

# Nagoya: Adaptation to climate change driven by biodiversity conservation

<b>Climate change impacts addressed</b>	High temperatures Urban flooding Drought
<b>Spatial scale</b>	City
<b>Response type</b>	Policy
<b>Core drivers</b>	Adaptation to climate change Mitigation of climate change Biodiversity conservation Quality of life and attractiveness of place Sustainable but intensive urban development Water management Higher-level policy framework
<b>Good practice</b>	Prioritising adaptation Internal collaboration Public engagement

## Summary

Changes in land use associated with industrialisation and the expansion of residential areas have reduced green sites in Nagoya to about 25% of the area of the city. An additional cause of concern is the increase in temperature of Nagoya City associated with climate change. These factors are exacerbating the urban heat island effect and problems associated with high temperatures in the urban areas of Nagoya. Given these threats, the City of Nagoya has undertaken various measures to create more sustainable lifestyles in the city. The main initiative that can help the city become better adapted to climate change (in particular to high temperatures) is the 2050 Nagoya Strategy for Biodiversity, which aims to improve and extend the green areas of the city. Sitting within the Biodiversity Strategy, the Water Revitalisation Plan aims to recharge ground water supplies by increasing infiltration through the use of green spaces. A crucial aspect of the Biodiversity Strategy is its implementation in close collaboration with the city's residents, business and non-governmental organisations.

## Case study location

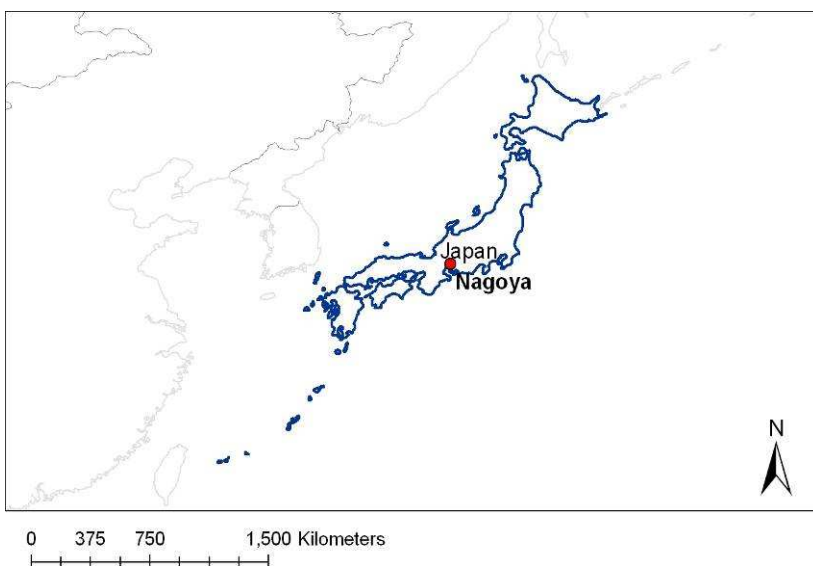


Figure 1. Location of Nagoya

The City of Nagoya is located on the Nobi plain on the Pacific coast of Japan. It covers an area of 326 km<sup>2</sup> and includes diverse landscapes ranging from hilly areas to the east and the central plateau, to the alluvial plains and reclaimed lands in the north, west and south. The city was established as a castle town in 1610, and has developed a strong manufacturing industry over recent decades and is now one of the most important ports in Japan. Nagoya's population currently numbers approximately 2.2 million (density of population 6903 people/km<sup>2</sup>), and it is the fourth largest Japanese city <sup>(1)</sup>. The city

aims to become sustainable through the transformation to a low-carbon economy, by promoting co-existence of people and nature, and by recycling of natural resources <sup>(2)</sup>.

The city has a warm and humid climate, with an average annual temperature of around 16° degrees Celsius, with a minimum of -3.7°C and maximum of 37.5°C. The average annual rainfall (1976–2005) is around 1600mm <sup>(3)</sup>. Over the last 100 years, the average temperature has risen by approximately 2.7 °C, which is roughly 3.5 times the global average. In addition, the frequency of intense, localised rainfall events has increased since the 1970s. Events of over 50mm rain per hour are now 1.6 times more frequent, and events of over 100mm per hour are now 2.3 times more frequent. This means that the city (in particular areas below sea level) is vulnerable to flooding and the management of runoff and drainage is consequently a problem <sup>(4)</sup>.

Nagoya has about 8,800 hectares of green space (24.8% of the total city area) <sup>(4)</sup>. Green space has significantly decreased in recent years due to the development of industrial zones along the coast and on reclaimed land, and through the loss of woodlands to construct residential buildings to house an increasing population. In addition, the city's social and economic structure has changed from an agricultural to an industrial and then service industry based model. This has resulted in a reduction of agricultural land and deterioration of the *satoyama* coppices that once provided people with firewood and that were home to a diverse range of wildlife <sup>(3)</sup>.

## Development of the initiative

### *Key aims*

Given the threats of climate change and the loss of green spaces in the city, Nagoya has undertaken various measures to create more sustainable urban lifestyles <sup>(1)</sup>. The key initiative that aims to increase green space in the city is the **Nagoya Strategy for Biodiversity** <sup>(5)</sup>, which recognises the links between the green space cover and the urban heat island effect. The Nagoya Strategy for Biodiversity also includes **Nagoya Water Cycle Revitalisation Plan**, which aims to re-establish the natural water cycle, which has been disturbed due to continued urban development <sup>(3)</sup>. The implementation of these initiatives is likely to increase green cover in the city and help to moderate temperatures.

### *Themes driving the initiative*

#### National legislation

- **Biodiversity:** In 2008, the Japanese government adopted the “Act on Biodiversity” which recommends that all Japanese local governments adopt a Local Biodiversity Strategy and Action Plan (LBSAP). These local strategies align with the National Biodiversity Strategy and Action Plan, which Japan developed as a signatory to the Convention on Biological Diversity.
- **Urban heat island:** In 2001, the urban heat island (UHI) was declared by the Ministry of Environment as a form of air pollution. In 2002, a cross-departmental ‘Inter-Ministry Coordination Committee to Mitigate Urban Heat Islands’ was established. In 2002, the Cabinet adopted the ‘Basic Rules for Urban Renaissance’, which included urban heat island mitigation as a means of revitalising urban areas. In 2004, the ‘Outline of the Policy Framework to Reduce Urban Heat Island Effects’ <sup>(6)</sup> was established. This was accompanied by a set of guidelines which specified that building owners should plant trees and provide green spaces around their buildings as a UHI mitigation measure, and also provide green roofs and green walls where appropriate. At the city level, provision of green spaces and parks, as well as extensive green belts, is promoted as a key UHI mitigation measures. In 2005, the

Government designated several model areas for investigating measures for mitigating the UHI, including the Nagoya Station, Fushimi and Sakae districts <sup>(7)</sup>.

### A history of environmental initiatives in Nagoya

The City of Nagoya launched its first environmental conservation initiatives in the early 1950s to improve the water quality of the city's rivers and at the Port of Nagoya. Air pollution started to be monitored and controlled in 1960s. The Nagoya City Basic Concept, developed in 1977, emphasized the importance of a green environment in city planning. This was followed by the adoption of the "Greening City Declaration" in 1978. Growing public interest in the planting of greenery motivated the city to develop greening projects with public participation. In the 1990s, following the increased interest in sustainable development, the City of Nagoya enacted the Environmental Basic Ordinance to promote the emergence of a sustainable society capable of minimizing its environmental impact <sup>(5)</sup>.

### Emphasis on environment in the city development strategy

The City of Nagoya aims to become the Environmental Capital of Japan <sup>(4)</sup>. This aim is to be achieved by following three initiatives:

- A low-carbon society, with the 2050 target of 80% reduction in CO<sub>2</sub> emissions, which has been incorporated in the 2050 Nagoya strategy for Low-carbon city <sup>(2), (4)</sup>. This aims to concentrate development around train and subway stations freeing up land for green space elsewhere.
- A society that coexists with nature, guided by the Nagoya Strategy for Biodiversity, which emphasises actions such as the preservation and wise use of wetlands, the regeneration of Higashiyama Zoo and Botanical Gardens, and the creation of managed *satoyama* woodlands.
- A recycling-based society, guided by the Biomass Town Plan and the 2050 Nagoya Strategy for Water Cycle Recovery.

These initiatives aim to achieve the vision of **Low-carbon comfortable city Nagoya** (Figure 2).



Image of a „Low-Carbon and Livable City Nagoya“ in 2050

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Figure 2. Vision of Nagoya in the future <sup>(2)</sup>

### Water management problems

Urbanisation processes have inhibited the functioning of the natural water cycle. For example, the volume of rainwater permeating into the ground has been decreasing due to surface sealing. Further, the increased surface runoff of rainwater has raised the load on sewage systems and rivers. Meanwhile, the volume of water within the evapotranspiration process has been declining, which in turn has exacerbated the heat island effect. In an effort to resolve these problems, the city developed the Nagoya Water Cycle Revitalization Plan in 2008 <sup>(5)</sup>.

## Participation in international networks and projects

Nagoya will host the 10th **Conference of the Parties to the Convention on Biological Diversity** (CBD COP10) in October 2010. Furthermore, Nagoya is a member of ICLEI – Local Governments for Sustainability - and has participated in ICLEI’s Local Action for Biodiversity project as well as ICLEI’s Cities for Climate Protection Campaign.

### *Details of the initiative*

The Biodiversity Strategy clearly acknowledges the effect of green spaces in moderating the urban heat island. The target for the Strategy is to increase the green space cover in the city from the current 25% to the 1967 levels of 40% <sup>(4)</sup>. To achieve this target, the main objectives of the Strategy are as follows <sup>(5)</sup>:

- To conserve existing open green spaces, including private woodlands.
- To promote greening of roads. The area of new green spaces has been increasing steadily through tree planting, continuous greening with shrubs, and the greening of median strips.
- To improve the provision of greenways, i.e. roads where the pedestrian and cycle traffic have a priority and the vehicle traffic is restricted.
- To promote local greening. This program is intended to facilitate the cooperation of local residents, private enterprise, and government to develop greening agreements.

An important element of the Biodiversity Strategy in Nagoya is the **Water Cycle Revitalisation Plan**, which aims by 2050 to increase the infiltration of water into the ground from the present level of 24% to 33%, and to reduce runoff levels from 62% to 36%. This is to be achieved through protection and increased provision of green space, green roofs, permeable paving and structural measures <sup>(4)</sup>, allowing the infiltration of rainwater to ensure the effective use of underground water and recycled sewage water <sup>(3)</sup> (Figure 3). The main objectives of the Plan are as follows <sup>(5)</sup>:

- To restore the functions of the natural water cycle by increasing infiltration of rainwater and facilitating the evapotranspiration process;
- To undertake city planning while factoring in a people-friendly waterfront and green environment that is also beneficial to wildlife;
- To revive the water cycle via partnerships based on mutual understanding of respective roles of stakeholders, and collaboration among the public, NGOs, private sector, and government.

## Implementation of the initiative

The 2050 Nagoya Strategy for Biodiversity was developed in 2008 and runs until 2050. Street greening initiatives are carried out by the City of Nagoya (Figure 4) in close collaboration with local residents and businesses. Three interesting mechanisms are being used in the implementation of the Strategy and the Nagoya Water Cycle Revitalisation Plan:

1. Under the programme of preservation of existing green spaces, the City of Nagoya uses “loan for use” agreements with private green space landowners in order to secure favourable urban environments and provide the public with opportunities to experience local natural surroundings <sup>(5)</sup>.
2. An incentive scheme for developers is applied, which allows developers to increase the volume of their buildings if they concentrate their development on a smaller land footprint and allow for creation of continuous green areas (for a similar example see the City of Faenza).
3. In order to reduce the heat island and enhance water infiltration, the City of Nagoya recently established a policy to require tree planting on all plots of new development over 300 m<sup>2</sup>. Greenery must account for 10-20% of the plot. Compliance with the rule is now a precondition for planning permission <sup>(8)</sup>.

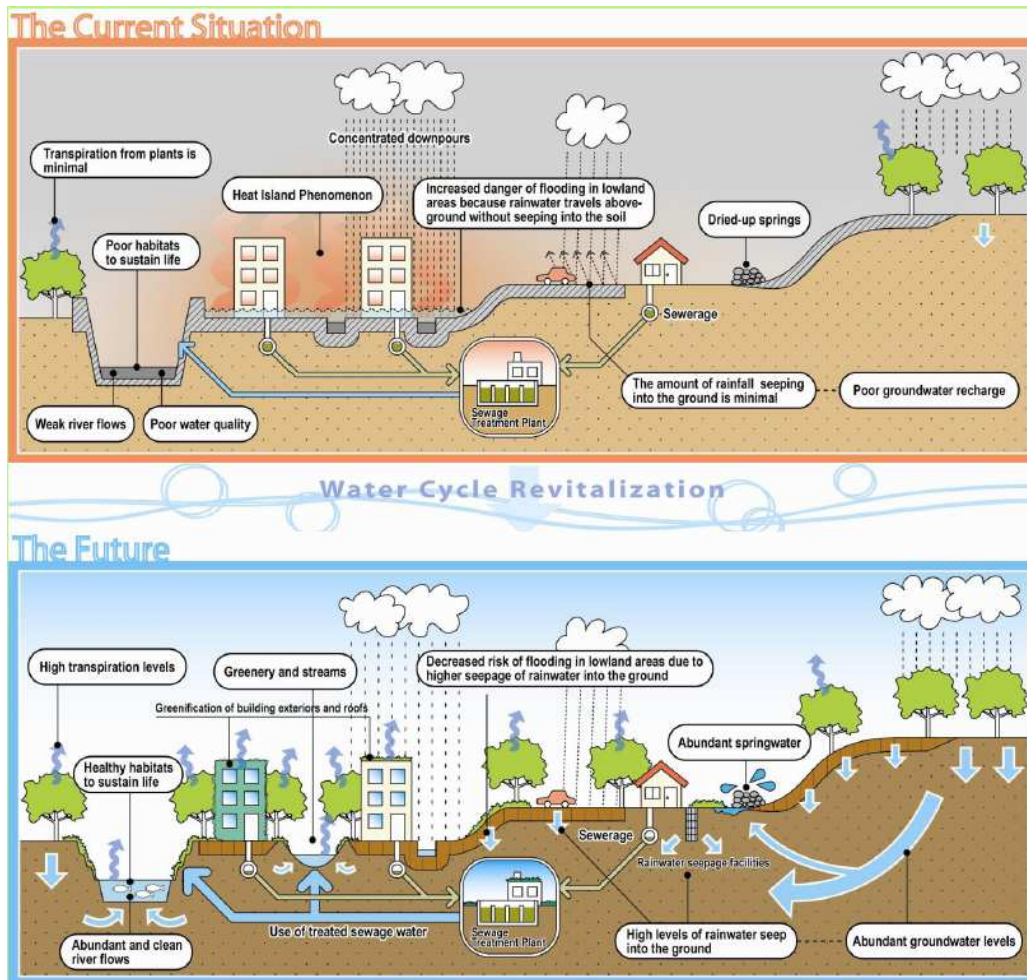


Figure 3. The Water Cycle Revitalisation Plan <sup>(9)</sup>

### *Challenges and barriers to implementation*

A key challenge in promoting biodiversity conservation in Nagoya is that the term “biodiversity” is not well recognised. To address this, the City of Nagoya raised awareness that biodiversity conservation is a critical and shared challenge for members of the public, the government, and private sector <sup>(5)</sup>.

Furthermore, while the awareness of climate change is high among the general public and the city officials, it is not explicitly linked to present day extreme weather events. In terms of climate change, emission reduction is the first priority. In terms of adaptation to climate change impacts, living with rising sea levels is seen as the key priority. While the urban heat island effect is well recognised and is seen as a problem that should be solved, it is not linked to public awareness of climate change. Indeed, the main effect of climate change is perceived as being flooding.

Another challenge is the relatively weak position of the Environmental Department in the preparation and implementation of policies. However, this has been addressed through close collaboration with the Department of Planning and Construction, who manage the road network, enabling greening of the streets to be carried out in a collaborative manner.



**Figure 4. Central Park in Nagoya separating two lanes of traffic – an example of greening in the city centre of Nagoya. Photograph by Aleksandra Kazmierczak**

### *Building the evidence base*

The Greenification & Public Works Bureau conducts surveys on the ratio and trends of green space in the city. This facilitates the preparation of basic materials for raising public awareness, increasing the ratio of open green space, and developing measures for mitigating the heat island. Compiled from aerial photography and data from the Geographical Information Service (GIS), this survey has been conducted every five years since 1990<sup>(5)</sup>. Also, there are a number of research projects being carried out at the University of Nagoya. These are investigating the possibility of achieving the vision of low-carbon, comfortable city of Nagoya with different modes of urban planning and methods of greening that would limit the severity of urban heat island.

### *Monitoring and evaluation*

The Strategy for Biodiversity includes clear targets for the percentage of green space that should be greened and the proportion of water that should infiltrate into ground in the future. These targets enable monitoring of the progress in achieving the aims of the Strategy.

## **Stakeholder engagement**

While the City of Nagoya is the lead authority on the Biodiversity Strategy and the Water Cycle Revitalisation Plan, the involvement of local residents and other stakeholders is emphasised. The policies aiming to reach the 2010 biodiversity target focus on three key themes; sustainable lifestyles (e.g. Nagoya Water Recovery Plan), human resource development (e.g. environmental education) and co-existence with nature (e.g. preservation and creation of green areas, forestation). All three themes place emphasis on public participation. In particular the collaboration between an Experts Board a Citizen Review Board in the Nagoya's Biodiversity Strategy Committee is interesting (Figure 5). Also, as part of efforts to promote and elevate awareness of biodiversity conservation, the city is working to improve the water quality of rivers by introducing groundwater as well as by monitoring and surveying spring water (which is to be monitored by members of the public)<sup>(5)</sup>.

In addition, many public open green spaces are managed and administered through collaboration between the City of Nagoya and citizens' groups<sup>(5)</sup>. In the *Higashiyama* Forest, citizens' groups are working together on various projects, such as maintaining woodlands and holding nature watch tours. In the south-west of the city, where little existing woodland remains, the *Todagawa* Green is being developed. This unique public-private project, named 'Building the Western Woods of Nagoya', is being carried out in partnership between citizens, corporations and government for planting and cultivating trees to create a forest for future generations<sup>(3)</sup>. COP10 promotes the idea of *satoyama* and supports the activities of citizens in planting and maintaining woodlands. A specific example is the Nagoya partnership for improving forests (Box 1).

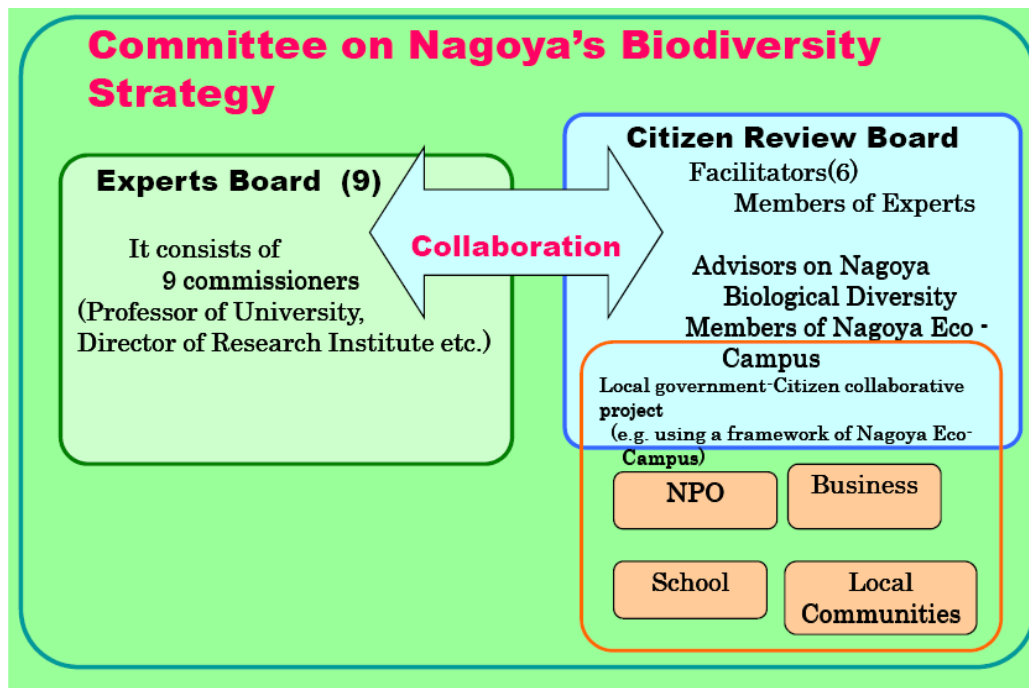


Figure 5. Emphasis on collaboration between experts and citizens on the Biodiversity strategy <sup>(10)</sup>

#### Box 1. Nagoya Partnership and Liaison Meeting for Improving Forests <sup>(5)</sup>

In March 2003, the Nagoya Partnership and Liaison Meeting for Improving Forests was established via cooperation between the City of Nagoya and citizens' groups working on the conservation and redevelopment of the natural environment and parks and green spaces in the city. The Liaison Meeting promotes activities working toward the common objective of protecting and fostering local natural features whilst respecting the autonomy of citizens' groups and the public duties of the government. As of September 2007, 28 organizations had participated in the Liaison Meeting.

The liaison meeting facilitates information exchange amongst organizations through regular meetings, field visits and workshops. In addition, partnership projects are developed with relevant government organization in an effort to share challenges, add momentum to activities, and expand the network of cooperation.

In 2009, a conference on biodiversity management for local authorities in Nagoya was attended by 200 participants, with more than 100 representatives from Japanese local governments. The event offered an opportunity for delegates to share information and learn from each other in view of preparing their local planning documents and improving biodiversity management and conservation at a local level.

#### *Political buy-in*

Political engagement was necessary to secure the necessary level of support for and momentum behind the CO<sub>2</sub> and biodiversity initiatives that Nagoya is now involved in. The City mayor, Takehisa Matsubara, has been proactive in this respect.

#### Can it have an impact?

The increased greening of the City of Nagoya can be seen as an achievable goal because it lies at the core of strategies targeted at biodiversity conservation, water cycle improvement and achievement of a low-carbon, public-transport based economy. This multi-functional cross-sectoral

approach increases the possibility of greater provision of green space in the city. Furthermore, the collaborative approach of the city (both inter-departmental as well as collaboration with citizens and local businesses) makes it more likely that the city will be greened, and therefore better adapted to the urban heat island effect and flash flooding in the future.

The linking of climate change mitigation and adaptations strategies into one vision for the future of the city can be considered as a very effective way of raising the profile of adaptation. However, the danger remains that the push for mitigation will overshadow the need for adaptation, and that adaptation will be seen as an 'add-on' to the overall climate change and biodiversity policy.

## Key messages

- The biodiversity and water infiltration targets are to be achieved through close cooperation with citizens. The City of Nagoya has recognised that only by working with residents and local businesses will it be possible to achieve the vision of low carbon, liveable city. The Japanese culture emphasises the need for individuals to contribute to the common good, which supports public involvement in such initiatives.
- The involvement of the City of Nagoya in international initiatives, such as ICLEI and the organisation of the COP10 conference, has raised the profile of environmental issues locally and helped to provide political buy-in for related actions.
- The vision of the city's future development takes an integrated approach linking adaptation and mitigation. It emphasises the importance of controlling urban sprawl and concentrating the built environment around transport hubs, while at the same time increasing the presence of green areas to improve biodiversity, water management and help to reduce the urban heat island effect.

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