Local/Regional
Economic Health Attribute

Garden Workbook:

Climate &
Sustainability
Alliance

AMERICAN PUBLIC GARDENS ASSOCIATION

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Introduction

The Climate Adaptation & Risk Management attribute focuses on adapting to rapidly changing ecosystems. Higher temperatures, changing landscapes, rising seas, increased risk of drought, fire and flood, stronger storms with greater storm damage, increased heat-related illness and disease and higher economic losses are all directly related to climate change. Climate Adaptation & Risk Management will not prevent the effects of climate change, but can drastically reduce the impacts upon people, valuable infrastructure, and plant collections.

Increasingly, science and historical trends are able to illuminate the causal relationship between climate change and increased intensity and frequency of disasters. These trends coupled with site-specific data can provide gardens with insights on potential impacts to specific buildings, transportation route disruptions, and landscape devastation. Resilience planning can be hard to justify, particularly when changes may be gradual, but necessary now that numerous gardens and communities have been affected by climate change.

This document lists the goals and key performance indicators that have been identified as standards for gardens to better address this attribute in their policy and practice. Please refer to this document as a workbook for what items gardens should try to prioritize (as it makes sense for your gardens needs).

United Nations Sustainable Development Goals

The Public Gardens Sustainability Index is intended to share examples of how gardens are contributing to specific SDG goals and to inspire gardens to advance their own garden programs to further the mission of their institution while connecting to local, national, and global sustainability efforts. This Index is a first step guide on how to "get started" with implementing the Sustainable Development Goals (SDGs) from 2015. It aims to help gardens of all sizes and governance models understand the SDG Agenda, to start an inclusive dialogue on SDG implementation, and to prepare SDG-based local or national development strategies (or align existing plans and strategies with the goals).

Preparing for climate change is one of the most important things a garden can do to safeguard plant collections and people from hazards. The ability of a garden to anticipate, adapt, and flourish in the face of climate change will help preserve plant species.

Impacts of Climate Change

01

Phenological Mismatch

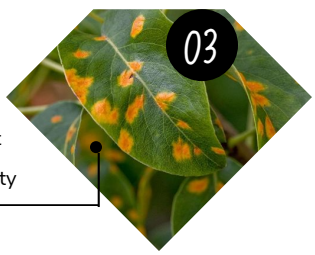
There is a concern that climate change may cause some plants to bloom when pollinators are not present, particularly in the early blooming season. This is known as *phenological* mismatch.

02

Food Security

Wheat, oats, and barley are some of the grains that provide a majority of calories in diets worldwide. More research is needed to fully understand the effect climate change has on these plants that we rely on for survival and well-being.

03



Disease

Many studies have shown that climate change is responsible for increased plant susceptibility to diseases and pests.

04

Habitat & Extinction

More and more research is being conducted on the impact climate change will have on wildlife and their traditional habit and some of our oldest and rarest plant species. The UN estimates 1 million species of plants and animals at risk for extinction due to climate change.

05

Natural Disasters

The number of natural disasters per year is increasing and every public garden needs to be prepared to safeguard valued plants, infrastructure, and buildings (especially historic landscapes).

06

Urban Sprawl

Due to the growth of the human population and cities across the world (urban sprawl), there has been a depletion of vital natural resources like water and an increase in GHG emissions, making public gardens all the more valuable as centers for educating and protecting plants.

Other Examples of Climate Change in North America

Mexico reported its third warmest year in its 48-year record, and Alaska reported its second warmest in its 94-year record.

On April 14–15, 2018, 1,262 mm of rain was recorded at Waipā Gardens (Kauai), Hawaii, setting a new U.S. record for 24-hour precipitation.

There were 14 weather and climate events during the year that each caused over $1 billion (U.S. dollars) in damages—the fourth highest in terms of cost since records began in 1980.

Climate Goal 1: Assess short and long term climate related threats to people, plants, and infrastructure through plans or policies.

Key Performance Indicator (KPI)

a. Garden makes written and organizational commitment to address climate change in plans or policies.

b. Garden annually assesses core assets and creates a ranking system and timeline for determining most and least threatened to climate change.

c. Garden tracks and benchmarks progress of climate adaptation and mitigation strategies.

Outcomes

a. Garden has a strategic plan or mission related directives that factor in climate change over the next decades, updates existing or creates new policies, garden success strategy/master plan, and operations/facilities plans to include climate preparation and adaption strategies.

b. Garden has added climate change into the regular review process for living collections, building, and other infrastructure property to determine most vulnerable to climate stressors.

c. Garden tracks invasive plant, pests, disease manifestations, loss of biodiversity, signficant changes to natural areas, GHG emissions from garden activities, and energy/water usage on site.

Suggested Strategies

Foster collaboration between plant records and horticulture staff, scientific experts, and outside consultants to develop appropriate policy guidelines and decision frameworks that are designed to anticipate changes 15 years into the future and beyond. When creating plans and policies, keep in mind SDG 13 (Climate Action) and the associated targets and indicators for 2030 (Climate.1.a).

Monitor phenology (timing of life cycle events such as first leaf and first flower) of targeted plant species for protection against climate stressors. Collect data for visual modeling purposes and analysis and inform the public about the effects of climate change on plants. Collecting data on phenology also serves an inclusive and educational purpose engaging those in your region to participate in citizen science projects such as the USA National Phenology Networks (Climate.1.c).

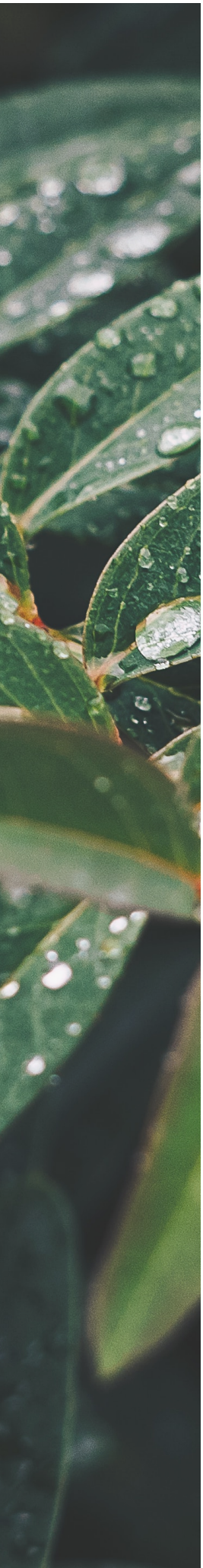
Join external pledges, plans, or movements for a more sustainable future. For example, many cities have Climate Adaption Plans that your garden can look to as a resource and find ways to contribute to. Publicly report progress and actions through various platforms and collaborate with your local government to advance best practices in sustainability and climate action (Climate.1.c).

Think about how your garden can redesign or build greener infrastructure that is more climate resilient: green walls, permeable surfaces, green roofs, stronger and more efficient pipelines, and other engineering strategies that can more efficiently use energy, materials, and water (Climate.1.b).

Strategy In Action

San Luis Obispo Botanica Gardens (SLOBG) partnered with Cuesta College to design and build a structure meeting LEEDs (Leadership in Energy and Design) Gold Standards. It minimizes the carbon footprint of the SLOBG using the least possible energy with 85% of the heating and 95% of the cooling accomplished without using any external energy sources. The building is constructed out of rice straw bales covered in stucco, which keep the heat inside during the winter and capture the cool air in the summer.

Seed banking and collections networking is an excellent long-term conservation method for plant species that are susceptible to climate change. Compile information for rare plant species in threatened natural communities and develop adaptation plans that include seed bank repository collection and registry of living collections for documentation (Climate.1.c).



Climate Goal 2: Build adaptation strategies that address collections, design, maintenance, interpretation, programming, and training.

Key Performance Indicator (KPI)

a. Garden consults or collaborates with others to learn, apply, and align climate change adaptation strategies to reduce carbon footprint and improve operations

b. Garden devotes resources (staff and budget) to ensure core assets are safeguarded from climate change.

c. Garden plant collections are prioritized, managed, and safeguarded in anticipation of climate change.

d. Garden educates the public on climate change impacts through programming, interpretative elements, and landscape designs.

Outcomes

a. Garden consults federal branches (FEMA, NOAA, USDA, etc.), local colleges/universities, other peer gardens, non-profits, or businesses for climate preparedness and adaptation resources and tools.

b. Garden staff have received training to maintain and monitor plants/infrastructure threatened by climate change and engage donors/members to improve resilience. Garden invests in infrastructure, insurance coverage, and software/database tools for climate resilience.

c. Identify highest value plant collections, list and label high priority collections so staff know which to prioritize, incorporate climate change into long-term planning for collections, propagate high priority taxa and accessions, and preserve highest value genetic resources through seed banking.

d. Garden has climate change focused demonstration garden or educational exhibit, communicate climate stressors/strategies to visitors, and has workshops/events to talk about climate impacts on community.

Suggested Strategies

Designated staff members or volunteers can record weather data for educational and research purposes. There are a variety of methods to collect informative weather pattern data: installing weather stations, micro-stations, sensors, working with NOAA and your state climatologist on utilizing the latest technology, partnering with climate science departments at your local universities, etc. This data can inform horticultural management strategies, enhance record keeping, and facilitate comparisons with field observations. This information is highly valuable for both mapping climate patterns over time and for locating areas of the landscape where planting specific plant species improves their chances of survival (Climate.2.a).

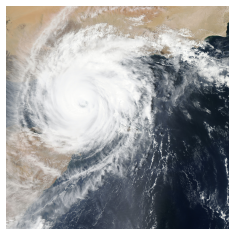
Form strategic partnerships with outside experts, relevant plant societies, and other public gardens to maximize plant collection climate adaptation strategies and ensure their longevity (Climate.2.a).

Build, maintain, and design plant collections and infrastructure with climate adaptation in mind. Start by ranking the sensitivity of your assets as high, medium, or low. This could include a rare and historic plant collection that's irreplaceable or an historic sculpture or building that cannot be restored if damaged. Evaluate the risk climate poses to your most vulnerable assets. Ensure that your garden assets are appraised and covered by an insurance plan (Climate.2.b).

Climate Goal 2: Build adaptation strategies that address collections, design, maintenance, interpretation, programming, and training.

Suggested Strategies Continued

Establish a tracking system for records and documents of all existing plant collections, keeping data and information stored on and off-site (accession numbers, herbarium, DNA tissue, germplasm, GPS locations). This should include routinely photographing plants in anticipation of extreme weather events. Ensure you have paper and electronic versions of your data, research, and important records, reports, and documents. This should also include tracking every single expense and the categorization of those expenses. FEMA requires very detailed paperwork of expenses so it's crucial to not lose track of those financial accounts (Climate.2.c).






Consider implementing in vitro conservation of germplasm such as cryo-preservation and micropropagation. There are several advantages associated with in-vitro germplasm conservation:

- Large quantities of materials can be preserved in small space.
- The germplasm preserved can be maintained in an environment, free from pathogens.
- It can be protected against nature's hazards.
- From the germplasm stock, large number of plants can be obtained whenever needed.
- Obstacles for their transport through national and international borders are minimal (Climate.2.c).

Modify existing public outreach, education, and engagement programs in natural areas to include climate change mitigation and adaptation messaging and volunteer opportunities to enhance green infrastructure that will facilitate climate change resilience and adaptation. An example could be Installing climate change panels that are informational on what to expect in 2030, 2050, or beyond. Panels should include detailed information such as: days over 90 degrees, days of rainfall over one inch, an increase in the frequency and duration of heat waves, annual temperature rises, average annual precipitation increases, etc. (Climate.2.d.

Strategy In Action

In May of 2014, Cornell Botanic Gardens installed a climate change garden with the intention of increasing visitor understanding of the phenomenon. Conceptually simple, the garden allows visitors to see and feel an approximation of the environmental impacts of climate change, as it is projected to advance in upstate New York by 2050.

Climate Goal 3: Address climate threats with emergency planning, operational protocols, and appropriate design

Key Performance Indicator (KPI)

a. Garden develops best practices for safety (visitors and staff) in emergency disaster scenarios.

Outcomes

a. Garden has an emergency/disaster response plan that is reviewed regularly to protect/move staff and visitors in extreme weather. This includes providing training to all staff for likely climate-related emergencies for your region and inviting local first responders on-site so they are familiar with the grounds, infrastructure, and key access points.

Suggested Strategies Continued

Put together a list of actions that were taken from previous severe weather events and identify important lessons learned and what climate adaptation strategies need to be prioritized in the future to better protect people, plants, and infrastructure. If your garden hasn't experienced a natural disaster, adopt and conform aspects of other gardens or cultural institutions natural disaster preparedness plans and climate adaptation strategies to formulate your plan of action. Establish a list of climate induced stressors relevant to your region that you need to plan for (e.g., salt water intrusion, fire) (Climate.3.a).

Create teams and team leaders for each department that are in charge of leading aspects of your emergency disaster plan and can meet annually to discuss revisions. Assign duties in case of emergencies (e.g. storm team). Create a contact list of emergency services that may be called to action during and after a natural disaster. Review and update your emergency and safety protocols and disaster preparedness documents annually (Climate.3.a).

Identify and adopt your local or regional government emergency preparedness documents (e.g., Office of Sustainability) (Climate.3.a).

Strategy In Action

The Royal Botanic Gardens-Melbourne Working Wetlands are part of the garden's efforts to use stormwater runoff from the city to irrigate their collections. When it rains, stormwater throughout the city is diverted to the streams and ponds at RBG Melbourne, where the wetlands remediate the water. Once clean, the water can then be pumped through the garden's irrigation system. In addition to their environmental benefits, the Working Wetlands also have significant economic value. Reusing stormwater decreases the garden's dependence on buying potable city water for irrigation, lowering costs for the garden, reducing demand on the city's supply of drinkable water, and reducing flood risk in the city.

Align with your City: Climate Action and Adaptation Plans (CAAP)

What is it?

A lot of cities currently have Climate Action and Adaptation Plans that set a vision to reduce carbon emissions by 2030 or 2050. As a sustainability leader, public gardens can align their efforts with their city's plan and demonstrate the power of partnerships with their local government and community members. These Climate Action Plans include specific actions that the city and community can collectively take in the short-term to reduce carbon emissions and improve resilience to climate impacts. These plans are typically revised every three to five years to account for changing regulatory context, evolving technologies, behavior trends, and community needs.

Climate Action Plan Examples:

The city of Boston, MA, set GHG reduction goals of 80 percent below 2005 levels by 2050 for municipal operations, and requires the city to plan and prepare for the impacts of climate change. In 2011, the city released A Climate of Progress, Boston's first community-wide plan, which set the same GHG reduction goals for all of Boston, while continuing to prepare for the impacts of climate change.

The Arnold Arboretum of Harvard University is set to complete a groundbreaking project that complements Harvard's Climate Action Plan and the city of Boston's Carbon Free Boston initiative to become fossil-fuel free by 2050. When completed in the fall, the Weld Hill Solar Project will provide up to 30 percent of the energy used by the Weld Hill Research and Education Building in Roslindale. On about 1.2 acres adjacent to the facility, the solar project marks the most ambitious sustainability initiative to date for the Arboretum, and for the University.

The city of Anchorage, AK, Climate Action Plan strives to reduce GHG emissions 80 percent from 2008 levels by 2050, with an interim goal of 40 percent by 2030. This goal aligns with the Global Covenant of Mayors for Climate and Energy and the Paris Agreement for emission reductions necessary to avoid severe impacts of climate change.

To draft the Climate Action Plan, Municipal staff worked with a Steering Committee, an Advisory Committee, and nearly 100 technical advisors, including university faculty, staff and students, agency representatives, scientists, and community members. These groups helped identify the near-term actions most likely to result in the long-term changes necessary to achieve these ambitious climate action goals, while also advancing other community goals related to economic development, equity, resilience, and public health. Hundreds of Anchorage residents participated in community events and provided important ideas and feedback throughout the development of the plan.

The city of Santa Monica, CA, Climate Action & Adaptation Plan has established an interim goal of reducing carbon emissions 80 percent below 1990 levels by 2030. The plan is the product of collaboration and engagement with the public, businesses, stakeholder groups, and subject matter experts from academia, industry and interdepartmental staff representatives. It provides an ambitious, community-focused platform to advance policies that enhance quality of life and wellbeing, embrace smart city innovation and improve social equity.

Santa Monica has committed to meeting the goals of the Paris Climate Agreement to limit global warming below 2 degrees Celsius and pursue action to limit warming to 1.5 degrees. Santa Monica is committed to pursuing aggressive action and publicly reporting efforts to increase awareness and maintain accountability. The city publicly reports their progress and actions through various platforms and collaborates with local governments around the world to advance best practices in sustainability and climate action. This plan was developed over a 3-year period using extensive analysis, modeling, stakeholder input, and community engagement to ensure buy-in and feasibility. A Steering Committee representing City staff, local institutions, community groups and regional experts provided guidance and feedback throughout the project.

Disaster Planning

What is it?

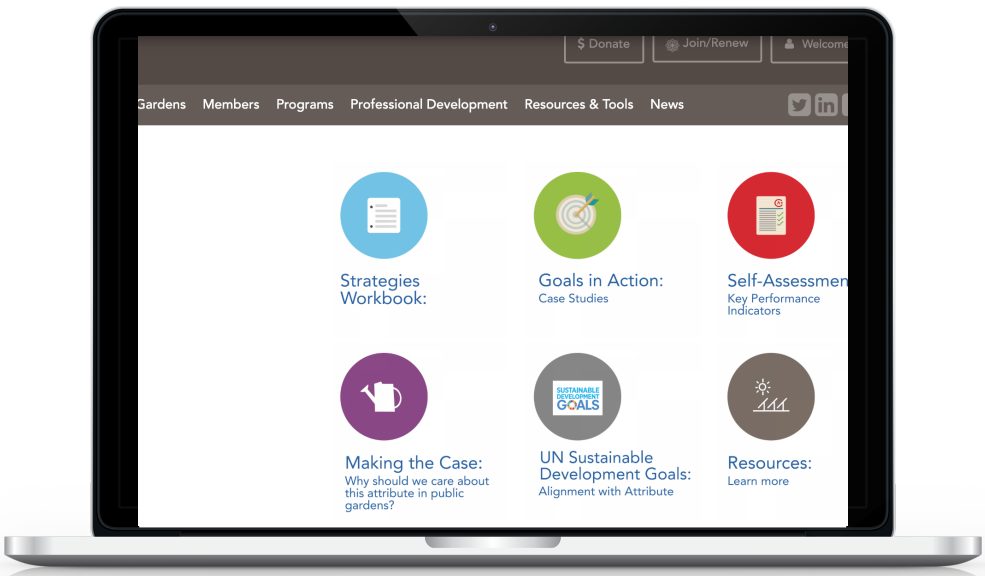
Disaster planning helps to safeguard plant collections and needs to be a core part of garden management processes. While extraordinary plant safety measures may not be warranted for every plant or for every collection, the general process of disaster planning for plant collections is necessary. The disaster planning process forces staff to stop and evaluate their collections in ways that they may normally overlook. What are the collections' strongest features? Are there any threats to the collections that the garden is unprepared for? Are there any maintenance practices in need of attention for plant health and protection? What other gardens in the region or country have or do not have our rare specimens? Such questions may not arise in everyday collections maintenance, but are very important when evaluating the collection's importance, and can be addressed through the process of planning for disaster.

Features of a Disaster Plan:

- Includes preparedness and response plans for all relevant emergencies and threats (natural, mechanical, biological, and human).
- Addresses the needs of staff, visitors, structures, and plant collections.
- Specifies how to protect, evacuate, and recover plant collections in the event of a disaster including relocation procedures for the collections.
- Includes evacuation routes and assembly areas for people.
- Assigns individual responsibilities for implementation during emergencies.
- Lists contact information for relevant emergency and recovery services.
- Includes up to date floor plans and maps of entire property.
- Includes date of last revision.
- Identifies assets (including staff, plant collections, and buildings) and clearly prioritizes them in order of importance.
- Includes ways to mitigate the effects of potential disasters, such as training staff in the use of fire extinguishers and installing smoke detectors and fire suppression systems.
- Identifies location of supplies that can be used in emergencies (first aid kit, batter powered radio, etc.)

FOR MORE INFORMATION

Visit the sustainability index attribute pages for more case studies, resources, and a self-assessment!



Go To: https://www.publicgardens.org/sustainability-index/attributes/climate-adaptation-risk-management