

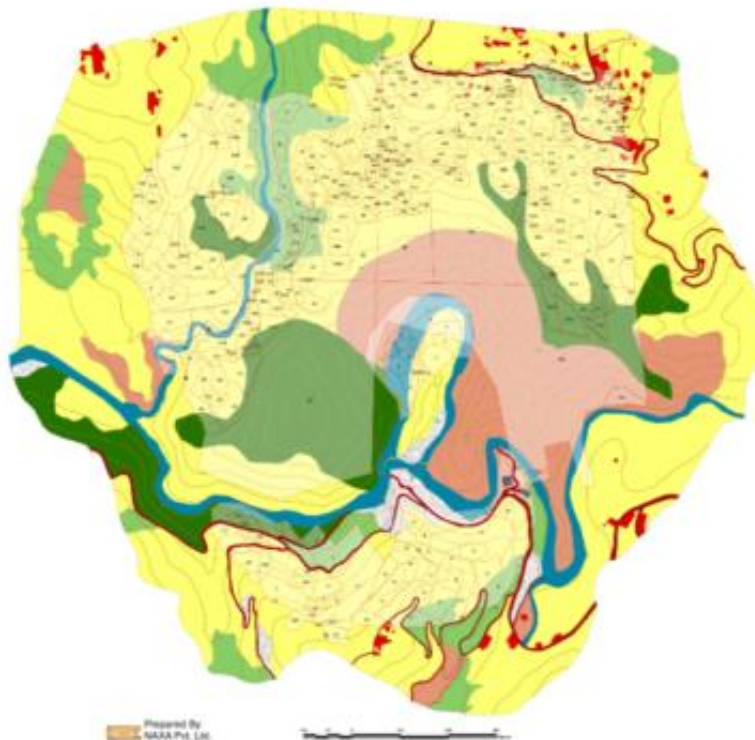
Drones to estimate dumping sites capacity

ORTHOPHOTO OF BANCHAREDANDA AND SAMYAKHOLCHA



Orthophoto of Bancharedanda and Samyakholcha

TOPOGRAPHICAL MAP WITH ACQUIRED LAND PARCEL



Legend	
★	GCP
—	Foot Trail
—	Weir
—	Contour
■	Road
■	River
■	Camp Area
■	Barren Land
■	Bush
■	Cultivation
■	Forest
■	River
■	Sand
■	Settlement
■	Parcel

Topographical map with acquired land parcel

OVERVIEW	
Flying Labs	Nepal Flying Labs
Geographic area	Banchare Danda, Okharpauwa, Nuwakot, Nepal
Date	July 2017
Sector program	DevRobotics
Main SDG	Goal 6: Clean Water and Sanitation Goal 8: Decent Work and Economic Growth Goal 9: Industry, Innovation and Infrastructure Goal 11: Sustainable Cities and Communities

SCOPE	
Stakeholders (clients)	The office of the Investment Board Nepal (IBN), under its Integrated Solid Waste Management (ISWM) project (Partnership project with NAXA)
Beneficiaries	Investment Board Nepal Kathmandu Metropolitan City Kathmandu Waste Management Department
Challenge	Kathmandu has been struggling with garbage disposal for several years. The landfill site at Sisdole in Okharpauwa, Nuwakot district, has already reached its maximum capacity. The government, including the metropolitan offices in Kathmandu, has been working to build a long-term facility for proper waste disposal in Banchare Danda, a location near the current landfill site but the progress has been too slow.
Scope	The technical team at NAXA together with Nepal Flying Labs and their business incubation program's winner - Dronepal, jointly proposed the Investment Board of Nepal (which is currently supporting the construction of permanent structures at the new proposed locations), to use drone-captured images for preparing accurate maps, properly estimate how much land area needs to be acquitted and also calculate the amount of waste that could be deposited in the available area.
Outcome	The technical team used drone images to generate the following outputs: <ul style="list-style-type: none"> ● Topographical map with accurate contours The volume of waste the new sites could hold was calculated using the contour maps derived from drone images. ● High resolution orthophoto maps The high-resolution orthophoto maps were overlaid with the existing cadastral maps to estimate the volume of land within the landfill site and the amount of land that needs to be acquired. The cadastral map helped in recognising information on the quantity and ownership of the lands to be acquired.

	<ul style="list-style-type: none"> ● High resolution DSM and DTM The digital surface model holds the three dimensional data of the proposed site and can be used during future construction works. ● Three dimensional model of the proposed site The 3D model can be used in visual overview of the site, in project sharing presentations among the project senior committee members.
Impact	The project will allow estimating the capacity of the dumping site to ensure a proper waste disposal in the future. It will further help with scaling of the site and finding alternative solutions at the right time.
Next steps	The authorities will use the output datasets to estimate how much land area needs to be acquired for the establishment of waste dumping facilities at the location, and accurately calculate the amount of waste that can be deposited there after constructing a certain height dam in the future.

DATA ACQUISITION

Size of area	0.45 km ²
Drone	DJI Phantom 3
Sensor(s)	Optical Sensor
Flight plan software	Pix4Dcapture
Flight height	75 m above ground
GSD	4cm/pixel
Number of images acquired	800
Number of flights	7
Time invested in data acquisition	3 days
Georeferencing	Ground control points (accurate differential GPS device was used to accurately measure the GCPs)

DATA PROCESSING & ANALYSIS

Processing software	Pix4Dmapper
Processing time	20 hrs
Data products	Orthophoto, DSM, DTM, contour lines
Analysis tools	ArcGIS Pro
Analysis outputs	Cut-Fill Volume calculation over DTM
Final outputs shared with stakeholders	Orthophoto Map, DSM map, DTM map, topographic map (0.5m & 1m contour interval), cadastral map laid over topographic map and orthophoto map, cut/fill volume calculation, 3D animation of the site
Data sharing	Google Drive and hard drive