ASSESSING LAND TAKE IMPLICATIONS FOR ENVIRONMENTAL JUSTICE: A CASE STUDY USING THE ECOSYSTEM SERVICES APPROACH

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Abstract
Land take is consuming a non-renewable resource and an essential one to human wellbeing?, with relevant social impacts and different implications as far as several sectors of the economy are concerned (EC, 2012). Assuming that (a) right livelihood is based on ecological balance and social justice (Shiva, 2008) land take may be considered as an unjust practice, in terms of fair share, equal opportunities, recognition and participation of present and future generations. Within the frame of the Land System Science (Verburg et al., 2013; Turner et al., 2013), the relationships between land take and environmental justice is analysed through the lens of the ecosystem services (ES) approach (MEA, 2005). ES evaluation is a challenge to be undertaken by planners (De Groot et al. 2010) because it enables the assessment of the benefits that the natural environment provides to human well-being and can help to assess environmental justice claims. A case study has been carried out for one of F *15 wards, the X Municipality, where large amount of green land was built up in recent years and more is expected in the future causing relevant impacts such as increasing flood risk, overloading of existing drainage and sewage systems, loss of agricultural land, natural area fragmentation. A GIS-based semi quantitative assessment of relevant ES has been conducted, and a number of experts (including scientists and local administrators) have been consulted to gather their views on values and responsibilities connected to land use change occurred in the area. The case study draws out lessons for an analytical framework that operationalizes the ecosystem services approach to assess environmental justice land take implications.*

1. Introduction

How to assess and manage social inequality resulting from land-use changes, in particular those produced ad consequence of land take and unequal access to ecosystem services? This is the question we are trying to answer in this paper, using ecosystem services (ES) approach (MEA, 2005) as a lens to analyse the relationships between land take and environmen evaluation is a challenge to be undertaken by planners (De Groot et al. 2010) because it enables the assessment of benefits that the natural environment provides to human well-being and can also help to assess environmental justice claims .
The X (10th) District case study was selected both because of the relevant land take acted in the area in recent years and for the expected further changes in next future. impacts such as increasing flood risk, overloading of existing drainage and sewage systems, loss of agricultural land and natural area fragmentation are increasing In the area together with land take.
The way land use changed and loss of natural soil took place in the area brought to unequal access to ES, influencing environmental conditions and causing justice concerns. The expected further transformation, planned in 2008, made the X District an interesting opportunity to analyse potential land take and ES impacts on environmental justice.

2. Background and conceptual framework

Concepts of Environmental Justice, land take, and Ecosystem Services are integrated in the proposed methodology, with the assumption that the effects of land take on ecosystem services profoundly influences environmental justice in the study area.

2.1. Environmental justice

Recognizing that a right livelihood is based on ecological balance and social justice (Shiva, 2008), there is a concern about distribution of scarce resources between present and future generations and between social classes, but also about people s capabilities to access these resources with framework of participation and democracy (Sen, 2009). In this framework, land take must be considered as an unjust practice, which relates to efficient and fair use of present resources, to the equal opportunities between present and future owners, and to a just consideration of local issues and participation of communities.

The environmental justice (EJ) is a multifaceted concept, emerged first in US in the early 1980s from environmental activism struggling against polluting facilities, and then addressing social factors like income, race and other socioeconomic variables and disparity in hazard levels and environmental quality. The EJ debate has been further developed by the political and the academic spheres, leading to a four dimension concept of Environmental inequality (OECD, 2006; UK Environment Agency, 2007; Pye et al.,2008) that are: exposure and access inequalities (distribution of environmental quality/goods); policy inequalities (effect of environmental policies); impact inequalities (different environmental impact of individuals and social groups with regard to their incomes and/or lifestyles); policy-making inequalities (access to environmental policy-making).

Integrating environmental and social initiatives at the local level, with the objective of achieving more sustainable environmental and social policies, is possible with a common objective (Pye, 2008). In these terms analysing the potential of ES scheme to address social dimension of ecosystem benefits could lead to a new synergy making environmental policies more equal.

Following the growing interest in studies addressing urban ecosystem services distribution by race, ethnicity, socioeconomic class, and other demographic characteristics and studies on social-ecological resilience and adaptive governance of ecosystem services connecting fields like ecology, planning, and law, there is a promising research area addressing the distributional impacts of providing ecosystem services and the challenges posed by pursuing environmental equity, in order to guide decision makers to equitable urban ecosystem services provision (Salzman et al. 2014). The main research questions emerging from these studies are: how to incorporate environmental equity and justice concerns into planning for ecosystem services? Should certain ecosystem services (e.g. parks and green space) be prioritized over others? How to deal with the impact of pre-existing levels of environmental inequality in a community and which inequality to address first? Which stakeholders must be involved in policy making?

In this context, several studies considering equitable environmental benefit provision, such as ecosystem services, are becoming more common and highlight some interesting research area (Ernstson, 2013).

Considering that the main issue is related to assuring environmental equity and justice in accessing ecosystem services, this paper tries to integrate land take, ecosystem services and inequality in a methodological approach that includes the quantification of land take, the assessment of land take impacts on ecosystem services, and the assessment on inequality in the case study, analysing main factors in decisional process through a network analysis, as proposed by Actor-Network Theory (Latour, 2005).

2.2. Land System Science and land take

As highlighted by the Guidelines on best practice to limit, mitigate or compen the European Commission (European Commission, 2012), soil provides a great variety of ecosystem services with direct and indirect use value for humans.

In the last few years, the increase of land take in Europe has been mainly driven by demand for industrial, commercial infrastructures, and transportation, without a direct correlation to demographic growth (Indovina, 2009). Consequently, the attention towards the land take issue has increased in the last decade, particularly at European level with the Thematic Strategy for Soil Protection (European Commission, 2006; European Commission, 2011).

In this conditions of increasing land take, the unjust social and economic effects shall be addressed by national policies particularly those dealing directly with spatial planning and land management to achieve a more efficient, sustainable and durable use of natural resources. The European Union developed a specific environmental monitoring product (i.e. Degree of Imperviousness) in the frame of the Copernicus initiative, which aims to foster the assessment of land take and urban fragmentation at regional and local level (European Commission, 2014). Moreover, the role of ecosystem services related to soil is crucial in the mitigation and adaptation to extreme events such as floods or droughts (European Commission, 2014). In fact, land cover change caused by human activities has indirect effects on climate processes (i.e. non-climatic driver) because of the role of soil in carbon fluxes and greenhouse gas emissions (IPCC, 2001).

Considering the complexity and interrelation of land cover change and environmental phenomena, this study endorses the framework of Land System Science (Verburg et al., 2013), which is a set of disciplines that aims to understand the relationship between urban development and impacts on ecosystem services. In particular, the Land System Science considers land cover change as cause and effect of climate change, which allows to analyse the interrelation between ecosystem services and adaptation in order to improve policies and planning processes (Verburg et al., 2013). In order to assess ecosystem services, land cover monitoring of urban and peri-urban areas through remote sensing can be both affordable and efficient in order to support planning processes (Maes et al., 2012; Brook and Davila, 2000), allowing the assessment of land cover change and the impacts thereof on ecosystem services (Chen, 2013). This study used a built-up map developed by ISPRA using remote sensing images and semi-automatic classification techniques.

2.3. Ecosystem services approach and methods

The role of soil in the ecosystem is fundamental because of the provided services in terms of food production, biodiversity, and sustainability (Lal, 2005). The comprehension of how the land use trend can affect the ecosystem services is an innovative tool in the planner s hands benefits that people obtain from ecosystem (MEA, 2005) can be used by the pu as an incentive to reduce the soil consumption and the urban sprawl. It should be noticed that an exclusively monetary evaluation of ecosystem services has the main risk of underestimating the natural resource values, and generate a trade based on compensation, with evident unequal effects on poor people and countries. The purpose of evaluation should be to associate a value to the soil as a resource with a unit of measure easily comprehensible by everyone in order to motivate the public opinion to avoid its uncontrolled urbanization.

In this study, we analyse two individual ecosystem service as a demonstration of the evaluation method proposed: carbon storage and habitat quality. The economic value has not been defined. It must be pointed out that crop production is the only ecosystem service with financial data available. In evaluation of the first ecosystem service, habitat quality, the average agricultural values have been linked to the land use classes to get a picture of the crop production extent in the area. Average agricultural values do not represent cost of production but the expropriation price of the land. Another ecosystem service evaluated is carbon sequestration. Ecosystems regulate the atmospheric concentrations through the carbon flows, playing a role in regulating the Earth climate. Soil ecosystems have a great carbon absorption capacity. Capturing carbon, not binding the oxygen in the atmosphere, lead to a prevention in the greenhouse gas formation such as carbon dioxide.

3. Methodology

The research focuses on land take, as one of the major drivers in reducing, unequally, the ecosystem services. Once established the linkage between ecosystem services and environmental justice, the case study analyses the land take amount, the effects on the ecosystem services and the inequalities in this situation. The target is to provide useful tools for the planner, the end user of the study.

X District was chosen because of the relevant land take in past years and for the remarkable social differences at local and urban level.

The proposed methodology used to relate Ecosystem Services of Land with Environmental Justice, implies a comparison of outcomes from a public consultation at the local level and two different environmental evaluation about land take and ecosystem services in the area. The focus is to highlight impacts of land take on environmental quality and equal distribution of ecosystem services.

3.1. Land take

To assess land take impact on environmental quality, land cover monitoring is crucial for environmental sustainability. There are several ways to monitor land cover, the use of which depending on the specific objectives and scale of the study (Verburg et al., 2013).

A key factor as far as the environmental monitoring is concerned is spatial resolution.

European Environmental Agency (EEA), in collaboration with other European and National Institutions, developed several High Resolution Layers (HRLs) in the Copernicus framework, referred to the year 2012. The main objective of HRLs is European countries land cover monitoring with a highly detailed level (20m resolution) regarding major environmental issues (i.e. soil imperviousness and natural cover such as forest, grassland, wetland, and surface water).

In Italy, ISPRA developed a monitoring network to assess land take evolution over time at national and regional level; this method has a high accuracy level , nevertheless it doesn t allow urban areas spatial analyses or cartographic representation. In this study we used a Very High Resolution Layer (VHRL) that identifies built-up areas with a spatial resolution of 5m (year 2012), this allows an accurate estimation at local level, developed by ISPRA in 2015(ISPRA, 2015).

The classification process is based on semi-automatic identification of built-up areas from satellite images (i.e. RapidEye) and the integration of local ancillary data such as OpenStreetMap enhancing the classification results and correcting omission and commission errors.

Further, a classification of 2000 has been produced by photointerpretation [1] using the 2012 classification applied to 2000 high resolution images .

It is worth mentioning that the VHRL and HRL of impervious surface have some classification differences in terms of definition: the Copernicus HRL excludes from the impervious area: railway lines, dump sites, mines, which, on the contrary, are included in the ISPRA VHRL.

3.2. Ecosystem services assessment SE

Land take affects the ecosystem services, decreasing the offered benefits and increasing natural environments degradation . To quantify the selected ecosystem services carbon storage and habitat quality it has been used the InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) evaluation software, a tools set developed by Stanford University within the Natural Capital Project. InVEST, together with a GIS software, allows to establish where the ecosystem services are provided and to quantify the variations caused by different soil uses in two different periods.

As far as Rome District X is concerned , the case study area, maps and data come mainly from the regional level ones, sometimes even national. The proposed models ideal application would require on site samplings or even more accurate studies of the selected area.

InVEST model Carbon Storage and Sequestration provides a map that links lar codifications with the sum of the carbon values of the main four natural pools: above / underground biomass, soil and dead organic matter. Working on the X Municipality, the reference values of the forest categories land use have been obtained starting from the biomass volumes charts published by the Italian Forest Inventory (Inventario Nazionale delle Foreste e dei Serbatoi For Carbonio - INFC). Once established the connections between INFC and land use categories, the pools data have been calculated through coefficients derived from scientific literature (IPCC, 2006).

As far as others land use classes are concerned (urban and agricultural) the soil s data have been obtained by matching, at national level, the land use / cover map and the SIAS map (Sviluppo

[1] Thanks go to Eng. Monica Palermini for photointerpretation and correction of the 2000 and 2012 study area VHRL .

Indicatori Ambientali sul suolo). Aboveground biomass, belowground biomass and dead organic matter values have been extracted from literature researches.
Some values (continuous urban fabric, port areas, dumpsites and building sites) were forced to zero.
The reference is Lazio Region land use map of (2003).
The second InVEST model applied to the area of interest, Habitat Quality , has While some consider biodiversity to be an ecosystem service, this model treat attribute of natural systems, with its own intrinsic value (NCP, 2014).
The test on the X Municipality has been developed with the aid of Nature s Cha 2009).
The threats analyzed, based on values extracted from bibliography (Terrado et al., 2015), are: urban zones and road net (coming from the Urban Atlas layer) and agricultural zones (from the Land Use Map of Lazio Region).

3.3. Values and responsibilities

Environmental Justice dimensions selected for the case study analysis (Beretta,2012) are:

1. Exposure and access inequalities: unequal distribution of environmental quality and natural resources availability, connected to a higher vulnerability;
2. Policy inequalities: unequal impacts of environmental policy and regulations, fiscal regulation and economic incentives;
3. Impact inequalities: unequal environmental impact from individuals and groups with different behaviour, life style, education level and different impacts of settlement models on land take and ecosystem services;
4. Policy-making inequalities: unequal access to policy making, in terms of existing and effective participation processes, , different perceptions of topic relevance an/or under representation of certain interests or groups.

These dimensions, as explained in the 2.1, are related with values and issues emerging from the case study in District X, here analysed. Relationships between land take and environmental justice in the case study are investigated trough the critical reading and network analysis of the participatory process involving citizens, public administration and other actors, through the lens of Ecosystem services.
The participatory process object of this analysis has been framed within two initiatives promoted by the City of Rome Municipality planning department, involving the Ostia X Distr March 2015):

1. the local level urban planning conferences: a cycle of public meetings that brought to a Values Charter a shared document summarizing perceived local values, pl objectives. This initiative consisted in six local conferences coordinated by the Municipality planning department and participated by an average of thirty neighbourhood committees representatives , private citizens and some cultural and environmental associations.
2. the 100Resilient Cities program, participated by Rome administration and promoted by Rockefeller Foundation. It focused on proactive and integrated strategies to face sustainability challenges, and it is aimed to allow cities to survive, adapt, and react to chronic stresses and acute shocks (environmental, social, economic). The workshops, coordinated by Rome Resilience office , involved a more complex stakeholders netwo institutional, scientific and economic level. A specific water cycle management workshop focusing even on hydraulic risk assessment (February 2015) provided information about perception of land take effects in Ostia and its inner-land.

Many authors, investigating in the last few decades how policy works and which are main factors in decisional success or failure, focused on network analysis. Actor-Network Theory, developed initially in sociology in the 1980s to study scientific practices (Latour, 2005), includes things and objects together with humans values and relations, in actor-networks able to achieve power enrolling more humans, artefacts and social arenas in their articulation. Assuming that a policy success depends

strictly on the ability to correctly understand the decisional situation and consequently strategies preventing and overcoming obstacles (Dente, 2014). Adopting conceptual frameworks to understand how public and private interests are represented and how policy decisions are taken in the decision-making process analysis is very useful. The main questions to be answered are:

- who are the actors of the process, and which is their type, including managers and scientists, the nature of their goals, which resources and abilities they have, and the decisional arena they belong to;
- how actors participate in constructing values around different and sometimes opposite resources, including ecosystem services (i.e. their role in the interaction);
- which are the connections in the network and their type of interaction: comparison, bargaining and problem solving (Richardson, 1982).

The discussion on decision making about natural resources can be divided into two views : the finding the right trade-off , on a rational and science-based solutions basis , a position we represented by PES, and the value perspective , helping to un-pack the inherent political and relational process that such problems entail. We assume that a value perspective together with a strong ecosystem services bio-physical evaluation is to be preferred, to achieve a more effective natural resources and services protection. In the given condition actor-network analysis used in our case study helps understanding structural conditions (that give shape to the network) with direct influence on decision about land take, giving analytical tools to understand why certain values (and certain ecosystem services) would be prioritized over others (Enstrom, 2013).

4. Case study findings

4.1. Rome s X District area and the environment

The X District territory lies off the GRA[2] in Rome south-western area : its borders are the sea, the river Tiber and Castel Porziano natural reserve . It is one of Rome largest and most populous areas, spreading on 150 sq. Km and with 220 thousands inhabitants, by 2012 rates. Despite that, the population density is rather low (522 per sq. Km) if compared to an average urbanized surface. The district faced a very quick urban growth, over the last 40 years. What happened led to several consequences, which affect:

- land take
- Ecosystem services (on both offer and demand)

These are the reasons why this territory is a relevant case study for this paper. The Ostia District urban development was based on extensive housing (mostly unauthorized or un-planned) [3] . This characteristic can be regarded in terms of both values and criticism with values lying in a high rate of green areas and permeable soil, as in private gardens, and criticism focused on the extensive housing itself, which means a wider land consumption than in intensive housing.

The sudden and massive urbanization brought systematic soil sealing in an area with a fragile balance on both hydraulic and hydro geological aspects. Furthermore, the building expansion itself did not mean an adequate infrastructure development, which led to a disruptive perception, that backed up criticisms perceived by the population. Free un-urbanized ground is mainly included into the Castel Porziano Natural Reserve area and along the river Tiber. Both areas represent founding values for environmental and ecological reasons.

The urban growth process in this area is grounded on historic reasons linked to the progressive development of Rome towards the sea[4]. Before that, by the end of XIX Century, a vast land

[2] Gran Raccordo Anulare , the highway surrounding the city of Rome

[3] not planned neighbourhoods cover up to 64% of the urbanised area.

[4] In the 1916 the town plan for a core residential and tourist area of Ostia has been published as a part of the Fascist program for a monumental expansion of the capital towards the sea, having the EUR district as head. This planned expansion was supported by a big infrastructure system including two main roads (Via del Mare

reclamation for agricultural use was planned and realized around Ostia. It was only by the beginning of the second half of last Century that this area faced a huge, systematic expansion, partially planned by urban plan in 1962.
In those years, most part of residential development took the typical forms of urban sprawl. This problem affected particularly the inner portion of the territory, while on the coast itself the urban development tended to be intensive and mostly planned.
The development and growth of neighbourhoods that started as unauthorized ones and later redeveloped after being regularized[5], had a huge and risky impact in land use terms: it represents half of the entire urbanized area in Ostia hinterland.
Actually, with population facing flooding hazard, that risk is considerably higher. The fact itself that the vast majority of those suburbs was built on wet-lands, with no adequate infrastructures put peoples lives at risk.
The new urban plan for Rome released in 2008, reaffirmed the greatest part of the previous program, and added some new ones, focusing on its full implementation. Similar transformation has certainly affected other Districts, but some factors are more relevant in the Ostia area because of :

- The effects of land take on hydraulic and hydro-geologic hazard
- Presence of significant environmental values and ecological potential in the surrounding area
- The present perception/awareness of land take as loss of environmental values and of an increased flood risk

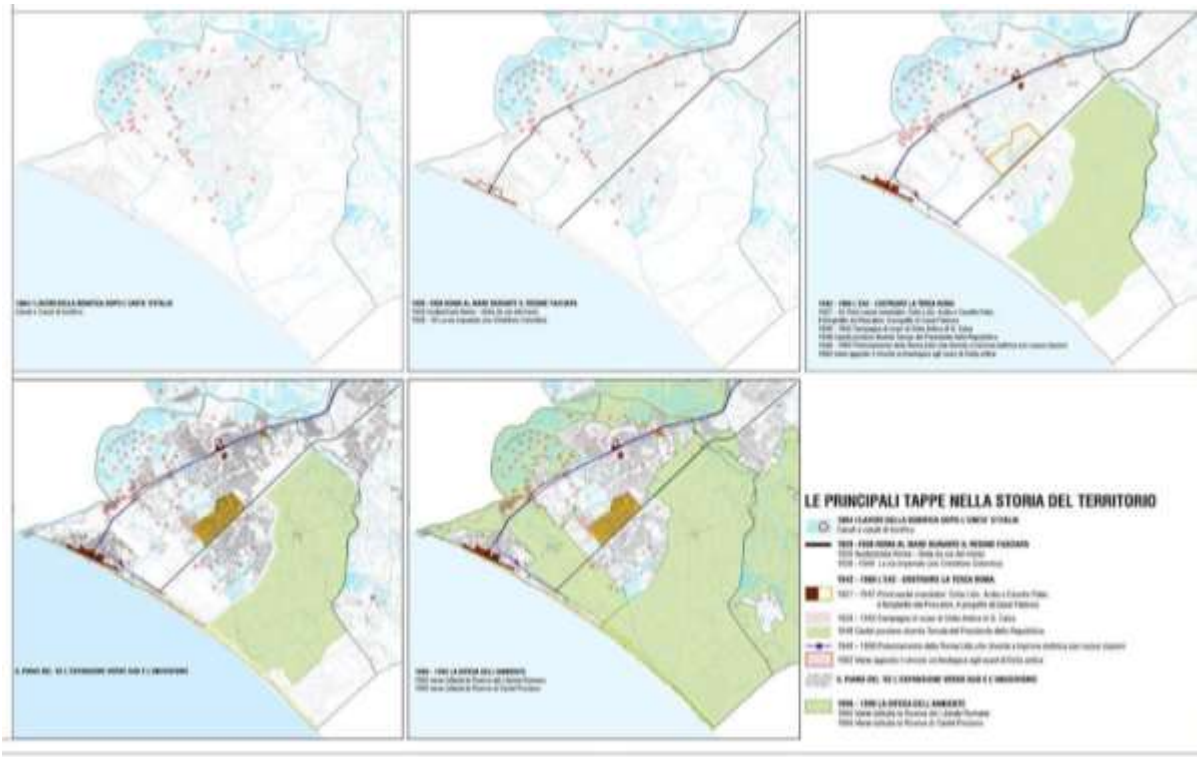

Figure.1 Trasformation process of District X

Making actual reference to the resilience concept, which goes along with ecosystem services, environmental values are recognized as structural ones for the territory. Coast, beaches with dunes, the

and Cristoforo Colombo) and the railway Roma- Lido . Nevertheless until the World War II Urbanised area was represented only by few isolated suburbs of public housing (INA Casa).
[5] A variation to the Regulatory Plan in 1978, followed by executives plans for the spontaneous areas, the so-called O-zones .

river Tiber itself along with the canalization system made for reclamation, archaeological sites and areas of private green inside neighbourhoods, are globally recognized as environmental resources, which made resilience easier and allowed to offer eco system services both in the local and extended area. The above figure (Fig.1) represent the transformation process through the years from late XIX Century up to date, and the potential further transformation in the previsions of the 2008 urban plan of Rome.

4.2. Land take and ecosystem services in the study area.

As shown also by ISPRA monitoring network, impervious surfaces in Rome remarkably increased in the last few years. The built-up area has grown from 7.1% of the 60s to 26% in 2008 (Munafò e Tombolini, 2014). The built-up surface of the Disctrict X, the case study area, has been estimated for 2012 using the Copernicus HRL, resulting in 3.410 ha, that is 22.6% of built-up in the study area.

In addition, this study used the ISPRA VHRL for 2012 producing the 2000 classification for the District X. Figure 2 illustrates the imperviousness classifications of 2000 and 2012 in the study area.

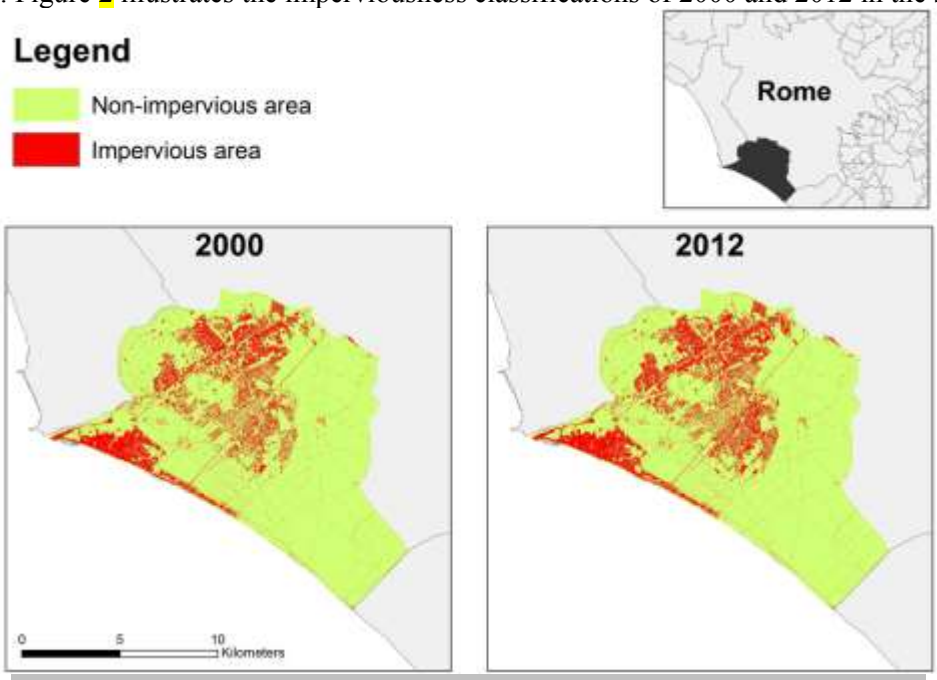

Figure 2. Imperviousness classification of X municipality for 2000 and 2012 -

The built-up surface of the Municipality for the 2012 using the ISPRA VHRL is 2.620 ha that is 17.3% of built-up in the study area. It is noticeable that spatial resolution of used data influences the estimation of impervious surface causing a difference in the two estimates of about 5%. In addition, the classification of 2000 showed that impervious surface was about 2.300 ha (15.2% of the study area). These results demonstrate an increase of impervious surface of about 300 ha in a dozen years which can be related to the urban development (both formal and informal) described in the previous paragraphs. It is remarkable that the use of the VHRL allowed for accurate estimates and facilitated the production of the 2000 classification. Therefore, this type of study could be used by local administrations to create and update a database of impervious surfaces with little effort.

In terms of ecosystem services, the presence of a forest area consisting of 6.000 hectares makes District X the most relevant carbon storage for the entire Rome area. Taking account of the agricultural zones, mainly situated in the NE and the input (minimum) coming from the medium/low built-up urban fabric, a total estimate is around 1.500.000 tons of carbon stored in the area distributed as showed in the Figure 3.

Soil consumption causes the emission of noticeable quantities of carbon from this large storage into the atmosphere, so increasing the formation of dioxide and consequent negative effects on the climate.

In Figure 3, it is shown how urbanized areas with less carbon-intensive soils than forest areas - provide a lower level of habitat quality and, at the same time, generate environmental degradation along its boundaries. As shown in lower part of Figure 4, the area includes the Castel Fusano Pine Forest and the Castelporziano Reserve, both rich of vegetation and carefully protected from the human influence. The habitat quality is at a very good level (left map), only presenting some degradation along its boundaries, affected by the considered threats (right map). As shown in the ma negative effect is maximum when a small natural area is surrounded by a built-up zone.
By matching the land use classes and the average agricultural values coming from the public chart for Lazio Region - rural area No 15 Lido di Roma (source:Agenzia delle Entrate), - a to around 220 MM has been estimated for the whole territory of District X.

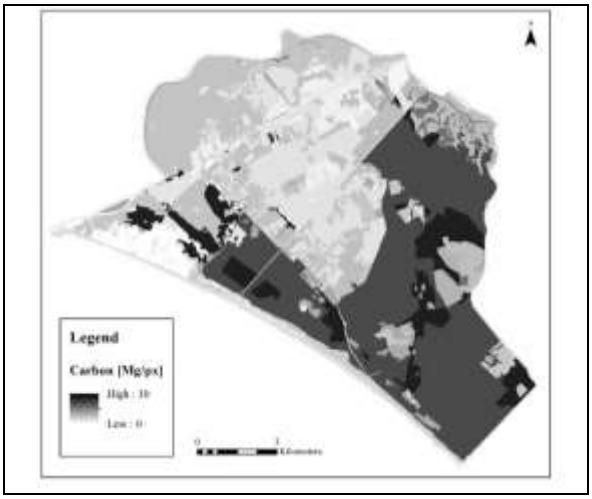

Figure 3. Carbon distribution map in the ecosystems of District X. Values in Mg/pixel (20x20 m each).

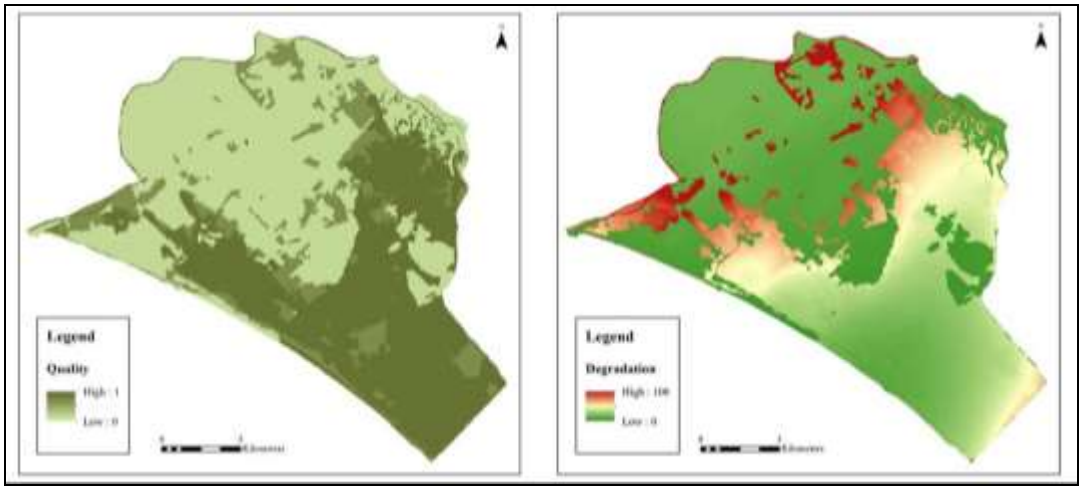

Figure 4. Habitat quality and habitat degradation maps in the District X of Rome.

4.3. Views on values and responsibilities.

In the public meetings of urban planning conferences in the District X, for the definition of a Value Charter, population interests were manly represented by neighbourhood committees, private citizens and some cultural and environmental association. The main outcome was a quest for a stop to further urbanization, and for re generation and renovation of existing structures. It is largely recognized that urbanization in Rome in the last twenty years was too much and unqualified. As a result, Rome is

actually facing lack of public services and infrastructure along with proliferation of commercial and residential buildings. In this context, the Value Charter construction process was focused on four criticalities, all relevant for land take prevention:

- flooding risk and security of buildings, especially in informal neighbourhoods grown on wet lands;
- lack of mobility infrastructure (the existing highways and railways were planned in the late 50);
- despite a grate extent of green spaces the informal settlements are not providing the necessary services to community in terms of quality of life;
- the lack of valorisations of the rich environmental, historical and archaeological heritage on the territory , represents an economic and cultural loss for community.

Land take and ecosystem services are deeply interconnected with those criticalities. Despite the role of ecosystem services had not been explained in the participation processes, the natural resources availability, including land, and the sustainability of their use was perceived like one of the principal issues that affects also life quality of inhabitants,,. The strategic role of unsealed soils in terms of environmental quality and resilience to natural risks emerged as a priority in the value charter. After years of continuous and unlimited urbanization in the area, the discussion is finally on alternative development scenarios focused on renovation and re generation.

Figure 5 Extract of value charter of District X- Objectives for the urban planning development, resulting from the participation initiatives

It must be pointed out that the stakeholder participation was not full. Stakeholders that have a very strong position in influencing land use decision, as economic actors and land owners, real estate companies, land and environmental protection public agencies, and public services managers did not participate. For that the Value Charter must be better intended as a citizen
analysis of the workshop on water cycle in District X, within the participatory process of 100 Resilient cities program in Rome and the four urban planning local conferences, was an useful tool to identify

actors to involve and values/needs and opportunities to be considered (table 2), with the aim to improve the functioning of ES and to limit land take in the area, preventing more injustice.

Table 2 the water cycle participatory process in District X -Values/needs and opportunities

Values/needs	**Opportunity**
The need for a vision for the district ;	Participatory initiatives (i.e. Contract for a water district area)
Pilot projects to help coordination and problem solving;	Rehabilitation of the Tevere river
Best practices sharing and integration of action under different policy sectors;	Research and case studies from university
Providing awareness and supporting transition;	New regulation on building sector for Rome area
Promoting new and present business sectors, including archaeology;	Awareness of citizens about natural resources values;
Training for enterprises and citizens	Coherence of plans from different level or sector
Promote networking	Overcome illegal behaviour
Overcome fragmentation in territorial management	Overcome disapplication of regulations and incoherent licencing for new buildings
Fiscal incentives for reuse, regeneration and renovation	Transition to smartness for old approach enterprises
Communication between actors;	Overcome Lack of planning
Simplified (and clear) regulation framework overcoming fragmentation of competences and responsibility;	Overcome Lack of communication, education, training about environmental matters
Usability and maintaining of public resources and spaces;	Overcome Lack of effective knowledge by decision makers
More participatory democracy in decision making;	and lack of coordination about environmental condition

The actor network scheme, focusing on land take and ecosystem services issues in X District is shown in the Figure 6, dividing actors by type (by colour of rectangle): orange for technical and operative institutions (general interests- bourocrats), blue for elective institutions (politicians bureaucrats), red for special interests actors, green for university and research bodies (experts). In the scheme we show different arenas (by colour of circle) highlighting how actors are connected to ecosystem services management.

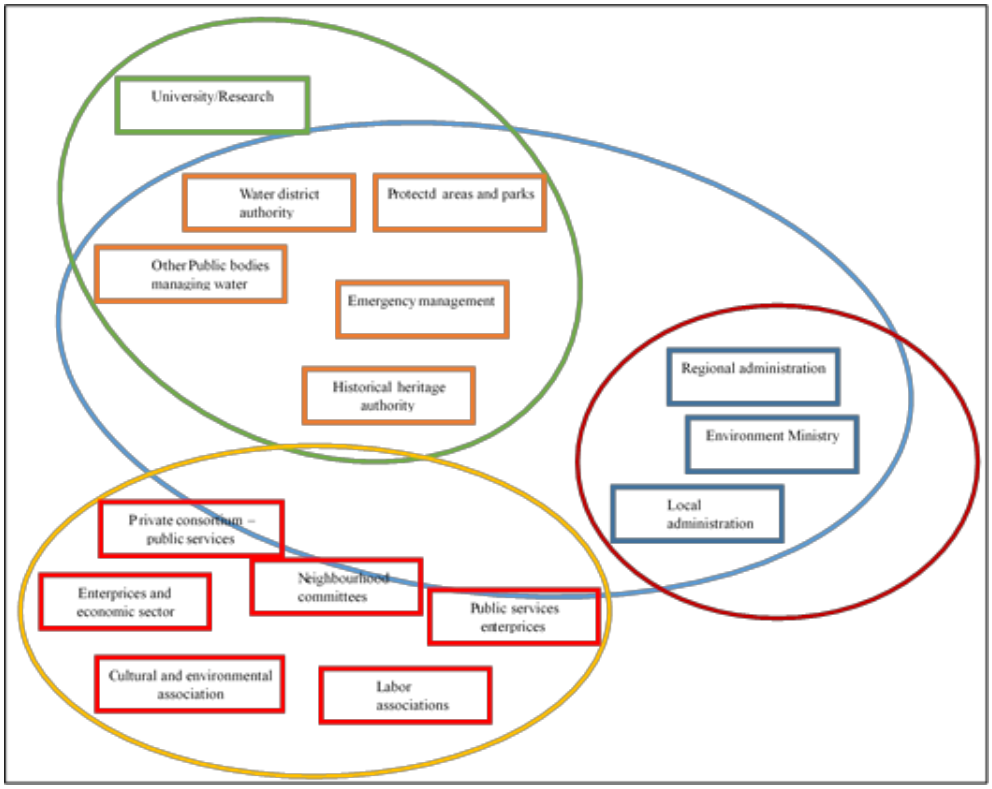

Figure 6 Distict X Actor network on land take and ecosystem services

The green circle, including research and operative institutions is involved in ES management and discussion, and offer technical competence. The dark red circle include institutional competences involved at different level depending on the regional and local policy (in the case study, institution at district and municipal level are involved, without specific regional policy). The yellow circle include social actors, with a scarce level of connection with ecosystem services at the moment. it must be pointed up that only few of these actors have direct competence on ES and that the main (perceived) problems are economic and cultural obstacles. Finally the blue circle identify those actors to involve in awareness program in the next future.

4.1. First findings from the case study

A qualitative classification (high, medium, low) of relevance of connections between ES of land and environmental justice issues is provided (Table 2), with the aim to identify more sustainable land use planning directions. The classification is based on case study results on land take, ES and citizen s values. Some of the implication for ES management, urban planning limitation are discussed.

		Dimensions of environmental justice			
Ecosystem Services		Exposure and access	Policy	Impact	Policy-making
Provisioning services	Food production				
	Non-food biomass				
	Reservoir of minerals				
	Fresh water supply				
Regulating services	Water storage				
	Run-off and flood control				
	Pollution attenuation				
	Global Climate				
	Local climate				
	Biodiversity				
	Invasive species				
	Air purification				
	Noise control				
Cultural services	Recreation /Tourism				
	Archives of human history				
	Landscape				
	Education				

Table 2. relevance of connections between ES of land and environmental justice issues

A first reading of the table shows that unequal distribution of environmental quality and natural resources, and the resulting different level of vulnerability, has a strong connection with provisioning and regulating services. An increase of ecosystem services, like food production, bio-mass and fresh water supply or runoff and flood control, help in increasing resilience at local level. Provisioning services, like the availability of food produced in agricultural areas and the access to the drinkable water, directly contribute to guarantee an essential level of social justice.

Regulation services improve the response capacity of urban settlements to mitigate effects of natural hazards linked to climate change (flood, drought). Those services have an important role in reducing environmental inequalities and have significant relationship not only with exposure and access inequalities but also the other dimensions of environmental justice (policy, impact and policy making inequalities). It must be pointed out that services as global climate, having impacts at the global level, are not directly producing inequalities. Indirect unequal effects comes from

stresses on economic systems and capacity to cope transitions produced by global change.This is the reason why we evaluate a low connection with unjust exposure or access.
As highlighted by the participatory activities, both workshops of Resilient cities program and the urban planning local conferences, cultural services have an important role for local communities and impacts on environmental justice, particularly in policy-making and participatory process.
The environmental and cultural values from Values Charter discussed above are a representation of social meaning of the ES, here connected to different justice dimensions. Cultural services (tourism, heritage, education, landscape) valorisation is directly connected to the awareness of inhabitants about environmental resources and its economical, touristic and cultural potential. Thus, working on ES awareness in local communities is also a way to promote a sustainable economic development.
This table highlights how different environmental policies influence the ecosystem services management and perception. Notwithstanding a broad regulation on environmental management at the European level, Italy still suffer from difficulties and delays in adoption of EU Directives, for example water Directive 2000/60. In this case the lack of regulation and the ineffective policy results in a unequal effects on water storage ecosystem service. Another example for Italy is the lack of effective regulation on land take, dangerous for ecosystem services produced by soil. The table offer the base for a first discussion to define tools and methodologies, with the final aim of guiding the discussion and policies on ES management, urban planning and land take limitation in a more equal way.

5. Conclusions

This research, focused on land take as one of the major driver in impoverishment of ecosystem services, tried to highlight the resulting social inequalities, in particular those produced as consequences of unequal access to ecosystem services.
As a result, it can be affirmed that there is a problem of social inequality produced by land take. There is a certain level of awareness by citizens, certainly of land take and of loss of environmental quality, less of ecosystem services values.
Environmental assessment of land take and ecosystem services and promotion of awareness must work together for the common aim of helping land planning in reducing unequal effects of land take. It must be pointed out that the choice of the two ecosystem services analysed in the case study, even partial, is specific for that area. Studies on local condition should be based on a specific selection of the proper ecosystem services to evaluate.
High resolution data used in this study of land take are a useful tool for local administration for making decision. Their free accessibility make them also a tool for population in assessing the decisions on land use and therefore foster environmental justice.

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