

Contribution of periurban forests to the viability of urban space

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INTRODUCTION

Urbanization is a worldwide phenomenon. In Greece, the process of urbanization started after the Second World War and was culminated between 1960-1970.

After 1950, due to social and economical reasons, massive emigration was observed from rural areas to the cities. All these people had to find accommodation. For this reason, houses were demolished and multi-storey buildings were erected in their places. During those days saving trees was considered to be a luxury. On the contrary, trees were the victims of urbanization in favour of asphalt and cement (Hatzistathis et al, 1999).

Nowadays in greek cities the present situation is far away from ideal. The average of open green urban spaces is very low in every greek city. Athens, the capital city of Greece has an average of 2,8 square meters open green spaces per citizen (Tsalikidis 1993, Georgiadou 1995, Papadimas 1995).

During the last years, the standard of living has been changing and people demand an increase of green spaces in urban and periurban zones. According to World Health Organization the minimum acceptable average of urban green spaces must be 8-10 square meters per citizen while at the same time a higher average of periurban green spaces is desired (periurban forests). Consequently only when the average of green spaces in the urban and periurban zones reaches 20-25 square meters per citizen we will be able to say that cities are viable and friendly.

Keeping in mind the low average of urban green spaces in the greek cities, the necessity to increase these valuable spaces in the urban and periurban zone is obvious.

The history of periurban forests in Greece

The most of the periurban forests of Greece exist during the last 40-70 years. This means that the first attempt for reforestation in areas around cities, towns and villages began before the Second World War. This attempt was interrupted for almost ten years and continued intensively during the decades of '50, '60 and '70 (Hatzistathis et al 1999).

The main purpose of creating periurban forests was the stabilization of soils and the protection of urban and other inhabited areas, facilities, public works and agricultural land against floods, because soils were extremely degraded due to overgrazing and other human activities. These forests started as protection forests and the beginning of their establishment was connected with the provision in the forest law "For protection forests" which is still in force and with an attempt to "extinguish" goats. They do not have anything to do with the national parks and other categories of protected areas for which special legislation exists, although some of them have been declared as protected. In a few cases forests were created for amenity purposes, especially around churches and monasteries. These forests are rather monotonous in appearance and very often their boundaries are straight, due to fencing for protection against grazing. This makes them seem to be imposed on the landscape (Trakolis, 1980).

The artificial periurban forests, are chiefly, pure coniferus forests composed of different pine species which are:

<i>Aegean pine</i>	<i>Pinus brutia</i>
<i>Aleppo pine</i>	<i>Pinus halepensis</i>
<i>Stone pine</i>	<i>Pinus pinea</i>
<i>Black pine</i>	<i>Pinus nigra,</i>

according to the area of the country and the vegetation zone. In many cases in combination with aegean and aleppo pine two other varieties of cypress, – the cypress variety "pyramidalis" (*Cupressus sempervirens* var. *pyramidalis*) and – the cypress variety "horizontalis" (*Cupressus sempervirens* var. *horizontalis*) have been planted too.

Those artificial forests were criticized for a long time by specialists and non-specialists chiefly for their aesthetic monotony, their attacks by the insect *Thaumetopoea pityocampa* and their vulnerability to fire.

The truth is that for the era during which they have been created, with lim-

ited, scientific knowledge and tools, it was a really important attempt.

On extremely degraded soils where every vegetation form did not exist, dense forests have been established which have seized their farther degradation, have protected settlements, infrastructural and agricultural lands from flood phenomena and have improved the local microclimate.

These pioneer forests have improved also the ecological conditions, so that afterwards more demanding ecologically and sensitive to extreme conditions forest species, would be able to grow. Nowadays scientific knowledge is developed and we must apply to these forests the suitable treatments, according to the principles of Silviculture and Landscape Planning, so that they are transformed into ecologically more stable and functional and visually more attractive.

While theoretically there is this ability, practically unfortunately, absolutely nothing is done and these valuable for the citizens forests have not received the appropriate care.

The protection measures, since many years ago were not the necessary, having as a result, many of them to be destroyed by wild fires which many times are aiming to land use changes in large areas of them.

During the last decades a lot of such damages have been observed and continuously were dramatically understood positive functions of them. During the decade of '80 the periurban forest of Kavala was destroyed by wildfire and for many years, despite of reforestation works, the streets of the city were covered by mud.

In 1997 was destroyed by wildfire the greatest part of periurban forest of Kedrinos Lofos (=Hill) of Thessaloniki. Large amounts of money have been spent on reforestation and works against floods. Fortunately no floods were observed but the city has lost the valuable services of the forest.

Reforestation works are continued until today, the microclimate of the area has noticeably changed and many years will pass until the forest is recreated.

Periurban forests of Athens were destroyed by wildfires to their greatest parts during the decades of '80 and '90 and the city has suffered from the biggest floods in the history due to destruction of Hymettus' and Penteli's forests.

During the summer of 2007 the last forests, of Hymettus, Penteli (many of them for the second time during the last years) but also the ancient fir forest of Parnitha were burnt.

As far as it concerns the change of microclimate in the general area of

Athens (Lekanopedio) the result is noticeable.

From the above it is clear that periurban forests accomplish a multiple role which is of determined importance for neighbour urban centers. This role consists of the following:

- The improvement of microclimate (air, temperature, relative humidity)
- Mitigation of the pollution of atmosphere
- Flood controls
- Benefit of recreation to citizens
- Aesthetic upgrade of periurban spaces
- Conservation of biodiversity and maintenance of ecological balance
- Saving of energy
- Environmental education and familiarization with natural environment (botanical gardens, paths, environmental education centers, view positions etc.).

Periurban forests and viability of urban spaces

Contemporary cities, due to their construction, without green spaces been planned and materials which absorb heat, have become degraded “ecosystems”.

These are characterized by a large concentration of energy demanding technical systems and energy and commodity over-consumption. As a result, the microclimate of cities and the urban environment in general, have suffered important alterations. These alterations have serious consequences on citizens’ quality of living and they concern:

- Air temperature and relative humidity
- Quality of atmospheric air
- Rainfall and flow conditions
- Atmospheric air movement
- Physico-chemical quality of soils
- Lighting and sound conditions etc.

All the above unfavorable consequences can be modified with proper use of vegetation in large expands, in and around cities by creating periurban forests or their conservation and their appropriate management when natural forests exist.

Every contemporary city should have green spaces in the largest possible rate, in order to achieve an improvement of degraded micro-climate which crushes people and reduces their organisms’ resistance.

These spaces are usually divided in three zones. The first one concerns the

urban vegetation as alleys, parks, house gardens and verandahs of contemporary residences.

The second zone, has to do with periurban forests and their beneficial protective and balancing effects, that can become for the residents, recreation grounds daily or weekly.

In the third zone, belong forests which exist in larger distances and can be visited by citizens for vacations of many days..

The second zone is the object that is going to be evolved in this unit.

The environment of a city differs, from equivalent of the countryside, in almost every parameter. This difference depends on its' size and its' construction.

Periurban forests can contribute to improve of the parameters above and turn cities into more friendly to people places. Consequently they can contribute essentially to the viability of urban spaces. The sections to which contribute periurban forests impressively are:

- Temperature and relative humidity regulation
- Air filtering (cleaning)
- Lighting conditions regulation. Anti-dazzling protection
- Noise reduction
- Flood preventing protection and enrichment of underground water.
- Radiation protection
- Aesthetic and recreational effects.
- Environmental education etc.

Temperature and relative humidity

The temperature of a city rises from the suburbs to the city about 0,5-3,0° C not only during summer but during winter too. This is due to every kind of heat emission and also to the "furrace" effect that is noticed during summer mostly, because of structure materials that absorb and emit easily heat. Relative humidity of air is usually lower in the cities due to high temperature and the elimination of rain water through drains.

Trees of periurban forests through transpiration reduce air-temperature and rise air relative humidity, while on the other hand they also absorb and reflect through their leaves a part of solar radiation. The difference between surfaces exposed to the sun and those in the shade can exceed 7° C, while from the canopy of a forest to the surface of the ground can be reduced in calm from 35° C to 23,3° C, while relative humidity can be raised from 33% to 87%. By

this way trees work as air-conditioning as according to FAO researches, in tropical areas three trees in appropriate positions around a residence, can save 10-15% of the energy necessary for air-conditioning (Polikarpou 1995).

At Nankin of China, a city of 1,5 million residents, 34 millions of trees were planted around and inside the city during the period 1950-1985 (22 trees per resident). They achieved by this way to reduce the mean summer temperature 1,8° C while they expect a temperature reduction at least in double, when trees grow in age and size (Dafis 1994).

Air filtering

The air in the cities contains large quantities of dioxide of sulphure, dioxide and monoxide of carbon, fluorine and nitrogen oxides, chlorides and ozone while the oxygen content is lower. In Athens during days with photochemical cloud episodes the oxygen content reduces from 21% to 17% (Schance 1983 from Dafis 1989). This reduction is attributed to the destruction of periurban forests and the dramatic reduction of urban vegetation.

As far as the movement of the air is concerned, tall buildings block it and reduce its' speed. Overheat of cities leads to their function as cyclones (miniatures) with the centre of the city being the centre of low pressure. The air in the centre is thinner, hotter and as a result lighter. In this way a vertical movement of air is created and an horizontal from the periphery to the centre, having as a result its recycling. If the city is surrounded by a forest this air is clean and fresh while if it is surrounded by high speed roads or industrial zones, the air contains pollutants and aggravates more the already degraded atmosphere.

Furthermore trees of periurban forests act as giant filters and retain suspending particles (dust, soot etc.). A pine tree can retain up to 40 Kg of solid particles, while broad-leaved trees up to 80 Kg. A hectare of forest can absorb and retain 250 Kg SO₂, that is to say that every tree absorbs about 300 gr.

Except the above, periurban forests, through their effect on temperature (especially during the night) they contribute to the creation of descending airstreams, through which colder masses descend from higher layers, free from pollutants. By this way the air of the city becomes cooler, and the most important cleaner. We understand therefore that periurban forests act like giant filters and trees hold with their leaves, branches and barks large amounts of suspending solid particles. For this reason it is essential that forests come in between the sources of these particles and inhabited areas. Thessaloniki is a city with large quantities of dust and soot.

For this reason the creation of a periurban forest in the west side of the city is obligatory in order these pollutants to be reduced. This forest belt is necessary for every industrial city, in order to protect the urban environment from industrial pollution.

Lighting conditions-regulation antidazzling protection

Solar radiation creates an illuminated and heating environment. In cities, smooth and shimmering surfaces and in general those which cause bright reflections constantly raise. These reflections cause various problems, from simple annoyances to accidents. During the night we have to deal with the dazzling and shimmering lights from the cars., street and resident lights and every kind of illuminated signs.

Streets which come through periurban forests protect drivers from these annoying shimmers and head-lights which disturb citizens. Trees of periurban forests along speedways protect drivers from sun effects during the morning and the afternoon.

Noise reduction

Noise pollution is a serious problem for contemporary cities. Trees through their leaves absorb sounds effectively and as a result they reduce its' volume. The closer the trees are to the source of sounds the more effective they are. Furthermore, plants create their own sounds as the rustle of leaves and birds' singing. These sounds are really pleasant and can cover the unpleasant ones.

We should therefore notify that plants while reduce noises they do not efface them. Only densely planted trees and bushes have results. Especially when they are used appropriately not only do they have a psychological effect but they also contribute to reduce noise. For this reason along ringroads through forersts, suitable bushes with branches and leaves must be densely planted too, such as "Pyracantha" (*Pyracantha coccinea*) and *Crataegus* sp., in order to reduce annoying noises and protect residents in neighbouring areas.

Flood preventing protection and enrichment of underground water

Cities do not affect rainfall. It is therefore possible that they affect rainfall quantities. This is due to the speed reduction of wind that control raining, as there is a roughness of surfaces in the cities and consequently an increased period of stay of rainbringing clouds. This explanation is doubted by many peo-

ple, but not by the fact that in the cities we have more storms and higher rain-falls. The water though, flows fast and on the surface, without being absorbed by the soil, mainly when they come from storms, which are rains of high intensity and short duration.

In this case vegetation and mainly trees, play a very important and equalizing role not only for the reduction of force and surface flow but also for the improvement of air humidity and soil moisture conditions. This role is extremely important in periurban forests which protect soil and city settlements which sometimes are built next to them. City residents many times unfortunately notice the beneficial effects of periurban forests after they are destroyed. In our country the first periurban forests was planted in order to protect settlements. These forests reduce or eliminate floods, while in parallel they contribute to the underground water enrichment. This is the reason why after the destruction of such forests serious flood damages happen.

Radiation protection

According to researches (Herbs 1965, 1968 from Dafis 1994) vast stands of trees can reduce radiation in the air. The destruction of radiation is impossible of course, therefore trees can change its' spreading. When radioactive particles are in the air, tree foliage had four times more radiation at the windward side than at the lee side. Grass and food coming from the leese side of a forest have 4/5 less concentration of radiation than those of the windward side. Even a 30-60% reduction of incoming radiation, that is possible under the protection of a forest, can protect health and life.

Aesthetic and recreational effects

Aesthetic and recreational effects of periurban forests are known since a long time ago. The first attempts of reforestation in our country started at 1930 while before, reforestations were realized by associations, civilians and rarely by the government. The purpose of these attempts was the foundation of the well-known "Forest-Parks" in villages and cities in order to enhance green spaces that were rare and their presence would give the citizens a sense of protection and health.

The principle of forest landscape planning were completely unknown. As a result, dreary, dense forests, without a variety of species were created, which in many cases destroyed the variety of characteristic topographical elements of

landscape. This technique of creation of forests around cities was not the best, but during these days was a commendable attempt. Nowadays, in order to create forests, whose purpose is the aesthetic upgrade of urban landscape and the residents' recreation, we should exploit and improve its' aesthetic characteristics, having as a basis the principles of landscape planning setting off its' dominating elements (shape, line, colour, texture) while we use its' basic factors of landscape aesthetics (contrast, succession, convergence, domination, framing, axial arrangement, balance) (Hatzistathis and Ispikoudis, 1995). Creation of proper bare spaces should also be considered, responding to certain aesthetic demands which will offer the proper ecological environment for wild animals (Hathaway 1973, Cauley and Schinner 1973). As a general principle of "duplicating nature" should be applied, although it is replaced by artificial shapes and combinations, and the creation of a mixed forest instead of a pure should be preferred.

Trees and bushes offer their own beauty in any place and they constitute aesthetic parts of our environment. They are beautiful thanks to their line, shape, colour and texture and also compose a dynamic part of landscape, by their different appearance through seasons. Trees and bushes split views, soften architectural lines, set off and complete architectural elements, unify declined elements and bring nature touch into landscape (Grey and Deneke 1978, Dafis 1994, 2001). All the above presuppose a proper use which will come through knowledge, experience and research of them by experts.

Periurban forests give the opportunity to residents to visit them daily, renewing by this way their bonds with natural environment. Citizens have the chance, in very little time to be in a clearer and calmer environment, enjoy their walk with a variety of images, fleeting or not and being physically or psychologically renewed.

For this purpose periurban forests can be better organized with proper infrastructures such as:

- Walking passages
- Open-air lunch spaces (pick nicks)
- Sites of view and wild life watching
- Playgrounds
- Cycling trucks etc.

Enviromental education

The urbanization that took place in our country during the last decades had as a result younger generations to ignore even basic physical processes. This

fact combined with the increasing environmental problems, imposes citizens and especially new generations to be environmentally educated.

For this reason, appropriate spaces must be found, where trainees, in parallel with theoretical constitution will have the chance to see different elements of natural environment but also procedures that take place in it.

Periurban forests constitute ideal places for this purpose. Parts of these forests can be formed in such way, so that they contribute to the realization of environmental education programmes. Forest sections with alterations and variety of biotopes and species in small expansions are the most appropriate.

For this reason periurban forests should be appropriately organized by necessary infrastructures as following:

- Paths of nature observation along which trainees could be informed about different flora species. (trees, bushes, mosses), biotopes, rocks, geological formations etc.
- Information centers or environmental education centers
- Botanical gardens
- View sites and observation posts, etc.

Periurban forest creation

Periurban forests may be already natural forests or artificial forests.

In the first case, natural forests are used in such way that they respond to their multiple role.

Artificial periurban forests have nothing to do with the past practices, when forests were created without a plan of landscape, so that species which are used to serve in the best way their multiple role.

During planning some basic principles must be maintained, such as:

- Periurban forests should be composed of more than one forest species. This will be the result of detailed ecological researches and landscape planning so that all species that are used will be ecologically compatible for a certain area and will give the best aesthetic and functional result.
- Periurban forest boundaries should not be straight lines but irregular in shape, adapted to the area's bas-relief, so that they seem as natural as possible.
- Various bare spaces that are necessary for wild fauna and the enhancement of biodiversity, should be irregular in shape so that they improve the landscape aesthetic.

- The remnants of natural vegetation should be utilized and incorporated in under-creation forests.
- Species that are used should be native and especially those that grow in the wider area.
- The mixture of coniferous and broadleaved trees is desirable due to different ecological demands, shape, colour, contrasts, size and texture but also ecological functions. Species related to food habits of different species of fauna should be preferred.
- During periurban forest planning, landscape elements should be elevated, such as ecological formations, rocks and other special characteristics according to the principles of designing, so that the best results arise and the natural character of the area is preserved.
- Disturbed soil surface must be covered with forest vegetation (trees and shrubs), for aesthetic and protection reasons.
- By the change of forest species, landscape's lines such as streams, watersheds etc. should be emphasized and our interventions should be incorporated in the best possible way in landscape. Furthermore they should also be emphasized and complete the aesthetic and functional role of periurban forests.
- Different cultural elements, should be incorporated in the best way to landscape, be showed and complete the aesthetic and functional role of periurban forests, Such elements can be small churches, old buildings, agricultural stone walls etc.

Periurban forests silvicultural treatment

Periurban forests treatment due to its multiple role that is supposed to accomplish, is different from other forest treatments.

The priorities of silvicultural treatment are the following:

- Constant improvement of their aesthetics and function
- Support of their protective function
- Conservation of biodiversity.
- Accomplishment of their ecological function through storing large quantities of CO₂, supporting important food chains and their balance effect on the area's microclimate.

For the achievement of all the above, the silvicultural treatment must have as aims:

- The conservation of mixed stands in groups and gaps of coniferous and broadleaved forest species in preference.
- The creation of unevenaged stands in groups and gaps
- The tending of forest stand sides for better aesthetic results
- The avoidance of clear cuts for aesthetic and ecological reasons.
- Conservation of giant trees for aesthetic and ecological reasons as they constitute real biological laboratories and impressive elements in landscape.
- The conservation of biomass of forest stands in high levels so that they constitute significant reservoirs of CO₂, contributing this way to the mitigation of the Greenhouse Effect and the climate changes in general.

Fire protection of periurban forests

Through all mentioned in the previous chapters, it is clear that periurban forests constitute valuable ecosystems which support life in urban areas.

For this reason forests must be protected in the best way, from every kind of danger, especially forest fires. Much attention is paid to this, as during the last years, and especially of the summer 2007 we watched many periurban forests of our country and particularly around the biggest cities, Athens and Thessaloniki. In 1997 the biggest part of the forest-park Kedrinos Lofos of Thessaloniki was destroyed. The forests of Lekanopedion (Attica basin) started being destroyed in the decade of '80's continued in the '90's and was almost completed this summer (2007) by the destruction of fireforest of the national Park of Parnitha, the forest of Kareia at Hymettus and the forest of Penteli.

All these happen in our country because there is not even the slightest organization in the issue of prevention of forest fires. It is worldwide known that forest fires must be prevented and faced at the time they are born, with a critical period of interference from 10 to 15 minutes. From the moment a fire extends only indirectly can we face it, by creating firebreak zones or "controlled fire". Air means help to put out forest fires but in the one hand they are not able to complete it on their own and in the other hand, their action has many restrictions (weather conditions, inability to act during the night).

It is obligatory therefore to organize a system of forest fire, emphasizing on prevention. This will be based on:

- The constant supervision of the area, by a supervising network of observation towers on a 24-hour basis, during the dangerous (xerothermic period) time which starts in our country in May and ends in October after the au-

turn rainfalls. This supervision can be supported by means of contemporary technology, but in no means should they substitute human presence. We are obliged, on this important matter to conserve double and triple safety values.

- The development of an advanced and credible system of communications, so that there is an immediate announcement and localization of every outbreak of fire. On this matter should exist at least two or more alternative systems for security reasons. For example systems of wireless communication can run at the same time, and furthermore systems of wired telephony, so that the time of fire announcement is as short as possible.
- Fire fighter teams immediate action especially trained for this purpose. After the localization and announcement of a fire, a trained team especially for this purpose will arrive on supply vehicles which carry water-reservoirs of 500-1000 litres and the appropriate equipment. This team will attempt to put out the fire while they estimate if they are in position to face the fire. Otherwise they will have to call for reinforcements while continuing to extinguish the fire. Except the above, the recent configured state imposes high measures to be taken in all levels:
 - Public services
 - Prefectural Government
 - Local Government Organizations
 - Built-up areas level
 - Personal level

Decisive role in starting and spreading fires play:

- Fuel
- Weather conditions
- Area topography.

Among these factors the only one that is possible to be transformed is fuel. For this reason forests should be properly operated in order to reduce fire risks. Through different silvicultural operations there is a possibility:

- Of partial or total remove of fuel
- Modification of fuels (chipping)
- Isolation of fuels

The organization of manpower and the prediction of essential infrastructures and means are appreciated on control level. These are following:

- Enough and well-trained personal.
- Sufficiency of any kind of equipment and means.
- Planning and organization of a developed communication system
- Planning and organization of a water intake system for the fire tenders and air means.

On the basis of all mentioned, for every periurban forest a fire protection plan must be realized annually. This is mainly based on prevention through:

- Information
- Constant vigilance (spouts)
- Water tanks and hydrants net.
- Vegetation and dry wood management.
- Fire break zones properly planned.
- Road maintenance
- Organizing of available means.

Only by this way should we fight the scourge of forest fires and protect our country's forests and natural environment in general.

CONCLUSION – PROPOSALS

Through all these mentioned, comes to light that periurban forests are real lungs of a city as they remarkably improve its' climate and constitute places of psychological uplift of motion, of playing, of calmness and relaxation.

For this reason periurban vegetation is a matter that concerns everyone. Every citizen should be aware of all its' potentials, so that with his love to greenery he contributes to the improvement of urban environment and by extension the improvement of his quality of life.

- Periurban forests are exposed to dangers and are destroyed by fires very often. Consequently they need everybody's attention, if we want them to exist and offer their valuable services.
- Every available space, no matter the owner, from the moment a long time passes should turn into a green space.
- Various authorities but citizens too must help to increase the protection of periurban forests by the method of adoption and volunteering even if through this procedure they promote themselves.
- Environmental education should start soon and proper places inside periurban forests should exist
- In every city should exist a Greenery Service that except for the care of the

already existing greenery it will also deal with the planning and maintenance of certain rules by different authorities. Furthermore, the upgrade of urban environment and by extension the citizens' quality of life will be their primary purpose.

- In the end, limits of permissible capacity of urban space should be fixed and an active policy which will have as a concern urban and periurban greenery should be legislated, for the simple reason that every urban planning change or extension is against them.

For the realization of all the above, therefore we need not only well-informed experts and authorities but also citizens (Zagas 1995).

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