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Sustainable Stream Corridors Towards a Vision of Green Infrastructure Case Study: Tehran's *Evin-Darakeh* Stream Corridor

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Abstract

The fast pace of development of Tehran (a capital city with a population of 12 million and grandiose ideas) over the last 30 years is the major cause of the deterioration of the natural environment and watershed. Stream corridors in the northern part of the city are the major areas for most of the wildlife diversity in Tehran and are easily affected by human intervention. The two major elements of the stream corridors are soil and water. If either of these is affected by human activities the ecosystem will become unhealthy and its natural balance will be unsettled. Therefore special consideration to environmental capacities is essential. This study was conceived on the basis of a phenomenological approach; an extensive literature review on the subject and the case study were also conducted. The research attempts to consider the Evin-Darakeh stream corridor as a green infrastructure by describing the benefits of green infrastructures. In order to reach this goal, planning principles for this stream corridor and the related strategies are explained.

Keywords: Green infrastructure, Stream corridor, Evin-Darakeh stream corridor, Tehran, Intermediate Technology.

رود دره‌های پایدار به سوی نگرش زیرساخت سبز (نمونه موردی: رود دره اوین - درکه، تهران)

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چکیده

شتاب رشد شهر تهران پایتختی که روزانه با حدود دوازده میلیون جمعیت و ایده‌های بلند پروازانه توسعه سر و کار دارد در طی دهه‌های اخیر موجب آسیب‌های فراوانی به محیط طبیعی از جمله مسیل‌ها شده است. رود دره‌ها در بستر کوهپایه البرز در شمال شهر تهران رابطه بین شهر و طبیعت بکر را برقرار می‌نماید و متضمن گوناگونی گونه‌های گیاهی و جانوری می‌شوند. این کیفیت با فعالیت‌ها و دخالت‌های انسان‌ها و توسعه بی‌رویه شهر در معرض خطر قرار گرفته است. دو عنصر اصلی رود دره‌ها آب و خاک هستند. اگر هر کدام از این دو عامل توسط همجواری با فعالیت‌های انسان‌ها آلوده شوند چرخه زیست‌محیطی سلامت خود و طبیعت توازن خود را از دست می‌دهند. بنابراین نیاز به بررسی و بازنگری قابلیت‌های محیطی الزامی شده تا توسعه‌ها در چارچوب پایدار شکل گیرند. پژوهش در دست تحقیقی کیفی است که بر اساس روش پدیدار شناسانه شکل گرفته است. فرآیند وسیع گردآوری ادبیات کتابخانه‌ای در حوزه‌های نظریات مطرح و اطلاعات موردی در فرآیندی تحلیلی منجر به کشف اصول و ارزش‌های زیرساخت‌های سبز گردیده‌اند. گام بعدی بررسی قابلیت‌های رود دره اوین - درکه به عنوان زیرساختی سبز برای شهر تهران است. برای دستیابی به اهداف بالا ضروری است که اصول برنامه‌ریزی این رود دره و استراتژی‌های مربوط نیز ارائه شوند.

کلمات کلیدی: زیرساخت سبز، رود دره، رود دره اوین - درکه، تهران، فن‌آوری میانی.

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Introduction

Natural features as well as infrastructural ones, such as highways, bridges and storm sewers, can create or restore a community's identity. These systems define the public realm, accentuating its unique spatial organization and delineating outdoor 'rooms' in the landscape (Morrish, 2006). On the other hand, many of the problems plaguing urban environments—polluted water, polluted air, polluted soil—can be seen as the inevitable results of paying too little attention to the evolved wisdom of the planet's ecological functions. Instead of being guided by nature, people have degraded urban habitats by ignoring basic natural processes and principles. The relationship between culture and nature for a populated city such as Tehran has a major impact in moving towards a new vision for the green infrastructure as a source of recreation. One of the most important contexts for natural infrastructures is the stream corridor which can be conserved by planting trees and creating secondary ecosystems during time in order to become a sustainable environment.

Historical points of irrigation waterways and stream corridors illustrate that there were some rules

for conserving these waterways. However, since traditional management practices lack legislation, such as guidelines and limits, it inevitably causes lots of destruction to the natural infrastructure.

It must be taken into consideration that the natural infrastructure, such as stream corridors, is more valuable in the long-run than synthetic urban infrastructures. One group of professionals working to meet this challenge in an interdisciplinary approach is that of landscape architects. This group is using new green technologies to solve these problems. Green technologies are living systems such as wetlands and greenways which are used to elevate environmental potentials and solve environmental issues. Evin-Darakeh fits into this category and, by conserving this living ecological entity, we can introduce a significant natural element to the city life.

Green technologies are a form of intermediate technology. Unlike highly engineered technologies, intermediate technologies are relatively inexpensive, require little energy and are generally easier to comprehend and use. Green technologies, such as constructed wetlands and greenways, are also sustainable or regenerative (Sabri, 1997).



Figure 1- Stream corridors, stream valley slopes and floodplain gradients influence stream corridor function (www.nrcs.usda.org).

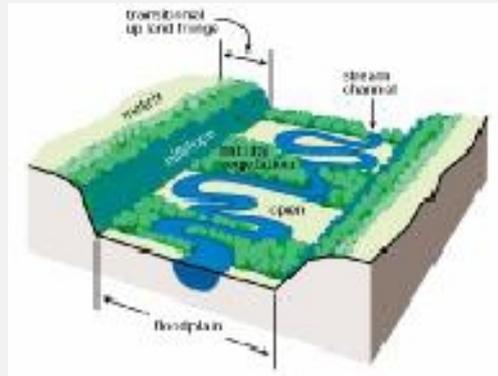


Figure 2- Components of a stream corridor (www.nrcs.usda.org).



Figure 3- Stream corridors have great economic, social, cultural and environmental value (www.nrcs.usda.org).

Discussion

Tehran's Stream Corridors

One of the ways in which Tehran, a capital city which has always been a trend setter for other cities in Iran, keeps connected to nature is via the streams that flow through the city from the Alborz mountains (Sabri and Miller, 2002). The Alborz mountain range lies to the North of Tehran while to the South, however, there is a vast desert. The streams flowing from the mountains extend the rich natural beauty found there throughout the city. There are seven of these streams and the people of Tehran not only rely upon these streams for

water, but also for recreation and a healthy relationship with nature. Without Green Infrastructure, the streams' seasonal floods cause damage in the city, the ecology is harmed by misuse of the river and the water supply is contaminated by runoff. It is imperative to preserve these ecological keystones through green infrastructure, and make a strong positive feature out of a liability and also connect Tehran's urban life to the natural wildlife of the surroundings.



Figure 4- Stream corridors that run through the city of Tehran (Makki, Sabri 2000).

Green Infrastructure: A Definition

Green infrastructure is the interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for communities and people. Green infrastructure should be planned and designed according to and be invested in following the same principles and approach that are used for the built infrastructure of roads, sewers, and utilities. Green infrastructure planning should be the first step in land use planning (Morrish, 2006). Webster’s New World Dictionary defines infrastructure as “the substructure or underlying foundation, especially the basic installations and facilities on which the continuance and growth of a community depends”. Most people associate infrastructure with roads, sewers and utility lines (the “grey” infrastructure) or hospitals, schools and prisons (the “social” infrastructure)—collectively, the “built infrastructure”. Today, people are talking about another kind of infrastructure that is critical to “the continuance and growth of a community”—namely, the “green infrastructure” (Walmsley, 2006). “Green infrastructure” has been defined as follows:

Our nation’s natural life support system—an interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and wilderness and other spaces that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality of life of America’s communities and people (Benedict and McMohan, 2002).

“Green infrastructure” is a term that describes the abundance and distribution of natural features in the landscape such as forests, wetlands, and streams. Just as built infrastructure features like roads and utilities are necessary for modern societies, green infrastructure provides the ecosystem services that are equally necessary for everyone’s well-being (Weber *et al.*, 2006).

The Value of Green Infrastructure

The conversion of natural areas, farms and other open land to urban uses has resulted in:

- loss of natural storm-water retention and flood control, resulting in flood damage;

- loss of natural filtration of pollutants resulting in contaminated air and water;
- habitat fragmentation;
- loss of biodiversity and wildlife populations; and
- disruption of larger natural landscape processes, increasing the risk of natural disasters (www.cdfinc.com).

Most land and water conservation initiatives are: reactive rather than proactive; haphazard not systematic; piecemeal not holistic; single-scale not multi-scale; and single-purpose not multi-functional. Current conservation efforts often focus on individual pieces of land, limiting their conservation benefits to the environment and human health. The Mission of Green Infrastructure is aimed at illustrating that identifying and planning for Green Infrastructure – multi-purpose green space networks - provides a framework for smart conservation and smart growth. A Green Infrastructure network can create a framework for future growth whilst also ensuring that significant natural and cultural resources will be preserved for future generations. The “storm-water management, flood control, and water quality components” are connected to the ecosystem and economic processes. The ‘watershed’ is a good planning unit through which to address Green Infrastructure’s needs. This plan for Green Infrastructure will help us identify where the best opportunity sites are for watershed Best Management Practices.

Stream Corridors

Floodplains naturally support stream corridors, which are the bands of vegetation that flank a channel or lake. Stream corridors provide important habitats; filter suspended sediments from flood waters, and uptake nutrients from shallow groundwater, leading to improved water quality. Distinct riparian vegetation zones can be identified, defined by hydrology and substrate materials, each offering a habitat for endemic

species. Floodplain water bodies, such as side channels, are commonly hot spots for biodiversity. During floods, floodplains also often serve as feeding or breeding areas for fish (www.nrcs.usda.gov).

Principles for a Sustainable Stream Corridor as an Urban Infrastructure

Identify and protect stream corridors before development. (APA, 2006). Green infrastructure and stream corridors, as a part of the landscape architecture process, need to be identified and protected in advance of land development where possible. This is due to the high cost of restoration and the difficulty of creating human-made systems that function as effectively as natural systems. Identifying where green infrastructure is needed will aid in the public and private protection of resources.

Engage diverse people and organizations in a green infrastructure initiative. To be successful, the green infrastructure initiative must excite and engage many people. It must plan and implement green infrastructure systems by involving public input and incorporating the comments and issues of citizens, community organizations, and private landowners. Green infrastructures and stream corridors can be considered as substantial elements which can create or restore community identity. In different projects, such as widening corridors or creating built infrastructures, natural infrastructures should be protected. They must be protected from drastic changes, which occur as a result of human intervention.

Emphasize that green infrastructure benefits are afforded to both nature and people. Green infrastructure provides a diversity of public and private functions and values that address both natural and human needs and benefit the environment and communities. These benefits need to be documented, both in terms of their ecological values for people and the environment and their economic values to society.

Interference along stream corridors should be

bounded. Concrete waterways, a common practice in Tehran, are not a good solution for improve the efficiency of these infrastructures. On the other hand, those contaminating functions should be eliminated from the preserved area.

Green infrastructure should be designed holistically. Like our transportation system, the green infrastructure should be designed to link diverse green space elements into a system that functions as a whole, rather than as separate, unrelated parts.

Green infrastructure should be laid out strategically. As with the electric power, communication and water systems, green infrastructure systems need to be laid out strategically to connect across multiple jurisdictions and incorporate green space elements and functions at each level of government—at state, regional, community and parcel scales.

Green infrastructure should be planned and implemented publicly. Like our built infrastructure systems, green infrastructure systems should be planned and implemented with input from and involvement of the public, including community organizations and private landowners.

Green infrastructure should be funded up front as a primary public investment. Like other infrastructure systems, green infrastructure should be funded with

other essential services, rather than using surplus money for sustainability applications, after all other services have been provided. Money for green infrastructure must be made an integral part of Tehran’s budget. In time, this system of infrastructure pays for itself, with many ecological and societal services, as well as providing other benefits which save the city money.

Green infrastructure should be the framework of conservation. Just as roads, sewer lines and other built infrastructure provide a framework for the type and location of different functional lands, green infrastructure should be the framework of conservation.

Case Study of Green Infrastructure: Tehran’s Evin-Darakeh Stream Corridor (DSC)

The Evin-Darakeh stream corridor is located in the north of Tehran. It originates in the Shahneshin mountains and passes through Evin-Darakeh district towards the South of Tehran. The planning for this green infrastructure has a great influence on the enhancement of ecological conditions.

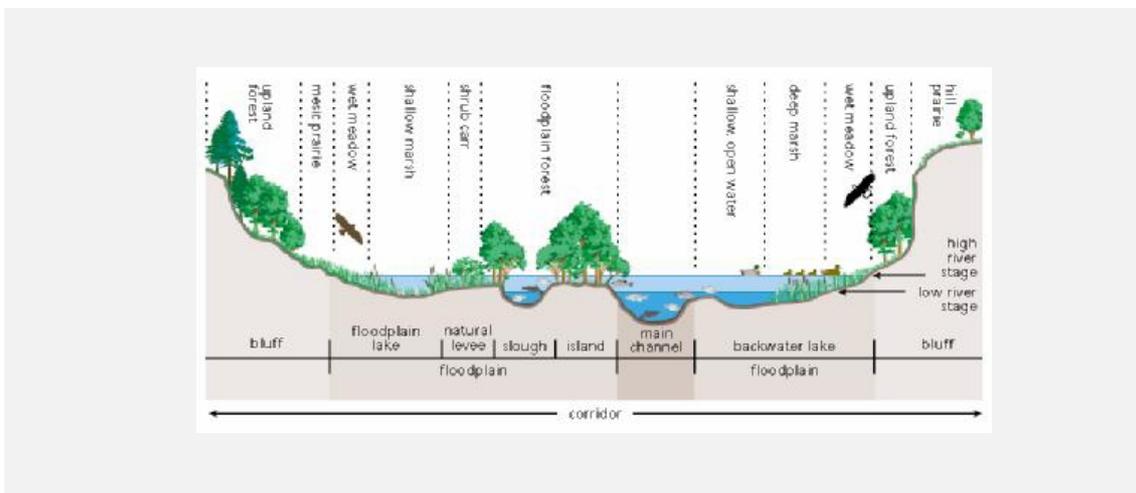


Figure 5- Cross section of a stream corridor (www.nrcs.usda.org).

Components of the Evin-Darakeh Stream Corridor

Referring to the researches on DSC, this green territory can be divided into three sections:

- 1- Evin-Darakeh stream and its green banks
- 2- Linear irrigation paths of gardens which branch from Evin-Darakeh Stream
- 3- The valuable private gardens

Each of the above mentioned components is separately an influential factor for planners.

Green Infrastructures Planning Principles for Evin-Darakeh

Conservation and control of green areas is one of the important responsibilities of urban management. Urban management is responsible for preserving natural resources as well as cultural heritage. Therefore, specific strategies for infrastructures must be collected. Below, we set out several principles for the management of green infrastructures.

Principle 1: *The role of incentives in the development of Green Infrastructure must be researched.*

There are ecological, as well as social incentives for the Green development of the Evin-Darakeh stream corridor. The relationship between public and private sectors and a full program of their collaboration towards sustainable development should be encouraged. A collaboration of these incentives is vital for the successful implementation of Green Infrastructure.

Principle 2: *Green infrastructure must be planned as integrated and joint networks.*

- Identification, categorization and evaluation of all green infrastructures
- Consideration of the hierarchy of irrigation paths and their bounds
- Providing a comprehensive plan for all of the green infrastructure networks and the preparation strategy for irrigation paths

Principle 3: *In the planning and design of infrastructure, the scale of exploitation is an important value (APA, 2006).*

- Identification and evaluation of exploiters of the infrastructure.
- Capacity evaluation of this infrastructure for local districts: region, district and city.

Principle 4: *Beneficiaries and stakeholders must be involved in the planning and execution of green infrastructure projects.*

- Organizing public meetings including all beneficiaries in order to gain their satisfaction and support.
- Training people to participate in the different steps of planning and executing of green infrastructure projects.
- Organizing a unique management to support all groups in the executing phase (APA, 2006).

Principle 5: *Pay attention to the natural resources and the ecology of the area.*

- Consideration of extending surface water via these paths.
- Preserving of the river-beds and optimizing them.
- Consideration of environmental issues related to water and waste water pollutants.
- Special consideration to the relationship of biotic to abiotic elements of nature.

Principle 6: *Conventional rules and models of water dividing must be taken into consideration.*

- Special consideration given to conventional rules of preservation, usage of irrigation paths and ownership.
- Consideration given to water division, periodic usage and comprehensive management of usage.
- Verification of conventional rules and legislation of new rules.
- Evaluation of ownership in the path direction.

- Performance evaluation of conventional rules and extracting optimized rules from them.

Principle 7: *In order to access the benefits of green infrastructures strategic planning is necessary.*

- Information collection and identification of all related components which are involved in the planning of green infrastructure.
- River path and trees must be considered as fixed elements.
- Emphasizing the recreating usage of green infrastructures.
- Paying attention to the appearance of natural environment.
- Considering the financial profits of investment in the planning.
- Creating comprehensive management for coordinated planning and their executions.
- Stating and declaring the rules of the water usage and their irrigation paths (Shoaybi, 2006).

Conclusion

With regard to the principles of green infrastructure, the protection of the Evin-Darakeh stream corridor with integration to the city of Tehran will facilitate a healthy ecosystem as well as a rich culture. Green corridors will connect the streams to the city. These corridors will not only control floods and prevent pollution and sedimentation, but will also provide clean air for the city (which has a thermal inversion layer). Green infrastructure will add value to the stream corridors by facilitating the wildlife habitat.

Considering Tehran's lack of natural recreation areas, special preservation and exploitation of environmental capacities are crucial. One of these capacities is the stream corridors in the North of Tehran which require special attention. In this research, the Evin-Darakeh stream corridor is mentioned as one of the most important stream corridors of the North of Tehran. We must emphasize

the potential of integrated and joint stream corridors in planning and design.

Some of the most crucial factors in planning for the development of this stream corridor as a green infrastructure are acknowledging stakeholders, finding the right incentives to join public and private interests, teaching all individuals involved the principles of the planning, and public participation. Taking into consideration the efficiency of traditional rules for land irrigation, it is essential that these rules be evaluated and optimized. By strategic planning for the districts and the supervision of the implementation of the entire Evin-Darakeh stream corridor as a green infrastructure, this important area of the city can become an indivisible part of Tehran's public realm.

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