THE FAULT IN OUR ARTIFICIAL STARS: EFFICACY OF SATELLITE SURVEILLANCE SYSTEMS IN INDIA'S CONSERVATION EFFORTS

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ABSTRACT:

In modern times, technology has intersected every field of study and research. Environmental law has thoroughly integrated technology in conservation and protection efforts under various national and state legislations. Under legislations such as the Wildlife Protection Act and the Forest Rights Act, satellite imagery is used for data collection to help the authorities study and analyse the need for protection in certain areas. It is labour free and cheaper compared to the infield, manual counting and surveying method. The authorities rely on it to take environmentally directed actions such as reservation of forests, preservation of species, or eviction of forest dwellers. The courts too have often relied on it to decide whether traditional forest dwellers adversely impact the forest and the wildlife and whether they should be evicted and relocated. Their popularity can be attributed to the fact that science and technology enjoy the benefit of objectivity. Yet, as the Gujarat High Court noted in Action Research In v. the State of Gujarat, technologies such as satellite imagery are not infallible. It faces issues such as lack of clarity due to cloud cover, air pollution, and other externalities. Moreover, its interpretation requires skillsets and institutions which are not yet widely accessible or adequate. There are hurdles such as lack of access to resources by the stakeholders, insufficient training of the authorities, and an absence of a screening authority. The indiscriminate use of satellite imagery by the authorities has adverse implications for the forest-dwelling communities. It is used in reserving forests which leads to the large scale displacement of these communities, thereby substantially interfering with their traditional and cultural rights. In this paper, we will trace the use of satellite imagery by the courts in environmental cases. We will then analyse its evidentiary value and provide recommendations for improving its application.

I. INTRODUCTION

Renaissance was a period of enlightenment because its advocacy of science offered reliability and objectivity, a truth devoid of biases.[3] The modern litigator has artfully used

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this to advance the reliability of technology by tethering it to objectivity. It is important to acknowledge the critical role played by satellite data around the globe in addressing the issues of climate change and ozone depletion.[4] International bodies such as the United Nations, Intergovernmental Panel on Climate Change (IPCC), and National Aeronautics and Space Administration (NASA) have consistently used it to rally nations together for addressing the concerns posed by first, ozone depletion, and now climate change. NASA frequently collaborates with various countries to provide data on weather and ocean pattern studies.[5] Closer to home, in India, the Environment Pollution Control Authority (EPCA) has used satellite data to monitor air pollution in Delhi.[6] It has also proven to be a useful tool in river valley litigations. Several disputes surrounding the Narmada valley have extensively used this remarkable invention.[7]

Technologies with broad applications and straightforward human collaboration have provided a significant vantage point. However, the ones situated in the complex web of human interactions need a closer critical appraisal and a reconsideration. One such example for the latter use is satellite data for forest conservation. The technological advancement in the field of satellites and image capturing has induced a shift from the traditional ways of collecting evidence for reserving national parks and forests. State agencies rely heavily on satellite imagery as one of the most commonly used methods of data collection. Satellite imagery costs far less than a physical survey and is also less time-consuming. The State exercises its powers under various legislations to collect evidence, which helps in identifying an area for conservation.

Most of these legislations lack technologically informed implementation. Due to this, there is excessive reliance on low quality, old, and misinterpreted satellite imageries and remote sensing technology. Several studies in various jurisdiction have shown that satellite

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[3] A.C. Crombie, 'Science And The Arts In The Renaissance: The Search For Truth And Certainty, Old And New' (1980) 18 History of Science.

[4] Rosamund Pearce, 'Satellites and Climate Change: how Scientists are using observations from Space to Study the Climate System' Carbon Brief (2016) https://www.carbonbrief.org/interactive-satellites-used-monitor-climate-change#:~:text=A%20geostationary%20orbit%20allows%20satellites,of%20ground%20with%20each%20orbit.

[5] 'Rising Waters: How is NASA monitoring Sea Level Rise' NASA. https://www.nasa.gov/specials/sea-level-rise-2020/

[6] Sandhya Dangwal, 'Delhi air quality: Satellite imagery to be used by EPCA to identify pollution hotspots in Delhi-NCR', India News (2017). https://www.india.com/news/india/delhi-air-quality-satellite-imagery-to-be-used-by-epca-to-identify-pollution-hotspots-in-delhi-ncr-1939546/

[7] *Narmada Bachao Andolan v Union of India*, W.P. (C) No. 319 of 1994.

imagery can be flawed due to various reasons like pollution, cloud cover and other atmospheric disturbance. Furthermore, it is often the case that the pixels are distorted which leads to an inaccurate count of the trees or wildlife in herds. Therefore, the Forest Rights Rules (the Rules)[8] reiterate the cautious use of satellite imagery and that it should not replace the traditional surveying and mapping of the forests and animals.[9] Even if we consider that satellites are reliable for counting trees and mapping forests, they are still incapable of giving accurate data on wildlife.[10] The State incorrectly uses satellite imagery to protect the forest covers, evicting the forest-dwelling communities in the process. Resultantly, these communities, which are minorities and mostly illiterate, are deprived of their rights. The key lies in carrying out surveys and mapping the forest manually and then supplementing it with the satellite imagery. In this paper, we argue that while Satellite Imagery is an indispensable tool in environment protection, its current application is unsuitable for India's Wildlife and Forest Conservation Efforts. Firstly, the technology is in its nascent stage and faces issues such as lack of clarity and other externalities. Secondly, the agencies rarely use the necessary skillsets in its interpretation. This leads to instances of faulty data and unscientific usage.[11] Thirdly, despite such insufficiencies, the agencies choose to rely solely on satellite imagery. This is contrary to the legislation and common practices in this regard all over the world. All of this leads to a faulty implementation and the illegal use of the technology.

We have primarily considered the use of satellite data to resolve human-wildlife conflict while mainly focusing on the Forest Rights Act (the FRA).[12] In Part II of the paper, we highlight the intersection between Technology and Legislations. Legislations lack the scientific advancement and leave a void when it comes to evidence collection for preserving flora and fauna. Due to this, the State conveniently relies on cheap and labour free method of remote sensing and satellite imagery for evidence purposes. In Part III of the paper, we analyse the evidentiary value of the satellite data and its misapplication. The evidentiary requirement under the various Environmental Acts is similar. Firstly when dealing at the quasi-judicial level, the authorities must use at least two pieces of evidence including satellite imagery. Secondly, when the cases are dealt with by the higher courts, the courts must be

[8] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007.
[9] Howard Latin, Gary Tannehill, Robert E. White, 'Remote Sensing Evidence and Environmental Law', CLR December (1976)
[10] Perras, M. & Nebel, S., 'Satellite Telemetry and its Impact on the Study of Animal Migration' 3 Nature Education Knowledge 12, (2012)
[11] *Action Research In v State of Gujarat*, W.P. No. 100 of 2011.
[12] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

mindful of the fallibility of the data. However, the same is not followed in practice, which leaves a huge implementation gap. In Part IV, we offer recommendations based on successful domestic practices.

II. INTERSECTION OF TECHNOLOGY AND LEGISLATIONS

Governments and the State rely primarily on evidence to determine which parts of forests, species, or other flora and fauna to be conserved. The legislations which vest the power to the government to reserve a certain area and species are the Indian Forest Act 1927[13], The Wildlife Protection Act 1972[14], the Forest Rights Act 2006[15] and their instrumentalities. Unfortunately, most of these legislations are severely outdated and have vague notions of data collection which form substantial evidence during the claims process. This is mostly because the analysis of individual trees based on remote sensing images is a complex problem. What is detected as a single object may represent a separate branch or even a group of trees.[16] Most commonly, satellites that capture large forest areas use image technology and the images are made of fine pixels. The pixels of current coarse spatial resolution sensors typically represent a ground area of 1 km and so the vast majority of pixels will cover a ground area with two or more land cover classes mixed pixels cannot be accommodated or appropriately represented in the conventional 'hard' techniques used widely in remote sensing. Consequently, this results in a classification error of up to 50% with the extent of forest cover underestimated, resulting in an overestimation of deforestation rate.[17] one-to-one (canopy to-canopy) assessment is very challenging for tree crown change due to both systematic and non-systematic errors that occur during the acquisition of satellite images over different periods.[18]

Satellite Imagery Technologies in India and Their Pitfalls

Aerial photography of forest and tree covers started roughly a century ago in many western countries. India was one of the later countries to join the list. The multispectral data obtained from satellites like LANDSAT were used to study broad forest features either by

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[13] Indian Forest Act, 1927.
[14] Wildlife Protection Act, 1972.
[15] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
[16] Marilia Ferreira Gomes, 'Detection of Tree Crowns in Very High Spatial Resolution Images Intechopen' (2015)
[17] D.S. Boyd1, F.M. Danson, 'Satellite Remote Sensing Of Forest Resources: Three Decades Of Research Development' PPG 7 (2005).
[18] Kabir Uddin*, Hammad Gilani, M. S. R. Murthy, Rajan Kotru, and Faisal Mueen Qamer, 'Forest Condition Monitoring Using Very-High-Resolution Satellite Imagery in a Remote Mountain Watershed in Nepal' MRD (2015).

visual interpretation of data in the form of imageries or by computer analysis of the multispectral data. However, the limitations are low spatial resolution and lack of stereo coverage[19] However with the increasing presence of technology in every realm, more technologically advanced satellites are being currently used including third party applications like Google Earth. Due to the efficiency and success rate of the LANDSAT series of satellites, NASA is planning to send LANDSAT-9, later this year. However according to a report, since 2003, a mechanical fault in the Scan-Line Corrector (SLC-Off) of the Landsat-7 satellite resulted in a 22–25% data loss in each image.[20]

A fundamental problem faced by researchers studying forests is the lack of appropriate ground data that can be brought together with the remotely sensed data.[21] The state cannot rely on GPS and satellite imagery because the problem with GPS systems is that they do not function if the signal path is blocked (e.g., by dense forest canopies or natural topography), nor do they transmit/receive signals underwater. Even when a physical GPS transmitter is attached to an animal, the weight of the transmitter has to be less than 5% of the animal's body mass. Further, The smallest satellite transmitter commercially available weighed 9.5 g, which means that animals that weigh less than 240 g cannot be tracked with current satellite technology.[22] This excludes about 81% of all bird species and two-thirds of the world's mammals from satellite tracking. Moreover, the expense of the flawed technology is too much, the cost of these telemetry devices is quite high, more than $3000 US.[23] Although some might consider the cost of raw satellite data meagre, the image processing cost and expert fees for interpretation are a major concern for most litigators especially the marginalised.[24]

Improper legislation or application of scientific data collection is most dangerous to the marginalised forest-dwelling communities which are evicted in name of conservation of flora and fauna. In a circular released in 2017, the National Tiger Conservation Authority

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[19] Madhvan Unni 'Forest survey and management using remote sensing' PIAS 6, p. 209-231 (1983).
[20] Lahiru S. Wijedasa 'Overcoming Limitations with Landsat Imagery for Mapping of Peat Swamp Forests in Sundaland' R.S. (2012) doi: :10.3390/rs4092595
[21] D.S. Boyd1, F.M. Danson, 'Satellite Remote Sensing Of Forest Resources: Three Decades Of Research Development' PPG 7 (2005).
[22] Perras, M. & Nebel, S. 'Satellite Telemetry and its Impact on the Study of Animal Migration' 3 Nature Education Knowledge 12, (2012).
[23] Ibid.
[24] Sharon Hatch Hodge 'Satellite Data and Environmental Law: Technology Ripe for Litigation Application' *2* PELR (1997).

(NTCA) ordered the directors of all tiger reserves to refrain from recognising the rights of forest dwellers within critical tiger habitats.[25] This is one of the examples when the indigenous population and the forest-dwelling community is evicted and the authorities cite maps and evidence collected by faulty imageries. On the contrary, numerous surveys and case studies have shown that the forest-dwelling communities and indigenous population have contributed to the forest growth by their ancient wisdom and knowledge.[26] Additionally, a lack of redressal mechanism and unawareness in these communities takes their basic rights away. We will now analyse the primary legislations which deal with evidence collection and try to understand their faulty mechanism in detail.

Indian Forest Act, 1927

The Indian Forest Act (the IFA) is the primary legislation which defines forests and lays down the procedure for the government to protect the same. However, this Act is a part of the long list of colonial legislation which has outlived their duration. The process, definitions and redressal mechanism in the IFA is vague and outdated. Section 35[27] of the IFA provides the government with the power to protect forests for special purposes even if that land is not a property of the government. This process is usually done with evidence collected from the local gram panchayat, maps and surveys. After the introduction of remote sensing and image capturing technology, satellites and drones are relied on. The Act is silent on data collection and minimum evidence to be procured to declare a certain area as reserved. Although the Act has gone through many amendments since its inception, it has not caught up with the modern technological advancement in its various fields.

Wildlife Protection Act, 1972

The Wildlife Protection Act is also a half a century old Act which is technologically outdated. It vests immense discretionary power in the collector[28] who identifies the wildlife species based on vague evidence. The collector acts on the behalf of the state government which has the power to declare a certain area of a forest as national parks and sanctuaries. This power is granted in Section 35[29] of the Act. Section 19[30] of the Act vests extreme

[25] The Wire 'Criminalising Forest-Dwellers Has Not Helped India's Forests or Wildlife. It's Time for a New Deal' https://thewire.in/environment/forest-rights-dwelling-communities
[26] C. Madegowda Economic and Political Weekly Economic and Political Weekly Vol. 44, No. 21, 2009, p 65-69
[27] Indian Forest Act, 1927, Section 35.
[28] Wildlife Protection Act, 1972.
[29] Wildlife Protection Act, 1972, Section 35.

discretionary power with the collector to decide on the rights of the forest-dwelling communities. This leads to discrepancies in vesting of traditional rights. Section 23[31] talks about the power of the collector to identify, survey or map a land to be protected as national parks. Like the IFA, this Act also does not clearly describe the type of evidence collected therefore lacking in the advancements. The immense power with the collector with vague and ambiguous guidelines on evidence collection leads to a problematic situation not only for the forest-dwelling communities but gives an inaccurate result of the forest area. Although satellites and images are used in drawing maps and identifying big mammals, they fall behind to capture smaller animals and lightweight birds. Therefore, an extensive ground survey is necessary to advance satellite imagery.

Forest Rights Act, 2006

Being a relatively new Act, the FRA has inculcated scientific and technological methodologies like satellite imagery. However, this part will only focus on the evidentiary value of the FRA which deals with satellite imagery. The FRA aims to recognize and vest the forest rights and occupation in forest land in Forest Dwelling Scheduled Tribes (FDST) and Other Traditional Forest Dwellers (OTFD) who have resided in such forests for generations. Initially, the British had arbitrarily demarcated and reserved forest land, notwithstanding the people already inhabiting such lands. Then after independence, there was a string of legislation such as the Forest Conservation Act,[32] and judgements which relocated forest-dwellers for development and industrialization needs.[33] In the landmark judgement of *T.N. Godavarman Thirumulpad v. Union of India,* the Supreme Court held that the FCA applied to all forest area, irrespective of ownership. [34] Resultantly, the forest-dwelling communities became encroachers instead of owners. Thus began the first wave of mass-eviction of forest-dwelling communities.[35] The Forest Rights Act is a landmark piece of legislation which promises to undo the historical injustice meted out to forest-dwelling communities by recognising their rights over the land, forest and natural resources that they conserved and

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[30] Wildlife Protection Act, 1972, section 19.
[31] Wildlife Protection Act, 1972, Section 23.
[32] Forest Conservation Act, 1980.
[33] *Banbasi Sewa Ashram v. State of U.P.* 1987 SCR (1) 336.
[34] W.P. No. 202 of 1995.
[35] Madhu Sarin, 'Undoing Historical Injustice - Reclaiming Citizenship Rights And Democratic Forest Governance Through The Forest Rights Act', *Democratizing Forest Governance in India* (1st edn, Oxford University Press, India 2014).

managed traditionally for generations.[36] The objective of the FRA is to recognise and vest forest rights. It is a benevolent piece of legislation[37] and a remedial statute aimed at securing social welfare.[38] The pertinent task here is to ensure awareness amongst the tribal and other traditional forest dwellers of their rights and their ability to access such technology without hindrance.[39]

However, the over-reliance on satellite evidence as a form of evidence collection can hamper the process of vesting rights among other things mentioned in the FRA. It envisages a proactive role by the Gram Sabha to increase stakeholder participation. Yet, due to inaccessibility and lack of awareness, the Gram Sabha often relies upon inaccurate reports. The same reports are in turn used for future dispute settlement by the divisional and state authorities. The maps used are generic Google Earth images or low-resolution satellite images (old LANDSAT images) which are outdated. Rule 13[40] of Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007 (the Rules) mentions the evidence for determination of forest rights wherein 13(1)(a)[41] counts satellite imagery as evidence. Section 12 A (11)[42] explicitly mentions that the use of satellite imagery should only supplement the evidence and not replace the physical form of gathering evidence. The over-reliance on maps as a piece of substantial evidence and not backing it up by technological advancement is also worrisome. Forest are dynamic in nature and shift and change in quick successions, therefore the reliance should be on extensive field mapping and should be supplemented by advance satellite imagery.

III. CRITICAL APPRAISAL OF ITS EVIDENTIARY VALUE

The application of Satellite data for forest conservation and wildlife protection differs from its usage in other environmental law concerns such as mining, industrial operations, pollution, or climate change analysis. Its successful integration with every other field of

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[36] 'Undo Historical Injustice to Forest Dwellers, Once Again' Oxfam India https://www.oxfamindia.org/blog/undo-historical-injustice-forest-dwellers-once-again#:~:text=What%20is%20the%20Forest%20Rights,and%20managed%20traditionally%20for%20generations.

[37] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Preamble.

[38] *Union of India v. Akhil Bhartiya Vikas Parishad* (2010) 12 SCC 375.

[39] *Orissa Mining Corporation v. Ministry of Environment and Forest*, WP (Civil) No 180 of 2011.

[40] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007, Rule 13.

[41] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007, Rule 13(1)(a)

[42] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007, Rule 12A (11).

environmental law has led critics of FRA and conservationists to ask why this thoroughly vetted technology is not enough for Forest Conservation. It is in biodiversity conservation and wildlife protection that satellite data meets its most cynical sceptic and ardent supporter.[43] Therefore, the jurisprudence evolved in this regard requires a distinct critical appraisal. Under the FRA, according to Rule 13 of the Rules, there should be at least two pieces of evidence used to advance a particular conclusion.[44] When approaching the higher courts through writs, the courts should give effect to this requirement under the FRA.

Three-Tier Quasi-Judicial System Under the FRA

As discussed earlier, the primary legislation where satellite imagery finds an explicit mention and utilisation is the FRA. Therefore, in this section, we will explore the nature and quantum of value attached to satellite imagery vis-a-vis cordoning off forest areas and settlement of forest rights under the FRA. It provides a framework for recognition of such vested rights and the nature of evidence required for such recognition and vesting. It follows a three-tier quasi-judicial system including the Gram Sabha, the Sub-Divisional Level Committee (SDLC), and the Divisional Level Committee (DLC). According to Section 6, the Gram Sabha is authorised to initiate the process of rights recognition of the individuals and communities.[45] It receives the claims, verifies them, passes a resolution recommending approval or dismissing the same. Any person or state agency aggrieved by the resolution of the Gram Sabha can petition before the SDLC within 60 days of passing of the resolution.[46] If they are unsatisfied with the decision of the SDLC they can further prefer a petition against it in front of the DLC.[47] The SDLC and DLC must give the aggrieved person a reasonable opportunity to present their case.[48]

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[43] *Action Research In v State of Gujarat*, W.P. No. 100 of 2011, *Wildlife First Case v Ministry of Forest and Environment* W.P. No. 109 of 2008.
[44] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007.
[45] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Section 6(1).
[46] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Section 6(2).
[47] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Section 6(4).
[48] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Section 6(4).

Section 11[49] talks about the procedure for filing, determination and verification of claims by the Gram Sabha. Section 11 (2) further directs the Forests Right Committee to assist the Gram Sabha in collecting evidence by maps. Rules 13 (1) and (2) of the Rules provide a comprehensive list of evidence which can be used by the forest dwellers to prove and existing rights. Rule 13(1)(a) enlists satellite imagery as one such acceptable evidence. Rule 13 (3) further provides that the Gram Sabha, SDLC, and DLC must rely upon a minimum of two evidence.[50] Moreover, during the settlement of rights process and declaration of a Critical Wildlife Habitat under the FRA, Section 4(2)(b) stipulates that the concerned agencies must establish that the presence of the right holders is sufficient to cause irreversible damage and threaten the survival of the species and their habitat. Therefore, it indicates a high standard of proof wherein there must be a direct correlation between the activities of the forest dwellers and the reduction in forest cover. Reading together the provisions of the FRA and the Rules, the authorities must prove based on certain and objective criteria that the presence of the forest dwellers is detrimental to forest conservation and wildlife protection. Rule 12 B (11) (2) clarifies that a simple reliance on satellite data is not enough to fulfil this requirement and therefore, it must be supported by additional evidence.[51]

The jurisprudence of Forest Conservation and Forest Rights

Under writ jurisdiction, the High Courts and the Supreme Court do not participate in fact-finding, therefore do not engage with the general principles of evidence law.[52] However, satellite imagery is used as substantial evidence while accepting or rejecting a claim at the quasi-judicial level. Oftentimes, the interests of Forest Dwellers are pitched against the interest of Forest and Wildlife. This begs the important question of how to adequately balance these rights for which substantial evidence forms an integral part. Inaccurately determining the cause of deterioration of the Forest and the Wildlife harms both, the forest dwellers and the Environment. Therefore, in the interest of justice and social welfare, the courts must include a certain framework in its orders with regards to interpretation and usage of satellite data by the state bodies. Otherwise, there will be a huge lacuna and uncertainty

[49] The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Section 11.
[50] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007.
[51] Ibid.
[52] *K.L. Mysore v. State of Mysore*, 1976 SCR (3) 913.

regarding the usage of satellite data. Wherein, the ground realities do not match with what the legislation requires or what the Courts order.

Action Legal Research In. V State of Gujarat

The Gujarat HC observed in the case of *Action Research In v State of Gujarat,*[53] that satellite imagery on its own is a weak piece of evidence. In this case, the petitioners approached the high court citing that the State had made a highly unscientific use of satellite imagery while settling claims. They claimed had indulged in a defective, unsatisfactory, and illegal method. The petitioner also prayed that the use of satellite imagery should be transparent, along with the active involvement of the claimants and the Gram Sabha as envisaged by the FRA. They further prayed that satellite data be used as only one of the acceptable evidence along with other pieces listed in the Rules and that claims should not be rejected solely based on satellite data.

The Gujarat High Court in this case opined that the FRA being a benevolent piece of legislation requires special consideration. The Courts are dutybound to adopt a constructive approach to achieve the purpose of the FRA. To demand strict proof of rights from underprivileged and marginalized citizens would frustrate the very objective of the FRA. It also considered the fact that being illiterate and specially situated, such forest dwellers would lack any strong and convincing evidence which could satisfy the authorities. However, this does not mean that every claim should be accepted at its face value but rather that satellite imagery should not be the only evidence used to accept or dismiss a claim.

Therefore, owing to the uncertain nature of satellite data, they must always be supplemented with other strong pieces of evidence along with the practice of ground-truthing.[54] Ground truthing refers to the information collected on location and the ground. It aids in the interpretation and analysis of the data and helps minimise the errors of omission and errors of commission.[55] Hence, a singular reliance on satellite imagery is not enough. This position is akin to general international practices wherein satellite data must be supplemented with a thorough in-field observation and data collection.[56]

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[53] WP (C) 100/2011.
[54] *Action Research In v State of Gujarat*, WP (C) 100/2011.
[55] J.B. Campbell, *Introduction to Remote Sensing*, The Guilford Press, New York (1996).
[56] Sharon Hatch Hodge, 'Satellite Data and Environmental Law: Technology Ripe for Litigation Application', PELR (1997).

Wildlife First v Ministry of Forest and Environment

In the ongoing case of *Wildlife First Case v Ministry of Forest and Environment,*[57] the Supreme Court is assessing the constitutional validity of the FRA. In February 2019, initially, the apex court had ordered the states to evict individuals with rejected claims by the concerned authorities. This would result in the eviction of as much as 10 lakh tribal people, the second wave of a mass eviction. However, after public outcry, it later placed a stay on its previous order and asked the Forest Survey of India (FSI) to conduct a satellite survey. The FSI is required to collate the data from various states and corroborate its findings. The FSI has informed the Court that it would take it 16 years to do so given the lack of adequate funds and need for cooperation from the various state machineries.[58]

There are numerous State-sanctioned studies and reports which testify to the increased accountability and transparency accompanied by reliance on satellite imagery.[59] State agencies have made extensive use of this technology by assigning several independent agencies such as the Saxena Committee appointed by the Ministry of Tribal Affairs, TERI appointed by the Maharashtra Government, and BISAG appointed by the Gujarat Government.[60] Wildlife First, an NGO and also a petitioner to the present case, believes that the reports clearly show a rapid encroachment of forest lands and that most of the claims are bogus.[61] The FSI initially filed an affidavit in the case to claim that "satellite imagery shows massive encroachment after the Forest Rights Act was enacted".[62] Firstly, the FSI is responsible for ascertaining the forest cover in India. It is not the authority to comment or determine whether or not the claims of the forest dwellers are legitimate. Secondly, such rhetoric without adequate data collection does not take into account whether such a reduction in the cover is caused by legitimate cultivation by people whose claims were accepted and settled. Or whether the reason is different altogether. Therefore, satellite imagery in and of

[57] WP (C) 109/2008.
[58] Ibid.
[59] Bhavya Goswami, 'Geo-informatics for Forest Rights: Harnessing Technology for Better Livelihood Support and Access to Forest Rights', One World Foundation India (2014)
[60] Meera Bhardwaj, 'Satellite Imageries, the Only way to Clear the Forest Rights Act Mess', Green Minute (2019) https://greenminute.in/2019/07/24/satellite-imageries-the-only-way-to-clear-the-forest-rights-act-mess/
[61] Shruti Agarwal, 'Can Technology Support Forest Rights Process?', Down to Earth (2017) https://www.downtoearth.org.in/blog/governance/can-technology-support-forest-rights-process--59345
[62] Satellite imagery shows massive encroachment after Forest Rights Act was enacted, Deccan Chronicle 2020 https://www.deccanchronicle.com/nation/in-other-news/200120/satellite-imagery-shows-massive-encroachment-after-forest-rights-act-w.html

itself does not provide us with the reason for the reduction of forest cover but only that there has been such a reduction.

The problem here is not the reliance on the Satellite imagery but an exclusive and uncritical reliance. Without ground-truthing it becomes impossible to deduce and verify how the land is being used thereby rendering the interpretation of encroachment incorrect.[63] The anti-FRA petitioners and the Supreme Court have placed heavy reliance on Satellite imagery to determine the validity of claims. But the Rules clearly provide that they can only supplement other forms of evidence, and cannot be used as a replacement.[64] Therefore, the use of technology should be accompanied by additional evidence in the interest of justice and science. The evidence provided by the Forest Department was inadequate in proving that the claims of the forest dwellers were bogus.[65] While satellite data undoubtedly has its benefits, it cannot make up for the intricate facts which are unearthed by local, on-site data collection and verification.[66]

IV. RECOMMENDATIONS

The problem with satellite imagery remains in its implementation and lopsided interpretation. So long as the technology requires considerable human coordination, it runs the risk of a biased application. Difficulty arises when the State tries to monopolise it and use it in a non-transparent manner, overlooking the inherent discrepancies in order to get the job done. It becomes even more problematic when the agencies claim that these are 100 percent accurate and objective.[67] Contesting the same is especially challenging for the underprivileged and marginalised communities. On the one hand, Satellite Images can be produced swiftly, are cheap, and labour free. On the other hand, they are often used unscientifically. When they are used properly they can take as much as 16 years to provide comprehensive data.[68] The critical question that arises is how to strike a balance between a

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[63] Ibid.
[64] Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007, Rule 12 A(11).
[65] 'Manthan: Report of the National Committee on Forest Rights Act', A Joint Committee of Ministry of Environment and Forests and Ministry of Tribal Affairs, Government of India. December 2010.
[66] Nandini Sundar, 'A Mahagatbandhan in the Forests is the Need of the Hour', The Hindu Centre for Politics and Public Policy, https://www.thehinducentre.com/the-arena/current-issues/article26978490.ece/binary/A%20Mahagatbandhan%20in%20the%20Forests%20is%20the%20Need%20of%20the%20Hour.pdf
[67] Shruti Agarwal, 'Can Technology Support Forest Rights Process?', Down to Earth (2017) https://www.downtoearth.org.in/blog/governance/can-technology-support-forest-rights-process--59345
[68] WP (C) 109/2008.

quick but sloppy work and a thorough but time-consuming approach. In the 16 years that it takes the agencies to come up with the data, the entire mapping process might become futile if the species and habitats become endangered.

Therefore, the key to resolving the conflict lies in a bottom-up approach towards implementation as also envisaged under the FRA. By increasing transparency and a true collaboration on the ground level, it will decrease the risk of a biased application. As the Hon'ble Supreme Court itself held in its landmark judgement, it is the village and the Gram Sabha which are primarily responsible for recognition of forest rights.[69] The Gram Sabha and the communities must be empowered and systematically included in the mapping process.

The Narmada district of Gujarat is the perfect example of one such beneficial collaboration. With the help of Action Research in Community Health (ARCH), an NGO, the Forest rights Committees from 150 villages learnt the use of GPS and GIS. They then mapped the claimed plots and superimposed them on satellite images from 2005 and 2009. First, to determine the status of the lands in 2005 and then on the image from 2009 to determine possession post the enactment of FRA.[70] Ensuring proper and error-free implementation at the ground-level will reduce the chances of error and conflict later on. Thereby, reducing the complexity and the time consumed in settling claims and conserving forest lands. After all, doing a job thoroughly once is more efficient than doing it poorly multiple times.

V. CONCLUSION

Technology is a part of every realm of our society in the contemporary era. It is often considered to be more precise and quick than manual work. The environment conservation regime has also introduced the use of technological tools in various aspects, satellite imagery being one of them. Agencies rely on Satellite imagery for identifying areas to conserve and protect. Although it is a labour-free and expeditious way of collecting evidence, it is not completely reliable. Owing to the misapplication of satellite data which often results in inaccurate conclusions, the Rules categorically provide that such data should not be used unaided. They further require the use of minimum two pieces of evidence. When such cases

[69] *Orissa Mining Corporation v. Ministry of Environment and Forest*, WP (Civil) No 180 of 2011.
[70] Action Research in Community Health and Development- Gujarat, 'The Forest Rights Act, Implementation of the FRA' https://archgujarat.org/the-forest-rights/

are raised in the Courts, the courts must give due regard to the rationale behind this prerequisite. In its current application, the concerned authorities often perform a shoddy job of data collection by relying on a questionable data set and incorrect interpretation.[71] There are three misapplications of satellite imagery in Conservation. Firstly, at the ground level, old data is used unscientifically without supplementing it with ground-truthing. While the use of generic Google Earth Images is wide-spread, it should be accompanied by data collection. Secondly, the images produced often lack reliability. The agencies that the State authorities engage in produce faulty data which is used uncritically. And thirdly, the judiciary has given its spin to the interpretation without taking into account the checks and balances put into place by the FRA. These three distinct approaches make its application ambiguous and leave a gaping hole in the implementation of the FRA. Since satellite imagery is a substantive piece of evidence, an incorrect premise will lead to incorrect conclusions. Therefore, if the conservationists and state agencies indeed wish to protect biodiversity, then they should push for the strengthening and proper bottom-up implementation of the FRA. Its dilution and misapplication by reducing the evidentiary requirement will be counterintuitive for conservatio

[71] Ibid.