Nurturing plants in the Permaculture way:

The HortaFCUL case study.

This article was submitted and accepted for oral presentation in NutriPLANTA 2014 "XV Simpósio Luso-Espanhol de nutrição mineral das plantas (http://www.congressos.abreu.pt/Nutriplanta2014/index.htm)

Abstract

Current conventional agriculture is dominated by a linear system organization with productivity dictated by high external energy input and short-term efficiency goals. Due to the intense land and resource use, these systems have widespread environmental impacts, including soil degradation, loss of biodiversity and wildlife habitats, as well as public health threats. Therefore, there's urgency for an imperative transformative change on system-level towards agricultural sustainability.

HortaFCUL advocates the application of permaculture design principles as an appropriate framework for redesigning human food systems to achieve long-term sustainability. Following this framework, productive agriculture systems should mimic the productivity, processes, patterns and relationships of natural ecosystems. In HortaFCUL we try to discover working with, rather than against nature, through the incorporation of biological and ecological scientific knowledge. In this presentation we will show concrete examples of the application of those principles with the aim of promoting healthy plant nutrition with economic, environmental and social side effects. More specifically, we explore how permaculture systems contribute to more sustainable and resilient communities in the Faculty of Sciences of Lisbon University (FCUL), through community development processes such as relationship building, genuine participation, inclusiveness, resource mobilization and creating space for knowledge sharing.

Introduction

The Green Revolution was a turning point in terms of how agricultural systems were managed to support livelihoods through food and fibre production using an industrialized agriculture approach reliant on fossil fuels. At the time this was seen as an alternative (and superior) way to reduce famine after the Second World War economic crisis, by increasing agricultural production through the use of chemicals such as pesticides, herbicides and inorganic fertilizers (Coutts, 1997). As a result, *Millenium Ecosystem Assessment, 2005,* stated that in the last 50 years humans have more dramatically and rapidly changed the ecosystems than in any other moment of our history. Today, we are facing an exponential population growth, as well as an increase in food demand, but we are still lacking the possibility to increase arable land without further destroying natural habitats. Agriculture already covers about 38% of the Earth's terrestrial surface and uses up 70% of the global freshwater withdrawals. Moreover, the actual practices of intense farming bring along countless environmental impacts, such as soil degradation, alterations in nutrient cycles, water pollution and loss of biodiversity, with all effects together contributing 30–35% to global greenhouse gas emissions (Foley et al., 2011). Furthermore, food, drugs, fuels and all kind of natural products travel long distances to get to the consumers, which generate waste and a discrepancy in resource distribution.

Current natural resources management cannot supply our growing global demand. The challenge of reversing the ecosystems degradation, while meeting the increasing demand of services has to be achieved under alternative scenarios than the one pursued today. It needs to involve significant changes in policies, institutions and practices that are still not under way (Millenium Ecosystem Assessment, 2005). As a result of this, solutions for a sustainable food production and its fair distribution are crucial to create sustainable human populations. This is especially relevant in urban systems due to the contrast between its demand and supply of

food. The resulting food importation leads to an increased ecological footprint due to the necessity of long distance distribution.
To face these new societal challenges, several agroecological systems have been proposed and tested in cities worldwide. Some examples of these alternative approaches are organic agriculture, biodynamics, community supported agriculture, community gardens and urban permaculture. As a concrete example, “HortaFCUL” applies the permaculture principles to not only address the question of food production, but also the relations between people and the environment. It was started in 2009 on the FCUL campus by a group of students already familiar with Permaculture techniques and concepts. FCUL is more than a 100 years old and well recognized for its mission on education, research, innovation and knowledge transference in the natural and technical science areas stakeholders. Moreover, it also promotes culture production, diffusion and sharing, with strong the integration of civil society (FCUL, 2014). Within this spirit, the project HortaFCUL demonstrates how an urban food garden can look like if being built with Permaculture techniques. This is achieved by mimicking patterns found in nature in order to maximize the production of a small piece of land, keeping always in mind the aesthetic value of a campus. The project was created with the purpose of demonstrating and spreading the Permaculture concepts with “hands-on” work as well as by collaborating with the academic and social community (by workshops, talks, celebrations or even small parallel projects).

Figure 1: The landscape of the HortaFCUL project in 2010 (left) and 2013 (right).

Methods

HortaFCUL is located in FCUL, Lisbon, Portugal. With a edified area of 80 000m2, and has a staff of around 600 professors, researchers and other employees (642 in 2013), integrates around 5000 students every year (5236 in 2013) and graduates around 1300 persons per year (1352 in 2013).

HortaFCUL has 3 main infrastructures, the gardening area with around 160 m^2 size, the supporting house with 13 m^2 and the nursery with an area of 22 m^2. Currently, 14 people are actively involved (1st circle - the guardians) that have a long-term commitment with the project and are the ones responsible to make strategic decisions. There are around 25

people (2nd circle - the supporters) that come regularly to the project activities and events, but have no commitment with the project and around 100 individuals (3rd circle – the influence circle) that have joined at least one HortaFCUL activity in the past 2 years and stayed connected.

David Holmgren, one of the creators of the permaculture concept, put forward 12 fundamental design principles. The theoretical background of these ideas is heavily influenced by concepts on energy flow in ecological systems (Holmgren, 2007) from ecologist H.T. Odum, such as the maximum power principle: "[...], During self-organization, system designs develop and prevail that maximize power intake, energy transformation, and those uses that reinforce production and efficiency." (Odum, 1995). Following this reasoning, the project “HortaFCUL” tries to prevail, following the 12 principles, with the goal of setting up a permanent (agri)culture in FCUL, in the situation encountered on an academic campus with its specific resources and shortcomings. It is important to note that while each of them can and sometimes should be pursued individually, they'll only lead to a fruitful outcome if used in conjunction and being iterated various times.

Results and Discussion

1. **Observe and interact:** Our project applies zoning and species selection to certain places or areas, taking advantages of different environmental conditions along the land. For example, it was seen that the strawberries grow better in edge and marginal habitats, so this observation contributed to an interaction, represented by the replacement of all the strawberries to a marginal place. Other aspect where the project interact after observing is in the design corrections made along the time, in order to maximize efficiency and improve productivity. Every obstacle or difficulty found along the way is seen as an opportunity to learn and improve our methods and systems.

2. **Catch and store energy:** By developing systems that collect resources at peak abundance to use in times of need. In this aspect, the project tries to store sun energy through biological structures. A perfect example of this are the mulching and composting techniques that we apply. This way we can reuse the energy present in the compost or mulching to boost the fertility of the food garden soil. The architecture of our raised beds is compost and complex. The different layers of organic matter that form these raised bed enables the storage of energy and nutrients that can be quickly available to the plants.

3. **Obtain a yield:** Ensure that you are getting a useful return to the amount of input. Through the food garden, we get a small yield with the objective to be given or sold. This edible yield is consumed in some activities developed within the project, such as “Horta soup” (a soup made with vegetables harvested from the food garden) and many fairs where we have been involved. Of course that having a biological yield is important in a Permaculture design project, however, in the “HortaFCUL” project, the same importance is given to knowledge build up. The knowledge in this context can be seen as a yield that can be harvested and also consumed by all the community involved.

4. **Apply self-regulation and accept feedback**: We need to discourage inappropriate activity to ensure that systems can continue to function well. Focusing on a small number of people, there was a need to have weekly reunions to better distribute tasks in order to have a more efficient project. We have a non-hierarchical model of participation, sociodemocratic and use consese strategies to

achieve our goals. In our garden we also accept the feedback that nature gives us, as we know now that leaks and carrots do not grow yet in our soils but sunflowers, for example, grow comfortably in our area.

5. **Use and value renewable resources and services:** Make the best use of nature's abundance to reduce our consumptive behavior and dependence on non-renewable resources. In our project we use, for example, a nutrient broth based on the compost we produce to act as a biological fertilizer as well as a way to eradicate some species of plagues that naturally occur in our land. The short-term rotation of students in the project presents itself as an important renewable resource.

6. **Produce no waste:** By valuing and making use of all available, nothing goes to waste. As a team we try to take a better advantage of each resource we find, both in terms of knowledge and in terms of materials. Not only do we try to collect them (plants from the labs used for germination experiments, waste from coffee machines or simple undesired construction material) but we also give away goods that are considered a surplus (certain species we grow are used in some classes as well as plants that we give away for collaborators).

7. **Design from patterns to details**: Patterns form the backbone of our designs, with the details filled in as we go. Trying as far as possible to mimic the natural ecosystem allows us to develop, for example, dendritic shapes into the different pathways giving us a more structured network or to design particular designs such as the aromatic spiral.

8. **Integrate rather than segregate**: We embrace people from all ages and backgrounds as well as structures that serve multiple functions having a focus as a team to develop and grow our different collaborations, not only with the academy (Nutriplanta, for example) but also with different schools, workshops, artists and educational programmes.

9. **Use small and slow solutions:** To comply with this principle we use small initiatives to serve big purposes. For example, use of a donation box to collect funds, interaction with several schools in order to educate for the permaculture sustainable view. Furthermore, HortaFCUL itself is consciously a small scale project. This is, all the enrolled people are aware of all the actions taken. There is a collective and cautious future planning which enables saving effort in maintenance and management.

10. **Use and value diversity:** By adjusting the resident plant species, different fauna species are attracted. The occurrence of some insect and birds species is a powerful tool to fight pest invasions and help to pollinate crops. In this aspect, we have installed a bee hotel to attract solitary bee species and used mulching and green waste from the garden products to attract earth worms and other important soil fauna. In terms of plants, we measured a shannon index of 1.35, which is considerably high, taking into account that most agriculture systems tend to have an index around 0 (monocultures). Per m^2, we found 24 plants, of which more than 60% are edible (novembre 2014).

11. **Use edges and value the margins**: In the garden, the interface area is maximized by its elements of design. Through the construction of 5 raised-beds and a pond we more than doubled the interaction border between pathways and

planting areas from 60 to 140 m. Moreover, all the social interactions that support the project are a way of margin increase and valuation.

12. **Creatively use and respond to change**: Meetings, brainstorms, dragon dreaming or other thinking tools are used for problem solving. An example is the ecological fee ticket that was created as a way of raising awareness among drivers who parked their cars next to the garden, stepping on the plants. Another example is the integration of traditional portuguese pavement as an aesthetic response to design problems.

Figure 2: HortaFCUL social area, with the three ethics.

Conclusions

Permaculture is developing and growing at a fast pace. All over the world, new projects are popping-up every year and the number of supporters is also rising. Now that sustainability and conservation are mainstream topics, Permaculture has an opportunity to develop and grow even faster. However, Permaculture still has some obstacles in its way to a general worldwide acceptance. These obstacles are mainly the lack of scientific research in the topic and the lack of public encouragement for its practice (Scott 2010). HortaFCUL tries to help building this bridge between science and permaculture by connecting earth care with people care and fair share.

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Acknowledgments

Many thanks to all the people contributing actively to the project, supporting colleagues, and the professors that have been incentivizing it, in particular Professor Cristina Cruz.

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