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Landscape ecology or environmental studies (Land Ecology) (European Versus Anglo- Saxon schools of thought)

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Abstract: Environmental studies which were initiated in English speaking countries in 1960's-1980's and generated a school of thought ever since, are thought to be in par with another school of thought, which was formulated in central Europe, around 2nd world war and later (1980's) was followed by some North Americans, *ie.* landscape ecology. These schools are reviewed, analyzed, compared and discussed in definitions and principles of land/ landscape in one hand and landscape ecology and environmental studies on the other. Then they are also compared in a) data collection, b) surveying techniques, c) data analysis and integration, d) mapping units and scales, e) land/ landscape evaluation and assessment, and f) planning tasks. Both schools are acting as crisis- solving- oriented science despite their major differences in data integration for mapping units and land evaluation techniques. Slight discrepancies in other areas and similarities are pointed out, particularly where modelling is concerned.

Key words: Landscape ecology, Environmental studies, Data integration, Mapping, European, Anglo- Saxon, Land capability evaluation.

Introduction

Since 10500 years ago when Persian domesticated sheep (Halstead, 1980), and started the first land use practice (pasturing) on our planet, human activities have increasingly caused alterations of the land/environment/landscape, to the effect that at present few virgin areas remain to be discovered (Makhdoum, 2007).

Notice that I used the word landscape as a synonym to the words of environment and land in previous paragraph. Are they different or synonyms? That was my motivation for a sabbatical spent in Germany, and England in 2006, to investigate the Anglo- Saxon and European (mostly central) school of thoughts in land/ landscape ecology. I was wondering which one was true. Are they different or similar? I had had a nagging feeling that they were somehow alike.

Now I am of the opinion what Australian, Canadian, U.S.A scientists, and later British and Hollanders termed Environmental studies in 60's and 80's, and began to establish institutions in their universities to teach, and conduct researches in environment (Stewart 1968), is what central Europeans particularly in Germany, Switzerland and later in Scandinavia called Geoecology, and later replaced it by the term of landscape ecology as was introduced by Troll (1939).

However, objectives of this paper are to analyze and conclude differences and similarities between the two schools of thought in 1) definition and principles, 2) data collection (resources), 3) surveying techniques, 4) data analysis and integration, 5) mapping units and scales, 6) resources evaluation and assessment, and 7) planning principles, and finally to discuss the comparisons.

Backgrounds and definitions

European

The term landscape ecology initiated by Passarge in 1919-20, and was first coined by German biologist and plant geographer Carl Troll in 1939 (Naveh & Lieberman 1994; Forman 1995a; Numata 1992; Bastian and Steinhardt 2002; Naveh 2002; Klink 2002a). Actually, as

Numata (1992) and Naveh and Lieberman (1984) pointed out the basis of landscape ecology was laid by Alexander von Humboldt in his composing of plant physiognomy in 1808, who defined landscape as "the total impression of an earth region" (Volk & Steinhardt 2002). Whereas, Troll (1968) defined landscape as "the total spatial and visual entity of human living space, integrating the geosphere with the biosphere and its noospheric man-made artifacts" (Naveh & Lieberman 1994).

Among Europeans working on landscape ecology, there are no consensus on the term landscape, and eventually landscape ecology. Because, in Europe, particularly in Germany and Switzerland, landscape ecology has not been initiated by ecologists or environmental scientists, and landscape architects (like in most parts of the world), rather by geographers, biologists, geo-scientists, soil scientists and even foresters (Naveh & Lieberman 1994; Steinhardt 2002). For example, in 1967 Neef a geographer termed the landscape as "an integrative structure and identic process texture characterized special part of the earth surface" (Volk & Steinhardt 2002).

However, as Volk and Steinhardt (2002) rightly stated, there are several definitions, for the term landscape in the literature, and they often are dependent upon the working scale of the sub-discipline. They further focused on this fact that in the context of European landscape ecology" the term landscape is related to the perception, observation and view of the environment or living space" Moreover, original visual- perceptual and aesthetic them of landscape have been adopted by landscape architects and land use planners (Naveh & Lieberman 1994).

By this observation, Europeans consider landscape ecology as "the ecological consideration of geographical areas" which has diverse roots stemming from biology, geography and even forestry (Klink 2002a). To the effect that Troll (1968) replaced the term landscape ecology by geo-ecology, which was criticized by Naveh (2002). Whereas, Leser (1997) regarded geo-ecology as the physio-geographic branch of landscape ecology.

Klink (2002a) and Steinhardt (2002) summed this notation by considering landscape ecology as an interdisciplinary, trans-disciplinary integrative science reaching from different floors from the lithosphere to the atmosphere, and as landscape sphere.

Nevertheless, in Europe the geographical roots of landscape ecology play major role (Numata 1992; Bastian & Steinhardt, 2002), in the definition of landscape and landscape ecology. Consequently landscape is defined as "a complex of abiotic, biotic and human components" (Bastian & Steinhardt, 2002), which is subjected to an aesthic appraisal (Krause 2001; Panse, 2002), and landscape ecology is defined as a multi- disciplinary science dealing with the interrelation between human society and its living space, (Numata 1992), which could be called "a crisis- solving oriented science" (Naveh 2002). Presently, landscape ecology is viewed in Europe as the scientific basis for land and landscape planning, management, conservation, development and reclamation (Naveh & Lieberman, 1994; Forman, 1999; Wu & Hobbs, 2002). However, as shown there is not uniformity in Europe for the definition of landscape and landscape ecology between different scientists who call themselves landscape ecologist. As Potschin (2002) pointed out much of the scientific works in this field regarded as ecological studies rather than landscape ecological ones. It is my opinion that landscape architects should be excluded from this early conclusion, for they know what landscape means as an entity of visual perceptions.

Let's finalize this section of the paper by quoting from the glossary of the recent book "Development and Perspectives of Landscape Ecology "edited by Bastian and Steinhardt (2002) from the contributions of many prominent European landscape ecologists which reflect their notions. Accordingly, landscape is "part of earth's surface with a uniform structure and functional pattern". Both appearance and components (landscape factors: relief, soil, water, climate, flora, fauna, humans, and their creations), including their spatial position are concerned. Landscape is not only the sum of single landscape factors but an integration of the geocomplexes. Thus, landscape involves different spheres: "inorganic sphere, biosphere and socio sphere". By this glossary, landscape ecology is" ecologically oriented branch of landscape research focusing attention on the analysis and synthetic treatment of the complex interactions between abiotic and biotic features of the landscape complex".

What are the reasons for such discrepancies, first among European themselves and then between Anglo-Saxons and them. Are land and landscape in one hand, and environmental studies and landscape ecology, on the other identical?

Anglo- Saxon

Anglo- Saxon's school of thought on landscape/ land ecology differs even between English-speaking countries themselves.

In this respect, three categories could be distinguished: 1) North America, 2) Australia, New Zealand and to some extent South Africa, and 3) UK which is regarded somewhere between Germany and USA (Potschin, 2002). However, as Potschin (2002) quoted from Moss (2000), there is no single North American approach to landscape ecology. This is also true for other two categories as well. For example, in Australia many European scientists migrated there, are more inclined to use the term landscape (Hajkowicz *et al.,* 2005) instead of land which has often been used by Australian pioneers working on land use evaluation and planning for similar concept. (Stewart, 1968; Cocks, 1986). In fact, in Canada and Australia, from 1950's, until 1980's most of the research workers conducted land use research on land, hardly used the term landscape for similar purpose. In those times, one encountered uses of Environmental Studies (then a new multidisciplinary field) as a holistic concept which treated as a system, the same way that Europeans conceptualized landscape ecology. In Stewart (1968), Tomlinson (1968), and Cocks (1986) the study of Land/environment takes in the interrelationships between biotic and abiotic components, as well as, the human impact upon them in an integrated approach.

Simply put, environmental studies in those periods among workers in Anglo-Saxon countries were meant the same thing (Christian & Stewart, 1968; Stewart, 1968; Mc Harg, 1969; Fabos *et al*. 1978; Basinski & Cocks 1985; Cocks & Ive, 1988), which the landscape ecology meant for European research workers conducting researches on land. Similar conclusion could be found in Naveh and Lieberman (1984), when they discuss about landscape capability analysis and assessment.

However, the publication of the book on landscape ecology, by Naveh and Lieberman (1984) could be regarded as a turning point not only for Europeans, but also for Anglo-Saxon countries. Later it was followed by the book of landscape ecology by Forman and Gordon (1986). Since these two books considered the landscape ecology as an interdisciplinary and global science of human ecosystem, exploring heterogeneous combination of ecosystems, from woods, and meadows to villages and town and regarding their structures and changes, they reflected a better impact than pioneers did for environmental studies. Theirs and other contributions, like Zonneveld (1995), and Farina (1998) which put more emphasis on ecological principles, rather than on socio- economic entities have had some astonishing impact among Anglo-Saxon scientists working on environmental issues. As a result, recently one could find more frequent uses of landscape instead of land among some Anglo-Saxon workers. (Rolling & Brunckhurst 1999; Zheng & Chen 2000; Gessler *et al*., 2000; Thomas 2001; Bell 2001; Lundquist *et al.,* 2001; Kennedy *et al*., 2006; Runder *et al*., 2007).

Nevertheless, it should be noted that among European worker Zonneveld (1972) more than any other used the term land in conjunction with landscape. As in his book on photo interpretation, he believes landscape ecology is the crucial subdivision of "landscape science". In his book of land Ecology (1995) although he describes landscape ecology, but does not seem to much differentiate between the two terms of land/ landscape. Whereas, Naveh and Lieberman's (1984, 1994) notation on "many similar studies are being carried out in the English- speaking world to which the rather vague terms environmental conservation or environmental management are sometimes given", added much to the confusion. I have so far tried to elucidate that environmental studies in most Anglo-Saxon countries are what in European countries, and later in North American countries were conceptualized as landscape ecology.

This is greatly true for those English- speaking countries which worked on detailed treatment of integrated approaches for land/ landscape evaluation, planning and design, like Australian.

They use the word land to denote the complex combined effect and interaction of climate, land form, soil and plants, which includes all characteristics important to man existence (Christian & Stewart, 1968; Stewart, 1968; Cocks & Ive, 1988) in comprehensive land use planning, or (rather recently termed) environmental planning.

However, as Richard Forman, the distinguished North American landscape ecologist, in 1998 emphasized in his opening address in Prague; landscape ecology grown as a foundation of land use planning in urban and regional planning, as well as, resource management from nature protection to soil conservation and from water resource management to forestry planning (Forman, 1999). "The remarkable results are a field where nature and culture or people and the land are analyzed together and become thoroughly entwined". He means the same thing that other English speaking scientist particularly Australian meant when they introduced the field of Environmental Studies. As Potschin (2002) put it nicely "It is hard world out there". Now let us examine these two schools of thought, in more details.

Data collection and surveying techniques

European

Bastian and Roder (2002) consider geological basis, soil, water, climate, biota, and land use as landscape characteristics (Parameters) often necessary for the assessment of landscape functions and natural potentials in landscape diagnoses (equal to land evaluation used in Anglo-Saxon countries). Here another difference between the two schools appears. Most European landscape ecologists consider both ecological and socio economic data (land use) as the land/ landscape characteristics representing the natural potential (capability). Whereas, most environmental study workers hardly ever regard socio economic land characteristics, like land use as data necessary for land ecological capability evaluation (natural potential diagnosis in European terminology). Even, earlier North American landscape ecologists separated the two sets of data (Wu & Hobbs 2002), in their data handling, and emphasized more on natural entity for a reason, which will be discussed later.

However, in the European landscape- ecological planning process much attention is paid to the vegetation as crucial characteristics of the physical environment, and vegetation map regarded as basis for landscape ecological survey representing natural potential. Since, the type of potential natural vegetation in any area is dependent upon soil factors, soil mapping is used in conjunction with vegetation mapping, particularly in Netherlands (Naveh & Liebermon, 1984, 1994), where, plant ecologist like Westhoff, Van der Maarel, and Zonneveld played major role in developing the Netherland School of landscape ecology. In Europe, considering soil catena (a natural sequence of soil) as the basis of ecological catena in landscape ecological survey could be regarded a certain make- up in terms of landscape genesis (Klink 2002b).

However, consideration of specific and relevant resource data collection and surveying techniques in Europe could be addressed more precisely, when mapping units (ecotopes, biotopes, geotopes) are discussed later.

Anglo-Saxon

Some North American landscape ecologists also emphasize on soil catena concept in understanding of resulting ecosystem and soil pattern in landscapes (Gessler *et al*., 2000). While, Forman (1995a,b) consider large natural vegetation patches and spatial arrangement of vegetation (Forman & Collinge, 1997) as having many ecological role in landscapes. Different landscapes are distinguished on the basis of physical layout and amount of landscape elements in terms of patches physical layout (Lundquist *et al.*, 2001), and landscape pattern (Forman 1995a,b). In other English- speaking countries, land form patterns as defined by land system mapping are considered as representing stable unit of landscape (Thomas, 2001), as climatic and geomorphological processes provide patterns of land form, microclimate and hydrology that direct the processes of ecological pattern creation and modification (Rollings & Brunckhorst,

1999; Bell, 2001). Patch consideration of topography, landscape structures, land cover, and human activities in ecological networking are other examples of data collection.

Landscape ecologists as shown combine the two sets of ecological and socio economic data in the process of data collection and surveying. As Wu and Hobbs (2002) summed up, landscapes (the non-linear complex systems) are composed of physical, ecological, socioeconomic and cultural patterns and processes, whose behaviour may be inherently unpredictable, because of human activities and processes. This is the reason, why environmental study workers collect, and treat the two sets of data separately, but combine them later in data synthesis (Makhdoum, 1999).

In essence, for environmental study workers or simply put, land ecologists the kinds of resource data they collect, depend on a) purpose of data collection and surveying, b) methodology and approaches used for data analysis and integration, and c) the locality of the study area (Basinski, 1985; Smith & Theberge, 1986; Domon *et al*., 1989; Davis, 1990; Obee *et al*., 1998; Makhdoum *et al*., 2007). Whereas, for landscape ecologists, it seems the a and c determine the type of resources data collection, rather b, which more or less, is generally accepted methods and principles of landscape ecology, although, it is still lacking a generally accepted conceptual and theoretical basis yet (Naveh & Lieberman, 1994; Wu & Hobbs, 2002).

However, land ecologists divide the task of data collection and surveying in two categories: 1) physical, and biological (ecological), and 2) socio economic data (Stewart, 1968; Mc Harg, 1969; Cocks, 1980, 1986; Makhdoum, 1992, 1993). Generally, data of first category consist of climate, water, land form, soil, geology, plants, animal, and habitat. Data on human resources, economic resources, and present technology and infrastructures are the principal resources of the second category, which are termed temporal variables.

It is obvious that details of resource data to be collected and surveyed are different among land ecologists working in different parts of the globe, as it is the case among landscape ecologists. For example, in U.S.A land system is divided on the basis of land geological formation, whereas in Australia, land form is the basis of land system classification (Way, 1978). Nevertheless, GIS application in data collection does not much differ between the two schools (Gable, 2002; Makhdoum et al 2007), although it was initiated in Anglo-Saxon countries (Tomlinson, 1968).

Data analysis, integration and mapping units

Land denotes a complex of attributes in a comprehensive, integrating sense, significant to man (Christian & Stewart, 1968), and landscape exhibit spatial mosaics that form a patchwork complex of varying character and scale (Mabbutt, 1968; Thomas, 2001; Sklenicka & Lhota, 2002). Many attempts have been made to analyze these complexes in order to understand their nature and determine their essential features (Naveh & Lieberman, 1994), components (Thomas 2001), or elements (Forman, 1995a; Farina, 1998; Bastian & Steinhardt, 2002; Beierkuhnlein, 2002a) to recognize and define a hierarchy among land or landscape type (Thomas, 2001). As Loffler (2002b) pointed out the spatial topological analysis within the landscape is done by mapping horizontal structures of landscape complex in to homogeneous (Martin-Duque *et al*., 2003) mapping units (LMU) (Land/ landscape Mapping Unit). These mapping units are specific land area that could be mapped to exhibit land/ landscape characteristics (Rossiter, 1996), as the definable spatial unit of the landscape complex (Loffler, 2002a).

It is the classification and integration of mapping units which greatly differentiate the two schools, in terms of definition and delineation of integrated spatial units, at any scale, that are ecologically and functionally homogeneous (Martin-Duque *et al*., 2003).

Landscape ecologists

As Loffler (2002b) pointed out "Ecotope represent the landscape sphere and its related systems of landscape complexes (ecosystem) within the topological dimension", and econ, which is the smallest mapable unit, is defined as "the spatial representative of the ecotype for

vertical landscape functioning analysis". In fact, mapping unit of landscape ecologists, as an ecologically homogeneous tract of land at the scale level, is called ecotope with a great variety of definitions between landscape ecologists in Europe and North America, and even among them (Loffler, 2002a,b), where, considerations of landscape elements/ components/ factors are concerned in data integration. One encounters terms like biotope (phytotope, zootope), pedotope, hydrotope, etc to distinguish smallest spatial units on the basis of partial landscape complexes in the chorological dimension of nano, micro, meso, and macro- ecosphere. Therefore, at scale level, the hierarchy of mapping units to represent the heterogeneity (Sklenicka & Lhota, 2002) and homogeneity of ecological variability and diversity in spatial connection could be summed up according to Table 1.

Landscape ecologists believe at topological level they can determine more freely the homogeneous tract of land, by scaling down to connectivity, and fragmentation. However, as Wu and Hobbs (2002) and Steinhardt and Volk (2003) stated scale effects are widely recognized in landscape ecology, but the main concern is how to determine appropriate scale (up or down) to address particular patterns and processes across heterogeneous landscapes.

Table 1: Hierarchy of mapping units in landscape ecology

Mapping unit	Levels	Scale
Ecoregion, Ecozone Sub zone	Global	$10^{12}<$
Macro region Meso region Micro region	Regional	10^{8}- 10^{12}
Macrochore (main landscape) Mesochore (land system) Microchore (land facet) Nano chore	Chorological	10^{4}- 10^{8}
Ecotope (site) Patch, matrix, corridor (discrete spatial connection) Mosaic pattern (sequence, process and change) Connectivity and fragmentation (spatial processes)	Topological	10^{2}- 10^{4}

After Zonneveld (1972, 1995), Forman and Gordon (1986), Forman (1995a,b, 1999), Collinge (1996), Forman and Collinge (1997), Rolling and Brunckhorst (1999), Bell (2001), Steinhardt (2002), Loffler (2002b), Barsch (2002), Beierkuhnline (2002a), Wu and Hobbs (2002), Steinhardt and Volks (2003), Kennedy *et al.,* (2006).

Environmental study workers/ Land ecologists

The first important organization to address the concept of land unit and land system (Christian, 1958; Christian & Stewart, 1968)in multidisciplinary integrated land survey for land evaluation and development in environmental studies was Australian CSIRO (Commonwealth Scientific, and Industrial Research Organization) (Naveh & Leiberman, 1984, 1994).

In this context, watershed boundaries, for having well- defined edges make up a fundamental unit for environmental studies (Lundquist *et al*., 2001). Because several contiguous land system, land forms, ecosystems (arbitrary), form a watershed (Makhdoum, 1992). So, in this school composite mapping unite (or land unit) is freely derived from watershed, land system, land form units and ecosystems, at different scale level.

However, for land ecologists the aim of classification of mapping units is to organize the complexity of earth's system into hierarchical arrangements, which facilitates their application to different scale of planning and decision- making, rather to delineate a tract of landscape into ecological- cultural mapping unit.

In this respect, the mapping unit, in this school has been named according to strategic, tactical and operational planning purposes. They have been named terrain (Stewart, 1968; Way, 1978; Mitchell, 1991), ecological, ecoregion (Bailey, 1995), biophysical (Lacate, 1969; Moss, 1975), phytogeomorphologic (Howard & Mitchell, 1985), land systems (Christian, 1958) land form (Stewart, 1968) land units (Zonneveld, 1989; Hyman & Liebowitz 2000), environmental units (Makhdoum, 1976, 1992, 2007), mapping units (Johnson *et al*., 1994), vegetation units (Sisinni & O' Hea Anderson, 1993), geometric units (Yin & Pierce, 1993), ecosystem units (Leibowitz *et a.l,* 2000), and even landscape (Mabbutt 1968), or landscape units, equal to geopedologic units (Velazquez *et a.l,* 2001). However, the hierarchy of all respected mapping units falls into categories according to Table 2.

Table 2: Hierarchy of mapping units in land ecology/ Environmental study

Mapping unit	Levels	Scale
Ecoregion- Hydrologic region, Biome, Ecological zone	National to Global	10^6- 10^8
1- Macro watershed 2- Sub- watershed 3- Landsystem, landform, ecosystem, environmental, geometric units … etc	Regional	10^4- 10^8
1- Watershed 2- Land type- water type 3- Forest habitat, etc 4- Site	Areal to Local	10^2- 10^4

After Holdridge (1947, 1967), Christian and Stewart (1968), Schwarz *et al*., (1976), Ive and Cocks (1986), Yin and Pierce (1993), Bailey (1995), Makhdoum (1976, 1992, 1993, 2007), Velazquez et al (2001), Martin- Duque *et al*., (2003). Nevertheless, some developed countries like Canada and Australia which are considered pioneers in environmental studies, along with U.S.A. and Netherlands, have developed a comprehensive mapping units for different levels. These comprehensive mapping units resulted from a long term surveying and land evaluation in their respected countries. In this regard, Canadian example is summed up in Table 3. Finally, it should be added that in some countries like England, where landforms are more flat than hilly to mountainous, grid system is mostly used (Smith, 1982; Rossiter, 1996), instead of composite mapping unit. This is also true where surface water bodies are studied, or a fuzzy application of several biomes are concerned (Makhdoum, 2002).

Table 3: Comprehensive mapping units

Mapping units	Scale
Ecoregion	1:1/000/000-1:3/000/000
Ecodistrict	1:125/000-1:500/000
Ecosection	1:50/000-1:250/000
Ecosite	1:10/000-1:50/000
Ecoelement	1:10/000-1:25/000

Source: Westman (1985).

Land evaluation and assessment

As Rossiter (1996) and, Naveh and Lieberman (1984) pointed out land evaluation practice grew out of U.S. soil conservation service, beginning with the work of Christian (1958) and Stewart (1968) in Australia. Earlier land evaluation had been largely based on soil resource practiced by European soil scientists working in agricultural division of F.A.O. (FAO, 1976). Gradually, other ecological parameters were added in the process of assessment of land performance, when the land evaluated for other uses than agriculture (Mc Harg, 1969; Whittaker, 1975; Hill. 1976; Cocks & Austin, 1978; Zonneveld, 1979). Subsequently, quantified prediction of land performance, which needs detailed models, was developed mainly by environmental study workers, working in their countries, FAO, or by scientists in ITC

(Netherlands) like professor Meijerink, who developed GIS based ILWIS system for land evaluation (Meijerink *et al*., 1988). Similarly, LUPIS was developed for multi- area suitability in Australia (Ive & Cocks, 1986; Cocks & Ive 1988). Through these type of works, environmental study workers/ land ecologists could properly and distinctively define some terminologies (Naveh & Lieberman 1984, 1994; Rossiter, 1996), for land evaluation practices, distinguishing land evaluation, land assessment, carrying capacity determination (Makhdoum, 1984), land capability evaluation, land suitability evaluation, and modeling techniques, which are classified as empirical deterministic process and stochastic process models (Makhdoum *et al*., 2007). In this context, some approaches for land evaluation have been generated (Basinski, 1985; Johnson *et al*., 1994), which are not virtually exclusive. They consist of land analogues, parametric approach, and system analysis (Makhdoum, 1992).

On the other hand, landscape ecologists, particularly, in central Europe, have not coherently developed land evaluation techniques, terminology, and practices, despite the introduction of the term potential into landscape research by German geographer Erenst Neef in the sixties (Bastian & Roder, 2002).

They usually confuse land evaluation with land diagnosis (Barsch, 2002; Haase & Haase, 2002), land carrying capacity, which is a quantitative measure, with land capability, a qualitative prognosis (Haase & Haase, 2002; Sybre, 2002), capability (natural potential) with suitability (cultural potential). As Bastian and Roder (2002) emphasized there are terminological confusion between different landscape ecology research workers, e.g. function and potential are often applied synonymously, which is not justified. Whereas, for most land ecologists, function of a unit of land, preferably ecosystem, is the resulted performance of land's structure (land ecological characteristics) induced by a natural or man made processes, and not often an inherent natural capability of the ecosystem (Nunes *et al.*, 2003).

Nevertheless, landscape ecologists are catching up environmental study workers in land evaluation practices, of landscape/land, although they are at present in par with, particularly, in modelling (Vuilleumier & Prelaz-Droux 2002; Runder *et al*., 2007), which is essential for quantitative land evaluation (Makhdoum 1993; Makhdoum *et al*., 2007)

Planning

Land evaluation is a fundamental tool for strategic land use planning (Stewart 1968; Makhdoum, 1976, 2007; Beek, 1978; Rossiter, 1996). There are more consensuses among environmental study workers for strategic land use planning in the context of regional planning, spatial planning, and recently formulated environmental planning than landscape ecologists, about the concept and procedures of land use planning. The former consider land use planning as an integration of all types of land uses (including urban and rural areas), and as a final function of any given ecosystem (Makhdoum, 1992, 1993; Rossiter, 1996; Rolling & Burnckhorst, 1999). Whereas, for most landscape ecologists, landscape planning means (Bastian, 2002; Barsch 2002) "planning for the preservation and the development of landscapes as spatial patterns of ecosystems with the aim to keep the sustainable capacity of nature to protect its scenic beauty", although, Forman and Collinge (1997), Forman (1999), Farina (1998), and Krause (2001) interpret landscape planning as a foundation of land use planning in spatial and regional planning. However landscape ecologists pay much attention to environmental protection (Beierkuhnlien, 2002b) rather to the integrated environmental development and conservation, despite their claim in meshing nature and culture (Forman 1990, 1995a), to the extent that some believe (Weiland, 2002) spatial planning and landscape planning are conflict- ridden, with environmental aspects often being disregarded in spatial planning.

Conclusion and discussion

The early development of landscape ecology occurred chiefly in 1930's in the eastern and central Europe by geographers working on land conservation, and restoration, and later on land use planning and management. In 1980's, some North American ecologists followed the European example, with emphasis on spatial heterogeneity, and its effects on ecological

processes. As Wu and Hobbs (2002) pointed out "there have been two contrasting and complementary perspectives in landscape ecology: one is more humanistic and holistic, and the other more bio- ecological and analytical".

In contrast, environmental studies/ land ecology initiated with the work of soil scientists and begun with Christian (1958) and Stewart (1968) working on land capability evaluation in Australia. Meanwhile, this school of thought also took place in Canada and later in the Netherlands and U.S.A to pursuit sustainable development.

These pursuits stems from sustainable yield principles to increase net national benefits without depletion of natural capital for facilitation of socio- economic processes. The general concept of environmental study/land ecology consists of an integrative treatment of ecological, economic, social and cultural aspects of changes in the long term.

However, both schools of thought consider the societal time and spatial uses of urban, sub-urban and rural dwelling in the context of regional/ spatial planning, or recently put environmental planning (Capon, 1992), but in different ways, terminologies, and techniques.

After working 6 month in some German, and English universities, now it is my understanding what Europeans conceptualize (except UK) as landscape ecology it is what English speaking scientists termed environmental studies in 60's and 80's. As Naveh and Lieberman (1984) in the preface of their first edition of landscape Ecology stated the "vague prefix environmental has been given" to "land and landscape appraisal" rightly show the linguistic barriers (Bastian & Steinhardt, 2002) existed between workers of these schools of thought, thinking about similar concepts (Tres & Tres, 2002). However German word for environment (umweldt) does not sufficiently implies what English- speaking reaction is to it. This is also true for some central Europeans, where they established applied landscape ecology laboratory (Pechar & Matris, 2006).

Evaluation value judgement, because of the existence of very different standards of values (Bastian, 2002) differs between and among two schools, as is mapping units, and land/ landscape elements. What Meyer (2002) believes that a landscape element may cover a polygon or share it with other elements never occurs in analysis of data for integration of mapping units among most land ecologists, for they precisely bound the natural unit with a set of exact combination of land characteristics (or elements). This is because landscape ecologists in both Europe and elsewhere integrate ecological (Natural) data and socio economic data simultaneously (Forman, 1999; Rollings & Brunckhorst, 1999; Runder *et al*., 2007). Whereas, land ecologists/ environmental study workers separate the two sets of data in land survey, analysis, and evaluation processes and integrate them in planning stages for facilitation of decision- making (Vink, 1983; Johnson *et al*., 1994; Rossiter, 1996).

Nevertheless, for landscape ecologists mapping unit is called econ to from the ecotypes. There is not yet a uniform methodology (Loffler. 2002b; Wu & Hobbs, 2002) among them, as is the case between land ecologists, who name mapping units by different precepts. But, in landscape ecology a uniformity exist for naming mapping units and its derivatives like patches, mosaic *etc*, for they believe by managing the pattern of component patch types, the cumulative patterns and processes of landscape mosaic could be managed (Lundquist *et al*., 2001).

In terms of scale, both schools deal with the scale from global (macro- scale) to site (micro-scale), but, landscape ecologists go rather further to nano-scale. (Forman, 1995a,b, 1990, 1999; Forman & Collinge 1997; Villeumier & Prelaz-Droux, 2002; Steinhardt & Volk 2003). They even work on mapping scale of larger than 1:5000 (Rutledge, 1971; Krause, 2001), which is very useful for design and implementation purposes.

Landscape ecology and environmental studies, in these days of global warming and chaotic problems of strongest extinction (Gorke, 2003) facing the environment of living and non- living entities (Ott, 2002) have gone beyond being considered merely applied science. As Naveh (2002) rightly pointed out they are now "crisis- solving- oriented science", despite their slight to major differences in a) approaches, and methodologies, b) scale, c) mapping units, d) integration and analysis principles, e) modelling, f) evaluation value judgment, and g) planning. However some landscape ecologists differentiate landscape planning and landscape ecology (Barsch

2002), to the extent that some German scientists (Breuste, 2002) formulated urban ecology as applied landscape ecology.

In the post- Rio- world of sustainable development trans-disciplinary perspectives should take environmental research or landscape ecology beyond what is geographical, ecological, or biological (Potschin, 2002). As Capon (1992) stated environmental studies is the foundation for decision- making and planning in our crisis- oriented world in tackling human affairs of a) politics, b) culture, c)industry, d)economics, and e) nature.

The future of landscape ecology should be towards spatially oriented ecology (Golley & Bellot, 1991; Wiens & Moss, 1999; Tress & Tress, 2002; Wu & Hobbs, 2002), with management process as a new planning culture (Farina, 1998; Weiland, 2002), in spite of its scientific immaturity (Wu & Hobbs, 2002), and its five key driving forces applicable to the society (Forman, 1999).

Nevertheless, socio economic processes considered in integration with landscape under study from the beginning (a major approach of landscape ecology) hinder later decision- making in understanding landscape metrics, because a sound technical and ecological understanding of those metrics is still lacking (Wu & Hobbs 2002). Whereas, later integration (a major approach of land ecology) of these two sets of data (Makhdoum 1999), permit both scientists and policy makers to grasp the meaning and outcome of integration between theory and application.

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