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Ganga river corridor mapping, pollution impact assessment in the Haridwar District, Uttarakhand using Drone and space technology

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ABSTRACT

River Ganga is not only the cultural and spiritual mainstay of India but also provides economic sustenance, water, and food security to more than 43 percent of the country's population. A part of the collective consciousness of India, Ganga can easily be considered the most revered river across the world. As a representation of India's identity and culture, it became important to restore the river to its clean and pristine glory. Considered the lifeline for millions of people, River Ganga has been facing several challenges: the pollution of the river from different sources with growing urbanization and industrial growth. On the other, the excess abstraction of water from the river for agricultural, industrial, and drinking needs. Pollution abatement measures comprehensively tackle all sources of pollution such as municipal sewage, industrial effluents, municipal solid waste, rural sanitation, non-point sources of pollution such as agricultural runoff, open defecation, and un-burnt dead bodies, etc.

The UAVs (Unmanned Aerial Vehicles), commonly referred to as 'Drones', are nowadays a valuable platform for facilitating temporal and spatial data acquisition. They have become a low-cost alternative to classical aerial manned photogrammetry. Its ability to access previously unreachable, remote areas and carry a payload, like a camera, to capture 2D images is beyond the scope of any other existing technology. Specialized software can convert these two-dimensional images to three-dimensional scalable models. This has empowered the researchers and policymakers to have a fast and holistic view of the area in discussion and expedite decisions.

Aerial images were processed using Image processing & GIS-based software to create the Orth mosaic (2-D Data), Point cloud (3D Data), Digital Elevation Model, and Map composition of the study area. This study aims to acquire the data to understand the patches of pollution in the river Ganga, which may be solid waste and sewage discharge into the river. Before large-scale efforts can be made to prevent and clean up pollution, it is a cost and time-effective solution to identify the major hot spots where the pollution originates.

Keywords: UAV, Ortho, Digital elevation model

Introduction

The Ganga River is one of the largest river systems in the world encompassing diverse habitat characteristics. The Ganga basin constitutes 26% of the country's landmass (8,61,404 sq km) and supports more than 43% of its population. The basin covers an area of 1,086,000 sq km, extending over India, Nepal, Bangladesh, and China. About 79% of the Ganga basin area lies in India covering 11 states viz., Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal, and Delhi.

It is a widespread belief that the river Ganga can purify all that came into contact with it. However, the river's existence in terms of clean and continuous flow is threatened due to the intensity of human activities. Human interventions are directly or indirectly affecting the river. Anthropogenic activities have generated important transformations in rivers during the last few decades. The advancement of human civilization has put major questions about the safe use of river water. River water pollution due to heavy metals is one of the major concerns in most of the cosmopolitan cities of developing countries. Heavy metals in the riverine environment represent an enduring threat to human health. Cultural and religious on the banks of the river along with the tourists have been one reason for the water pollution in the river. Unwanted activities such as illegal dumping, liquid waste discharge, disposal of garbage, etc., affect the quality of the river. River Ganga has become very polluted because of speedy urbanization and industry throughout the basin. The Ganga watercourse has started losing its potency due to the big amount of untreated sewage and noxious industrial influents

discharged into it. Waste matter and industrial effluents discharged from cities direct lose disposal into the river Ganga or its tributaries. Domestic and different solid waste drop directly or indirectly into the watercourse; also, the waste from hospitals and nursing homes, that ought to be suitably treated, is disposed of untreated into the river. Increasing demand for water from the domestic and industrial sector is leading to the over-extraction of water from the river because of which river water is declining as a result of which concentration within the river water is increasing. Deforestation in the watershed and the river's origin because of the deforestation rate of runoff, it's raised, resulting in increased pollution in the river. Constructions of dams in the chain region and major construction within the catchments area also cause higher material concentration in the watercourse.

With the advancement in space technology, it is now possible to employ remote sensing techniques for estimating surface and subsurface water over large areas. The necessity of remote sensing-based groundwater mapping of large and unreachable areas. Remote sensing techniques provide the ideal solution for river corridor monitoring due to their non-intrusive nature, wide range, spatial coverage, and repeatability. For a better understanding of river corridors, we need data that are continuous over various scales, with remote sensing being the ideal solution to achieve this.

Unmanned aerial vehicles (UAVs), also known as drones, have emerged as a potential alternative for mapping and monitoring water resources' quality and quantity. This is because drones are flexible and relatively cheaper in comparison to in situ measurements and spaceborne remote sensing, and can be flown at low altitudes, offering very high-resolution data, with high prospects of timely and accurately characterizing water quality and quantity of water. UAVs could be used in monitoring hazards (i.e., after floods, fires, landslides) because they can generate near real-time, fine resolution, spatially explicit information. UAV-generated very high-resolution Digital elevation model (DEM) may be used to inspect the validity of classical circulate and floodplain category theory, thereby now no longer handiest searching at programs as is usually finished but additionally augmenting our clinical knowledge of hydrological procedures. Analyzing the benefits of UAVs, argue that piloted plane surveys provide a feasible opportunity for satellite tv for pc structures due to the fact they supply finer spatial decision records, however, excessive fees can restrict ordinary surveys and deployments can hardly ever be commissioned at brief notice, Brazier et al [1]. Consequently, declare there may be a shortfall in cutting-edge far off sensing records provision with regards to the subsequent demanding situations that cannot be met with cutting-edge satellite or airborne imaging survey technologies:

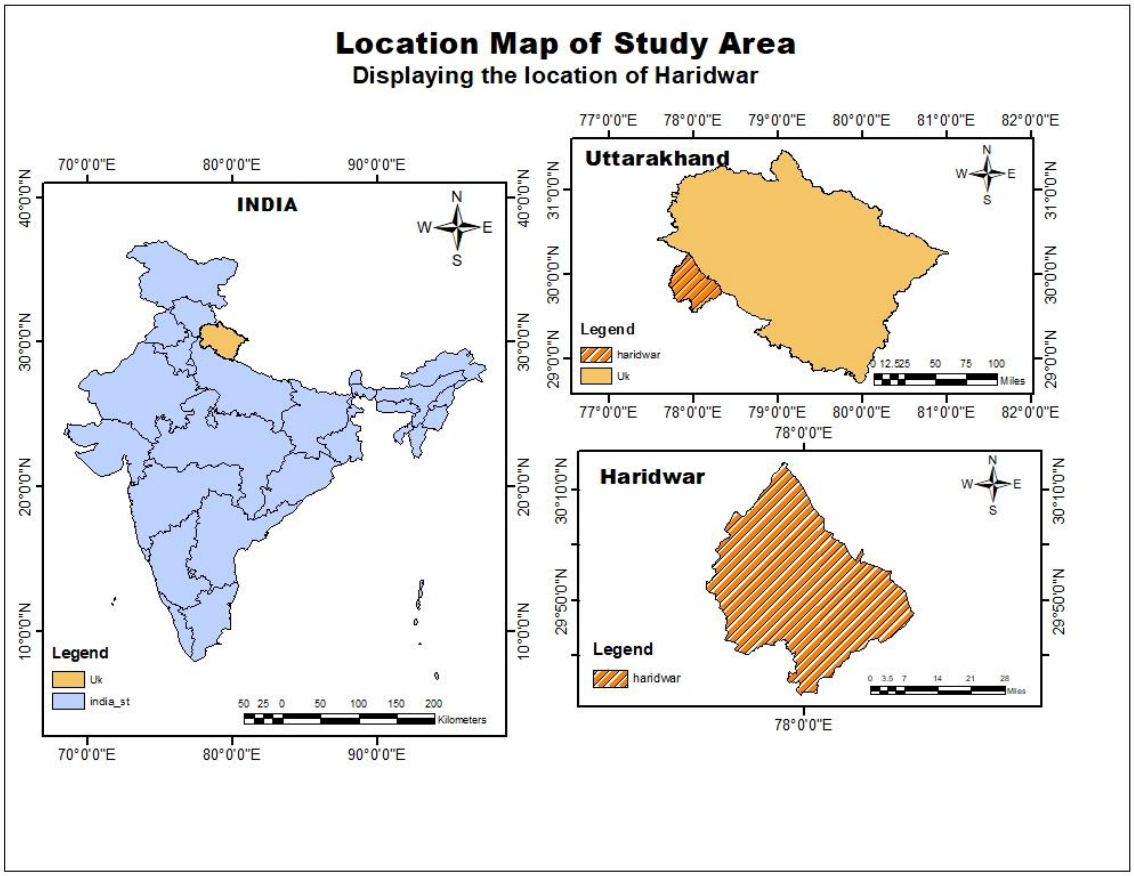
1. Cost-powerful seize of excellent-scale spatial records describing the cutting-edge hydrological situation and water aid popularity of catchments at user-described time-steps.

2. Data seize at an excellent temporal decision for describing water gadget dynamics in soil moisture, flora, and topography in catchments in which there are vital downstream outcomes on water resources (e.g., floods, erosion activities, or flora removal).

This project aims to accumulate statistics to apprehend the patches of pollutants in the holy river Ganga, which can be dry waste and any moist or liquid waste. Before huge scale efforts may be made to save and ease up pollutants, we first need to become aware of the most important hot spots in which the pollutants originate. We would typically conduct a survey of pollutants alongside the holy river Ganga, working on the land to accumulate data, on which pollutants are coming from and in which it is focused to higher apprehend the problem.

STUDY AREA

The study was conducted in Haridwar, Uttarakhand. Haridwar's location indicates the geographical position of the north Indian city that's renowned jointly among India's greatest journeying sites. Haridwar city is sited in its district. Haridwar encompasses a district of 2,360 sq. km and stretches between the angular distance parallel of 29°58 ' N and therefore the longitudinal meridian of 78° 10' East. The city is alert at an altitude of 790 m above sea level.



DATA / TECHNOLOGY USED

Identifying pollution sources is a critical first step toward completing an assignment for a clean river. Manually identifying pollution sources takes a long time and is not always accurate in identifying the maximum number of sources.

To reduce human effort and error, we used cutting-edge technologies such as UAVs, DGPS, and GIS to acquire, process, and deliver the data location data

We were able to significantly speed up the process of data collection along the holy river Ganga by using drone images, which will be processed to identify pollution hot spots, by using UAVs and other technology.

The following technologies were used in the course of this project's execution:

A. DGPS
B. UAVs
C. Photogrammetry & GIS

DGPS

A Differential Global Positioning System (DGPS) is an enhancement to the Global Positioning System (GPS) which provides improved location accuracy, in the range of operations of each system, from the 15-meter nominal GPS accuracy to about 1– 3 cm in case of the best implementations.

UAV (Unmanned Aerial Vehicle)

An unmanned aerial vehicle (UAV) commonly known as a drone) is aircraft without a human pilot on board. UAVs are a component of a UAS; which include a UAV, a ground-based controller, and a system of communications between the two.

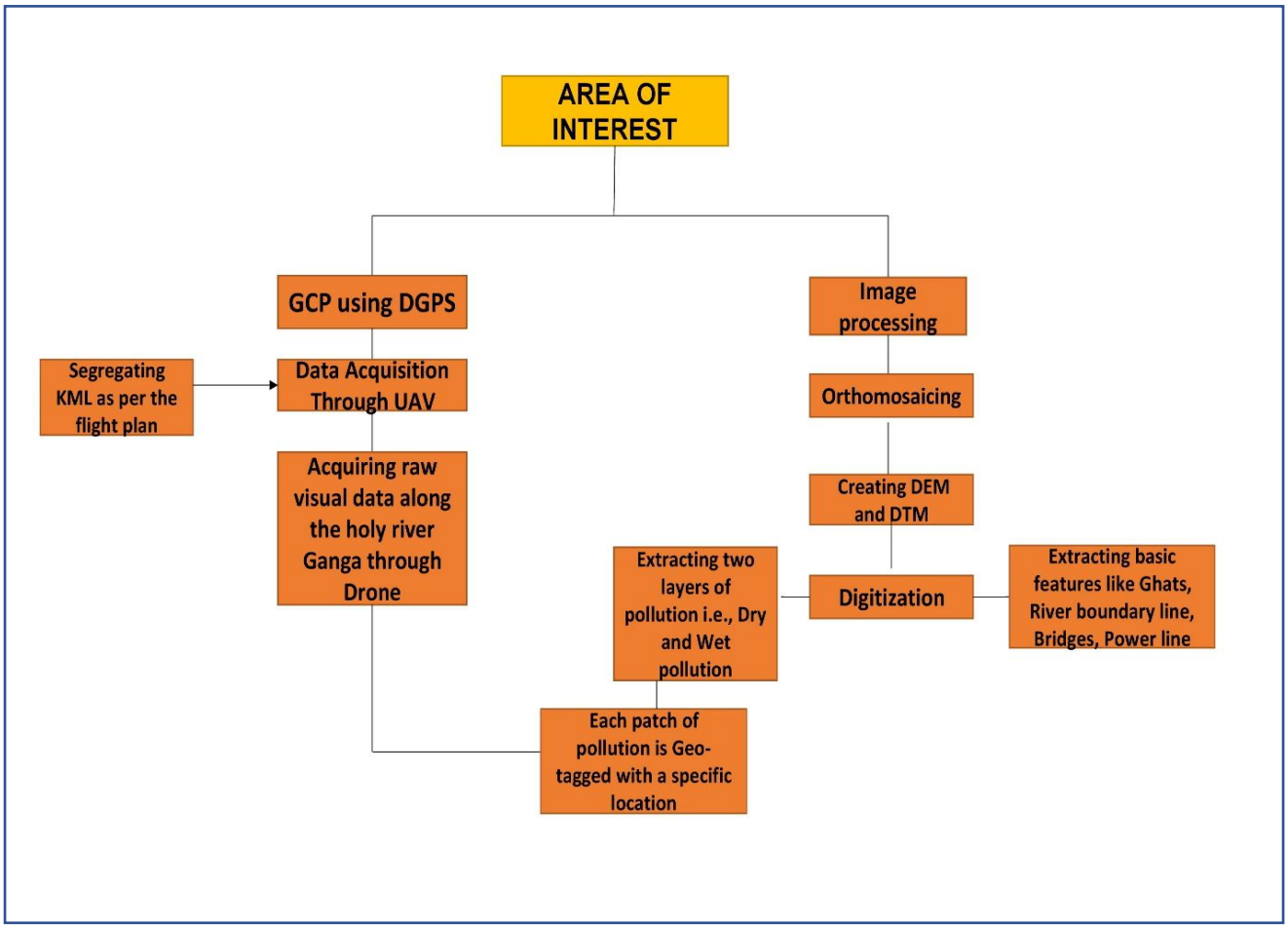
The flight of UAVs may operate with various degrees of autonomy either under remote control by a human operator or autonomously by onboard computers referred to as an autopilot.

GIS

A geographic information system (GIS) is a conceptualized framework that provides the ability to capture and analyze spatial and geographic maps. GIS applications (or GIS apps) are computer-based tools that allow the user to create interactive queries (user-created searches), store and edit spatial and nonspatial data, analyze spatial information output, and visually share the results of these operations by presenting them as maps

SOFTWARE USED
Raw data- Any Image Viewer
Orthomosaic- QGIS
KML- Google Earth Pro
Digitization- AutoCAD
Video- VLC player

METHODOLOGY



- **Differential Global Positioning System (DGPS)-** A much more advanced form of GPS navigation that provides more precise positioning than standard GPS. DGPS is based on error correction signals sent from a GPS receiver in a known location. DGPS eliminates all measurement errors in satellite ranges, allowing for highly accurate position calculation.

- **Ground Control Point (GCP)-** GCPs are used for data processing to accurately refer to and calibrate the image.

- **Keyhole Markup Language (KML)-** The Keyhole Markup Language (KML) is an XML notation used to express geographic annotation and visualization in two-dimensional maps and three-dimensional Earth browsers. KML was created to be used with Google Earth.

On-Site process:

A.
Temporary Bench Marks (TBM) for reference to the Ground Control Points (GCP) using DGPS.

B.
Ground Control Points(GCP) for getting absolute accuracy around 3-4 cm.

FIGURE 1. ON SITE PROCESS

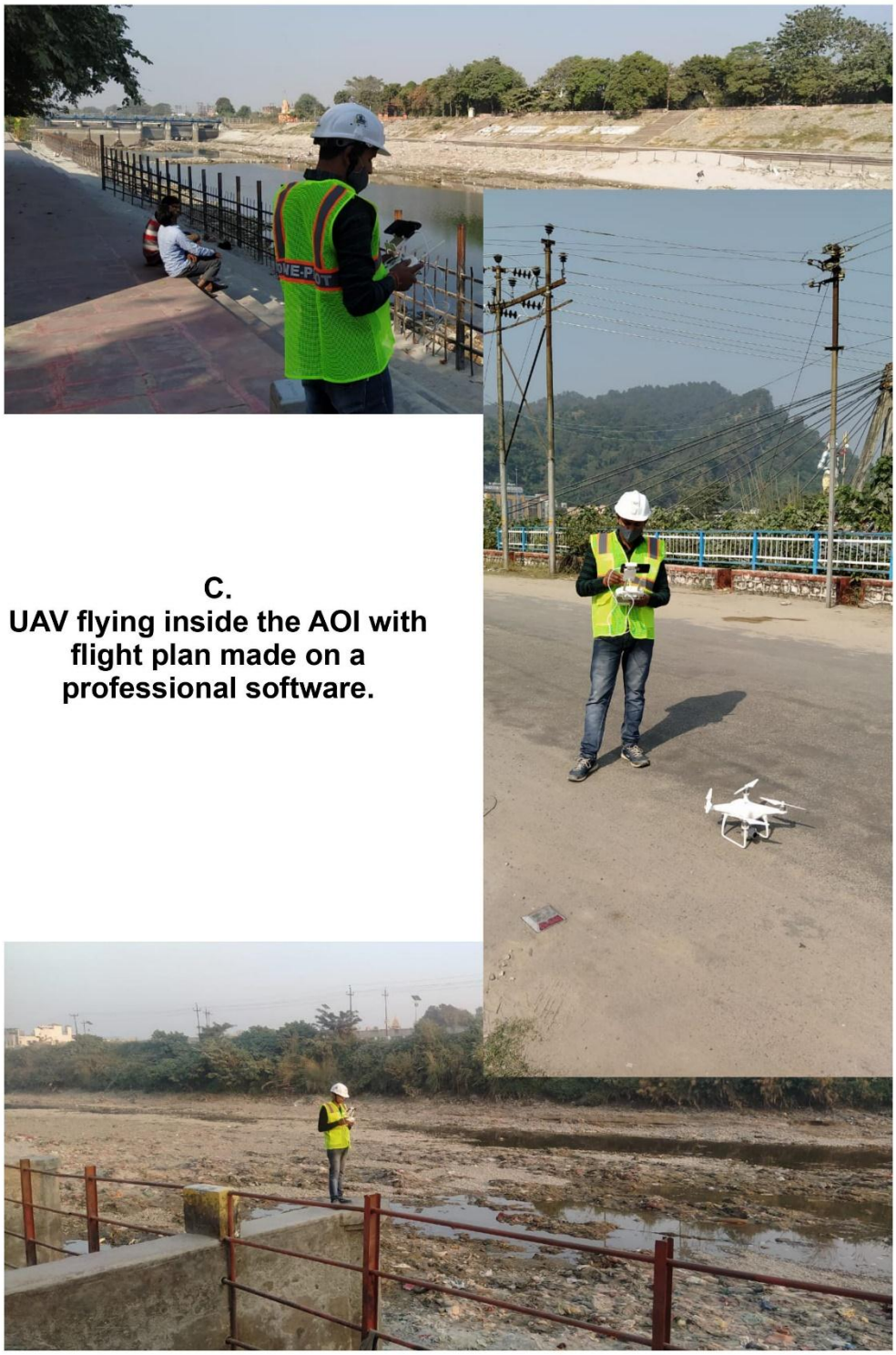
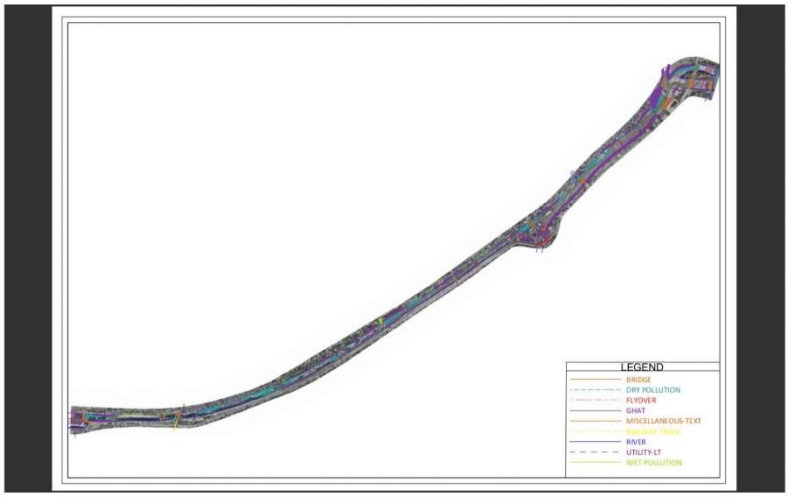


FIGURE 2. UAV FLYING

PLANNING AND OUTPUTS:

A.
Final KML of the AOI with GCP plans. Total 47 GCP were places inside the AOI of 11 km.



B.
Delivery of data with Orthomosaic and digitised data layer overlapped on it.

FIGURE 3. PLANNING AND OUTPUTS

RESULT –

We acquired the major hotspots of the patches of pollution in the holy river Ganga, which may be dry waste and any wet waste. In figure 6. Wet pollution is marked as the ocean green layer inside the river. And Dry pollution is marked as the green layer on the holy river. The result shows how the domestic and industries let out their pollution in the river.

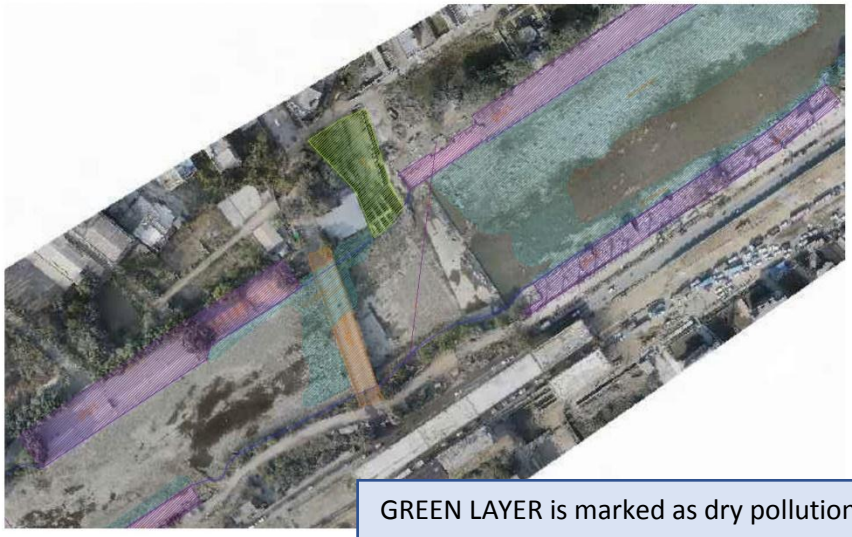
Wet Pollution Patches

FIGURE 4. WET POLLUTION IMAGES

Dry Pollution Patches

FIGURE 5. DRY POLLUTION IMAGES

OCEAN GREEN LAYER is marked as wet pollution patches inside the holy river.



GREEN LAYER is marked as dry pollution patches on the holy river

FIGURE 6. MARKED POLLUTION PATCHES

CONCLUSION

The current study discovered significant changes in land use and land cover in 2020. The land area covered by forests, agricultural land, plantations, stony/rocky areas, and water bodies were affected by pollution, while mines, industries, roads, built-up areas, and ash fields increased. The solid and liquid pollution increases. The expansion of the developed region has resulted in the obliteration of water bodies, the holy river is polluted by ourselves we let out our waste in the river.

Concerning the life support system and the forest area, vegetation for biological organisms, industry and mine managers, and residents must focus on protecting the forest and reducing air and water pollution in water bodies.

REFERENCES

- Abdul Aabid, Bisma Parveez, Nagma Parveen, Sher Afghan Khan, Md Abdul Rahman, Jalal Mohamed Zayan, Omar Shabbir. "Reviews on Design and Development of Unmanned Aerial Vehicle (Drone) for Different Applications", Journal of Mechanical Engineering Research and Developments ISSN: 1024-1752, (2022).

- Amy S. Woodget, Robbie Austrums, Ian P. Maddock, Evelyn Habit. "Drones and digital photogrammetry: from classifications to continuums for monitoring river habitat and hydromorphology", (26 April 2017).

- Anoop Kumar Shukla, Chandra Shekhar prasad Ojha, Rahul Dev Garg. "Surface Water Quality Assessment of Ganga River Basin, India using Index Mapping", IEEE International Geoscience and Remote Sensing Symposium, (July 2017).

- Christopher Tomsett, Julian Leyland. "Remote sensing of river corridors: A review of current trends and future directions", Review Paper, (31 May 2019).

- Claude Flener, Matti Vaaja, Anttoni Jaakkola, Anssi Krooks. "Seamless Mapping of River Channels at High Resolution Using Mobile LiDAR and UAV-Photography", remote sensing ISSN 2072-4292 (2013).

- Das JD, Dutta T, Saraf AK (2007) Remote sensing and GIS application in change detection of the Barak River channel, N.E. India. J Indian Soc Remote Sensing 35(301–312).

- Javier J. Cancela, Xesús P. González, Mar Vilanova and José M. Mirás-Avalos. "Water Management Using Drones and Satellites in Agriculture", This article belongs to the Special Issue Water Management Using Drones and Satellites in Agriculture. (26 April 2019).

- Praveen k. Thakur, Chalantika Laha, S.P. Aggarwal. "Riverbank erosion hazard study of river Ganga, upstream of Farakka barrage using remote sensing and GIS", Springer Link, (2011).

- Widodo Budiharto, Edy Irwansyah, Jarot S. Suroso, Andry Chowanda, Heri Ngarianto & Alexander Agung Santoso Gunawan, "Mapping and 3D modelling using quadrotor drone and GIS software", Journal of Big Data volume 8, Article number: 48 (2021).