Transparency, GIS and River Basin Management in the Ganga-Brahamputra-Meghna Basin

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Abstract

As the discussion widens on the types of commissions and citizen and diplomatic channels needed to share water and solve common problems in the Ganges-Brahmaputra-Meghna (GBM) river basin, the lack of access to reliable data will be the first challenge to address. All countries in the GBM basin are hesitant to share their hydrological data on the shared rivers and information on the construction of hydroelectric projects is harder to find. Data and information on land use changes, river bed and flow regime changes and actual stages of project construction should be available to governments, scientists, civil society and all river basin residents through online resources, satellite imagery, and aerial photography, in order to facilitate the most conscientious use of these shared hydrological resources. This paper provides a number of suggestions for developing methods and forums for exchanging current and historical hydrological, ecological and socioeconomic data in the GBM. It also reviews examples of the benefits of open data and information exchanges in other transboundary basins.

Introduction

The Ganga-Brahmaputra-Meghna river basin is a place of majesty where glaciers hug the world's tallest mountains, snow melt and precipitation combine to form the water of a vibrant river system, and millennia of cultural diversity guide human life ways. The towering mountains of the Himalaya house the great water storages of Asia in their vast glacial formations. Over the last century these natural storages and river systems have provided water to sustain millions of people across South Asia. Today the flows of these rivers have doubled in value for human populations, as they provide not only water but the power to fuel the desires and needs of 21st century civilizations.

Given the water wealth of the Ganga and Brahmaputra rivers, religions of the region have granted the tributaries and main stems of these rivers a revered position in cultural narratives and practices. The river Ganga is the most revered and her religious significance as a Mother Goddess and eternal purifier are unparalleled in human history. The water wealth of this river has been worshipped by humans as part of the overall engagement that is necessary for human life. From these great attachments have emerged understandings of the river that revere and thank her. The tributaries to the Brahmaputra are worshipped by Tibetan Buddhists (cite) and in India the main stem of the Brahmaputra is considered a sacred river (cite and add). For tribal groups in Meghalaya, the Barak river is ……But as water enters a new phase of global commodification, even more is at stake for these sacred rivers, its tributaries and the human populations that depend upon the river system.

In addition to the deep and vast ecological histories of these rivers and their tributaries, the concentrations of water in the snowfields and glaciers of the Himalayas are a valuable storage and frontier resource at a time when nation-states are vying for more water to meet growing demands and populations (Chellany 2011; China Dialogue 2010; Immerzeel et al. 2010). But what will happen to these storages if the planet warms? How fast will glaciers melt and how will this accelerated melting affect the flows of the river and its tributaries? These are questions propelling a new wave of policy and assessment on river management and engineering across the transnational basin. The availability of water storage in the glaciers and the assumption that these glaciers might be melting faster are motivating a push for hydropower across the Ganga and in the other eight river basins that receive their water run-off from the Himalayas.

Many decisions related to water governance occur at points of intersection, where interests in some water uses may drive out other water needs that are critical to human survival. In this transnational basin, upstream countries and regions have significant power over their downstream neighbors. The rapid development of hydropower is posing new challenges for human adaptation to a changing climate and to long term water availability for all downstream users. The public-private race into the hydropower market entails covert forms of influence and decision-making but produces overt ecological consequences that may impact a broad sector of water users. Additionally, hydropower facilities must be legitimized and made acceptable by river basin policies and assessment reports that are made abroad or that are significantly influenced by other foreign relations matters. They may justify the ecological and human effects that may ensue from a rapid proliferation of facilities and supporting infrastructure without taking into account accurate hydrological and ecological effects and problems.

This paper explores the need for transparency in river basin planning as it sketches out ways that the basin countries of India, China, Nepal and Bangladesh can create open forums for the exchange of critical information on water uses and hydrological and ecological data. The paper will also sketch out the most intensive uses of water in the basin and therefore will focus on a project that has mapped out hydropower facilities across the Himalayas. The paper explains the GIS mapping project and then offers additional ways to expand the open-sourcing of science underway by NGO groups, civil society and legal activism in India, Nepal and Bangladesh.

Existing Portals and Public Information Sites

Some of the best public information sites are provided by nongovernmental organizations and International Rivers (1) and the Circle of Blue (2) are among the best in North America. Many good maps are also produced in the public domain by smaller organizations and scientists.(3) However, most maps lack exact locational data and in some areas imagery that could reveal infrastructure projects in the GBM basin are blocked. The restricted access to information and satellite imagery on intensive water use schemes does not bode well for transboundary dialogue and water sharing agreements. Information on water and land uses in the basin can aid in flood alert and warning systems for residents and businesses, in water management for municipal, agricultural and industrial needs, and in overall human adaptation to climatic and anthropogenic changes to river flows. With water stress closely associated to climate change, any transboundary dialogue must start with a transparent method of information and data exchange on planned and current water use projects.

Today the Ganga-Brahmaputra-Meghna basin holds over one billion people. From the Himalayas to the Bay of Bengal, the Ganga passes by more than 30 major cities of more than 300,000 residents and the river borders many other smaller towns. The Ganga has provided municipal and industrial water for these cities. India’s Central Pollution Control Board reports that three-fourths of the pollution of the river comes from the discharge of untreated municipal sewage draining from these urban centers. (Central Pollution Control Board at http://cpcb.nic.in/water.php). The Upper Ganga plain in the state of Uttar Pradesh is home to sugar factories, leather tanneries, textile industries of cotton, wool, jute and silk, food processing industries related with rice, dal and edible oils, paper and pulp industries, heavy chemical factories, and fertilizer and rubber manufacturing units. Industrial wastewater is discharged by all these industries and contains hazardous chemicals and pathogens. Four major thermal power plants depend upon water from the Ganga (Alley 2002). The Brahamputra…. The Meghna……

These industrial and urban effluents have led to a very serious deterioration of river water quality across the plains. Moreover, groundwater levels are declining across Indian and especially in northwestern India from over-pumping for agriculture and domestic activities (Rodell et al. 2009; Scott and Sharma 2009). As surface water quality declines, residents turn to groundwater for a good portion of domestic, municipal, agricultural and industrial needs. The groundwater supply will need recharge from adequate river flows to continue to meet such high demands. River flows that are altered by hydroelectric dams and canals and that divert water to needy urban centers are affecting this recharge rate. In the warming climate, faster glacial melt may bring more water into the river system at some times of the year but can lead to flash floods especially in riverbeds that have become disembedded from ecological and hydrological systems by dams and diversions (Mustafa and Wrathall 2011). Increased rainfall and glacial melt may help to recharge groundwater and dilute pollution in the river's flow but both can lead to dangerous and deadly flooding.

Hydropower Developments in the basin

Hydropower is an important energy strategy that reshapes the ecological functions and services of a river system. Large dams were built just after Indian Independence as part of national development and significant resistances to these large dams developed in the following three decades Baviskar 2005; Dharmadhikary 2005; Gilmartin 1995; Singh 1997; Wagle et al. 2012).

The current wave of dam investment is motivated by the 21st-century interest in industrial growth and urban expansion, and by expanded water consumption. In 2002, the Government of India announced a *50,000 megawatt initiative* to narrow the gap between supply and the growing demand for power. This hydropower push has focused on the Indian Himalayas where the steep drops of tributaries to the Indus, Ganga and Brahmaputra rivers have the potential to generate larger outputs of power. The sites of current development are located across the northern region of India, in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Sikkim, Arunachal Pradesh and Assam.

Along the northwestern tributaries of the Ganga river in the State of Uttarakhand, the Tehri dam and several run of the river dams were completed in the first decade of the 21st centuryto provide energy and water supply to the northwestern states of Uttar Pradesh, Delhi and Rajasthan. The development has been fierce and controversial with energy and industrial interests in water pushing out allocations and uses for farmers and residents, and citizens have mounted various campaigns and movements against specific projects (Bisht 2009; Drew 2011; Kumar 1996; Mawdsley 2005; McAnaly 2012; Wagle et al. 2012). The practices in the Ganga basin are similar to those playing out along all the other river systems sharing the Himalayas. For example, along the Beas and Sutlej rivers that flow into the Indus river system, several hydropower projects have been constructed and many are underway. There are also local and regional protests over these projects. In Sikkim a cascade of dams is proposed along the Teesta river to augment the existing two. In the northeastern state of Arunachal Pradesh, the government has sketched up a blitz of projects along the main tributaries of the Brahmaputra, along the Siang, Subansiri, Lohit, and Dibang rivers (Yumnam 2012).(see figure 2)

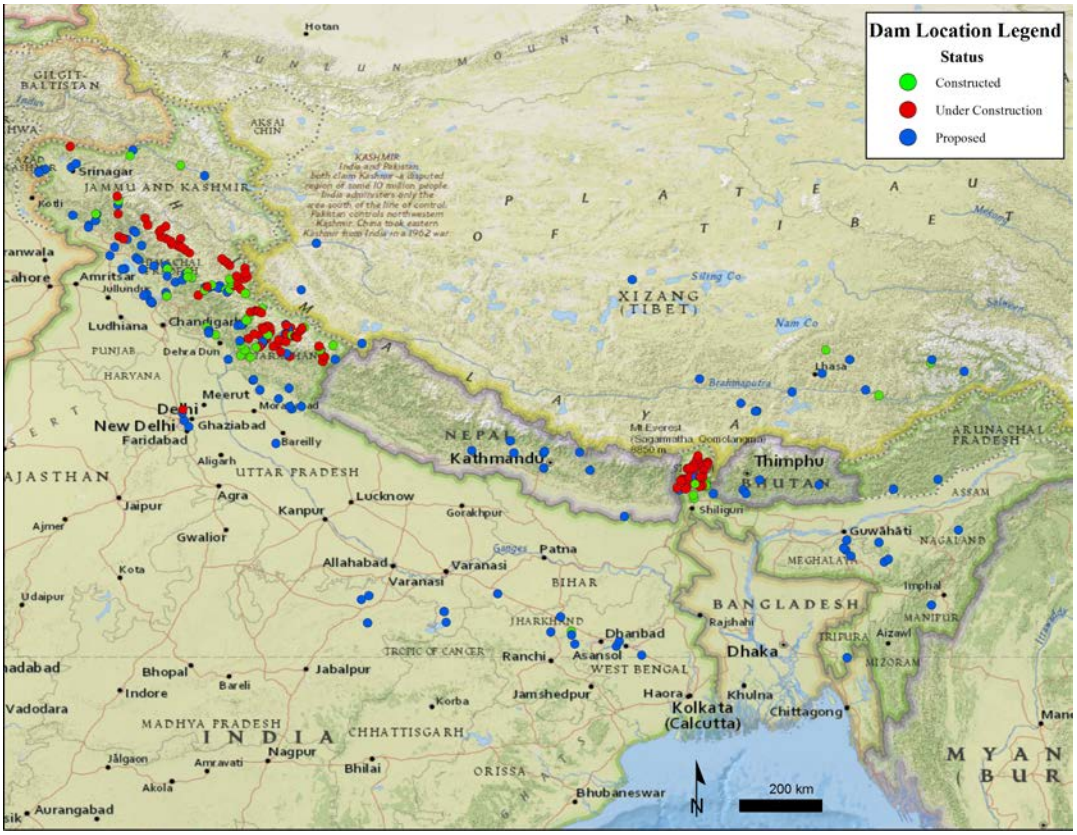

Figure 2. Dam sites (constructed, under construction, and proposed) within the Ganges and Brahmaputra basins. Source: National Geographic base map in ArcGIS. Map created by: Ryan Hile (permission granted) [file name: South Asia dams]

The current push for hydropower across the Himalayas is supported by assessments that only a small portion of the power potential has been tapped in the region (Menon and Kohli 2005; Government of India 2010b; Vagholikar and Das 2010). Investors have been lured by new incentives for open access and the freedom to sell power on a merchant basis, the possibility of transferring hydrological risks to the public, and recent trading in Clean Development Mechanism (CDM) carbon credits (Dharmadhikary 2008; Dharmadhikary 2010; Yumnam 2012). But contrary to expectations, hydropower does not always result in an increase in energy for people living in these river basin cities and towns; generally local citizens get the end of the trickle down effects of an increase in power supply. The bulk of energy generated is sold to high end users such as industries and urban facilities (Sreekumar and Dixit 2010; Wagle et al. 2012). In addition to their energy usage, the high end users also withdraw significant amounts of water for industrial and urban processes and return large amounts of wastewater to the river system.

Civil Society Movements against Hydropower Development

In the Ganga basin, the short term effects of run of the river dams have come to light after pressure from a number of groups forced the final cancellation of two projects in 2010. Shortly after the government's announcement of the 50 megawatt initiative, the Ministry of Power charted out an over-ambitious plan to dam all the tributaries of the river Ganga at more than 60 places in Uttarakhand state. Maps of these plans began circulating through civil society networks and people in and outside the state grew worried about the cumulative effects of these dams on water availability downstream, and general water quality in low flow situations (see South Asian Network for Dams, Rivers and People at sandrp.in). Local resistance movements formed and then pressure was exerted on government through exercises of resistance fasting. Civil society or environmental activists use the Gandhian ritual of fasting to push government officials toward a final decision on an issue or project, and to draw the attention needed to register the official decision in the public media. These public records can be used by citizens to enforce accountability when a government agency attempts to backpedal or reverse a decision later in time. To oppose the Loharinag Pala dam, a retired professor from a top engineering school and former chairman of the Central Pollution Control Board began a fast unto death. He started and stopped the fast several times before his final stretch in the summer of 2010. When he was critically ill, the Environment Minister announced that the dam would be scrapped and an eco-sensitive zone would be established in the area. This fasting by an important figure was the tipping point for the decision to cancel a problematic project (Drew 2011, 2012). A year later another sadhu-sant fasted for the cause of the river Ganga but there was little attention to his protest. He perished without any response from the authorities.

In 2010, the Indian magazine, *Frontline*, ran an announcement on the report titled "Performance Audit of Hydropower Development through Private Sector Participation" (Tripathi 2010). In the report, the Comptroller and Auditor General (CAG) argued that the government of Uttarakhand had pushed the state toward a major environmental catastrophe by following a highly ambitious hydropower policy. After the cancellation of run of the river dams at Loharinag Pala and two in the advanced planning stage (Pala Maneri and BhaironGhati), the Ministry of Environment and Forests issued the *Notification for an Eco-Fragile Zone on the Upper Bhagirathi* to protect the upper Bhagirathi and ban additional hydropower projects, indicating that some policy makers may have realized a threshold for altering the river stream and flow regimes in the upper reaches of the Bhagirathi. A new study on recent flooding in Pakistan states that the aggradation of river channels caused by water withdrawals and dam construction may be reducing the width of downstream channels, making river beds less elastic to extreme flows in the rainy season (Mustafa and Wrathall 2011). The loss of river beds and the carriage of sediment outside the channel may worsen flood peaks. Yet despite this understanding of the risks associated with emerging patterns of climate change, hydropower projects remain on the execution list for the end of India's 11th year plan and into the 12th year plan. The government has theoretically closed the upper Bhagirathi to additional dam construction, but continues to grant permits to projects on the Mandakini, Dhauli Ganga and Pinder rivers which flow into the Alaknanda river and eventually into the Ganga. On the Alaknanda tributary, a cascade of four dams is under construction with a mix of private and public sector financing and management. All the dams currently under construction — Vishnuprayag, LataVishnugad, Vishnugad Pipalkoti and Srinagar — are located in the fragile upper reaches of the Ganga basin. In total 13 dams have already been constructed in Uttarakhand and 57 more are approved or in various stages of construction (Alley 2011; Alternate Hydro Centre 2011).

In national policy and planning, this spurt in hydropower is justified by two general interests, a primary interest in additional energy generation and a secondary concern with reducing CO2 emissions by moving away from coal. The state of Uttarakhand along with Himachal Pradesh and Jammu and Kashmir are the fastest growing hydropower markets in the country. The steep drops of the high Himalayas are prime sites for hydropower where the greatest power of the river's flow resides in the drops of the feeder streams and tributaries of the upper reaches. Hydropower interests travel uphill toward glacial snouts and concentrate in the most fragile ecological zones. This is where high altitude flora and fauna temper glacial melt and monsoon rains, as if they are Shiva's braided hair. The expectation is that the greatest amount of power can be generated during the period of spring and summer, when melt water and monsoon rains greatly increase river flows. Power generation would then taper off during the lean season from November through February. During the spring and summer in particular, hydropower can meet needs for "peaking power," that is demanded at high load times of the day.

River flows are affected by large storage dams and run of the river projects. Since the majority of dams now under construction and planned for Uttarakhand are run of the river projects, it is anticipated that the flow regimes for all these rivers will be greatly impacted. A 'run of the river' dam differs from a storage dam in that river flow is halted for a short period behind a small barrage, held in a small storage pond and then released into an earthen tunnel. The tunnel then guides the river flow toward a steep drop and the sheer force of the engineered waterfall turns the turbines that generate power. The downstream flow of the river then alternates between reduced flow while water is halted and collected in the storage pond and a flashy flow at other times, when water is released into the tunnel and down the shaft. This alternation in flow creates somewhat unpredictable rivers for downstream residents and can increase erosion along the riverbanks. Hydropower engineers argue that this flashy flow can be leveled out by creating a series of run of the river dams in a cascade, so that each storage pond would stop the rush of flow from the tunnel above it. Engineers assert that alteration to the total flow will remain minimal. A new assessment report notes, "the downstream fluctuation will get moderated by valley storage effect and lateral flow joining the river" (Alternate Hydro Centre 2011: 65).

Therefore residents living downstream from these cascading hydropower projects will be "adapting" to an altered flow regime. This is not adaptation to ecological changes brought about through a complex process of climate change alone, but adaptation required by a specific set of engineering projects that will compound the experience of climate instability. River valley residents will undergo serial adaptation. In some climate change policies, this is called "maladaptation." These multiple and staged effects can occur across a range of offset projects created to reduce carbon emissions. These facilities and land use changes will create another set of impacts for communities and especially for subsistence resource users. Together, climate change and the programs established to mitigate climate processes make communities more vulnerable to changes in their water systems over time (Schwarzenbach et al. 2010; Malone 2010). This makes open information portals and effective exchange of information between residents critically important.

Environmental impact assessments are needed to create justifications for specific resource uses. Environmental assessments that must weigh a project's ecological costs and benefits may be used to grant project clearances and permits. A cumulative impact assessment is now required for projects that have many components spread across a region or river basin. A cumulative impact assessment may therefore become a clearing mechanism for many projects all at once, avoiding the need of individual assessments for each component of a large development plan. This makes the idea of a cumulative assessment suspect, and current institutions of governance at national or international levels cannot answer to the principle of intergenerational equity. So measures now used to calculate cumulative impacts and future scenarios are inadequate.

In 2009, the Uttarakhand High Court responded to a citizen petition demanding a cumulative impact assessment for all the hydropower projects planned and under construction in the upper Ganga river basin. The Court ordered a scientific study to analyze land use changes and basin-wide ecological problems, and to predict the effects of a rapid and prolific development of hydropower facilities. The final report brought new science and data into the public domain but had the effect of endorsing all the planned projects without finding a single one dangerous to ecosystems and services. In its conclusion, the report also argued to reopen three projects the Ministry of Environment and Forests cancelled in 2010. This science report also contradicted the Notification for an Eco-Fragile Zone on the Upper Bhagirathi, a legal document issued in 2010 to protect the upper tributary from additional hydropower and urban development (Government of India 2011). In late 2011, the Government of India announced a committee to perform final financial closure for the three canceled dam projects, suggesting that it would not reconsider them. However, the cumulative impact assessment report remains a part of a living policy for water management and planning in the state of Uttarakhand. Its status was bolstered when the World Bank cited it in the safeguard sheet as the required environmental impact assessment for the dam (World Bank 2011).

Citizen Involvement in Measuring externalities and EROI

Citizen groups, local and regional organizations and farmers' unions and religious institutions should be involved in the measuring of externalities of dam projects and in understanding the EROI metric. One method for measuring the externalities that is, the negative or positive effects of such projects, is to calculate the total proposed land use changes and then plot out the geomorphological and hydrological effects to the river system and the carbon footprint generated from the carbon fluxes of land use and river system changes. Documentation of sediment loads and land and hydrological changes can be plotted using ground and satellite data. In addition, the values of biodiversity and human cultural practices must be added to the total ecosystem services for the river system.. In terms of biodiversity, the Cumulative Impact Assessment report notes that hydropower facilities are located in the small streams that act as hatcheries for biological production at the first and second tropic levels of freshwater ecosystems. They are a rich source of aquatic biodiversity (Alternate Hydro Centre 2011:9). The report also notes that, "landslides and sediment movement as debris flow are frequent in these reaches" (Alternate Hydro Centre 2011:8). However in the end, the protection for feeder streams advocated in the Assessment report is undermined by the report's own recommendations to approve all projects; these are projects that will alter all regime flows, dry sacred confluences, and tamper with the fragile headwaters and ecosystems near glacial snouts. A holistic measure of climate change should account for these mitigation effects, for changes to river beds and land uses in the upper reaches that impact a range of biodiversity and cultural values essential to ecosystem services and species survival. These can be tallied into the final measure of carbon fluxes so important to climate policies (Tian et al. 2011).

This procedure can also be followed when measuring the energy returned on energy invested (EROI) for a particular hydropower project and especially for a series of projects (Lerch 2010). The metric must list the carbon tonnage “saved” by switching from coal to hydropower and then subtract all the carbon fluxes ensuing from land uses and hydrological changes. Then the human losses associated with cultural practices related to the sacrality of the river, and the economic costs and benefits of tourism and pilgrimage can be included. All these human needs and losses can be added to the total evaluation of river water uses and trade-offs between various uses, to determine how to allocate water across a range of needs and interests in a way that is beneficial to the largest number of people and the supporting ecosystems. This ensures that the metric of EROI, the energy returned on energy invested, does not just calculate energy but all the ecological, hydrological, land use and human and social costs of ecological change. Even though energy is the highest public and private good in industrializing society, water weaves through all ecosystems and human communities as a non-substitutable element and cannot be compromised.

The environmental impact assessments (EIAs) produced for specific projects should calculate safe levels of ecological and hydrological change through the guarantee of minimum flows, the protection for biodiversity and eco-fragile regions, and the support for cultural practices vital to local economies. Climate change policies legitimize the push to exploit the power of flow and allow energy interests to trump other uses and priorities. Engineering models support this push when they downplay the effects of water storages and alterations on river beds and flow regimes. In this way water security is subordinated to energy demands at the highest levels and in all quarters. This is a complex threat for residents of these river basins.

Image 4: Dam at Srinagar, Uttarakhand under construction. Photo by Kelly Alley [file name: Srinagardam1]

Image 5: Dam at Tapovan Vishnugad under construction. Photo by Kelly Alley [file name: tapovanvishnugaddam2]

Open Sourcing of Science in the Basin Countries

In the water and hydropower politics of the Ganga basin, the concept of integrated river basin management emerges as a policy ideal; in this the goal is to have all stakeholders at the table with a fair say on how to use the river basin resources for all. But in reality the coordination is a confrontation, a push and push-back that characterizes the evolution of decisions and subsequent water uses. Now the epistemic or decision-making community has expanded to include university scientists and extension specialists, nongovernmental organizations, religious institutions, finance and resource investors, Ministry of Environment and Forests regulators, World Bank and Asian Bank project managers and civil society members in India and Bangladesh (Ahmed et al. 2004; Alley 2004; Bhaduri 2012; Zawahri and Hensengerth 2012). Science groups have the potential to bring more ecological and climate expertise into the planning and assessment process. The new IIT (Indian Institute of Technology) consortium charting out the Ganga Basin Management Plan is a good example of a group carrying out research and specific management and policy and bridging government agencies and civil society (see Gangapedia web site http://gangapedia.iitk.ac.in/?q=content/grbemp-reports-1). Expert committees are also formed by court orders to offer analysis and comment on resource intensive projects including feasibility and detailed project reports. However, experts are hired within and outside India by all parties with an interest in a water project, and some of these experts find their way onto policy committees. The decision-making table will be dynamic and should include the leaders and citizens who depend upon this river system for their agricultural, municipal, religious and cultural practices. These are practices that provide a vital link to the ongoing human necessity for living rivers.

Hydropower Mapping Project

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Examples of Information Exchange in other Transnational Basin

Chandana-------------

Conclusions

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Portal Sources

1. **International Rivers http://www.internationalrivers.org/**
2. **Circle of Blue http: http://www.circleofblue.org/waternews/**
3. **South Asia Network for Dams, Rivers and People http://www.sandrp.in**

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