education, transport, recreation, biological resources, civic and municipal involvement, municipal policies & practices, and demographics. Also, the management practices for each resource will be assessed. The inventory will be the basis for identifying and formulating sustainability goals and targets for the plan.
- Formulation of goals, targets and indicators – Sustainability goals is formulated after effective consultation with the public and stakeholders. The goals statements express the commitment of the development plan to pursue sustainable development. Targets are set from the overarching goals and appropriate indicators are developed to measure the progress of the plan towards the stated goals.
- Development of a strategic sustainability action plan – Based on the formulated goals and targets, a strategic sustainability action plan is developed. The strategic sustainability plan outlines actions to achieve sustainability. The strategic plan

states the priorities in achieving sustainability base on adequate analysis of inventory data and information.

- Strategic environmental assessment of the plan – The strategic sustainability plan is subjected to strategic environmental assessment to ensure that significant environmental effects of the plan (including its attendant policies and programs) are taken into account. Alternative scenarios are assessed and the best course of action is selected with recommendations on mitigating the likely environmental effects.
- Implementation and monitoring – The strategic sustainability action plan is implemented with adequate monitoring and evaluation. The progress made towards the achievement of the goals and targets of the strategic sustainability action plan are measured. The evaluation is carried out by analyzing the data and information collected on the identified sustainability indicators. Obstacles to the implementation are identified and resolved. Changes in the components (transportation, housing, economic development, safety, energy etc) of the action plan are identified and documented to form the basis for the inventory of resources for future strategic sustainability plan.

Apart from the making the planning process sustainable, different elements/components of the Master/Development plan should be based on the principles of sustainability. Land use, transportation and natural resources are crucial sustainability issues or components

of development/master plans. Particular attention should be paid to the interrelationship between the three components. Land use decisions have a direct impact on a community's quality of life, the form and location of economic development, public sector investment decisions (e.g. infrastructure), and the viability of natural environments (Seasons, 2002). Also, land use generates travel demand and thereby dictates the need for transportation facilities. Thus, land use decisions and planning should be guided by the principles of sustainability. Land use and transportation should be integrated and compact settlements, mixed land use and re-use of already developed/derelict land should be promoted. Transportation has a large impact on resource consumption (energy and land area) and considerable source of pollution. Transportation is one of the sources of carbon dioxide, nitrogen dioxide and nitrogen monoxide emissions and a major cause of high noise level (Abolina and Zilans, 2002). Socially, transportation influences the degree to which the residents access the city and the mobility of the residents. Most perspectives to sustainable urban development are of the view that the method of addressing urban transport problems requires mixed-use development, pedestrianization, development of public transportation, promotion of non-motorized transport and reduction of travel demand. The conservation of natural resources is very vital to the achievement of the intergenerational and intragenerational principles of sustainability. The main goal is to maintain the resource stock and biodiversity of the community. That is, the use of non-renewable resources should be minimized and the efficient use of renewable resources should be encouraged.

These principles should reflect in the action plans that aim at promoting sustainable communities. It is noteworthy that studies (Counsell, 1998; Bruff and Wood, 2000; Alshuwaikhat and Al-Hussain 2001) have shown that these principles are only partially covered in most of development plans. It is important to improve on the breadth and strength of coverage of the principles to foster sustainable communities. Sustainability indicators have to be developed (bearing in mind the local context) and applied in development plans in order to monitor and improve upon the breadth and strength of coverage of sustainability principles. Indicators are measures of variables over time, often used to measure achievement of objectives or targets. It is important to develop viable, sustainable indicators in order to assess the master/development plans' sustainability (Alshuwaikhat and Al-Hussain 2001). Different international organizations and non-governmental organizations (United Nations Council on Sustainable Development, OECD and ICLEI) have developed sustainability indicators that could be applied in fostering sustainable urban development. The indicators are could be very complex to apply if all the elements are to be considered therefore different communities should choose and develop indicators that could be applied in their specific situations. Table 3 highlights some of the important sustainability indicators (social, environmental and economic) that could be applied in development/master plans.

It is important that the development plan reflects the sustainability indicators that are used in preparing the plans or that are attendant to the objectives of the plan so that the plan could be evaluated through the indicators. As noted by Seasons (2002), most municipalities used quantitative indicators in preparing plans but these indicators were

rarely presented in the municipal plans or were difficult to find in the documents. Indicators have become integral component of sustainability planning as indicator-based approach is more adaptable and useful than other approaches.

Operationalization of the Development/Master Plan Elements and the Indicators

The operationalization of the plan elements and the sustainability indicators can be achieved by linking indicators and targets with the goals and objectives of the development/master plan. The goals and objectives of the plan which should be derived from the sustainability inventory of the community and the contributions of stakeholders should be used to develop indicators and set targets for sustainability. Actually, the three components should be sequential; sustainability goals and objectives should be incorporated into the plan and indicators (which will measure the progress towards the goals) should be developed followed by targets (fig. 2).

Targets serve as benchmarks that indicate specific accomplishment to be achieved by a given date (Dalal-Clayton and Bass, 2002). Targets will not only indicate the direction of change but also the desirable levels or thresholds to be achieved. Apart from guiding the planners on action to take to achieve sustainability goals, targets make it easier to carry out the tasks of evaluation, monitoring and follow-up. Comparisons can be made between the stated targets and what is actually achieved and future goals, indicators and targets could be set from the outcome. Thereby, the community will achieve some levels of sustainability (fig. 3).

The development of sets of sustainability indicators and targets is very complex because there are a lot of components (social, economic and environmental) to measure and there is no single index that sufficiently measures these factors. Differences in local experiences and situations have also made it difficult to establish international standards. However, there are guidelines for developing applicable local sets of indicators and targets and even some sets of indicators have been recognized as 'core indicators' of sustainability. CSD (2002) highlighted some sets of indicators as core indicators having tested them in different countries of the world. The indicators include:

- Unemployment Rate
- GDP per capita
- Domestic per capita consumption
- Land use change
- Ambient concentration of urban air pollutants
- Emissions of greenhouse gases
- Emissions of nitrogen dioxides
- Annual energy consumption
- Population growth rate
- Use of fertilizers
- Ratio of threatened species to total native species
- Emissions of sulphur dioxide

It is recommended that this set of indicators or measurements that are similar to them should be included in national or local sets of indicators. In order to develop viable local indicators and targets, the following issues that should be considered are outlined below:

- Availability and reliability of data
- Linkages to other indicators
- How well does the indicators directly reflect the objectives

- Usefulness of indicators to decision makers
- Level of aggregation
- Resource input

Despite the complexity of issues involved in developing sets of indicators and targets, different organizations and governmental agencies have been able to develop both local and international frameworks of indicators and targets. The CSD (Commission on Sustainable development), ICLEI, OECD and IISD compiled sets of indicators that could be applied in fostering sustainable communities. These frameworks of indicators do not obviate the need to develop applicable local indicators because some of the indicators might not be applicable to all local settings. Also, international standards are unavailable for most of the targets that are developed. Table 4 highlights a framework of targets which have been developed for planning elements and indicators. The targets have been developed from the framework of CSD (2002), OECD (2002) and other sources. Probable targets are suggested for indicators that have no international or documented targets.

Apart from the three dimensions of sustainability mentioned above, there is another dimension which is often regarded as the fourth dimension in some literature; institutional dimension. We view the institutional dimension as a very basic and crucial aspect of sustainability that must be enabling for sustainability to be achieved. As noted by Lake and Hanson (2000), that sustainability is fundamentally a political

problem in the sense that the greatest barrier to sustainability lies in the absence of enabling institutional framework for fostering sustainable practices. This has implications for a country like Saudi Arabia where the planning process is still centralized. There is emerging worldwide consensus that decentralized control of spatial planning; enhanced local participation and municipal autonomy do promote sustainable communities. Thus, an enabling institutional context must be established along with the sustainable planning guidelines highlighted above to achieve sustainability in the Kingdom.

Conclusion

The paper has been able to discuss the major steps taken by Saudi Arabia in ensuring that sustainable principles are incorporated in the development plans. It shows that more efforts have to be expended towards sustainable planning in the Kingdom. A comprehensive framework of sustainable indicators and targets has to be incorporated into the development plans and plan evaluation guidelines based on strategic environmental assessment should be established. It is rightly noted by Al-Gilani and Filor (1997) that a formal and legally supported SEA framework is very important in fostering sustainability in Saudi Municipalities. The Ministry of Municipality and Rural Affairs (MOMRA) should be better positioned and empowered to establish an effective SEA integrated sustainable planning in the Kingdom.

In addition, there is the need to review the approaches adopted in the planning process to a more participatory approach which will encourage and ensure adequate input into development planning by the affected communities. The participatory approach can be enhanced by improving the level of environmental awareness of the citizens and

establishing effective training program for the staff of different agencies that are involved in the spatial planning process. Essentially, an efficient and effective information system should be developed to support and integrate the sustainable planning system. The information system must be robust and versatile enough to incorporate a system of sustainable indicators and targets especially spatial indicators which requires geographical analysis. The efforts of some municipalities (such as Riyadh) in developing geographic information systems for cities and villages are noteworthy and should be improved upon to incorporate environmental/sustainability information system. Overall, an effective system of institutional capacity building should be established in the Kingdom.

Although the guidance and framework illustrated in the paper are in reference to Saudi Arabia, it could serve as a general sustainable planning guidance because the guidelines are developed from current international practices in sustainability planning. The municipalities in the Kingdom could greatly improve the integration of sustainability principles in their master plans by adopting the international guidelines and practices.

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Figure Captions

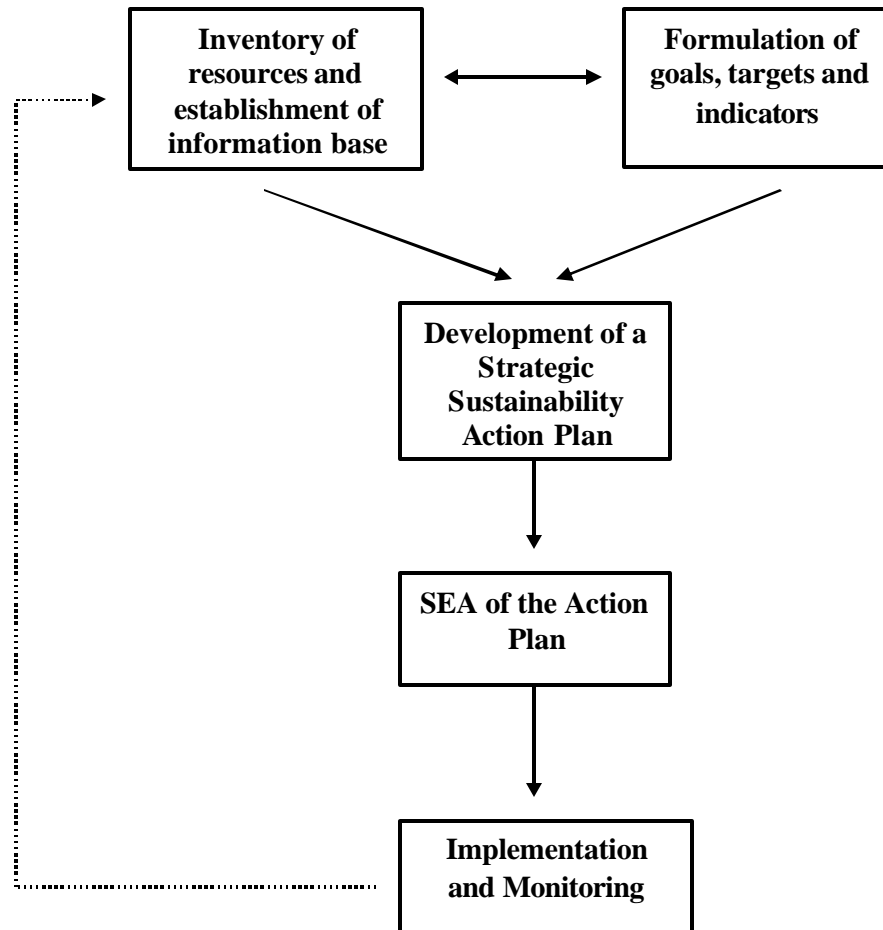


Figure 1. Procedure for making Strategic Sustainability Plan (based on Counsell, 1998; English Nature, 1994; Quaid, 2002; ICLEI, 2002).

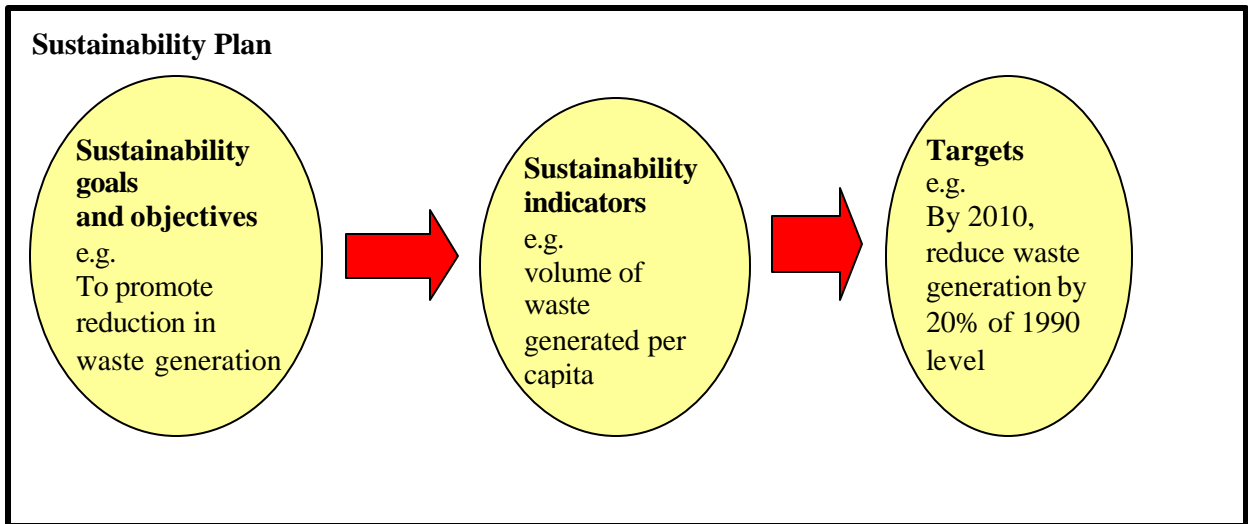


Figure 2. Linkage between goals/objectives, indicators and targets.

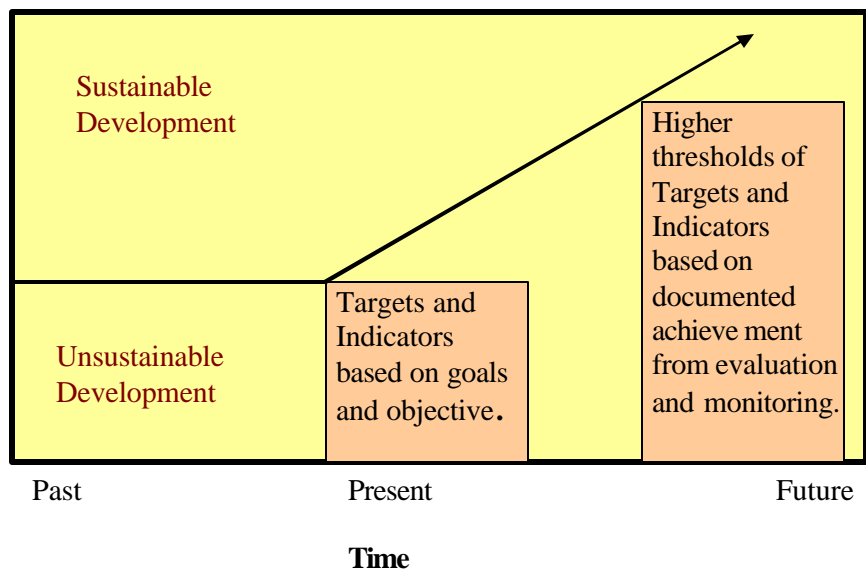


Figure 3. Using Indicators and Targets to achieve Sustainability.

Tables

Procedural	Substantive	Methodological	Institutional	Policy
<ul style="list-style-type: none"> • SEA should be a flexible and adaptable process • SEA should be within the context of alternative scenarios • The process should be participative • SEA is a part of tiered approach • The documentation of SEA should be different from the development plan • SEA is independent but interlinked with the planning process • SEA should be strategic and iterative • SEA should be within the existing PPP formulation process and should start early in the process 	<ul style="list-style-type: none"> • Focus on sustainability • Assessment of planning objectives • Linkages between environmental and socio-economic issues should be clarified • Guided by the precautionary principle of sustainability • Set of criteria of environmental quality • Consider the interboundary (from local to global) nature of environmental processes • Consider different time frames (short term, medium term and long term) of impacts 	<ul style="list-style-type: none"> • Interdisciplinary and participatory approach • Quantitative and qualitative assessment of plans, programs and policies • SEA methodology should be adaptable to different contextual dimensions (legislative change, sectoral plans and policies, integrated plans) of PPP formulation • An array of tools of analysis should be adopted 	<ul style="list-style-type: none"> • Incremental institutional adaptation • SEA should be within a legal framework • Adaptable to internal and external complexities • Long term institutional integration and development 	<ul style="list-style-type: none"> • Adaptable to different contexts of policy development (structured, semi structured, unstructured and mixed) • Broad definition of Policy to encompass the varying forms of policy decisions • Consideration of both direct and indirect effects of policies

Table 1. Guidelines of integrating SEA into the planning process.

Intra-generational equity	Inter-generational equity
<ul style="list-style-type: none"> • Have all social groups within the planning area been identified and have impacts on each group been assessed? • Will the planning document and Environmental Assessment be published and made available to the public? • Will all members of the public have the opportunity to participate in the planning process? • Have significant transboundary impacts been identified and properly assessed, are relevant international agreements complied with, and will affected parties be consulted before final decisions are made? 	<ul style="list-style-type: none"> • Have any potential critical ecosystem factors that may be affected been identified? • Has the risk of serious or irreversible damage arising from any such impact been satisfactorily assessed, with suitable systems for monitoring, impact avoidance and mitigation where needed? • Is it demonstrated that the rate of loss of natural capital (if any) will not exceed the equilibrium regeneration rate? • Is an appropriate contribution to reducing greenhouse gas emissions shown to be made, which is in accordance with the Kyoto agreement?

Table 2. Criteria for assessing the planning process. (Adapted from George, 2001)

Plan Element	Theme	Indicator
Land-Use	Urban area footprint	Total community land area in acres per resident.
	Infill	Percent of building permits issued annually on property platted more than five years prior to building permitting.
	Use mix	Dissimilarity among one-acre grid cells containing predominant land use.
	Land redeveloped	Percent of designated land area redeveloped per year.
	Jobs/housing balance	Ratio of jobs to dwelling units
Transportation	Travel density	Distance travel per Capita by mode of transportation
	Transit service density	Index of miles of transit routes multiplied by the number of transit vehicles traveling those routes each day, divided by total land area.
	Auto use	Auto vehicle miles traveled per capita per day
	Pedestrianization	Percent of all person trips made by walk/bike modes.
Environment	Natural areas protection	Percent of total land area protected as natural area or equivalent.
	Species biodiversity	Abundance of selected key species
Environment	Agricultural land conversion	Acres of agricultural land urbanized per year.
	Imperviousness	Percent of total land area covered by impervious surfaces.
	Water Quantity	Annual withdrawal of Ground and Surface water as a percent of Total Available Water.
	Water Quality	BOD in water bodies
	Air Quality	Ambient Concentration of Air Pollutants in Urban areas.
	Climate Change	Emissions of Greenhouse gases
	Ozone depletion	Consumption of Ozone depleting substances.
Infrastructure	Water consumption	Residential water use in gallons per capita per day.
	Park space availability	Acres of park and school yards per 1,000 residents.
	Waste generation and management	Waste recycling and reuse
Urban design	Preservation of historic and archaeological sites and buildings	Percentage of historic and archaeological sites and building designated for preservation.

	Open space protection	Percent of total land dedicated to open space.
Housing	Density	Dwelling units per net acre of land designated for residential use.
	Affordability	Ratio of average house sale price versus an “affordable price”.
	Transit proximity	Average travel distance from dwellings to closest transit stop in feet.
Energy	Energy use	Intensity of energy use and share of consumption of renewable energy resources.
Economic development	Economic performance	GDP per Capita
	Level of investment	Inward investment (as per level of output)
	Employment	Number of employees per net acre of land designated for employment uses and unemployment rate.
Population	Human health	Years of healthy life expectancy
	Poverty	Percent of population living below poverty line
Population	Education	Literacy rate
	Security	Recorded crime per 1000 population
	Social inclusiveness	Percent of the poor, children, women and disabled people that have access to community facilities and services. Percent of deprived people that participate in decision making.

Table 3. Development/master plan elements and sustainability indicators. (Adapted from ODPM, 2002; the UN Council on Sustainable Development; FSCN, 1999)

Plan Element	Theme	Targets
Land-Use	Urban area footprint	Reduce the total community land area in acres per resident by 10% by 2015
	Infill	Increase in the percent of building permits issued annually on property platted more than five years prior to building permitting by 10% by 2015
	Use mix	Increase the dissimilarity among one-acre grid cells containing predominant land use.
	Land redeveloped	Increase the Percent of designated land area redeveloped per year by 5%
	Jobs/housing balance	Increase the ratio of jobs to dwelling units
Transportation	Travel density	Reduce the distance travel per Capita by mode of transportation
	Transit service density	Increase the (index of miles of transit routes multiplied by the number of transit vehicles traveling those routes each day, divided by total land area) by 10%.
	Auto use	Reduce auto vehicle miles traveled per capita per day
	Pedestrianization	Increase the percent of all person trips made by walk/bike modes by 20%
Environment	Natural areas protection	Increase the percent of total land area protected as natural area or equivalent.
	Species biodiversity	Reduce abundance of selected key species
Environment	Agricultural land conversion	Reduce acres of agricultural land urbanized per year.
	Imperviousness	Stabilize the percent of total land area covered by impervious surfaces.
	Water Quantity	Reduce annual withdrawal of Ground and Surface water as a percent of Total Available Water.
	Water Quality	Reduce the level of BOD in water bodies
	Air Quality	Reduce by 55% of 1990 levels the emissions of fine particulates by 2030 and reduce NOx emissions by 10% of 1990 levels (OECD, 2002)
	Climate Change	Reduce emissions of Carbon dioxide by 5% of 1990 levels by 2012 (CSD, 2002)
	Ozone depletion	Eliminate ozone depleting substances by 2030 (CSD, 2002)
Infrastructure	Water consumption	Universal access to safe drinking water supply by 2025 (CSD, 2002)
	Park space availability	Reduce the acres of park and school yards per 1,000 residents.
	Waste generation and management	Increase percent of waste that is recycled.
Urban design	Preservation of historic and archaeological sites and buildings	Increase the percentage of historic and archaeological sites and building designated for preservation.
	Open space protection	Increase the percent of total land dedicated to open space.

Housing	Density	Increase the dwelling units per net acre of land designated for residential use by 50%.
	Affordability	Increase the ratio of average house sale price versus an “affordable price”.
	Transit proximity	Reduce the average travel distance from dwellings to closest transit stop in feet.
Energy	Energy use	Reduce the intensity of energy use and share of consumption of renewable energy resources.
Economic development	Economic performance	Increase the GDP per Capita
	Level of investment	Increase Inward investment (as per level of output)
	Employment	Increase the number of employees per net acre of land designated for employment uses and reduces the unemployment rate.
Population	Human health	Increase the years of healthy life expectancy
	Poverty	Reduce the proportion of people living in extreme poverty by at least one-half by 2015 compared to 1990 (CSD, 2002).
Population	Education	Universal access, and completion of primary education by 2015 (CSD, 2002)
	Security	Significantly reduce violence and crime (CSD, 2002)
	Social inclusiveness	Increase percent of the poor, children, women and disabled people that have access to community facilities and services. Increase percent of deprived people that participate in decision making.

Table 4. A framework of plan elements, themes and sustainability targets.