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Eco-city and Other Ecological Approaches in Urban Planning: A Review of the State-of-the-Art

Sangeeta Singh [1], Sudarshan Raj Tiwari [2]

[1, 2] *Department of Architecture and Urban planning, Pulchowk Campus, Institute of Engineering, Tribhuvan University, Nepal*
Corresponding Email: [1] sangeeta@ioe.edu.np

Abstract
Human settlement planning approaches in the various periods of history have been influenced by various paradigms. The planning approaches of the traditional agro-based societies were based upon planning in balance with nature in which it heavily depended. Frugal use of natural resources and community bonding were the key elements in the planning approaches. The industrial revolution in the nineteenth century brought about a major paradigm shift in the planning of settlements with the introduction of mechanization, which impacted almost all the sectors and changed the behavior pattern and livelihood dependencies of people. With growing realization of this increasing impact on a global scale there has been yet another paradigm shift in the recent years, in planning sustainable settlements and various approaches like the Eco-city, low carbon city, green city have been gaining global significance. This paper seeks to review the planning approaches undertaken during the two distinct periods in history, the pre-industrial and postindustrial periods and analyse it from the ecological perspectives. The principles and parameters associated with the recent Eco-city development initiatives along with the key elements of Eco-city is explored to provide a better understanding of the concept. The paper concludes with the lessons drawn from the various ecological approaches in planning and identification of challenges and opportunities for future eco-city initiatives.

Keywords
ecological approach to planning – eco-city

Introduction

Human settlements from the ancient times in history have emerged as a response of mankind to fulfilling its basic requirements and adapting to nature and its diversity. Starting from the Paleolithic (stone) age human beings have gradually advanced changing not only the surrounding environment also the livelihood and consumption patterns using the great potential of the human mind which differentiated them from the other species on earth. With the industrial development and technological advancement creating unlimited possibilities there has been a further shift in the livelihood and consumption pattern leading to societies largely depending on mechanized systems. There seems to have been innumerable endeavors for improving the living standards of the people through settlement planning initiatives in different periods and man has made tremendous progress in improving the living standards from the hunter gatherer man sometime before 10000 BC to the techno savvy man of the twenty first century. However this progress has been at the cost of the degrading natural ecosystems of the earth which does not seem to have received much attention until recently. The consequences of human intervention on nature have been realized more now than ever before, on a global scale with increasing number of manmade and natural disasters becoming more frequent events with global warming and climate change.“Awareness is growing of two critical energy-related issues, climate change and oil depletion, that will be key forces shaping the future of cities” [1]. This has brought about a major paradigm shift in the recent years in the settlement planning principles and parameters, leading to concepts such as Eco-city, low carbon city, green city and sustainable city focusing more on the ecological aspects of planning of settlements.

However this is not a completely new phenomenon as ecological considerations have been a part of settlement planning especially in the ancient and early medieval periods which seems to have received less attention in the later periods. This paper is the result of the analysis of the settlement planning initiatives by categorically considering the two distinct periods namely the pre-industrial and postindustrial periods. The emphasis is on exploring the ecological aspects in the settlement planning initiatives in the different periods including the recent Eco-city initiatives.

Key Settlement Planning Approaches from the Pre-industrial to the Post-industrial Period

Planning of cities have been guided by various factors in different periods in the history of planning of urban settlements. These were basically guided by concerns for the wellbeing of human beings and included security from the harmful elements, food security, prosperity etc. and were mostly guided by spiritual beliefs in the ancient times. The ancestors of human beings the Homo sapiens and the Neanderthal men lived in caves and rock shelters, wore animal skin clothes to protect themselves from the ice cold and harsh environment of the Paleolithic age through the Mesolithic and Neolithic ages (the stone ages) till 3300 BCE. These were nomads hunting for food and living in groups for security and were using tools made of stones for various purposes. It was only in Neolithic ages that farming was practiced which made a difference in the lifestyle being able to settle in one place, often near rivers having fertile soil unlike when they were nomads having to depend upon hunting animals for food. The bronze age (3300 BCE-1200 BCE) and the Iron age (1200 BCE – 586 BCE) saw further developments in the lifestyle of human beings due to the introduction of tools that were more and more sophisticated. This trend of innovation in the tools and machinery directed towards improving the efficiency in the daily activities have led to major paradigm shifts in the city planning principles especially after the industrialization in the early nineteenth century. “It brought about the concentration of workers in big industrial units and the growth of towns to house the working population, creating a new urban environment for social living. The new type of town, growing mushroom-like with industrialization, was not an adjunct to a predominantly agrarian society but a new dynamic force for change, the home of the majority of the population in a predominantly industrial society” [2].

Patrick Geddes distinguishes the “earlier and ruder elements of the Industrial Age as Paleotechnic, the newer and still often incipient elements disengaging themselves from these as Neotechnic : while the people belonging to these two dispensations were considered as Paleotects and Neotects respectively”. Paleotechnic order characterized by predominance of coal, steam engines, railways and extending markets led to the crowded and monotonous industrial towns that were dreary and constituted the bulk of the coalfield conurbations. The neotechnic order on the other hand, was “characterized by electricity, hygiene, and art, by efficient and beautiful town planning and associated rural development, and by a corresponding rise of social co-operation and effective good-will” and this led to the suburban development. [3]

The territorial organization of human settlements is based on the daily movement of people and up to 1825 CE the speed was constant at 5 km per hour as per Doxiadis (1964) in which all important functions of the city were accessible. Mobility, or freedom of movement, is a basic human demand. As cities spread out and cover more land area, it is necessary to connect areas within cities to each other, and also cities to other cities, via efficient and rapid transport systems [4] . With improving technology and increased energy systems the speed has increased and the time required to travel has decreased thus accelerating the growth of settlements and expanding them beyond boundaries. With the rise of the automobile during the 20th century, cities were created that depended completely on personal car transport - and they are characterized by having lower population density and being more spread out. We are now forced to accustom ourselves to an accelerating ecological interdependence among nations. Ecology and economy are becoming ever more interwoven locally, regionally, nationally, and globally into a seamless net of causes and effects. [5]

According to Doxiadis (1964), in what he describes as the science of human settlements termed as ekistics, the human settlements are formed due to the

interrelationships of the five elements of the "anthropocosmos" [6] which are nature (earth and the natural site on which they are built), and the shells (structures) forming the container and man, society, networks (functions) forming the content. All of these elements are equally significant in planning a settlement which can be formed through the best combination of the five elements, leading to the human happiness and evolution of better human species. "In shaping his settlements, man has always acted in obedience to five principles" [7]. Man constantly seeks to increase his contacts with the nature such as water and trees, with other people, and with the works of man such as buildings and roads (first principle) and in doing so tries to minimize the effort required for the achievement of man's actual and potential contacts (second principle), without intruding into the privacy and optimizing the protective space (third principle) and also optimizing the quality of man's relationship with his environment consisting of nature, society, shells and networks (fourth principle) and finally organizes his settlement so as to achieve an optimum synthesis of the above four principles (fifth principle).

Doxiadis explains the phenomenon of growth of cities based upon kinetic fields of human beings which is based on a man's walking field. A city of A level organization are according to him, the cities with compact urban settlements occupying an area of not more than 2 km by 2 km with no more than 50,000 population and these were the cities which survived thousands of years until the 19th century, when the introduction of the animal driven vehicles led to the B level organization of improved kinetic fields and thus growth of larger cities. With the introduction of subways especially in cities like London, Paris and New York which connected people over much greater distances C level organization of kinetic field led to the growth of metropolises. With the introduction of automobiles and highways D level of organization again facilitated growth to conurbation. With improvement in technology, with air movement and with increasing speed of travel in recent times, E level of organization has given rise to megalopolis. According to Doxiadis "eventually we will have a world needing eight levels of organization" leading to ecumenopolis [8]. Whereas the A and B level organizations are cities where human scale is predominant, the cities of higher levels with improved kinetic fields have become more and more mechanized and far from human scale. "It has overlooked the fact that some time about the beginning of the 19th Century, the city or 'polis' was transformed into a new type of settlement, the dynamic city or dynapolis" [9].

In the eastern world however imageability and identity of the city is seen to be guided by the religious and socio-cultural belief systems since the ancient times and nature and the natural resources have always been treated with due respect and played a key role in defining the urban form. The ancient texts like Manasara, Mayamatam, Aparajitaprccha, and Kautilya's Arthashastra have significantly addressed the settlement planning issues and it is worth revisiting these treatises that are relevant even in today's context especially in considering the planning of settlements in balance with nature. Manasara Shilpashastra which is an ancient planning principle considered in the Vedic period (400 BC) in India focuses on incorporating the nature apart from other features in the planning of a town. The various types of town forms were planned such as Dandaka, Swastika, Padmaka, Nadyavarta, Prastara, Chaturmukha, and Karmukha which emphasized on the perceived image of the cosmos and layout of roads and other landmarks such as temples and palaces so as to get the maximum benefit of nature. Mayamatam also describes eight kinds of villages; the five in common with Manasara are dandaka, swastika, prastara, padmaka, and nandyavarata. (Sinha 1998)

In the fourth century BC Kautilya regarded as the father of political science, has emphasized on the efficient use of natural resources in planning the towns while limiting its size for proper functioning and protection. He has suggested to form "villages consisting each of not less than a hundred families and of not more than five-hundred families of agricultural people of sudra caste, with boundaries extending as far as a krosa (2250 yds.) or two", and formed by river, mountain, forests, bulbous plants, caves, artificial buildings, or by trees [10]. Kautilya clearly recognized the role of natural resources such as forests, water bodies, and mountains etc. as valuable resources which were to be protected and used productively.

The arthashastra also recognized the role of proper water and waste management and suggests to have one

well for every ten households and emphasizes proper disposal of waste. The role of agriculture and forest preservation along with biodiversity conservation is reflected very well in the regulations defined in the Arthashashtra which suggests the division of city in concentric circles. The settlement is suggested to be located at the inner core of the concentric circles which should have perennial source of water; which is surrounded by the villages located amidst the mixed land use pastures, agriculture and which in turn is surrounded by forests for recreation and economic benefits towards the outskirts of the settlement. The forest based industries are suggested to be located adjacent to the forests and settlement area which needs to be protected and were occupied by tribes with traditional knowledge and enjoyed de facto rights on the forests.

The ancient Indian science Vastu Shastra which is a treatise on architectural planning, construction and design and emphasizes on incorporating nature into the built form applicable for setting up settlements, or in new constructions of any types or even into the functional units of the constructions. It emphasizes on the proper combination and utilization of the five elements: earth, water, fire, wind and cosmic space for harmonious living and stresses on increasing the net positive energy flow (prana) amidst the interaction of positive and negative flow of energy whenever we build something which causes this interaction. Feng Shui is a similar traditional practice and has been practised for the last two thousand years in China and it also focusses on balancing the positive and negative energy (ying and yang) for people to live in harmony with nature.

Socio cultural and religious traditions and belief systems is fundamental in formulating eco sensitive societies and in promoting ecologically sustainable settlements especially in the Eastern cultures. This is evident in the traditional towns of Kathmandu valley that have their own identities. The early settlements of Kathmandu valley seem to be strategically located considering the ecological aspects. The Kirat settlements called the pringga were located on high fallow ground along a ridge or on a hillock. “This very conscious ecology-sensitive tradition emphasized the preservation and use of dole, or irrigable slopes, and tala, the fertile plains along the riverbanks for agricultural purposes” [11]. According to Tiwari the Licchavi towns were planned and patterned as per hindu classical dictates, which sought to arrange activity zones and transportation network in a pattern that mirrored the cosmos and theoretically and conceptually presented as a mandala, or a group of elements bound by some rule. The town pattern also incorporated a sense of physical protection by providing a ring of walls for defence and moat all around.

The water supply to Kirat towns was provided through a reservoir-cum-service pond usually located at the edge of the thathu quarter of the town; the pond was fed with water canaled over long distances all the way from springs or river sources at the foothills of the valley. The reservoirs were also sometimes fed by canals called “tilmaka” which was developed into “pranali jaldroni” in the licchavi period both relying only on nature and natural formations like ponds, rivers, water falls etc. The Licchavi have tended to locate their new towns on riverbanks or if they expanded on a Kirat town, it was extended down towards the river and they applied the pit water conduit system as an urban utility and such pit water conduits were serviced from large reservoir ponds.

The construction of a chain of conduit pits with successive conduits at a level lower than the previous ones demands the use of filters in between to assure the purity of water all along the chain. [11]. The ancient Newari vastu Shastra highlights on the merits of not only digging well but also of planting the trees. “Clearly, to sustain an architecture that profusely used timber, a full participation of the society in the cultivation and nurture of trees must have been generated through creation of newer social, cultural and economic values” [12]. Several licchhavi inscriptions show the concern of the society about water quality; the technology of coagulation and filtration had apparently been developed. The ritual pouring of lapsi in huge quantities into the river during certain festivals “must be seen as a high water treatment technology of the licchhavi” as the hard core of the fruit along with sand, forms a perfect filter bed which control turbidity and bacteria present in water; balls of white earth, limestone and copper piping may also have been made for the same purpose. [13]

Literature on ancient and classic town planning considers that the most influential of thinkers in the Classical period of Greek Philosophy (420-320 B.C.)

were Plato, Aristotle and Socrates. Plato emphasized on the placement of temples around the agora and around the city for its protection and to maintain its purity and to locate the houses of public officials and law courts in association with the temples. He further suggests that city should have a unified presence and instead of city walls, the houses themselves should be built as city wall facing the street and argued that ideal city should be clean. Aristotle however was not much in favour of the hippodamium plan of grid irons saying that this is not good for defense as compared to organic and irregular pattern where road navigation is not smoothe. His idea on ideal city is based on the choice of site and considers the best orientation for the city where water was available. Socrates like Aristotle emphasized the importance of proper orientation of the dwelling.

Hippodamus of Miletus of the classical era Greece during the fifth century BCE emphasized on the importance of civic public spaces including the agora, the bouleuterion, theatres and temples and developed what was known as the hippodamian plan which was an urban plan based on a grid of streets at right angles and the allocation of public and private spaces. Sites for public space were allotted in advance, whereas prior to the Hippodamian plan, site allotment seemed to be done at random. What remained of the city, after the placement of sites dedicated to public life and sacred space, was to be used for housing. Hippodamus is credited with creating this division of public, sacred, and private land and it is the earliest example of the practice we now know as zoning. Hippodamus arranged the buildings and the streets of Miletus around 450 BC such that the winds from the mountains and the sea close to Miletus could flow optimal through the city and provide a cooling during the hot summer [14].

Vitruvius in the "ten books on architecture" has explained the significance of nature especially the sun and the wind, in planning fortified towns and the apportionment of building sites within and has discussed the general principles of planning; also the methods of selecting healthy sites, and the performance of various building materials in relation of the natural environment has been elaborately explained.

A healthy site according to Vitruvius will be high, neither misty nor frosty, and in a climate neither hot nor cold, but temperate; further, without marshes in the neighbourhood. In founding towns we must beware of districts from which hot winds can spread abroad over the inhabitants. The human bodies are composed of the four elements that is, of heat, moisture, the earthy, and air, and this is different for different animals of the world.

There was a tradition of sacrificing some of the cattles that were wont to feed on the site proposed in the ancient times before building a town for examining their livers. "If the livers of the first victims were dark-coloured or abnormal, they sacrificed others, to see whether the fault was due to disease or their food. They never began to build defensive works in a place until after they had made many such trials and satisfied themselves that good water and food had made the liver sound and firm". In the apportionment of house lots within the wall and the laying out of streets and alleys with regard to climatic conditions much emphasis was laid to exclude the winds from the alleys. Vitruvius has considered that there are eight types of winds that needs to be considered: Solanus from due east; Auster from the south; Favonius from due west; Septentrio from the north and Aquilo, Eurus, Africus, and Caurus from other directions. "The lines of houses must therefore be directed away from the quarters from which the winds blow, so that as they come in they may strike against the angles of the blocks and their force thus be broken and dispersed" [15].

In the modern context however the scenario is changing rapidly. The dynamic forces of developing humanity show that we must be prepared for a continuing increase of population which may well reach 20-30 billion people by the end of the next century, at which time it may level off. This will mean a universal city, ecumenopolis, which will cover the earth with a continuous network of minor and major urban concentrations of different forms" [6]. He has proposed that cities should not loose the human scale and that cities can be of the size 2 km by 2 km which is maximum comfortable distance for pedestrians and the automobile and pedestrian traffic can be separated completely, with automobiles consigned to underground conduits if possible. Doxiadis has proposed several measures for solving of the problems of the cities the growth of which is inevitable. Twelve global zones for landuse control ranging from the most natural to the one with greatest human interventions in order to save land for agriculture and food productions and with the ultimate goal of reaching a global ecological balance

which he termed as Naturareas (zone 1-5), Cultivareas (zone 6-7), anthroparea (zone 8-11) and insustrareas (zone 12) based upon least human intervention which is zone 1 till the zone 12 which is of highest human intervention.

It can be said that that during the 19th century, the city planning principles have been guided by abundant use of nonrenewable energy (fossil fuel) combined with new technologies leading to improvement in the quality of life. Access to clean water, centralized sewage treatment, vehicular oriented streets promoting higher and higher speed, increased comfort levels with lighting and heating technologies and increased consumerism, and improved communication technology have been achieved as the society made speedy progress to modernism. The societies became developed leading to the so called developed nations and the developing nations aspiring to become developed nations. However the 19th century models of city planning have in retrospect been very unsustainable models, with over exploitation of natural resources and this realization have brought forward the paradigm shifts in the planning principles in the twentieth and the twenty first centuries focusing more on sustainability issues.

The New Paradigm in the Ecological Approaches in the Twentieth Century

"Sustainable development" has become the new paradigm in global efforts towards economic development since the Brundtland commission published a report "our common future" in 1987 which defined it as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" [5]. The United Nations conference on human development in 1972 leading to the Stockholm declaration on human environment was the first major international gathering that discussed on sustainability issues on a global scale. Since then there has been a number of efforts on a global scale focusing on sustainability and climate change and has been more concerns on considering the ecological approaches in human settlement planning.

The Melbourne Principles for Sustainable Cities [16] is one of the product of the United Nations Environmental Programme International Workshop on Building Urban Ecosystems held in Melbourne in 2002 which were adopted at the Local Government Session of the Earth Summit 2002 in Johannesburg, and known as Local Action 21 or the Johannesburg Call. The vision promoted by the ten Melbourne Principles is to create environmentally healthy, vibrant and sustainable cities where people respect one another and nature, to the benefit of all. The World Wildlife Fund (WWF) conceived in 1961 having a mission to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, focusses on conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, promoting the reduction of pollution and wasteful consumption. WWF and its partners apply both ecological foot printing, and the 10 principles in projects which demonstrate One Planet Living into action.

One of the main outcomes from the UN Conference on Sustainable Development (Rio+20) in 2012 was international agreement to negotiate a new set of global Sustainable Development Goals (SDGs) to guide the path of sustainable development in the world after 2015 [17]. Resolutions adopted by the General Assembly on 25 September 2015 includes 17 goals which has included all the key elements of sustainable development including fostering inclusive, safe, resilient and sustainable human settlements as goal 11: Sustainable cities and communities [18]. The international political response to climate change began at the Rio Earth Summit in 1992, where the 'Rio Convention' included the adoption of the UN Framework on Climate Change (UNFCCC). This convention set out a framework for action aimed at stabilising atmospheric concentrations of greenhouse gases (GHGs) to avoid "dangerous anthropogenic interference with the climate system." The main objective of the annual Conference of Parties (COP) is to review the Convention's implementation [19]. With the sustainable development goals and COP21 and the recent COP 22 agenda targets it is inevitable that the way cities are planned and managed especially its heavy dependence on nonrenewable energies will have to undergo drastic changes.

Sustainable human settlement development should ensure economic growth, employment opportunities and social progress in harmony with the environment

(UNCHS 1996). The report on livable cities published by the cities alliance (2007) have focused on the strategic approaches of integrating environment into urban development processes. At different levels cities can use different instruments to integrate the environment into urban planning and management approaches like the policy instruments, process instruments, planning instruments and management instruments. The report further examines the characteristics, strengths and weaknesses of Integrated Development Plans, City Development Strategies, EcoCity Planning, Eco Budget and Strategic Environmental Assessment [20]. It is only in recent years that the eco-city phenomenon has become truly global and mainstream, against the background of a majority of people now living in cities and the growing international recognition of the scale and severity of climate change (Joss, 2010). Several new paradigms in city planning have been propagated in achieving sustainable development on a global scale all of which having similar objectives such as eco cities, sustainable cities, healthy cities, safer cities, cities without slums, smart cities, energy conscious cities, clean cities, and green cities, healthy communities, appropriate technology, community economic development, social ecology, the green movement, bioregionalism, native world views, low carbon city, zero carbon city, zero energy city, zero net energy city green capitalism, slim city, compact city, solar city etc.

Mark Roseland (1997) in his paper argues that though the term Eco-city was propounded by Register the idea itself was not new to urban planning and is based on a number of earlier spatial planning models starting from Garden city of Ebenezer Howard and the later theories of Patrick Geddes, Lewis Mumford, Ian Mc Harg, Christopher Alexander and others through the course of the twentieth century. Ian L. McHarg an architect can be considered as a pioneer in thinking about the ecological aspects in city planning. He valued site's natural features while designing, and stresses the importance of ecology in planning and in his book "Design With Nature" 1969. According to Frederick Steiner "environmental impact assessment, new community development, coastal zone management, brownfields restoration, zoo design, river corridor planning, and ideas about sustainability and regenerative design all display the influence of Design with Nature".

Utopian thinking has had an effect on city planning especially between 1890 and 1930, as a response to the problems of the nineteeth century cities that were largely unsustainable. Ebenezer Howard's 'Garden City', Frank Lloyd Wright's 'Broadacre City', and Le Corbusier's 'Radiant City' are some of the Utopian ideas for creating an ideal urban society. Howard introduced the concept of green belts of agriculture in the planning of cities very famously known as the garden city. His planning approaches have attempted in combining the positive aspects of the countryside with that of the town. In his book Garden cities of tomorrow (1902) which was previously published as "Tomorrow: A peaceful path to reveal Reform" (1989) he has laid emphasis on the synthesis of town and country which he terms as the "town-country magnet" where cities benefit from the urban and rural characters combined together. The concept of garden cities have had followers like Patrick Geddes and Lewis Munford. Lewis Mumford (1938) has explained the city to be an organism with 'amoeboid growth' and 'social chromosomes', and argued that there should be a definite boundary and maximum size in a city like in an organism. In the "Cities in Evolution" Patrick Geddes argues that urban form should follow the example of plant forms which illustrate how they organise themselves to process energy most efficiently. Jane Jacobs in "the death and life of great American cities" mentions that the Le Corbusier's"Radiant city" comes directly out of the garden city. "Le Cobusier accepted the garden city's fundamental image and worked to make it practical for high densities" [21]. In the Radiant city attempts are made towards densification in order to have more open spaces as high as 85 percent and having skyscapers occupying a very less space around 5 percent, thereby creating "vertical cities" surrounded by ample green spaces and housing 1200 inhabitants in an acre of land. With the heavy vehicles commuting through underground streets his vision was to develop "city without streets" and thus have more spaces for parks that are free from the transportation networks. Quite on the contrary to densification of the Radiant city however the Broadacre city of Frank Lyoud Wright "took decentralization beyond the small community (Howard's ideal) to individual family home" with everyone having the right to as much land as he can use, a minimum of an acre per person [22]. The City Beautiful movement is yet another movement which

began as a response to the problems in urban growth in America due to the industrial revolution.

Kevin Lynch has focused on imageability of cities and has offered some principles of city design in order to make a city's image more vivid and memorable. In studying the three cities Los Angelos, Boston and Jersey city he has come up with five elements that are significant in defining the visual form at the urban scale which are:

1. walkways and streets,
2. districts and neighborhoods,
3. nodes or points of activity like street corners,
4. landmarks and l
5. edges and boundaries between spaces [23].

According to Lynch the five basic dimensions of city performance are: vitality, sense, fit, access, and control with two "meta-criteria," efficiency and justice (Lynch 1981). As cities are becoming more and more universal however the imageability of the cities are changing too. Linear city, garden city, organic city, neighborhood unit, social city, are some other concepts along with the key concepts of the planning that have been implemented in the past years which mainly focused on the interdependence of a number of key aspects. These key aspects are the urban pattern, building form, pedestrian network, vehicular access, open spaces and greenery all of which create an urban environment which fulfill the needs and aspirations of the people living in the cities. These key aspects still make their appearance in the current eco-city model in a new and interconnected manner.

The eco-city approaches and its advocacy

Eco-city is quite a recent paradigm considered by the planners in trying to tackle the complex relationship between the human environment with the natural ecosystem. The concept of eco-city originates from the fundamental objective of sustainability and the application of ecological principles to urban planning, design and management [4]. The Working definition adopted by Eco-city Builders and the International Eco-city Standards advisory team, Vancouver, Canada 2010 can be stated as "An Eco-city is a human settlement modeled on the self sustaining resilient structure and function of natural ecosystems. The Eco-city provides healthy abundance to its inhabitants without consuming more (renewable) resources than it produces, without producing more waste than it can assimilate, and without being toxic to itself or neighboring ecosystems. Its inhabitants' ecological impact reflect planetary supportive lifestyles; its social order reflects fundamental principles of fairness, justice and reasonable equity".

Eco-city as a concept for planning cities is seen to have been popularized by Richard Register with the establishment of non- profit organization Urban Ecology in 1975 and Eco-city Builders in 1992 which urged discussions on ecological aspects in urban planning and also with the publication of a book Eco-city Berkeley (1987), the journal "urban ecologist" and later some other books on the subject matter. Register stresses on rebuilding our cities "in balance with nature", stresses on "as we build, so shall we live". He further raises concern on the impact of "peak oil" situation where practically everything from transportation, indoor climate, food, clothing, shelter depends on oil. "Given the crisis state of life systems on earth, the collapse of whole habitats and the increasing rates of extinction of species, it follows that cities need to be radically reshaped; they need to be reorganized and rebuilt upon ecological principles. "When we build the automobile sprawl infrastructure, we create a radically different social and ecological reality than if we build closely knit communities for pedestrians" [24].

According to the declaration of the World Eco-city Summit 2008 in San Francisco, an Eco-city is an ecologically healthy city. Into the deep future, the cities in which we live must enable people to thrive in harmony with nature and achieve sustainable development. People oriented, Eco-city development requires the comprehensive understanding of complex interactions between environmental, economic, political and socio-cultural factors based on ecological principles. Cities, towns and villages should be designed to enhance the health and quality of life of their inhabitants and maintain the ecosystems on which they depend. According to World Bank "Eco2 Cities" report: "Ecological cities enhance the wellbeing of citizens and society through integrated urban planning and management that fully harnesses the benefit of

ecological systems, and protects and nurtures these assets for future generations." An Eco-city may be defined as a city with a delimited urban structure where impacts on the environment have been much reduced in comparison to the urban form existing in the area; it is composed of a compact, pedestrian-oriented, mixed-use quarters or neighborhoods, which are integrated into a polycentric urban system in public-transport-oriented locations.

The success of an eco-city lies in the combination of land use, green areas and cultural heritage creating a sustainable and livable structure contributing to health, safety and wellbeing of the community and their identification with the eco-city. Eco2 Cities (Ecological Cities as Economic Cities) Initiative, adopted as an integral part of the World Bank Urban and Local Government Strategy, aims to help cities in developing countries achieve greater ecological and economic sustainability in synergy. Eco2 Initiative was globally launched in July 2009 at the Urban Research Symposium in Marseille and its Eco2 Book was published in May 2010. The Eco2 Pilot operations since then have been prepared in Indonesia, the Philippines and Vietnam. The World Bank and the Japan International Cooperation Agency (JICA) organized the first international conference on Eco2 Cities (Eco2 2010 Yokohama) on October 21-22, 2010 in Yokohama, Japan. [25]

Since Register, several others have propagated the concept of Eco-city, David Engwicht being one of them who published Towards an Eco-City (1992), (later as Reclaiming our cites and towns, 1993) in which he talks about how building more roads, shopping malls, gutting communities and increasing dense traffic, the city planners and engineers have greatly reduced effective human interaction. A city is "an invention for maximising exchange and minimising travel". He advocates 'eco-cities' where people can move via foot, bicycles and mass transit and interact freely without fear of traffic and toxins [26]. The eco-city vision links ecological sustainability with social justice and the pursuit of sustainable livelihoods. It is a vision that acknowledges the ecological limits to growth, promotes ecological and cultural diversity and a vibrant community life, and supports a community –based sustainable economy that is directed towards fulfilling real human needs, rather than just expanding [26]. The five principles of an Eco-city according to Prof. Sudarshan Raj Tiwari are a) green city, b) wet city, c) cool city, d) disposability and e) living with other beings. Rodney R. White describes the eco-city as 'a city that provides an acceptable standard of living for its human occupants without depleting the ecosystems and biochemical cycles on which it depends'. Rüdiger Wittig describes an eco-city by taking the characteristics of a city (high building density, high waste pollution, high levels of trade and commerce, a concentration of many diverse industries, etc.), and compares the differences of these characteristics with the characteristics of a natural ecosystem (their main energy sources, the composition of their surfaces and vertical structures, the direction of energy and material flows, methods of waste disposal, etc.). An Eco-city by its very appellation is place specific, characteristically spatial in significance. (Tai- Chee Wong, 2011) Tai-Chee Wing et.al suggests an ecological approach to urban design, management and towards a new way of lifestyle. The advocacy is for the city to function in harmony with the natural environment.

The ultimate objective of both eco-city and sustainable city is to improve the urban condition and create livable cities. Where problems often arise is managing priorities when it comes to the building of eco-cities, developers might prioritize the economic development aspect of an eco-city whereas a government employee might want to focus on the social dimension of development. Citizens or prospective residents of an Eco-city might prioritize the environmental perspective associated with this type of city building. Although it is a balancing of all these dimensions that is advocated by the concepts of eco-city and sustainable city, the people involved such as developers, architects, citizens or prospective citizens, government officials, etc., all have different ideas of how to achieve this balance. The approach to sustainable urban development is mostly process-oriented and pragmatic. This contrasts to the eco-city approach, which is more visionary and therefore also significant in the creative thought process essential in the development of scenarios for future sustainable urban management (Devuyst 2001, 44).

Discussion and Conclusion

The literature review on the state of the art regarding the Eco-city and other ecological principle in urban planning have revealed how the urban planning has evolved over time since the ancient periods through the pre-industrial and industrial to the modern and post modern times. It is seen that the innovation in tools in the ancient times led to the settlements which evolved with further innovations in the technical knowhow which expedited and led to industrial growth and industrial towns, the impacts of which were realized in the twentieth century which led to the paradigm shift in the way towns were conceived and which have focused on sustainability and ecological balance. This has led to a number of new concepts in town planning, the focus being on reducing the negative impacts on the ecosystem of the earth. These concepts are very relevant in the present context, however these are seen to have originated in the West with a general bias towards the technological and energy oriented societies.

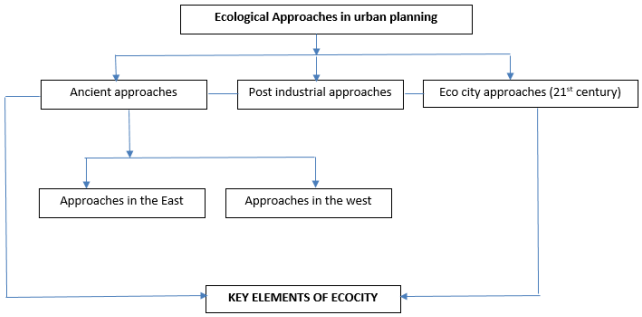

Figure 1: Key elements of Ecocity derived from the ecological approaches

The ecological approaches in urban planning can be understood from the three basic categories as shown in figure 1 which can help in identifying the elements of Eco-city. The Eco-city concepts advocated in the west seems to overlook the components socio cultural, agricultural and other aspects including disaster risk reduction component and are seen to be driven by the concerns to address the negative impacts of the industrialized and vehicle and energy oriented cities. The Eco-city phenomenon is quite a recent one and it would be worthwhile to explore the some of the cities across the globe where this initiative has been implemented so as to evaluate the applicability and the impacts of the Eco-city initiatives. Further research needs to focus on formulating the indicators in achieving the Eco-city status so as to facilitate in creating an Eco-city civilization on a global scale.

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