

Sustainability Innovation

Sustainable Community-Firefly And Human

Jiaxin Shi, Guangdong Country Garden School

Qishen Luo, Guangdong Country Garden School

Yuan Xu, Guangdong Country Garden School

Zili Zhou, Guangdong Country Garden School

Xinyuan Ji, Guangdong Country Garden School

Yawen Tan, Guangdong Country Garden School

Kejia Zhao, Guangdong Country Garden School

Jingjing Fu, Guangdong Country Garden School

Summary

Our project is the Firefly Ecological Community.

The firefly as an indicator species is the symbol of our community, presenting our target to build the balance between the modern human life and the natural environment.

To preserve an environment clean enough to restore the firefly, we separate the problem into 5 parts: water, waste, energy, plant, and regional planning.

Identify the Challenges

1. As we employ firefly as a symbol of our ecological community, maintaining clean water environment for aquatic firefly in any time of the life cycle is going to be a challenge. According to our investigation, many communities have artificial lakes, but with lots of rainfalls in summer and sunshine after rainfall, algae explosion happens frequently. The reason is excess nitrogen and phosphorous. Algae will cover lake surface and block sunlight, so oxygen concentration in lake decreases; some of the species will release toxic chemicals. Decrease in oxygen concentration in the artificial lakes and toxic chemicals kill organism living in and cause bad smells.

2. How to operate the garbage classification and recycling better? Through the survey, many Chinese residents are not enthusiastic to the garbage classification. That is because the resources are rich in most part of China and the residents have no sense of cherishing them. Some of them may also think garbage classification is inconvenient, which is the most direct reason preventing them to do it.

3. How to balance lighting needs and ecological environment? Lighthouses and illuminated skyscrapers attract migrating birds, thousands of which crashes into them and die. Street light disorient sea turtles hatching en route to the sea as well as females seeking egg-laying sites. And fireflies, their mating signals drowned in showers of photons from a variety of human sources, disappear from the landscape. Light pollution in the form of illuminated billboard, factories, residential porch lights and street light, which are all so common in our modern community is disrupting the natural cycles and rhythms as well as the growth and development of nocturnal animals.

4. How to ensure convenient transportation without affecting the ecological environment and residents' life? Today, more and more people can purchase the private vehicles. As a result, the lack of parking, the roads, and the noise from the transportation all become serious problems for the Chinese communities.

5. As for the design of house structure, how can we maximize the utilization of solar panels without affecting the appearance and lighting? The building's external walls absorb most heat from the sun. We can utilize the wasted solar energy thus reduce pollution from the energy transformation like coal burning.

Identify a Root Cause

According to the challenges and the target, the root cause is that the present human living style and activities like driving and shower pel are always causing harmful impacts on the environment. Our ecological community targets to lead a new life style and build environment-friendly infrastructure to minimize human's impacts. In another word, the ecological community aims to fix the unbalance between the modern human life and the natural environment.

Generate Solutions

Water:

1. Conduct an experiment to find out what aquatic plants can be used to inhibit growth of Chlorella. By reviewing journals, submerged plants and emergent plants are able to inhibit growth of some algae and absorb excess nitrogen and phosphorus in water.
2. Constructing an artificial reservoir and a filtration system underground and connecting all the pipelines that collect precipitation from roofs and roads to the filtration system, so filtered water stores in reservoir. If amount of precipitation exceeds volume of reservoir, goes to municipal drainage system. The precipitation flows from roads are dirty, so has to be filtered. Filtered water stored used for supplement of firefly pool, watering and car washing. This method is simple and fast to use.
3. Construct bio swales and rain gardens next to roads that direct precipitation on roads to the firefly pool. Grass swales firstly filtrate and transport precipitation and rain gardens lower the speed of water current so that firefly pool will not be muddy. The plants in swales and rain gardens should be well selected and suitable for local climate. This method has to be well planned so is time consuming, but it also creates green spaces for residents and a more environmentally friendly community.

Waste:

PLAN 1

We can build an Automated Vacuum Waste Collection System across the whole community. We have outlets for each floor in the building, which are connected by the pneumatic tubes to an underground collection station. The collection station compacts and seals the wastes in containers. When the container is full, the waste is then transported away and emptied. The kitchen garbage is transported to the farm in the community, while others are transported to recycling plant or fuel-recovery plant. The system helps facilitate separation and recycling of waste and reduce manpower.

PLAN 2

Firstly, we make policy to encourage the residents to do garbage classification at home. We can introduce intelligent recycling bins and give a scorecard to each household. The household who appropriately classifies garbage and throws it into the matched bin can gain credit monthly, which can be used to exchange water and electricity discount.

Secondly, the classified garbage should be transported to different usages by electrical vehicles in specified recycling date: the kitchen garbage is transported to the farm of the community, which is used to compost; the harmful refuse should be transported to the specific recycling station; the other recoverable garbage is transported to the recycling plants.

PLAN 3

Firstly, we make policy to encourage the residents to do garbage classification at home. We can introduce Intelligent recycling bins and give a scorecard to each house. The household who appropriately classify garbage and throw it to matched bin can gain score weekly, which can be used to exchange Water and electricity discount. Under the bins station is a collection station, where the wastes are compacted and sealed. Then the pneumatic tubes underground transport the classified garbage to different management places: the kitchen garbage is transported to the farm of the community, which is used to compost; the harmful refuse should be transported to the specific recycling station.

3. Alternating the frequency of our current light source so it appears invisible to animals species; therefore, not disrupting their natural development. Firefly emit their own light through a chemical reaction called bioluminescence. The flash pattern of adult firefly are species-specific and are used for sexual communication to find mate. Some twilight species uses ambient light levels as cue to begin flash activity. In sites with intrusive artificial light, flash activity may be wrongly triggered and normal mating is disrupted. By finding a new light source with frequency that won't trigger this flash activity, such disruption can be averted.

4. We need to build an area where has no car can pass through it in the center of the community(or just one road in the area for emergency). In this area, people can only use Low-carbon vehicles like bike or balancing car. Outside the area were roads which car can run on it, and on either side of the road we planting shrubs in the front row and trees in the back row, and the road must be asphalt pavement, so that it can reduce the noise and the pollution. And the lake for fireflies can be build in the center where far from the road and in the center of the area.

5. Firstly, solar water heater is used on the roof to directly convert light energy and improve utilization efficiency. Secondly, a retractable structure is used to connect the solar panels on the Windows, which can be used as a curtain to shade the sun, and the position of the panels can be changed to absorb more sunlight when the sun is at its strongest.(similar to the sunshade in the first row of the car)

Identify the Criteria

Waste management level: Does it recycle, reuse, or reduce the waste efficiently?
Does it release pollutants?

Community engagement: Does it educate residents about sustainable development? Does it involve the residents in environmental protection?

Habitat Invasiveness: Will it destroy the terrain? Does it introduce alien species that disrupt local ecosystems?

Natural resource utilization: Does it preserve and utilize the natural services? Does it have the highest generation level? Does it use renewable sources?

Feasibility: cost? Facilities maintenance? Durability?

 [Criteria](#)

Evaluate the Solutions

As shown in the document.

 [Evaluation sheet](#)

Make an Action Plan

As shown in the accessory.

 Waste- Action Plan

 Water- Action Plan

Prototype and Test

| Prototype Design

This part is absent or not available temporarily.

| Feedbacks learnt from users

As shown in the accessory.

 Waste- feedback

 Water- Test and Feedback

| Improvement for next iteration

 Water- improvement

 Waste- improvement

Team Credits

Shi Jiabin

She is responsible for the research of the waste sector of the sustainable community. She did lots of research about past and modern approaches to recycle solid waste and methods for liquid waste fermentation. So she concludes the advantages of past and modern approaches to make a new plan for our sustainable community. She always engages in group meetings and listens to others.

FU JINGJING

I am responsible for the water sector of the sustainable community, including water recycle and filtration system, bioswales, rainwater gardens, and environmental friendly roads. I arrange the information and articles in order and share with my team members.

I am responsible for the experiment about inhibition effect on chlorella growth of *Iris pseudacorus* L. and *Hydrilla verticillata*. The result of the experiment shows that alive *Iris pseudacorus* L. has the best inhibition effect of chlorella growth.

Judge Comments

" General comment: The focus on the firefly was on the one hand a very good metaphor, but on the other hand, your research is very broad and does not converge well with such a focus. From the presentation, it seems that you have been trying to do a lot of research on composting, however, this unfortunately did not come back well in the report and presentation.

Comment on the report: Many challenges are named, and they are kept as general that the research project is rather broad, e.g. also the root causes are kept rather general and do not clearly relate to the firefly, which is the focus of the presentation. Accordingly, the focus of the solutions part is not clear neither, although it clearly builds up on the rather general challenges. As the solutions cover a variety of aspects, and the criteria are rather specific, some of the criteria cannot be applied well to certain solutions. Why would one want to assess recycling bins against habitat invasiveness? Evaluation criteria should help to shed light on a solution, but in the case at hand, criteria can only tell us something about a limited number of solutions.

Comment on presentation: The motivation for the research is well introduced. The focus on the firefly as an indicator species is further explained after one of the judges asks for further clarification, i.e. because the firefly is more vulnerable. This focus however is only maintained in the oral presentation, and does not come back as much in the slides. Therefore, the solution does not necessarily follow from the problem analysis. Part of the ppts could not be presented due to time constraints. Time management is important for a presentation. "

" What you have been able to accomplish in the time you had to do this project is very commendable. Congratulations! The design shows clarity of thought as well as an overall understanding of broad sustainable principles. I encourage your team to take this further and work to accelerate scientifically sound community led initiatives at habitat restoration.

I am including some suggestions and points for your team to consider as you (hopefully) take this forward

- (i) A systematic description of how the indicator species was chosen would help most readers. Ideally, this would involve some secondary research (with citations) of common indicator species and the decision making criteria on why and how you selected the one for your needs
- (ii) While the breadth of your understanding of issues surrounding renewable energy and urban transport were highlighted in the project, the localized

interaction of these areas with the firefly habitat would be minimal. Stepping away, any sustainable effort helps the planet overall. But I think for a project like yours, it is best to start broadly and drill down to the details/solutions at the habitat restoration level.

The questions are - How is the habitat now? How should it look? What needs to change to get there?

(iii) Bring in cost components and social acceptance related considerations into the study as you go forward

Again, great work on this project and I hope your team takes this forward.

"