From Bytes to Bushlands: illuminating Australia and New Zealand's natural treasures through open government data (OGD) initiatives

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Abstract

In the era of digitalisation, where data is a catalyst for innovation and information accessibility extends beyond numbers, transparency now encompasses the natural world's essence. Australia and New Zealand, renowned for their breathtaking landscapes and rich biodiversity, have embarked on a transformative journey of sharing their environmental treasures with the world through Open Government Data (OGD) initiatives. This article explores how OGD initiatives in Australia and New Zealand illuminate the bushlands, mountains, coastlines, and unique ecosystems, fostering a deeper connection between people and the environment. It delves into the significance of leveraging OGD to address environmental challenges, including climate change and biodiversity loss, while highlighting the impact of OGD on promoting transparency, accountability, and public engagement in conservation efforts. Through a comprehensive methodology encompassing literature review, data collection, analysis, GIS mapping, and thematic analysis, this study assesses the effectiveness of OGD initiatives and identifies key challenges, opportunities, and best practices. The findings underscore the importance of OGD in advancing environmental stewardship, scientific discovery, and public engagement in the 21st century. In conclusion, the article advocates for continued innovation and collaboration to maximise the societal benefits of OGD, driving positive outcomes for current and future generations.

Keywords: Australia, Biodiversity, Environmental data, Environmental monitoring, Geographic Information System (GIS), Indigenous cultures, Natural treasures, New Zealand, Open government data (OGD), Sustainable development goals (SDGs)

1. Introduction

In the digital age, where information is at our fingertips and data fuels innovation, the concept of transparency and accessibility has extended beyond just numbers and statistics. Now, it encompasses the very essence of our natural world. Australia and New Zealand, known for their breathtaking landscapes and rich biodiversity, have embarked on a transformative journey of sharing their environmental treasures with the world through Open Government Data (OGD) initiatives. These initiatives embrace the principles of open access (Biswas, Brar, & Bhabal, 2022) ensuring that valuable environmental data is readily available to all. In this era of interconnectedness, where global citizens seek to understand and appreciate the wonders of nature, the utilisation of OGD has emerged as a powerful tool for illuminating the bushlands, mountains, coastlines, and unique ecosystems that define these nations. This article delves into how OGD initiatives in Australia and

New Zealand are not only opening doors to data but also unlocking the beauty and significance of their natural landscapes, fostering a deeper connection between people and the environment. Through the lens of data transparency, we embark on a journey from bytes to bushlands, exploring the intersection of technology, conservation, and appreciation for the natural world.

2. Literature review

In recent years, the convergence of technology and environmental conservation has led to the emergence of Open Government Data (OGD) initiatives (Biswas & Chakraborty, 2022; Biswas, 2022) aimed at shedding light on the natural wonders of countries such as Australia and New Zealand. This literature review examines the scholarly discourse surrounding the utilisation of OGD to illuminate the rich biodiversity and stunning landscapes of these nations.

One seminal work in this field is the study by Kitchin and McArdle (2016), who provided a comprehensive overview of OGD initiatives worldwide and their potential applications in environmental research and conservation efforts. Furthermore, research by Huijboom and Van den Broek (2011) underscored the significance of OGD in promoting citizen participation and collaboration in environmental monitoring and management. Through case studies from various countries, including Australia and New Zealand, they demonstrated how OGD platforms can empower citizens to contribute to biodiversity monitoring, ecosystem management, and sustainable development initiatives. In the context of Australia, studies such as those by Mendes and Wallace (2018) and Gault et al. (2020) explored the potential of OGD to enhance understanding of the country's unique ecosystems and biodiversity hotspots.

Similarly, research focusing on New Zealand, such as the work by Wilson et al. (2019) and Singh et al. (2021), examined the impact of OGD initiatives on conservation efforts and natural resource management. These studies emphasised the importance of data interoperability, standardisation, and quality assurance in ensuring the effectiveness of OGD platforms for environmental monitoring and reporting.

Despite the progress made in leveraging OGD to illuminate Australia and New Zealand's natural treasures, several challenges and opportunities remain. For instance, issues related to data privacy, security, and governance require careful consideration to balance transparency with the protection of sensitive environmental information (Chin et al., 2018). Additionally, there is a need for ongoing investment in digital infrastructure, capacity building, and stakeholder engagement to maximise the impact of OGD initiatives on environmental sustainability (UNDP, 2020).

3. Significance of the study

This study remains highly relevant in the present context for several reasons. Firstly, with the increasing urgency of addressing environmental challenges such as climate change, biodiversity loss, and habitat degradation, there is a growing demand for accessible and reliable environmental data to inform evidence-based decision-making and public awareness campaigns (IPCC, 2021). Secondly, the COVID-19 pandemic has underscored the importance of digital technologies and remote collaboration in supporting environmental monitoring and conservation efforts, making OGD initiatives more essential than ever before (Bennett et al., 2020). Lastly, as countries strive to achieve the Sustainable Development Goals (SDGs) set forth by the United Nations, including those related to environmental sustainability and biodiversity conservation, OGD can serve as a valuable tool for tracking progress,

monitoring indicators, and promoting accountability at the national and global levels (UN, 2020). Finally, the topic of leveraging OGD to illuminate Australia and New Zealand's natural treasures holds immense significance in the contemporary context, offering insights into how technology and data-driven approaches can contribute to environmental stewardship, scientific discovery, and public engagement in the 21st century.

4. Objectives

The objectives of the study are:

I. To assess the current status and effectiveness of Open Government Data (OGD) initiatives in Australia and New Zealand in providing access to environmental data related to their natural landscapes and biodiversity

ii. To investigate the impact of OGD initiatives on promoting transparency, accountability, and public engagement in environmental conservation and management efforts

iii. To identify key challenges, opportunities, and best practices associated with leveraging OGD to illuminate the natural treasures of Australia and New Zealand, including issues related to data quality, interoperability, privacy, and governance

iv. To provide recommendations for enhancing the effectiveness and accessibility of OGD initiatives in Australia and New Zealand, as well as strategies for overcoming barriers and maximising the societal benefits of open environmental data for both countries.

5. Methodology

Literature review: For this study a comprehensive review of existing literature, research papers, reports, and governmental documents related to Open Government Data (OGD) initiatives, environmental conservation efforts, and biodiversity data management in Australia and New Zealandwas conducted.

Data collection: Quantitative and qualitative data were gathered related to OGD initiatives, environmental datasets, and conservation efforts from relevant government agencies, non-governmental organisations, research institutions, and other authoritative sources in Australia and New Zealand. Official databases, websites, and reports were also utilised to collect information on the availability, accessibility, and scope of environmental datasets.

Data analysis: Collected data were analysed to assess the current status and effectiveness of OGD initiatives in Australia and New Zealand. Statistical methods were utilised to quantify the availability and coverage of environmental datasets, including natural landscapes, biodiversity, indigenous cultures, and environmental conservation.

GIS mapping: Geographic Information System (GIS) tools were utilised to visualise and map the spatial distribution of environmental datasets, including natural landscapes, biodiversity hotspots, protected areas, and environmental monitoring sites in Australia and New Zealand.

Thematic analysis: Thematic analysis techniques were employed to categorise and interpret the findings according to key themes such as data accessibility, quality, interoperability, privacy concerns, governance issues, and societal impacts. It has been done to identify patterns, trends, and correlations within the data to draw meaningful conclusions.

6. Findings

The different segments related to natural treasures found on OGD portals of Australia and New Zealand are presented in table 1.

Table 1: Data sets related to natural treasures found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	Dataset
Natural Landscapes	854	108
Biodiversity	2875	927
Indigenous Cultures	65	23
Environmental Conservation	737	997

Table 1 shows the different segments related to natural treasures found on OGD portals of Australia and New Zealand along with datasets. It is found Australia has the highest number of data except data on environmental conservation in comparison with datasets of New Zealand.

6.1 *Natural landscape*

Table 2: Different segments related to natural landscape found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	Dataset
GIS/ Topographic Data	132	22
Land use and land cover data	588	74
Water resources data	53	07
Protected areas data	81	05
	854	**108**

Table 2 presents the different segments under the natural landscape. These are:

i. ***Geographic Information System (GIS)/topographic data:*** This includes digital elevation models (DEM), contour maps, satellite imagery, and other spatial data related to natural landscapes such as land cover, vegetation types, terrain, and geological features in Australia and New Zealand. It is found that Australia and New Zealand so far uploaded 132 and 22 datasets respectively.

ii. ***Land use and land cover data:*** Data on how land is being used and the types of vegetation or land cover present in different areas of Australia and New Zealand has been presented. This includes information on forests, grasslands, agricultural land, urban areas, etc. Australia is in the leading position by uploading 588 datasets followed by New Zealand with 74 datasets. This is valuable for land

management and planning purposes.

iii. ***Water resources data:*** Information about rivers, lakes, wetlands, and other water bodies in Australia and New Zealand, including water quality, flow rates, and hydrological features have been provided. Though New Zealand has uploaded only 7 datasets Australia is in a little better position by uploading 53 datasets.

iv. ***Protected areas data:*** Information about national parks, conservation reserves, and other protected areas in Australia and New Zealand have been given. This includes boundaries, management plans, and ecological values of these areas. Australia has so far uploaded 81 datasets. At the same time, New Zealand has uploaded only 5 datasets in this regard.

6.2 *Biodiversity*

Table 3: Diverse aspects concerning biodiversity found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	**Dataset**
Species Distributions	1347	674
Threatened Species	475	38
Ecosystem Classification	266	164
Invasive Species	83	08
Genetic Resources	158	12
Citizen Science	546	31
	2875	**927**

Table 3 presents the different segments under biodiversity. These are:

i. ***Species distributions:*** Datasets containing information about the distribution of various plant and animal species across Australia and New Zealand have been connected. These datasets include species occurrence records, species richness maps, and species distribution models derived from field surveys, citizen science initiatives, and other data sources. It is found that a good number of datasets, i.e., 1347 have been incorporated into OGD portal of Australia. New Zealand's figure is also not bad, i.e., 927 in terms of total datasets, i.e., 927.

ii. ***Threatened species:*** Information about species that are classified as threatened or endangered according to national and international conservation assessments has been included. This includes lists of threatened species, their status assessments, recovery plans, and monitoring data aimed at tracking population trends and conservation efforts. Australia has reflected growing concerns by uploading 475 datasets and New Zealand has uploaded so far 38 datasets.

iii. ***Ecosystem classification:*** Information about different ecosystem types and classifications used to categorise Australia's and New Zealand's diverse landscapes and habitats are available. This includes vegetation classifications, ecosystem mapping products, and spatial datasets describing the distribution and composition of different ecosystem types. Both countries have uploaded 266 and 164 datasets respectively.

iv. ***Invasive species:*** Australia's OGD portal offers a more extensive collection, with 83 datasets related to natural treasures, focusing on invasive species' distribution, spread, impacts, and management efforts. Similarly, New Zealand's OGD portal provides 8 datasets which also encompass information about invasive species and their management. These datasets serve as crucial resources for understanding and mitigating the threats posed by invasive species, facilitating informed decision-making and conservation actions in both countries.

v. ***Genetic resources:*** Australia is ranked as having a more substantial collection of genetic resources data on its Open Government Data (OGD) portal compared to New Zealand, with 158 datasets dedicated to genetic resources. These datasets likely encompass data on the genetic diversity of plant and animal species, including genetic sequencing data, DNA bar-coding records, and information about genetic variation within and among populations. On the other hand, New Zealand's OGD portal offers a more limited selection, with only 12 datasets focusing on genetic resources.

vi. ***Citizen Science:*** Australia demonstrates a more extensive collection, with 546 datasets dedicated to citizen science. These datasets likely encompass a wide range of biodiversity monitoring, species recording, and environmental observation initiatives that engage volunteers. Whereas, New Zealand's OGD portal offers a more limited selection, with only 31 datasets focusing on citizen science.

6.3 *Cultural heritage data*

From the available datasets from table 1, related to indigenous cultures on the Open Government Data (OGD) portals of Australia and New Zealand, both countries demonstrate a commitment to showcasing culturally significant sites within their natural landscapes. Australia's OGD portal provides 65 datasets dedicated to indigenous cultures, offering information about indigenous heritage sites, archaeological sites, and historic landmarks. For instance, Australia offers details about Uluru-Kata Tjuta National Park, which holds immense cultural significance for the Anangu people, the traditional owners of the land. Additionally, Australia provides information about Kakadu National Park, a UNESCO World Heritage Site containing numerous indigenous heritage sites, including rock art galleries, burial sites, and ceremonial grounds, offering insights into indigenous culture and traditions. On the other hand, New Zealand's OGD portal offers 23 datasets related to indigenous cultures, highlighting sites such as Whakarewarewa Geothermal Valley (Rotorua). This living

Maori village is located within a geothermal valley near Rotorua and is home to the Tahourangi/Ngati Wahiao people, who have lived in the area for centuries. Visitors to Whakarewarewa can experience traditional Maori culture, including geothermal cooking, weaving, and cultural performances. While both countries provide valuable information about indigenous cultures, Australia's OGD portal offers a slightly higher number of datasets, reflecting the diverse range of culturally significant sites within the country's natural landscapes.

6.4 *Environmental conservation*

Table 4: Various facets pertaining to environmental conservation found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	**Dataset**
Environmental Monitoring	162	181
Natural Resource Management	264	412
Climate Change and Adaptation	202	313
Environmental Policies and Regulations	52	77
Education and Outreach	57	14
	737	**997**

Table 4 presents various facets pertaining to environmental conservation. These are:

i. ***Environmental monitoring:*** Australia's OGD portal offers 162 datasets dedicated to environmental monitoring, encompassing information about air quality, water quality, soil health, and climate indicators. Similarly, New Zealand's OGD portal provides 181 datasets related to environmental monitoring, indicating a comprehensive effort to monitor and assess environmental conditions.

ii. ***Natural resource management:*** Australia and New Zealand demonstrate a concerted effort to promote sustainable practices and conservation of their natural resources on their respective OGD portal. Australia's OGD portal provides 264 datasets dedicated to natural resource management, encompassing various aspects such as forests, water resources, fisheries, and agricultural lands. Similarly, New Zealand's OGD portal offers a more extensive collection, with 412 datasets related to natural resource management, indicating a comprehensive approach to managing and conserving its natural resources.

iii. ***Climate change and adaptation:*** Australia and New Zealand reveal a proactive approach towards addressing the challenges posed by climate change. Australia's OGD portal provides 202 datasets dedicated to climate change and adaptation, encompassing a range of information including climate change impacts, vulnerability assessments, adaptation strategies,

and greenhouse gas emissions. Similarly, New Zealand's OGD portal offers 313 datasets related to climate change and adaptation, indicating a comprehensive approach to addressing climate change challenges.

iv. ***Environmental policies and regulations:*** Australia's OGD portal provides 52 datasets dedicated to environmental policies and regulations, encompassing a range of information including environmental laws, regulations, permits, compliance records, and enforcement actions. Similarly, New Zealand's OGD portal offers 77 datasets related to environmental policies and regulations, indicating a comprehensive approach to environmental governance.

v. ***Education and outreach:*** Australia and New Zealand aim to promote environmental education and public awareness, albeit with varying degrees of emphasis. Australia's OGD portal provides 57 datasets dedicated to education and outreach, offering resources such as environmental education programmes, public awareness campaigns, and educational materials for schools and communities. Conversely, New Zealand's OGD portal offers a more limited selection, with only 14 datasets related to education and outreach. Despite the difference in numbers, both countries recognise the importance of environmental education in fostering informed decision-making and promoting sustainable behaviours among citizens.

6.5 *Format of datasets*

Table 5 : Formats of datasets pertaining to different segments of natural treasures

	Natural Landscapes		Biodiversity		Indigenous Cultures		Environmental Conservation	
Formats	**Aus**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**
AAIGrid	-	01	-	02	-			356
ArcGIS Geoservice REST API	-	65	-	657	-	09		37
bash		-		01	-	-		-
CSV	55	89	311	804	15	22	47	549
DOCX		-		01	-	-	-	1
DPKG	-	02	-	-	-	-	-	-
DWG	-	02	-	75	-	-		195
ESRI MAPSERVER	97	-	233	-	5	-	87	-
Esri REST	-	26	-	47	-	01	-	15
FNA		-		-	-	-	-	01
File GDB		-		02	-	-		-
GEOJSON	53	85	138	693	12	10	54	47
Geoservice api	-	04	-	03	-	-	-	-
GPKG		-		100	-	12	-	487
GTiff	-	01	-	10	-	-	-	409

	Natural Landscapes		Biodiversity		Indigenous Cultures		Environmental Conservation	
Formats	**Aus**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**
HFA		-		08	-	-	-	53
HTML	219	92	1144	713	26	11	258	54
JSON		-		-	6	-	-	
JPEG		-	120	20	-	-	-	53
JP2		-		08	-	-	-	52
JP2_ LOSSLESS		-		08	-	-	-	52
KEA	-	01	-	10	-	-	-	409
KML	-	87	-	768	7	10	-	240
MapInfo File	-	02	-	100	-	12	-	487
MapInfo MIF	-	02	-	98	-	12	-	487
OGS WFS	-	03	-	01	-	-	-	2
OGS WMS	-	03	-	03	-	-	-	3
OpenFile GDB	-	02	-	98	-	12	-	487
PDF	266	03	552	95	14	-	178	559
PNG	-	-		18	-	-	-	3
py	-	-		01	-	-	-	1
QUAL	-	-		-	-	-	-	1
r	-	-		-	-	-	-	1
R	-	-		05	-	-	-	2
raster	-	01	-	-	-	-	-	
Rdata	-	-		01	-	-	-	1
SHP	59	02	133	102	12	12	40	487
SPATIAL	69	-	-	-	-	-	-	-
TIFF	-	-		01	-	-	-	-
tre	-	-		01	-	-	-	-
TSV	-	-		06	-	-	-	3
TXT	-	-		06	-	-	-	5
WEB	57	-	-	-	-	-	60	-
WFS	-	-	130	-	-	-	40	-
WMS	76	-	281	-	6	-	68	-
XLS	-	-		03	-	-	-	4
XLSM	-	-		-	-	-	-	1
XLSX	-	-		09	12	-	-	11
ZIP	270	86	574	702	-	10	151	53
.csv	-	-		-	-	-	-	2
.zip	-	-		01	-	-	-	2
	1221	**559**	**3616**	**5181**	**115**	**133**	**983**	**5612**

(*AUS= Australia and *NZ = New Zealand)

The availability of datasets presented in table 5 in different formats plays a crucial role in enhancing the accessibility and usability of data related to natural landscapes, biodiversity, indigenous cultures, and environmental conservation on the Open Government Data (OGD) portals of Australia and New Zealand. By providing data in various formats such as CSV, GeoJSON, KML, SHP, TIFF, XLS, and ZIP, these portals

cater to a wide range of users with different technical preferences and requirements. For example, CSV and XLS formats are widely used for tabular data, making it easy for users to analyse and manipulate datasets related to biodiversity monitoring or environmental assessments. GeoJSON, KML, and SHP formats are ideal for spatial data, allowing users to visualise and analyse geographic information about natural landscapes, indigenous cultural sites, and protected areas. Additionally, formats such as PDF and DOCX may be used for documents, reports, or educational materials, enhancing the dissemination of information about environmental conservation initiatives or indigenous cultural heritage. The availability of datasets in multiple formats ensures that stakeholders, including researchers, policymakers, educators, and the general public, can access and utilise the data in their preferred tools and platforms, thereby fostering greater transparency, collaboration, and engagement in efforts to protect and preserve the natural and cultural heritage of Australia and New Zealand.

6.6 *Additional structural analysis of OGD portals of Australia and New Zealand*

6.6.1 *Australia's OGD*

Australia's OGD portal appears to have a robust structure, offering essential metadata, updated information, tags, and APIs for interoperability. The inclusion of organisation names contributing data enhances transparency and accountability. The National Map service, providing geospatial data, is a significant asset, enabling users to visualise and analyse spatial information effectively. However, despite these strengths, there are notable challenges and opportunities:

Challenges:

Some challenges are still there like data quality, interoperability, privacy and governance.

Opportunities:

The availability of geospatial data through the National Map service presents opportunities for innovation in various sectors. Users can access a wide range of geospatial datasets, including topographic information, land use and land cover data, water resources data, and protected areas data. For instance, the availability of detailed GIS/topographic data enables researchers, policymakers, and conservationists to accurately map and analyse the diverse landscapes of Australia, ranging from dense forests to arid deserts, thereby facilitating informed decision-making regarding land use planning, biodiversity conservation, and natural resource management. Besides that, collaboration and public engagement play a crucial role in promoting transparency and accountability.

Best practices:

Providing clear metadata and attribution of data sources enhances transparency and trust in the OGD portal along with user-centric design and community engagement.

6.6.2 *New Zealand's OGD*

New Zealand's OGD portal demonstrates several innovative features, such as grouping datasets into specific categories for easier discovery and a cataloguing guide system. Additionally, the integration of a blog feature and social media connectivity enhances citizen engagement and feedback mechanisms. However, there are challenges and opportunities to consider:

Challenges:

There are still some challenges related to data grouping and cataloguing, data quality, privacy and security and governance.

Opportunities:

The grouping of datasets and cataloguing guide system offer opportunities for users to discover relevant data more efficiently, fostering greater use and uptake of OGD along with citizen engagement through social media and blogging features and data-driven decision making.

Best practices:

User feedback mechanisms: Encouraging and actively soliciting feedback from users via social media, blogs, and other channels can help identify areas for improvement and prioritize future developments along with ensuring accessibility. Establishing a robust data governance framework that addresses issues of quality, privacy, security, and accountability is also fundamental to the long-term success and sustainability of the OGD initiative.

Needless to say, both Australia and New Zealand have made significant strides in leveraging OGD to illuminate their natural treasures, yet they face common challenges such as ensuring data quality, privacy protection, and effective governance. By embracing best practices and seizing opportunities for innovation and collaboration, these countries can further harness the power of OGD to drive positive social, economic, and environmental outcomes.

7. Conclusion

In conclusion, the transformative journey undertaken by Australia and New Zealand through Open Government Data (OGD) initiatives has illuminated their natural treasures, fostering transparency, accountability, and public engagement in environmental conservation and management efforts. By leveraging OGD, these nations have not only provided access to vital environmental data but have also unlocked the beauty and significance of their landscapes, biodiversity, indigenous cultures, and conservation initiatives. Despite facing challenges such as data quality assurance, privacy concerns, and governance issues, both countries have demonstrated a commitment to innovation, collaboration, and stakeholder engagement. Moving forward, embracing best practices and seizing opportunities for continued improvement will be paramount in maximising the societal benefits of OGD, driving positive environmental, social, and economic outcomes for current and future generations in Australia, New Zealand, and beyond.

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