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Climate Responsive Land Governance and Disaster Resilience: Safeguarding Land Rights

The Fundamental Role of GNSS in Modern Surveying and Mapping to Support Climate Responsive Land Governance and to Enhance Disaster Resilience

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Introduction

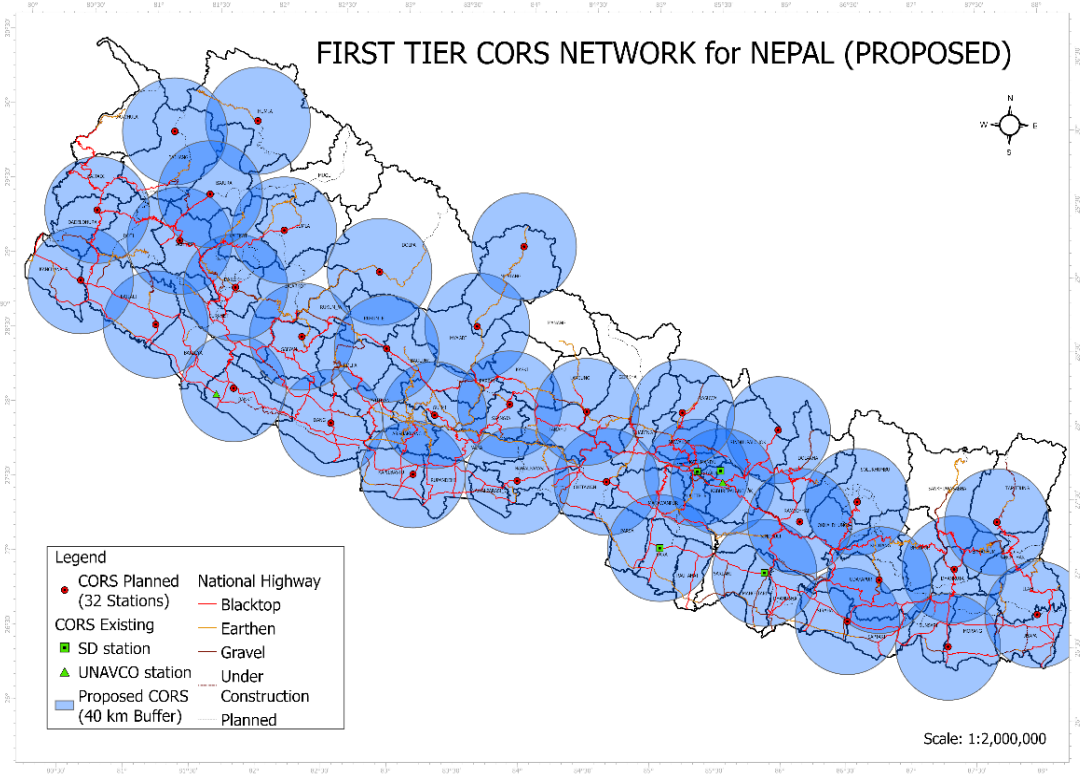
- GNSS due to its various capabilities and integration with other surveying instruments plays a crucial role in surveying and mapping domain.
- Geodetic infrastructure is fundamental to building and supporting climate-responsive land governance and disaster resilience.
- Climate responsive land governance involves integrating land use and management along with climate considerations to address the challenges of climate change.
- Disaster resilience refers to the ability of communities as well as systems to anticipate, prepare for, respond to and recover from the disasters.
- GNSS in modern surveying methods has directly and indirectly contributed to achieving climate-responsive land governance and disaster resilience.

Geodetic Infrastructure in Nepal

- Existing Horizontal reference frame (In collaboration of MoDUK and Survey Department)
- Nepal has gone through major and minor seismic events including mega earthquake 2015.
- Nepal hasn't updated the control stations since its establishment
- In realization of that, SD has established 4 CORS station and has the mandate to install 27 CORS Stations in this fiscal year
- One CORS Station in 70-80 km and later reduced to 30-40km
- CORS network will maintain the accurate horizontal reference frame leading to accurate surveys for climate-responsive land governance and enhancing disaster resilience

Proposed CORS Network

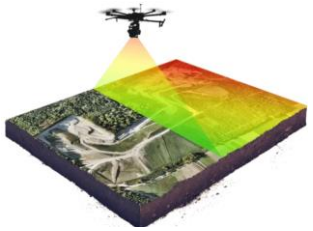
- 4 installed CORS Stations at Survey Department premises, Nagarkot, Bara and Mahottari.
- Precise Positioning datasets after establishment will be crucial for disaster resilience, tenure security, climate-responsive land governance, spatial planning, land administration, engineering survey, etc.



Modern Surveying Methods for Disaster Risk Management

- UAVs combined with GNSS, are used for disaster monitoring, early warning systems, post-disaster assessment, search missing persons, etc.

- LiDAR in combination with GNSS are used in emergency response, evaluating the impact of disasters, assessment of landscape change, identifying disasters risk and environmental alterations.



- RTK GNSS network systems are employed in earthquake prone areas to monitor crustal movements and provide early warning systems.

GNSS for Informal Settlement Management

- Management of Squatters and Informal Settlements is mentioned in Constitution of Nepal Part 4, Article 50 (J).
- Government of Nepal has started using GNSS control points for detail survey and satellite image georeferencing as well.
- GNSS applications for informal settlement management directly supports UN SDG 1 and UN SDG 11.

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- Initially registered as *"Parti Jagga"* i.e. barren lands.
- Later, those parcels became informal settlements informally.
- Formal transaction were not possible.
- So, detailed cadastral survey was done with the use of GNSS control stations.
- Then, Cadastral information were updated and Land Ownership Certificate were distributed based on those cadastral maps.

GNSS for Engineering Survey

- Major issue with the development projects in Nepal is compensating private lands used under the project area and accurate demarcation of Right of Way.
- This leads to proxy demarcation, mismatching of identified parcels and financial issues.
- But now, GNSS control points have almost eliminated this issue, as they are used to georeference the survey data and transform them to overlay with cadastral maps.
- Thus, project designs and corridors can be overlaid on cadastral data to identify affected parcels.
- GNSS for Engineering Survey supports UN SDG 9.

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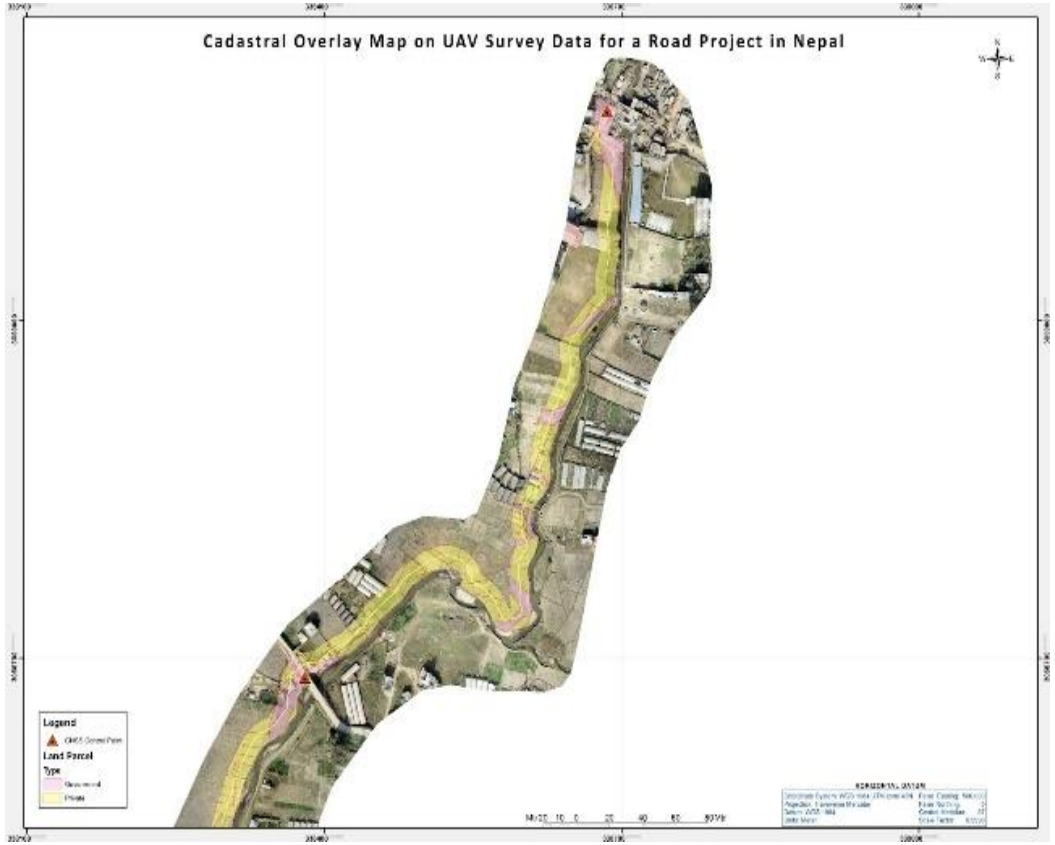
- A Section of road development project in Nepal.
- GNSS survey was done for topographical survey and cadastral analysis process.
- GNSS control points were used to georeference the orthomosaic and DEM.
- Then, Cadastral data were overlaid on top of survey data and was georeferenced using same GNSS points.



GNSS for Disaster Resilience

- GNSS can be effectively utilized for monitoring, modelling and determining the characteristics of various disasters in order to support disaster risk reduction and management.
- CORS provides the time series position, which provides subtle motion and subsidence rate of land for detection of landslide potential area.
- CORS has become a widely used technique for earthquake risk assessment and determine dynamic ground displacement during the earthquake.
- Geospatial products combined with GNSS-supported positioning are used to prepare thematic maps that helps in prevention, mitigation, preparedness, emergency response, rehabilitation and reconstruction.

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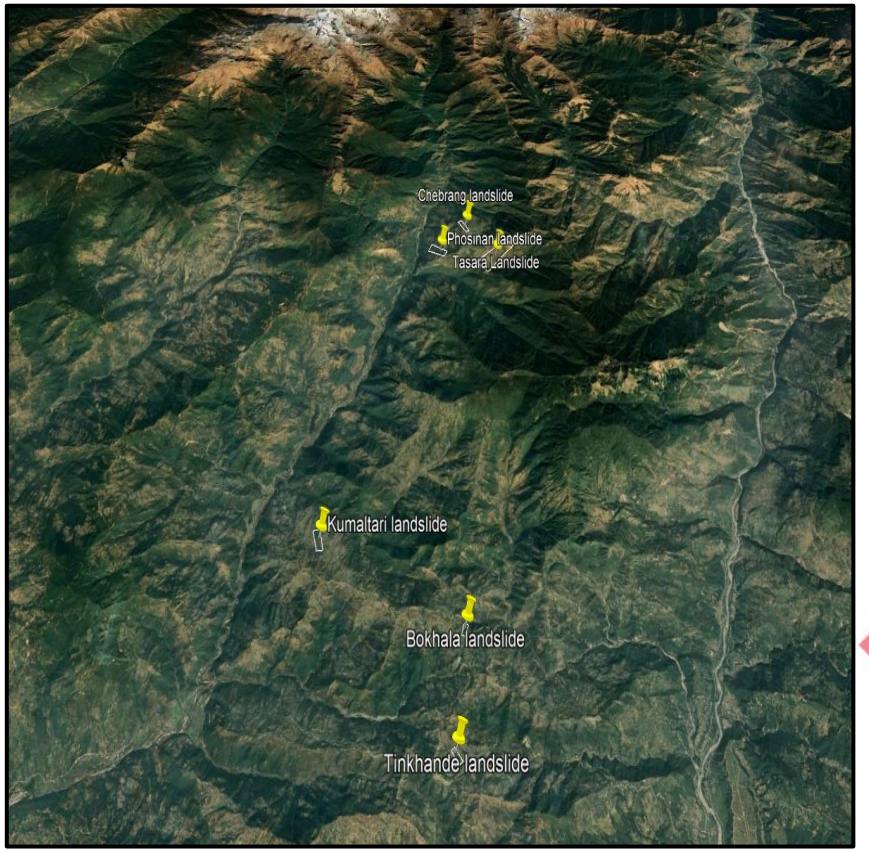
- GNSS control points and LiDAR survey were used to monitor the movement of earth mass in pre and post monsoon.
- Temporal datasets of GNSS control points were utilized to examine the spatial changes and UAV LiDAR survey to understand 3D position of surface.
- This analysis helped to understand the effect of monsoon, pattern of slides and early forecasting if any abnormalities in velocity of earth mass is seen.
- Among six zones, three zones were highly reactive to monsoon and thus road construction were re-routed.



Discussion and Conclusion

- GNSS provides accurate location information, crucial for tracking the movement and impact of various disasters.
- GNSS is utilized in every stage of disasters through integration with other geospatial technologies.
- Building nationwide CORS network and maintaining can be challenging, so coordinated efforts, adequate funding and robust policies is required to fully leverage the potential of GNSS.
- As GNSS has founds its application in almost all domains, future advancement of this technology for disaster management, climate resilience and land governance have huge potential.
- Thus, by providing precise spatial data, GNSS aids in achieving Sustainable Development Goals.

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ZERO HUNGER
QUALITY EDUCATION
GENDER EQUALITY
GOOD HEALTH AND WELL-BEING