



# The Therapeutic Value of a Green Roof in a Prison Facility

## A Case Study in Central Italy

Francesca Piccioni<sup>1</sup>(✉), Massimo Cecchini<sup>1</sup>, Chiara Grazini<sup>2</sup>,  
and Leonardo Bianchini<sup>1</sup>

<sup>1</sup> Department of Agriculture and Forest Sciences,  
University of Tuscia, Viterbo, Italy

francesca.piccioni@unitus.it

<sup>2</sup> Department of Economics, Engineering, Society and Business Organization,  
University of Tuscia, Viterbo, Italy

**Abstract.** Does a green roof built in a penitentiary context play an important role in preserving environmental resources and naturalness, with positive effects on inmates' health and well-being? In this setting, the study aims at investigating the potential benefits of a "green roof" for the inmates of a Women's Correctional Institution in Rome, Italy, as well as demonstrating the advantages for the Public Administration: Ministry of Justice - Department of Prison Administration. Though the overall benefits could be different, from easy maintenance to environmental sustainability, from low energy consumption to safety education, from training and employment opportunities for disadvantaged women to the therapeutic impact and general well-being for the inmates, this study focuses on the last two topics. This experimentation is unprecedented and unique in Italy. A questionnaire focusing on the individual relationship with green and the potential effect on the personal well-being was administered to a specific panel of inmates, while a second questionnaire concerning the attitude towards safety and green maintenance was administered only to specially trained convicts.

Results show the significant restorative effects of larger green areas in the penitentiary, especially on some specific groups of prisoners, corroborating the hypothesis of a positive cost-benefit analysis relative to the intervention. We conclude by discussing the implications of the present study on prison design in the context of sustainability.

**Keywords:** Therapeutic green · Social workers · Penitentiary · Restorativeness · Occupational safety and health

## 1 Introduction

The aim of this research is to carry out a cost-benefit analysis for the Penitentiary Administration regarding the renovation of a prison roof with a green roof. The cost-benefit analysis, taking for certain the numerous advantages in terms of energy efficiency and increase of environmental sustainability, focuses on the assessment of the regenerative capacity of the green roof in this particular context.

Referring to the evidence of positive health effects that access to nature generates in healthcare facilities [1], and to comparative research conducted in the UK and the Nordic region that shows evidence that access to nature generates the same effects in the custodial context as are recognized in healthcare facilities [2, 3], in this paper we explore the potential increase of well-being and restorativeness obtained by the views of and access to green spaces declined as a green roof inserted in the penitentiary context.

The experimentation was conducted in the “G. Stefanini” Women’s prison House in Rebibbia, Rome, and the green roof constructed on the library building.

Firstly, the preliminary loading tests on the slab of the building were carried out; following their positive outcome, the design criteria were adopted for ease of maintenance and cost containment: hence the choice of a green roof of the extensive type.

Finally, a training was provided for ordinary maintenance of the green roof to strengthen the involvement of women prisoners in the project.

## 2 Materials and Methods

### 2.1 Study Area

Being the largest women’s prison facility in Europe, the “G. Stefanini” Women’s Prison House in Rebibbia Penitentiary Institute, Rome was selected for this case study. The director of the Institute welcomed the research project which also benefited of the prison technical staff of agronomists and of a prison farm. The prison facility is located in an urban area which proves important for visibility testing and positive effects in terms of energy efficiency. In addition, the facility is a women’s institute with a specific attention to gender. Therefore, it proved particularly suitable for the evaluation of the restorative effects of the intervention in a population subject to a high level of stress caused by imprisonment, and of the possibilities of future work reintegration. These were all key factors in the choice.

As mentioned above, the building chosen to construct the green roof was the library, both for its central position, visible from the most populated detention sections and for its symbolic value as a place of culture with a special ‘cover’ that would uniquely identify it.

### 2.2 Design of the Green Roof

The design of the green roof results from two objectives: creating a structure with a strong distinctive identity and making it easier to maintain the site. This is why the design of the central path allocates the largest surface area to the plant parts providing a single central path covered with gravel offering ready access to the cultivated parts. A curved design gave the installation an “organic” language of rupture with respect to the regularity of the surrounding buildings. The choice of the plant species has been oriented on perennial officinal herbs which, due to their robustness and rusticity only need low maintenance. Furthermore, they could be used by the Institute that is planning the creation of a laboratory for the production of essential oils in the coming future, thus achieving a virtuous path of circular economy.

The layout of the plants was carried out to produce, on a visual level, an increasing view of green volumes, with staggered blooming and different colours.

### 2.3 Green Roof Construction

Following the positive result of the load tests, the Institute requested a quotation from a company specialized in waterproofing and certified in the construction of green roofs according to UNI 11235:2015, then it directly employed the company as building contractor to do the work.

The work expected completion period was of 60 days, with the following steps: installation of an aluminium parapet to secure the site; construction works: scaffolding and delimiting areas; demolition, site clearance and transport; support preparation with self-levelling fiber-reinforced mortars; installation of a new waterproofing system with non-woven geotextile materials, synthetic PVC coating, 100% root barrier and accessories; installation of the multilayer system: water-retention and protection felt, aeration and control of the vapor flow, filter cloth and substrate according the requirements of UNI 11235:2015; formation of a gravel path confined between two drainage profiles of aluminium containment; planting of the vegetative layer: carried out by the prisoners involved in the training course.

### 2.4 Training for Workers in the Maintenance of a Green Roof

The inmates suitable for the training had specific psychological characteristics and aptitudes, and were facing long-term sentences with a planned reintegration programme. Once selected, a test was administered to verify their command of the Italian language. Twenty participants were selected to attend the 13-h classroom training, but due to the long lockdown caused by the Covid-19 pandemic, only 6 inmates completed the course. The inmates' skills and knowledge were assessed with a test consisting of 20 multiple-choice questions.

### 2.5 Data Collection

The term "Restorativeness" indicates a process of recovery of cognitive and psychological resources compared to conditions of previous mental deficit [4]. Scientific research in this area is based on Stress Recovery Theory (SRT) [5] and on Attention Restoration Theory [6]. ART suggests that some environments can encourage the regeneration of voluntary attention, thus they are defined as regenerative. According to ART a regenerative environment must be characterized by four properties: being-away, extent, fascination, and compatibility. Environments with a higher degree of naturalness generally possess all these properties and a stronger regenerative potential compared to artificial environments [7]. There is currently only one instrument suitable for measuring the regenerative qualities and potential of an environment: Perceived Restorativeness Scale [8]. Some authors evaluated the validity and reliability of the PRS [9–11]. In particular, Pasini et al. demonstrated that the "Italian version" of the PRS (PRS/IT) is reliable and can discriminate between the four environmental properties [12].

On this basis, a questionnaire of 50 questions was designed to measure the regenerative capacity of the project: the first 25 questions, investigated the profile of prisoners and their ‘green’ attitude, while the last 25 questions were structured on a 5-point Likert scale: exploring the effect of green from a physical, emotional and social point of view in the prison context and outside, including the impact of the green roof project. The paper forms were distributed to the population resident in the main sections “Camerotti” and “Cellulare”, both with direct views of the green roof: the first mainly hosts detainees waiting for the first degree of judgment, while the second one houses the inmates with a final sentence. During the survey, the Institute was accommodating 307 people, while the above Sections were hosting 113 people: the sample obtained is considered representative, being 36.81% of the total.

The risk of inaccessibility of the questionnaire was reduced by educating the inmates with greater cultural skills to help the less-skilled ones. A total of 113 questionnaires were distributed, 69 of which in the “Camerotti” and 44 in the “Cellulare” Sections; although a few people did not answer all questions, all questionnaires were considered reliable.

Based on the abridged Italian version of the PRS, 8 questions were used within the questionnaire (2 questions for each property) to obtain, from the arithmetic mean, the regenerative properties of this project: Being-Away (BAWAY), Extent (EXT), Fascination (FASC) and Compatibility (COMP). The Restorativeness variable (REST), relating to the regenerative potential of a site, was calculated as the average of the regenerative properties as suggested by several studies on the subject [13–15].

## 3 Results

### 3.1 Profile of the Interviewees and Descriptive Statistics

A total of 113 women between the ages of 20 and 60 participated in the collection of data, with an average age of 45 for Italian women and 35 for foreigners, of which 69 (61% of the total) were resident in the “Camerotti” Section and 44 (39% of the total) in the “Cellulare” Section. 54% of the total are Italian, while the rest are of 23 different nationalities. In the “Camerotti” Section, hosting detainees awaiting trial, there is a greater presence of foreigners (34% of the total sample against 13% of the “Cellulare” Section). The survey confirmed that the average age of foreign inmates is lower than that of the Italian ones, and that those awaiting trial are younger than those with final conviction. 29% of the respondents have no children and 28% have only one child. 70% of the respondents were born in a city, while only 3.5% were from the countryside; 70% did not have a family background in farming.

Considering the educational background, 35% of the sample barely completed compulsory schooling, while 7% have no qualifications at all. On the other hand, nearly 6% of the interviewed have a degree, with a predominance of foreigners. The level of schooling, as confirmed by DAP (Department of Prison Administration) statistics, is therefore rather low, reaching the middle school certificate for most of the sample.

The vast majority of the convicted declared that at the time of imprisonment they had a regular job, a lower number was either unemployed or had an undeclared job, while among the prisoners awaiting trial the most representative sample consisted of undeclared workers. By the way, the definition of “regular work” can convey a special meaning in prison, in which precariousness and marginality are normal and not exceptional [16].

In addition, the questionnaire included, a detailed item on the working situation at the time of arrest: probably, for some of the people who replied, “regular” (27%) also meant “non-criminal”. As many as 65% of the interviewed believe that they will be able to resume the job they had before entering prison, but the percentage drops dramatically when the prison sentence, or the time spent in prison exceeds 3 years, while 22% would like to be able to do so, but they think it will not be possible for them.

As for the “green” profile of the sample, intended as affinity with nature and the habit to adopt environmentally friendly behaviour, a first-rate result regarding the preferred gardening activities compared with “at home, I have” highlighted that among those who had a garden at home it was a priority to take care of the plants, followed by walking and being outdoors. Considering the whole sample, plant care totals 46% of the choices, followed by walking and being outdoors (35% of the total). “Picking flowers and fruits” has only 15% of preferences.

More than a third of the sample (35%) has neither a garden, nor a vegetable garden or potted plants at home.

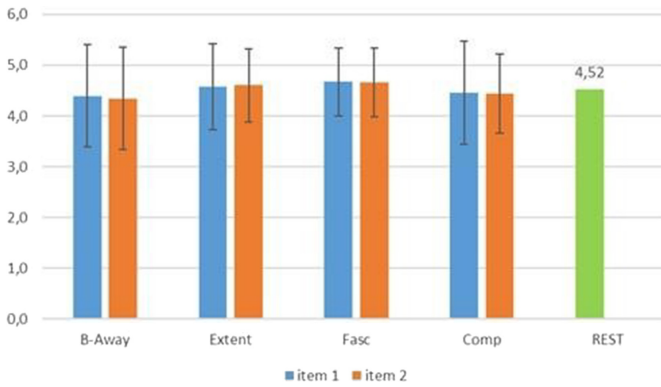
### 3.2 Evaluation of the Regenerative Capacity of the Intervention

In the current work, the regenerative capacity of the intervention was evaluated on the responding sample using the PRS on a 5-point Likert scale, from “strongly disagree” = 1 to “strongly agree” = 5. The related items of the questionnaire and the variables used are reported in Table 1.

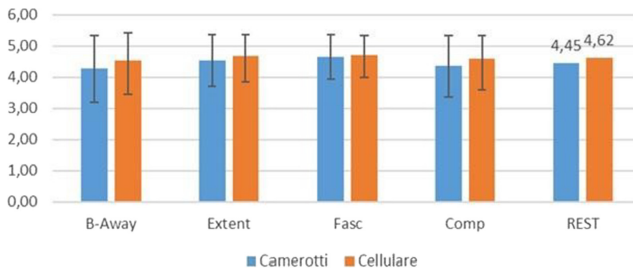
**Table 1.** Items of the survey and related regenerative properties to calculate Restorativeness

Questionnaire items	Regenerative properties
Spending time in the green gives me a break from my day-to-day routine	BAWAY_1
A green area is a place to get away from things that usually demand my attention	BAWAY_2
It seems that green sites are limitless	EXT_1
There is a clear order in the physical arrangement of the garden	EXT_2
Gardens are fascinating places	FASC_1
In a garden there is much to explore and discover	FASC_2
Being in a garden fits with my personal inclinations	COMP_1
In a garden it is easy to do what I want	COMP_2

Figure 1 shows the average values of the four environmental properties: Being Away, Fascination, Extent, Compatibility and Restorativeness (REST). The average value of REST is very high, being 4,52. In the «Cellulare» Section, hosting the convicts under a final judgement, the benefit of the intervention is greater, being 4.62 vs. 4.45 (Fig. 2).

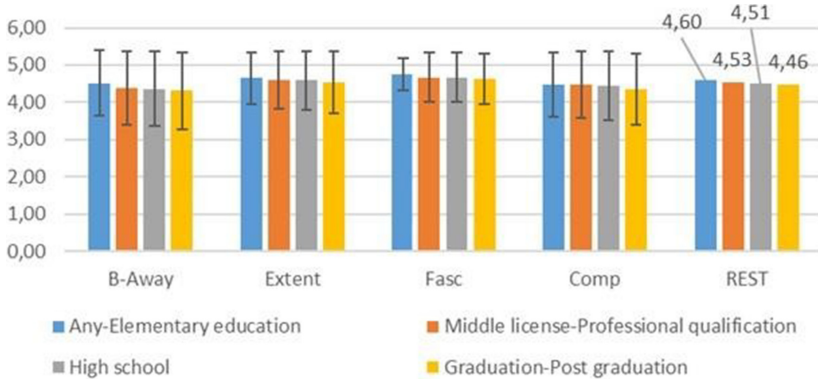


**Fig. 1.** Average values of regenerative properties and Restorativeness



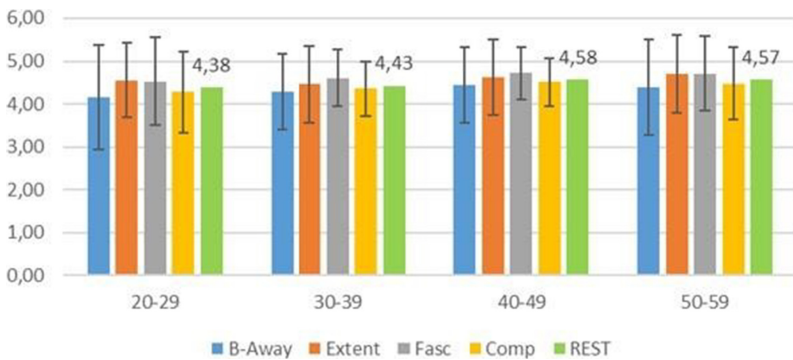
**Fig. 2.** Average values of regenerative properties and REST in the two Sections

As regards the educational background, the less educated seem to have a greater benefit: the higher value of REST for uneducated or poorly educated people being 4,6, but it decreases as the level of education increases, as shown in Fig. 3. The relationship between Restorativeness and the level of education is finally inversely proportional.



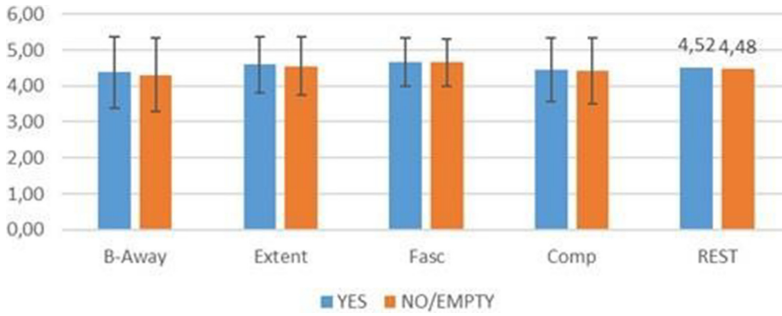
**Fig. 3.** Average values of regenerative properties and REST for levels of education

Concerning the impact of the intervention on different age groups, older women express a higher Restorativeness value: according to the percentage, the group 40–49 years is the one that benefits most from the intervention, as shown in Fig. 4.

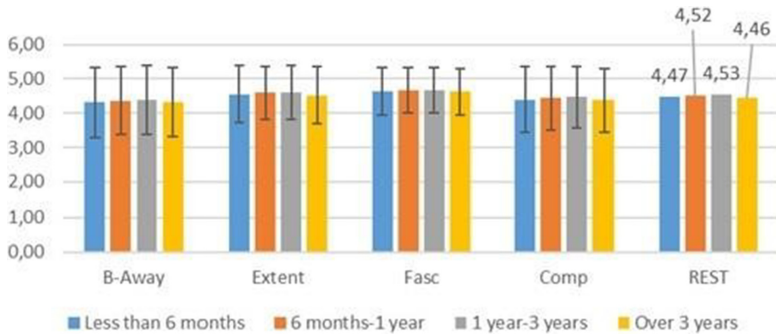


**Fig. 4.** Average values of regenerative properties and REST for each age group

As shown in Figs. 5 and 6, women who are involved in a working activity in prison and who have been detained from 1 up to 3 years are those with the highest values of Restorativeness, nearly the same as the largest group (jailed from 6 months to 1 year), this is probably related to a positive acceptance of punishment and a wish for social reintegration.



**Fig. 5.** Average values of regenerative properties and Restorativeness related to the question “current activity status”



**Fig. 6.** Average values of regenerative properties and Restorativeness related to the question “how long have you been in prison?”

## 4 Discussion and Conclusions

The first objective of this study was to assess the regenerative potential of a green roof in a prison context on the occasion of the remaking of a degraded cover. The overall results are encouraging: the average values of Restorativeness (REST) are always higher than 4. Considering that the measuring system adopted for the evaluation of the four regenerative properties is based on a five-level scoring scale (1 = strongly disagree; 5 = strongly agree) we can say that the choice of increasing the green area is, overall, highly regenerative. In the period considered, in front of a standard capacity of 268 inmates, there were, as mentioned, 307 detainees, with a relatively low overcrowding index (+15%) compared to the average of Italian Institutes, representing a medium stress factor. In the section “Cellulare”, housing mainly the prisoners with a final judgment, the benefit of the intervention was greater, which is probably due to the specificity of the place; since in the other section, “Camerotti”, where are housed the prisoners waiting for judgment, spatial and temporal perception are different. This perception translates into a different relationship with the architectural spaces, as it is



recognized that the condemned have greater need for privacy and independence, establishing a deeper and a personal connexion with the environments where they live [17]. Hence the appreciation for an intervention that, even just visually, represents an improvement in their everyday life. The level of REST is also higher among Italian women than among foreign ones: a data to be related to the larger presence of Italians in the “Cellulare” Section. The female prison population has a lower level of education than the entire prison population, and it is precisely for the less educated that the effect of regeneration is higher; this fact is confirmed in a constant higher level of regenerative property “Fascination” compared to the others; the most spontaneous approach to green and nature can indeed impose itself on rational awareness and denounce, on the other hand, on the negative phenomenon of prisoners’ infantilization. In the group of women between 40 and 60 years of age the impact of the intervention was more significant, this could be related to a greater maturity and ability to metabolize their condition, supported by the fact that the benefits appear to be greater even among people detained between one and three years; while it decreases in a period of imprisonment of more than three years, probably coinciding with the loss of hope and interest in external life in general. Higher values of REST are found in the group of women who had an occupation, which demonstrates the absolute centrality of work in terms of rehabilitation and reintegration opportunities. Results, consequently, corroborate the hypothesis of a positive cost-benefit analysis relative to the intervention as a valuable long term investment for the Department of Prison Administration. It is important to note that the period under consideration was marked by the outbreak of the Covid-19 pandemic, which inevitably conditioned the fruition and training of the prisoners about the ordinary maintenance of the green roof. It is considered that further research in this area is still needed to validate these results in other categories of prison facilities (for example, male or juvenile institutions) or to follow the evolution over time of the newly constructed green roof and the consequent attitude of the detained population.

This study, which is the result of the interaction between architects, agronomists and educators working in the difficult context of the prison administration, has provided useful information in this field of research, both in the development of study methods and because it provided applicable results in the maintenance of damaged roofs or the design of new pavilions. The designers’ awareness of the regenerative properties of green spaces, even in the penitentiary, could be an important step in the direction of urban sustainability, with the parallel non-negligible result, of the production of well-being within a population, such as that jailed, subject to strong stress, which is often cause of intemperance and self-injurious behaviour. The contradiction between the current legislation, which indicates rehabilitation as the goal of punishment, and the condition of the spaces where imprisonment is carried out, is clear. The research applied to the design of detention spaces, whether closed or open, would be useful to realize, in the places frequented daily by the detained population, the true purpose of the norm, allowing greater welfare for both the inmates and the employees in the prison administration.

## References

1. Ulrich, R.S.: View through a window may influence recovery from surgery. *Science* **224** (4647), 420–421 (1984)
2. Moran, D., Turner, J., Schliehe, A.K.: Conceptualizing the carceral in carceral geography. *Prog. Hum. Geogr.* **42**(5), 666–686 (2017)
3. Moran, D., Turner, J.: Turning over a new leaf: the health-enabling capacities of nature contact in prison. *Soc. Sci. Med.* **231**, 62–69 (2019)
4. Hartig, T., Staats, H.: Guest Editors' introduction: restorative environments. *J. Environ. Psychol.* **23**, 103–107 (2003)
5. Ulrich, R.S.: Biophilia, biophobia, and natural landscapes. *Biophilia Hypothesis* **7**, 73–137 (1993)
6. Kaplan, S.: The restorative benefits of nature: toward an integrative framework. *J. Environ. Psychol.* **15**, 169–182 (1995)
7. White, K.E.: *The Role of Nature in Physiological Recovery from Stress: A Critical Examination of Restorative Environments Theory*. Graduate Theses and Dissertations (2013)
8. Hartig, T., Korpela, K., Evans, G.W., Gärling, T.: A measure of restorative quality in environments. *Scand. Hous. Plan. Res.* **14**, 175–194 (1997)
9. Korpela, K.M., Hartig, T., Kaiser, F.G., Fuhrer, U.: Restorative experience and self-regulation in favorite places. *Environ. Behav.* **33**, 572–589 (2001)
10. Purcell, T., Peron, E., Berto, R.: Why do preferences differ between scene types? *Environ. Behav.* **33**, 93–106 (2001)
11. Purcell, A., Berto, R., Mainardi Peron, E.: Restorativeness, preference and the perceived naturalness of places. *Medio Ambiente y Comportamiento Humano* **3**, 19–34 (2002)
12. Pasini, M., Berto, R., Scopelliti, M., Carrus, G.: Measuring the restorative value of the environment: contribution to the validation of the Italian version of the perceived restorativeness scale. *Boll. di Psicol. Appl.* **257**, 3–11 (2009)
13. Berto, R.: Exposure to restorative environments helps restore attentional capacity. *J. Environ. Psychol.* **25**, 249–259 (2005)
14. Ivarsson, C.T., Hagerhall, C.M.: The perceived restorativeness of gardens – assessing the restorativeness of a mixed built and natural scene type. *Urban For. Urban Green.* **7**, 107–118 (2008)
15. Dentamaro, I., Laforteza, R., Colangelo, G., Carrus, G., Sanesi, G.: Assessing the restorative potential of different types of urban and periurban green spaces. *For. Riv. di Selvic. ed Ecol. For.* **8**, 162–178 (2011)
16. Molteni, A., Naldi, A. (a cura di): *Indagine Sulle Condizioni Sociali, Economiche e Abitative Delle Persone Detenute a Milano e Delle Loro Famiglie*. Caritas Ambrosiana, Milano (2007)
17. Giofrè, F., Posocco, P.: *Donne in carcere Ricerche e progetti per Rebibbia*. Lettera Ventidue Edizioni Srl, Siracusa (2020)