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India's Open Data Initiatives: A Way to Knowledge Discovery, Transformation and to Achieve Sustainable Development Goals (SDGs) 2030

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ABSTRACT

The Government of India (GOI) implemented the Open Government Data (OGD) policy for better services to citizens and to make the government more transparent. Researchers supported accessible data, especially in the sciences and technology sectors, to reduce the repetition of study. In the present study, the attempt has been made to examine the success of policy implementation and how it has resulted in a sustainable open government data ecosystem in many sectors, as well as the types of services provided by this portal and its supporting portals. We also want to know how India is achieving the Sustainable Development Goals (SDGs) by 2030 with the help of OGD.

Keywords: Open data; Open government data; Sustainable development goals; OD; OGD; SDGs 2030

1. INTRODUCTION

As we are in a data explosion era, it seems like everyone is creating data, whether they mean to or not. Open Government Data (OGD) is the most significant type of Open Data (OD); this is data that government institutions create as part of their citizen's everyday lives. Open government data is essential because it can help people with even the most routine tasks that they have to do every day. Public institutions become more open and answerable to citizens by making their datasets available.[1] Governments encourage establishing new businesses and cutting-edge, public-centric services by promoting the usage, reuse, and free sharing of datasets. A vital tool for boosting public accountability is open data. Government transparency, accountability, and public engagement can be facilitated by making information publicly available as machine-readable open data. It can simplify integrating, processing, and analysing current data, opening up new possibilities for public scrutiny. Yu, Harlan; Robinson, David G.[2] added that citizens may assist the government by participating in many areas and "adding value to that data."

Data that we access in a machine-readable form through the internet without discrimination against areas, individuals, groups, etc. and everyone can use, reuse, redistribute/republish without restriction, copyright and patent called "OPEN DATA".[3,4]

The OD specialists/scientists contend that public data release may impact government openness and accountability. Still, David Robinson and Harlan Yu[5] stated that sharing machine-readable data may give governments the appearance of transparency. Tiago C. Peixoto[6] a political scientist with the World Bank, expanded on past ideas by emphasising a primary sequence of actions required for open data to result in accountability: A) only information that is important to the public and that can be widely distributed and understood by that public will be made public. B) When the public reacts to the information, public authorities must either address that reaction or face institutional consequences from the public (e.g., elections, recall).

The OGD poses some questions to the government, like how they will collect and process big data in India because India has heterogeneity in culture and diverse demography. How do they keep data up to date, and what steps will they take to keep data and platform stable? What kind of datasets are they primarily making accessible so that the public benefit is maximised?

2. BENEFITS OF OGD

The government creates data in a large amount and places it in the public domain so anyone, from anywhere, at any time, can access and it stands for the stakeholders and public greater good. Following are some benefits of OGD.

- Better decision-making, operational support for strategic planning, increased competitiveness, encouragement of innovation in the service of the community, and improved effectiveness and efficiency of government are all aided by OGD.
- Through improved public awareness of its operations and assistance in accepting policies and judgments, OGD fosters public trust in the government.
- OGD promotes innovation by making data available

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and supporting academia and citizens. All sectors work together and develop new services with added value or find answers to solve societal problems.

- By doing research and investigations based on available data and statistics might enhance the motivation for scientific research.
- OGD aids in the improvement of economic and societal choices at all scales and offers people, businesses, and organisations the data they need to make investments, grow their operations, and promote economic development.
- Through transparency and openness, OGD can encourage foreign investment, support businesses, boost employment rates, provide job possibilities, and support economic success and social security.
- Due to a transparent general accounting system, OGD can decrease the potential for corruption and poor management. It may also ease the burden of RTI for data collection, speed up the efficient use of government resources, and help locate data.

3. PRINCIPLES OF OPEN GOVERNMENT DATA

If the following principles given in Table 1 are followed, government data is said to be "open data."[7]: Several national governments have developed websites to disseminate some of the information they gather. It is a proposal for a cooperative endeavour to organise and foster a culture of OD or OGD inside the local administration.

4. OPEN GOVERNMENT DATA: INDIA'S INITIATIVES

As we live in the digital era and are transiting for an open society, all publicly funded institutions are pressured to make their data available openly because we all know they are the most prominent data creators. With time, the amount of open data slightly increases. India joined this movement after USA and UK and led developing nations; many nations joined this movement, opted for OGD policy, and released their datasets to the public.[9] The Government of India (GOI)[10] introduced

Table 1. Principles of open government data

S. No.	Principles	Explanation
1.	Documentation	Creating the data usable begins with providing documentation on its structure and significance.
2.	Non-proprietary and Complete	Every item of publicly accessible data is made freely available in its entirety and downloadable formats.
3.	Primary	Data is presented in the most precise manner available, directly from the source, and is not aggregated or otherwise altered.
4.	Timely	Data is made available as soon as possible to maintain the value of the data since we know that it has a value at one point and that it loses or decreases that value after a given period.
5.	Accessible	The most significant number of users may access data for the greatest number of uses and can reach the end user if data is available through the internet.
6.	Machine processable	To enable automated processing, data is moderately organised. Appropriately encoding information is necessary for its ability to be utilised extensively.
7.	Non-discriminatory	There shouldn't be any restrictions on who may access data, and registration shouldn't be necessary.
8.	License-free	No copyright, patent, trademark, or trade secret legislation applies to data. Restrictions on privileges, security, and privacy may be acceptable. There are no limits on its reuse.
9.	Online & freely available	Information is not public if it cannot be obtained online for free or for no more than the cost of creation or replication. It must be easy to find.
10.	Permanent	OD should be made publicly available as long as feasible in a consistent data format and at a compatible Internet site.
11.	Trusted	"Published material should be digitally signed or include attestation of publication/creation date, validity, and integrity," according to the Association of Computing Machinery's Recommendation (ACMR) on Open Government (February 2009) [8].
12.	Safe to open	In 2009 ACMR stated, "Government bodies publishing data online should always seek to publish using data formats that do not include executable content."
13.	Designed with public input	The people are best placed to judge whether technological advances will work with the applications they want to develop for themselves. Therefore, public input is essential if knowledge is to be shared in a valuable way.

the "National Data Sharing and Accessibility Policy (NDSAP)" to the union cabinet on March 17, 2012. A second policy, "Draft India Data Accessibility & Use Policy 2022," was released in February 2022. Both policies claimed that, with specific exclusions, all data created, collected, and maintained by all government ministries and departments will be accessible and shareable. They stated that Researchers support accessible data, especially in the sciences and technology sectors, and to reduce the repetition of study findings. The Indian Data Council (IDC) and the India Data Office (IDO) will regulate and enforce metadata standards.

4.1 Open Government Data Platform

A platform was launched in October 2012 and set up by the National Informatics Centre (NIC)[11] under the Ministry of Electronics and Information Technology (MeitY), GOI, to share government data openly with citizens and Figure 1 shows yearly growth of open data resources in this portal.[12]

With the implementation of NDSAP, India's Open Data initiatives gave pace to the government in providing public data, and the usability of OD has been increasing. An open-source stack has been used exclusively in the development and management of the OGD Platform.

OGD India portal offers a large quantity of open data in several areas, including 12822 catalogues, 575177 available data resources, and 508 chief data officers. These dataset resources have been downloaded 9.38 million times and have been viewed 31.94 million times. On these datasets, more than 2737 visualisations have been generated. The platform provides dataset APIs (161.304) and (136) sourced web services for developer's use. Citizens can also look at the most recently added, most viewed, and high-value datasets. All these datasets are further divided according to Sectors (Health, Judiciary etc.), Groups (MSME, Agricultural etc.), Central (Ministries), State (State Gov.) and APIs basis.

4.1.1 Sector-Wise Resources on Open Government Data

Table 2 Shows all resources (Central), catalogues and APIs (Application Programming Interface).[13] API's gives the ability to easily locate and download the content. The data is arranged according to Sector-wise and a total of 49 departments/ministries sharing data openly. Around 92.30 % of resources are shared by top 10 departments *i.e* 530943 out of 575177 resources are shared by first 10 departments, and the rest departments share only 7.70 % of total resources. Only 14 states share data on this portal (only 4.7 % of resources), much less than central (95.3 %).

The public can use open-source datasets available in CSV, XLS, JSON, XML, RDF, etc. These publicly available government datasets can be used by scholars, professionals, entrepreneurs, and members of civil society for research and development in both commercial and non-commercial fields.

Here are some supporting portals or services that help the OGD platform.

4.1.2 Open Government Data Community Portal

Citizens can express their wants and ideas and request clarification or information from government agencies through the community portal.[14] This community site invites citizens to submit blogs, visualisations, infographics, and applications on various datasets. This portal is divided into four communities (Tamil Nadu, Karnataka, Smart cities and data gov community), and they provide data openly as depicted in Fig. 2.

4.1.3 Open Government Data Event Portal

Indian Government demonstrated OGDs potential to citizens and developers' community through various events,

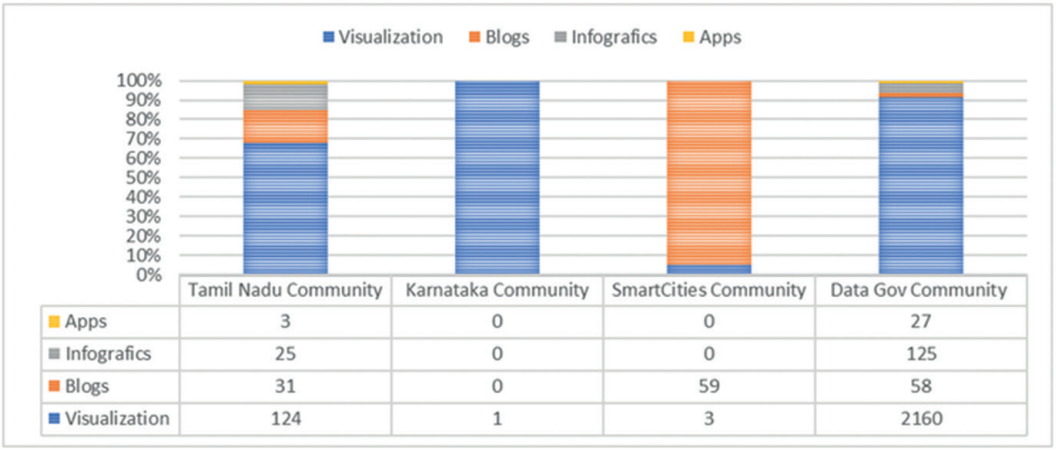
Figure 1. Growth of open data resources in OGD portal.

Table 2. Department/Ministry wise resources sharing

S. No.	Ministry/Department	Resources	Catalogue	APIs
1.	Ministry of Health and Family Welfare	307184	532	68559
2.	Ministry of Agriculture and Farmers Welfare	107563	403	14056
3.	Ministry of Home Affairs	45310	572	28070
4.	Ministry of Jal Shakti	26434	580	21926
5.	Rajya Sabha	17792	179	7764
6.	Ministry of Education	14937	89	14164
7.	Ministry of Housing and Urban Affairs	5135	3566	242
8.	Ministry of Statistics and Programme Implementation	2703	361	623
9.	Ministry of Road Transport and Highways	2140	159	418
10.	Ministry of Fisheries, Animal Husbandry and Dairying	1745	82	110
11.	NITI Aayog	1599	777	256
12.	Ministry of Consumer Affairs, Food and Public Distribution	1218	55	963
13.	Ministry of Environment, Forest and Climate Change	917	17	59
14.	Ministry of Civil Aviation	905	10	369
15.	Ministry of Power	658	8	69
16.	Ministry of Micro, Small and Medium Enterprises	525	19	475
17.	Ministry of Finance	406	134	133
18.	Ministry of Petroleum and Natural Gas	398	35	308
19.	Ministry of Development of North Eastern Region	377	17	1
20.	Ministry of Commerce and Industry	300	22	45
21.	Ministry of Tourism	233	3	143
22.	Ministry of Chemicals and Fertilizers	213	14	59
23.	Ministry of Corporate Affairs	203	27	130
24.	Ministry of Science and Technology	191	94	25
25.	Ministry of Communications	121	22	55
26.	Lok Sabha Secretariat	112	100	3
27.	Ministry of Mines	97	31	33
28.	Ministry of Railways	94	23	30
29.	Ministry of Earth Sciences	77	18	45
30.	Ministry of Ports, Shipping and Waterways	71	13	63
31.	Ministry of Law and Justice	51	6	21
32.	Ministry of New and Renewable Energy	40	12	2
33.	Ministry of Defence	35	26	6
34.	Department of Space	34	18	0
35.	Ministry of Information and Broadcasting	21	13	8
36.	Department of Atomic Energy	18	2	12
37.	Ministry of Tribal Affairs	17	1	4
38.	Comptroller And Auditor General of India (CAG)	16	16	0
39.	Ministry of Electronics and Information Technology (MeitY)	15	11	4
40.	Ministry of Steel	12	5	10
41.	Ministry of Panchayati Raj	11	7	5
42.	Ministry of AYUSH	10	10	1

43.	Ministry of Labour and Employment	10	3	0
44.	Ministry of Heavy Industries and Public Enterprises	9	9	3
45.	Ministry of Personnel, Public Grievances and Pensions	4	6	0
46.	Ministry of Skill Development And Entrepreneurship	3	3	3
47.	Ministry of Rural Development	2	2	1
48.	Ministry of Coal	2	2	1
49.	Ministry of External Affairs	1	1	1

Source: https://data.gov.in/metrics



	Tamil Nadu Community	Karnataka Community	SmartCities Community	Data Gov Community
Apps	3	0	0	27
Infografics	25	0	0	125
Blogs	31	0	59	58
Visualization	124	1	3	2160

Figure 2. OGD community data.

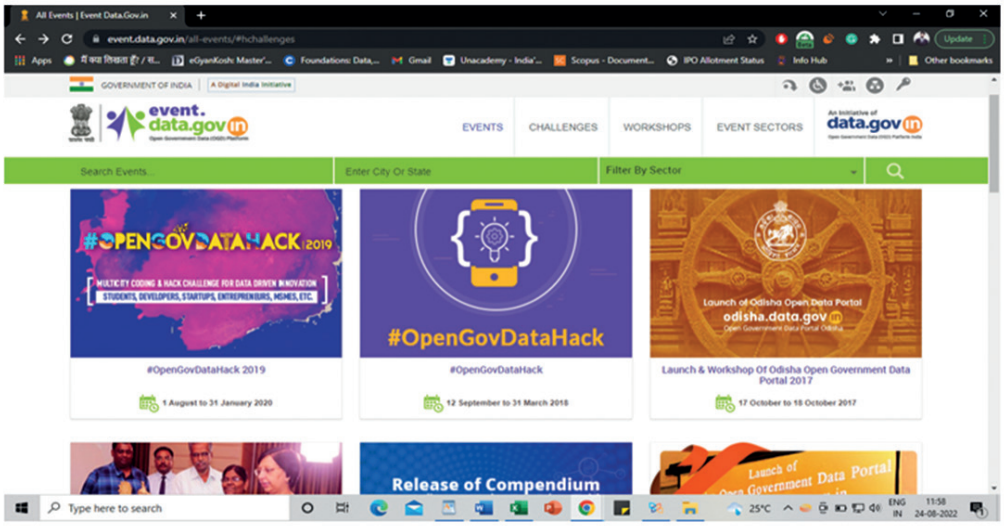


Figure 3. OGD events portal.

workshops and challenges such as 'OPENGOVDATAHACK 2019' 'DARPG Hackathon' 'Workshop for Data Contributors of Open Data Government (OGD) Platform India'. To administer these activities, a particular portal has been developed[15] (Shown in Fig. 3). For convenience, all events are further categorised into ten categories (such as education, science and technology, social development, etc.), so those interested may easily identify activities that match their interests.

4.1.4 Visualisation Portal

In addition to these programmes, the government is doing more to benefit Indian citizens. Anyone who wishes to contribute to visualising public data can use the Indian government's visualisation site.

4.2 National Data Platform and National Data and Analytics Platform

The Indian government is also establishing new

platforms to assist OGD initiatives. One such platform is the National Data Platform (NDP)[16], which will serve as a single national data marketplace for India and encourage participation in data discovery and usage by all stakeholders (public and commercial). National Data and Analytics Platform (NDAP) goal is improved access to and utilisation of publicly available Indian government data. The platform offers standardised datasets drawn from India's enormous administrative data ecosystem. NDAP helps users search, merge, visualise and download datasets with ease.

4.3 Ministry of Statistics and Programme Implementation (MoSPI)

In accordance with the general framework outlined in NDSAP 2012, guidelines on statistical data dissemination are being developed to define shareable and non-shareable statistical data produced by MoSPI (Table 1) and other statistical agencies, specify the terms and conditions for its dissemination, and outline pricing.[17]

A) Shareable data: All data sets that, if made public, would not jeopardise national security or that did not include information allowing for the identity of specific informants as well as businesses are thought to be shareable. The additional categories for the shareable datasets are as follows:

- Category A (open access data)
- Category B (Restricted access data free of cost)
- Category C (Restricted access data which is priced)

B) Non-shareable data: Data sets comprising information allowing for the identification of specific informants or establishments any information that may be utilised to discover the identify or details of a specific informant, whether directly or indirectly. As an example, it would not be possible to exchange the data of two distinct informants inside a recognisable geographic unit.

4.4 ICSSR Data Service

It is an MoU between ICSSR and MOSPI. This data repository hosted at INFLIBNET Centre, Gandhinagar. The goal of this repository is to address some problems, such as managing the massive amounts of social science research data from India which increasing day by day. MoSPI and Ministry of Home Affairs (MHA) creating huge data in interest to the social scientist such as- national sample survey and census data and to promote Open Access of this data to citizens. Pradhan[18] conducted research on the ICSSR Data Service and discovered 131 datasets. Since then, only nine datasets have been contributed to this repository during the previous seven years. Even though the data service was started on 20th June 2016, as on today we could see only 140 datasets available in the repository.

5. OGD FOR SCIENTIFIC COMMUNITY AND INSTITUTIONS

The research community benefits from open data in various ways, including greater academic record integrity, higher study visibility, and expanded data access. Open data also allows researchers to derive new conclusions from publicly available data. Open information also facilitates the replication and validation of investigations. The increase in researcher openness and the decrease in academic fraud, etc. Research funding is decreasing, datasets are not being appropriately preserved, more academics are vying for the same funding, and research-generated data is still unavailable. But we are overcoming these challenges thanks to OGD. By lowering the costs of data collecting, enabling the low-cost exploitation of inactive or inaccessible data, and expanding the chances for cooperation in research and innovation, OD can improve the effectiveness and quality of research.[19]

Because science is becoming more expensive and data-driven, accessible data is essential at scientific institutions. The government is addressing these barriers to protect and encourage more openness in research since science uses both textual and non-textual data. By facilitating worldwide access to data, improved research data accessibility can promote science's role in addressing global issues. OGD may also be utilised to encourage the development of nations' institutional frameworks while opening doors for innovative and collaborative research. Better access to data speeds up a scientific inquiry and increases the rate of innovation. We need projects such as "The Human Genome Project" built to provide "All human genomic sequence information should be freely available and in the public domain to encourage research and development and to maximise its benefit to society."

6. ROLE OF OGD IN ACHIEVING SDGS 2030 GOALS

In 2015 United Nations (UN)[20, 21] introduced the SDG's goals 2030; after this, the Open Science movement (OSM) started and boosted the "Smart Digital Government", which "focuses on doing more with less" data, which is the most valuable asset for modern governance. The importance of OGD may be shown in the beneficial ways that it could assist in achieving the SDGs. Here is a list of the 17 Sustainable Development Goals for 2030 shown in Table 3 and how open government data is being used to accomplish each.

7. DISCUSSION

To fully comprehend why users (citizens) would actively use open data and participate in the project, this model must have a deep understanding of human components. By fostering digital confidence in economic activities and its goals, the government should develop a data-driven governance architecture.

A. As we live in the digital era and the amount of data is growing very fast, but even after ten years of

Table 3. Sustainable Development Goals for 2030

S. No.	Sustainable development goals 2030	Role of open data and open government data
1.	No poverty	Data is necessary to depict urban slums, assess the severity of poverty, comprehend its origins, and guarantee that everyone has access to essential services. It is now much more straight forward to spot trends in the impacted population because of India's telecom revolution over the past ten years and the country's broad availability of mobile services, especially in rural regions. Open Data about employment and educational opportunities can help individuals achieve economic security.
2.	Zero hunger (No hunger)	The government provides information to farmers to help them make better decisions to end hunger, provide food security, improve nutrition, and support sustainable agriculture. Misuse of pesticides, fluctuating food prices, and small-time thievery are just a few of the regional issues that Open Data is aiding.
3.	Good health and well-being	The benefits of OGD for health range from delivering essential services to research that may substantially impact healthcare quality and cost, ensure healthy lives and promote wellness for people of all ages. Open data is a crucial weapon in the fight against infectious illnesses since it can forecast and control disease outbreaks and monitor and stop infection when it does spread. The best example of the Indian government's provision of primary information and its successful contribution to containing COVID-19's space is COVID-19.
4.	Quality education	The Ministry of Education provides education statistics, revealing various issues with the country's educational system, such as finding regionally specific student dropout rates. Accessible data may help schools become more productive. It encourages the possibility of lifelong learning for everyone and provides inclusive, egalitarian, and high-quality education.
5.	Gender equality	The shortcomings in the ways that institutions serve women and girls in health and education can be shown by open data analysis. Using demographic, educational, and health data from national statistics agencies, it is feasible to develop indices of gender inequalities in various professions. Leveraging open data on healthcare, education, and basic need promote balanced economic growth; it might highlight patterns between men and women and close any discrepancies.
6.	Clean water and sanitation	Communities may be mapped using GPS and satellite data to find the locations of water and sanitary services and the areas in which they are needed. Additionally, sensors on water pumps can keep an eye on who has access to clean water. By doing this, we can ensure that water is handled responsibly and available to everyone.
7.	Affordable and clean energy	Governments and businesses may prioritise green energy-generating investments and choose where and how to expand the electric grid by using open data from sources such as home energy surveys, satellite images, and other sources. For instance, Open Data is being utilised in India to create data-driven systems that estimate the amount of electricity produced by wind and solar sources, allowing for the prediction and management of these renewable sources to provide the most energy.
8.	Decent work and economic growth	Open data may be helpful for entrepreneurship, business growth, talent development, and job market advancement. It may be the starting point for cutting-edge new ventures in the economy's health, environment, energy, finance, education, and other areas. They may be able to grow and recruit additional staff if OGD helps them run more financially and effectively. Indicators like remittances and GDP may be obtained by analysing patterns created by linked devices and sensors.
9.	Industry, innovation and infrastructure	Rethinking and enhancing urban infrastructure requires the use of open data. To create "smart cities," the government must combine Open Data with broad, varied, and timely data gathered from sensors across the city to monitor things like traffic, air quality, and other variables. To comprehend urban problems and enhance urban planning, open data is employed. The improvement of public transportation and traffic control may benefit from using GPS data.
10.	Reduced inequality	Open data can expose Inequalities and assist in prioritising efforts to address them. Poverty levels, programme eligibility for nutrition and health, and a wide range of other social services are all determined using information from national statistics organisations and other sources. This information may then guide economic strategies to meet the best results.

11.	Sustainable cities and communities	Identifying at-risk locations and populations, reducing catastrophe risk, and coordinating relief activities, including applications using government and citizen-collected data, are some of the most successful uses of open data. It can contribute to the inclusiveness, security, resiliency, and sustainability of cities and human settlements.
12.	Responsible consumption and production	With open data, it is possible to monitor consumer prices locally and globally and identify the first indications of food shortages, inflationary pressures, and other market issues. It can aid in maintaining appropriate production and consumption patterns.
13.	Climate action	Today, significant national and international data initiatives focus on environmental challenges, including climate change. Various federal departments' data are now available for study with a cross-government initiative. Programs for open data aim to make communities and nations more resilient to climate change. It can assist in implementing a swift response to address climate change and its effects.
14.	Life below water	Government organisations monitor fishing worldwide, and by making their data public and easily accessible, they may put more pressure on other countries to comply. Open data on the marine environment can facilitate using marine energy resources like geothermal vents. Additionally, it may uncover unreported, uncontrolled, and illegal fishing activity.
15.	Life on land	To put more pressure on businesses to operate sustainably, NGOs and public organisations can utilise open data to track the status of the world's resources and the activities employed to extract them. This data helps assess how circumstances have changed and gauge policy effects.
16.	Peace, justice and strong institutions	Open data is essential to make institutions more transparent, inclusive, and responsible. India frequently uses data in expenditure transparency projects for internal controls and outside reputation. The Indian government works to support inclusive, peaceful communities for long-term growth, ensure that everyone has access to justice, and create inclusive institutions at all levels.
17.	Partnership for the goals	Available aid data on developing nations may enable more efficient distribution of foreign aid funds and support for sustainable development partnerships with industry, academia, and civic society to allow the fusion of statistics and open data to give people a better, more up-to-date understanding of the hyperconnected world of today. The global partnership for sustainable development may be reactivated and implemented with its aid.

implementation of the NDSAP policy, the total no. of Resources is insignificant in comparison to other countries with time.

B. Only two states contribute to the community portal, and 14 states and union territories provide data on the open data portal (4.7 % of resources).

C. Sectors have subcategories; however, their contribution is insignificant. For instance, ICMR is a subcategory within the Ministry of Health and Family Welfare that shares only one resource further, many sectors are submitting incomplete data. For example, The Tourism Arrivals 1981-2022 dataset.

D. Many departments are not updated with time and also do not sharing data with the site. For example, 14 out of 49 departments share less than 20 resources

E. The number of visualisations on these datasets is insignificant, and the visualisation of new datasets is not available yet.

F. We have approximately 135 crore people, out of which only 471346 are registered on the site, and just 3275 proposals for additional dataset entries have been submitted in a decade.

G. A deeper look at the open data initiative reveals strong intentions but erratic implementation. As a result, while India produces data points, relatively little of it is used by data consumers, scientists, and corporations. The socioeconomic impact is, of course, limited.

H. The comprehensiveness of a data stack or different data sets is complex. Currently, data sets shared in India are somewhat disjointed and not comprehensive. Clustering of relevant data sets and APIs would take it to the next level.

I. The relationship between the public need and the emphasis that open data lays need to be evaluated.

J. The sorts of user interaction available through the OGD portal might be related to the amount of user involvement. The evaluation will highlight many methods of user interaction and involvement made on the OGD portal, ranging from user ratings to community-based engagement.

K. Establishing an open data council facilitating cross-sector participation to monitor and regulate, as part of a comprehensive governance structure.

8. CONCLUSIONS

It is necessary to take adequate measures to make more scientific data accessible for the use and benefit of society with the cooperation of the government, academics, research institutions, and developers. Infrastructural issues, data shortages, governance issues, and issues with dependability, quality, and privacy are among the most prevalent obstacles. Protecting people's privacy

rights should be the government's top priority because data privacy has recently become one of the major concerns. OGD also boosts innovation and research and reduces barriers to interoperability. We need more policy, standards, and machine-readable metadata to improve interoperability. It will allow more transparency and accessibility to everyone. Open data are critical for the validation of research findings, for building widespread confidence in them, for preventing redundant studies, and for spotting false positives. In this study, we discussed advancements in OD, OGD, and its visualisation tools and their contribution to the SDGs, particularly in India.

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His contributions to the study are the introduction, literature search, assistance in data tabulation, interpretation, manuscript editing, and referencing.

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