FIG WORKING WEEK 2025
AND Locate25 THE NATIONAL GEOSPATIAL CONFERENCE
Collaboration, Innovation and Resilience: Championing a Digital Generation
FIG Geospatial Council of Australia
Brisbane, Australia 6–10 April

Transforming Cadastral Maps: Assessing the Feasibility of Prompt AI for Automatically Digitizing Historical Cadastral Maps

Presented By:
Sanjeevan Shrestha

Under-Secretary
Ministry of Land Management, Co-operatives and Poverty Alleviation

Vice President
Nepal Remote Sensing and Photogrammetry Society

Co-author: Tina Baidar, Shangharsha Thapa

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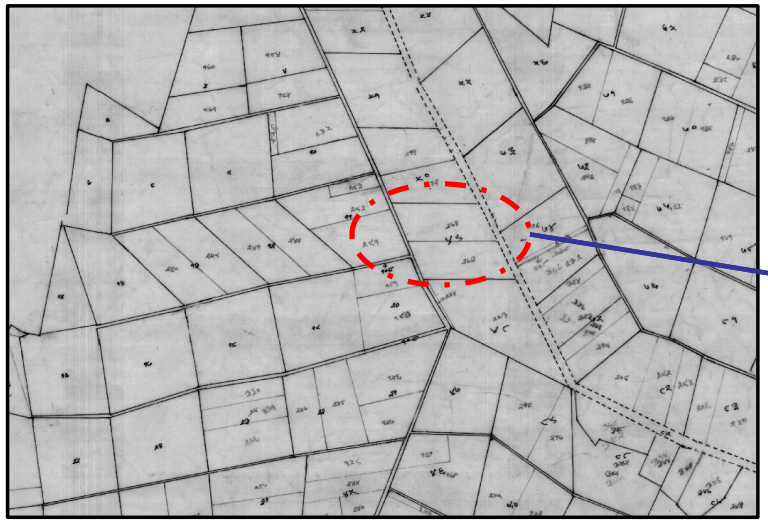
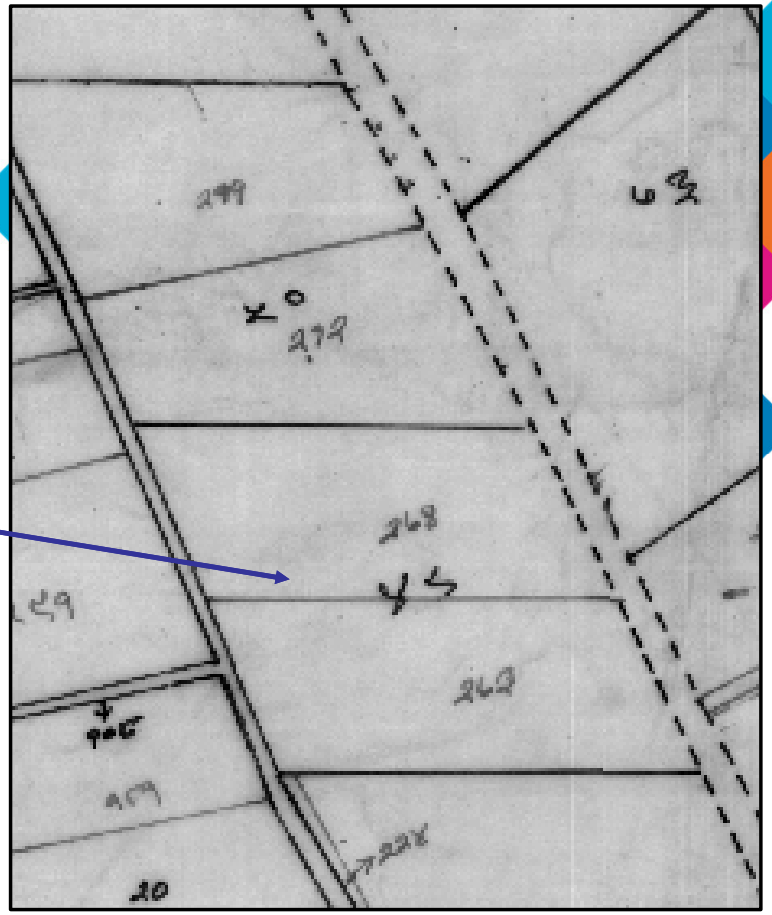
Improving Cadastral Accuracy for Disaster Management: The Role of Segment Anything Model (SAM) in Digitizing Historical Cadastral Maps

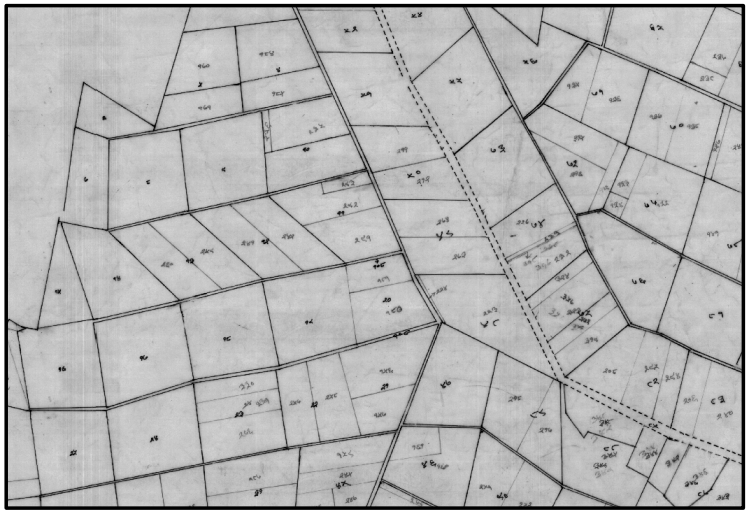
FIG Article of the Month, December 2024

Overview of Cadastral Map

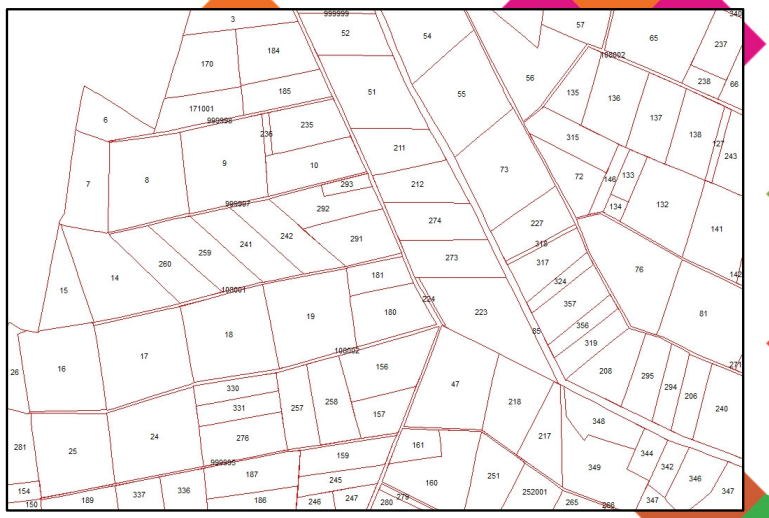




Overview of Cadastral Map



Scanned Paper Cadastral Map



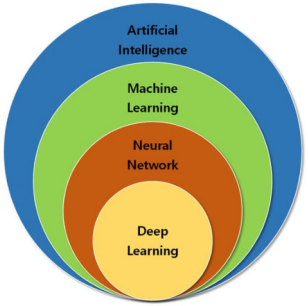
Digital Cadastral Database

Automatic extraction of cadastral parcels

Skeletonizing

OBIA

Segmentation



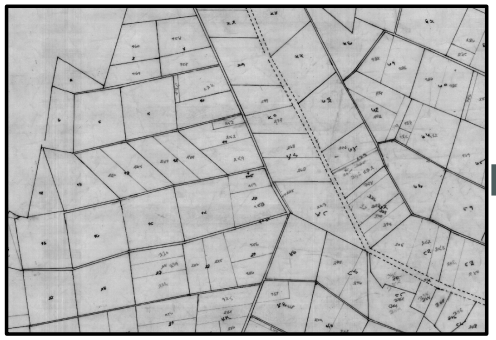
Semantic Segmentation

What is the next step?

Prompt AI: Segment Anything Model (SAM)

- Released by Meta AI research - zero-shot learning
- Can adapt to new datasets and perform unfamiliar tasks using '**prompting**' techniques, even with little or nor prior training
- SAM-2 – enhanced model of SAM

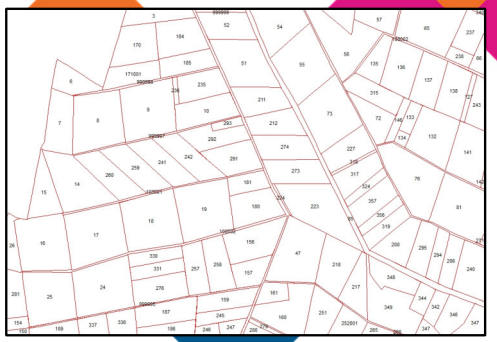
Objectives



Scanned Cadastral Image

Zero-shot

SAM/SAM-2

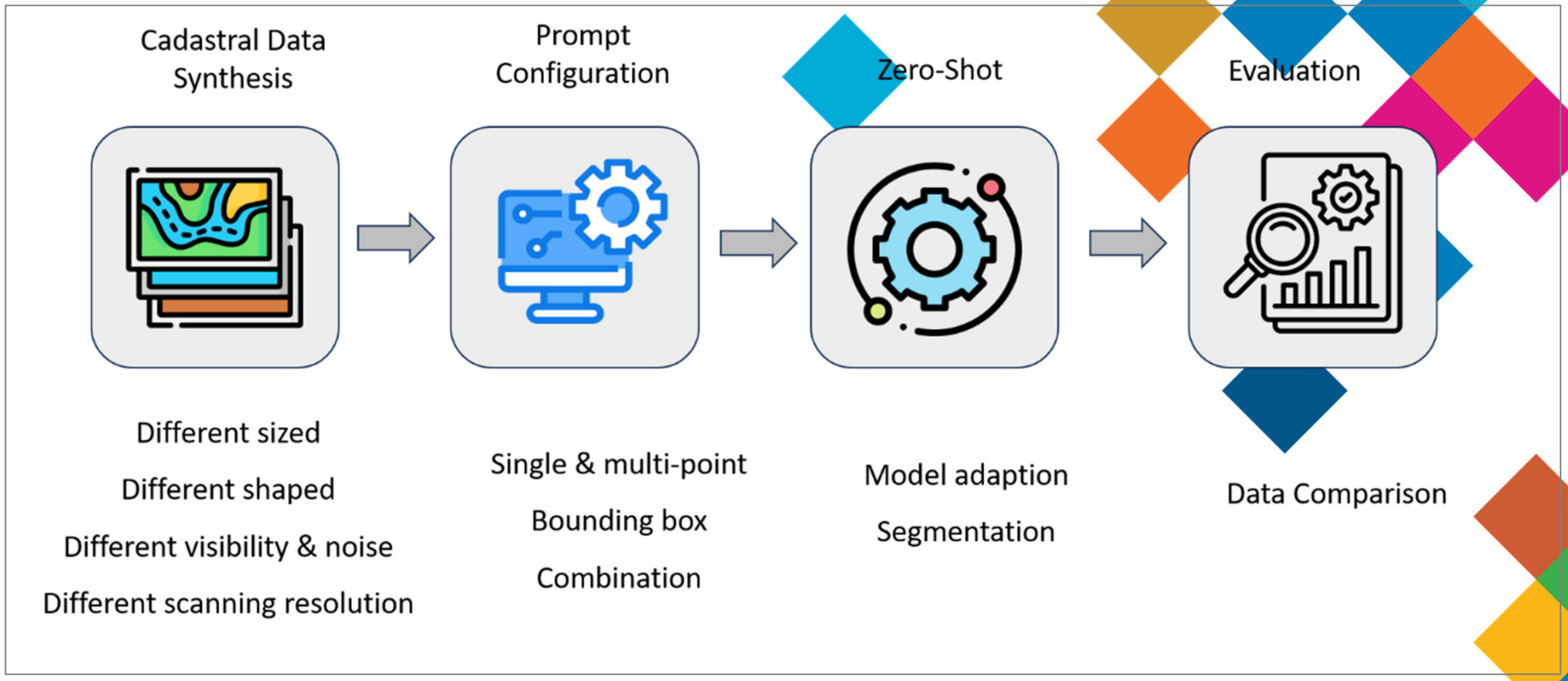


Cadastral Database

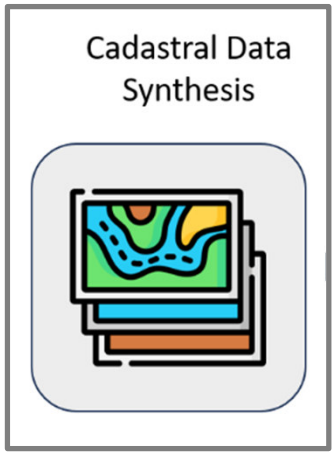
Feasibility

Effectiveness

Material and Methods



Cadastral Data Synthesis



Key five attributes:

Shape/Parcel Density

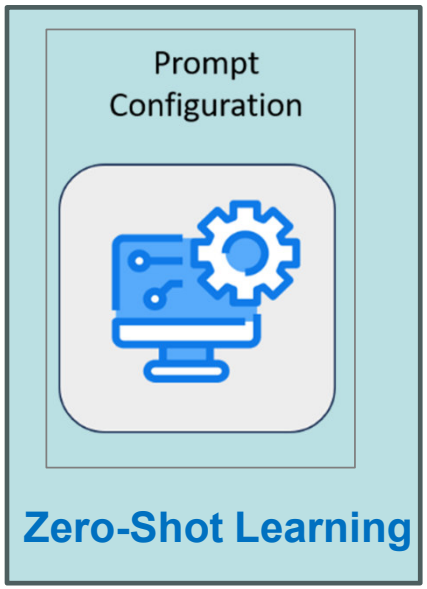
Parcel Size and Eccentricity

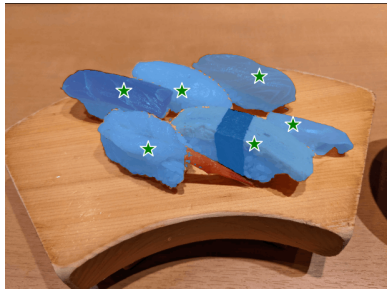
Parcel Boundary Visibility

Noise condition

Scanning resolution

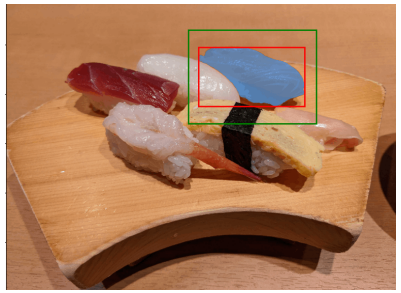
Prompt Configuration





Multi-Point

Combination



Bounding Box

Zero- shot

Model`	SAM	SAM-2
Platform	QGIS plugin “GeoSAM”	Google Collab Code
Model	ViT-L	Model – sam2_hiera-base-plus
Output from model	Image feature and valid mask	Image feature and valid mask
Final Output	Polygon shapefile	Polygon shapefile

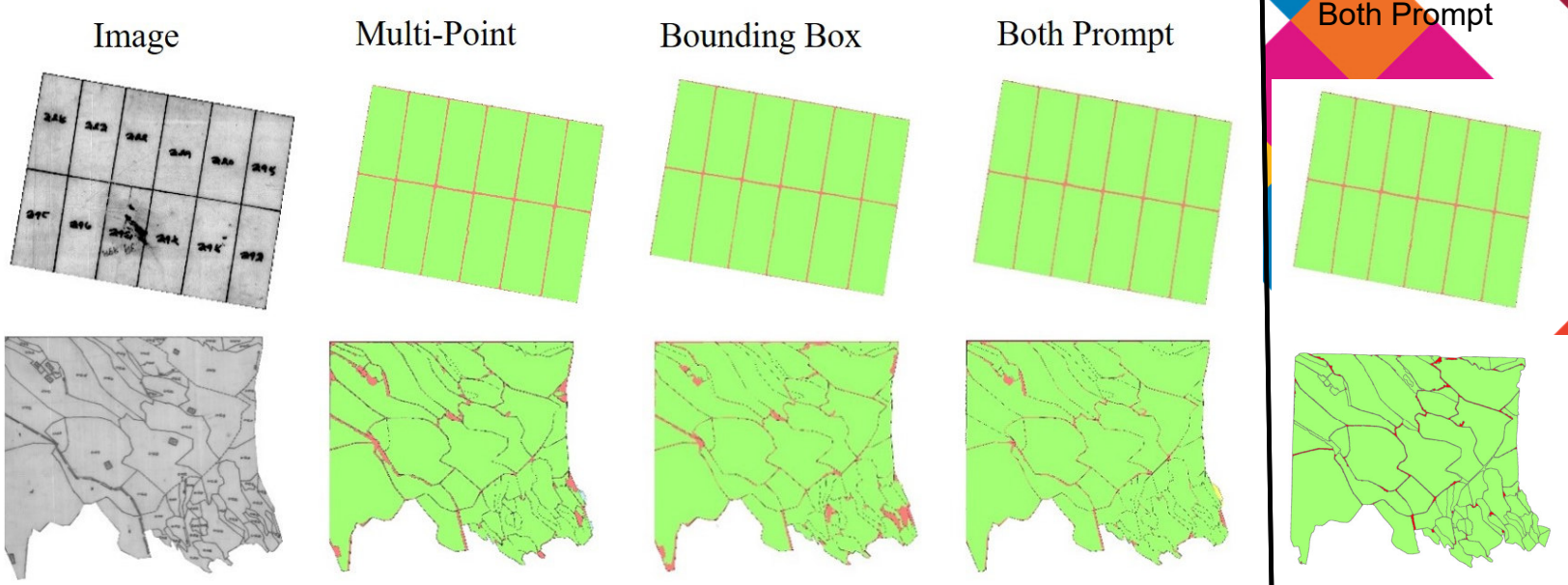
Result and Analysis: Parcel Density

Equal Size –
High accuracy

Dense and Variety
noticeable decline in Accuracy

Underestimation
mitigated by employing the combination

SAM-2 **enhanced** the performance towards **small parcel extraction**

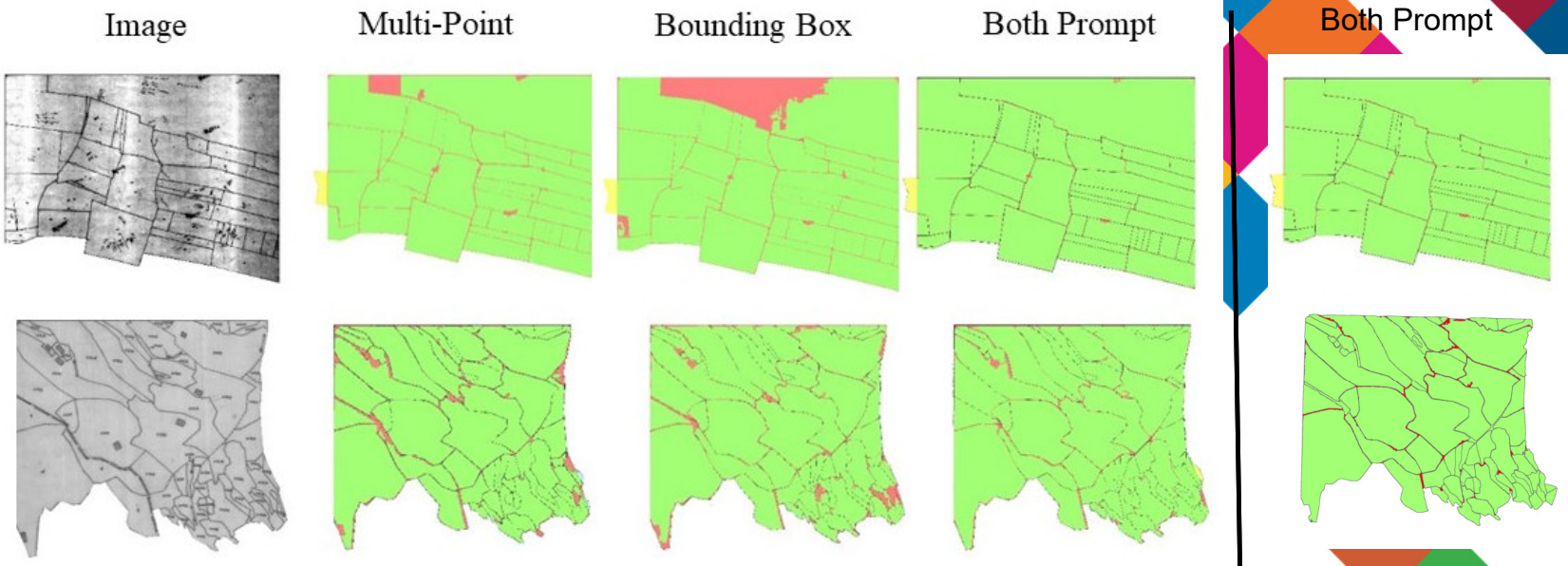


Result and Analysis: Parcel Size and Eccentricity

accurately extracted – matched well defined **geometric shape**

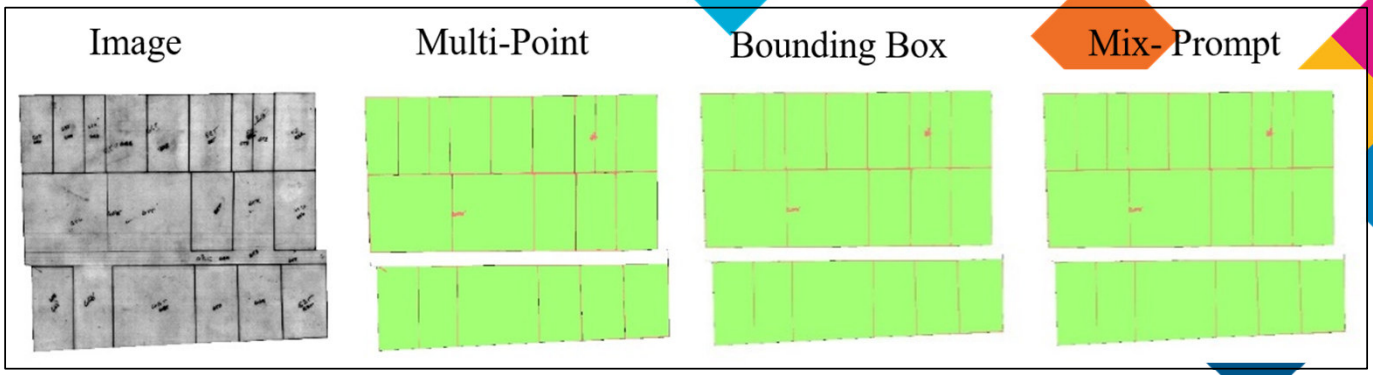
Underestimation – delineating larger parcels with **high eccentricity**

Segmentation accuracy- highly **correlated** with their **eccentricity**



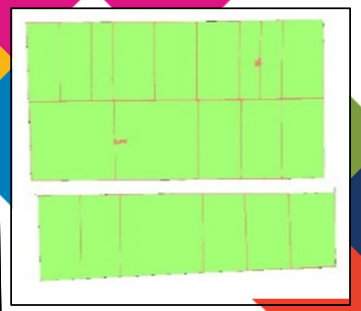
Result and Analysis: Parcel Boundary Visibility

promising results in delineating parcels, even under **varying degrees of boundary clarity or ambiguity**



SAM

Mix Prompt

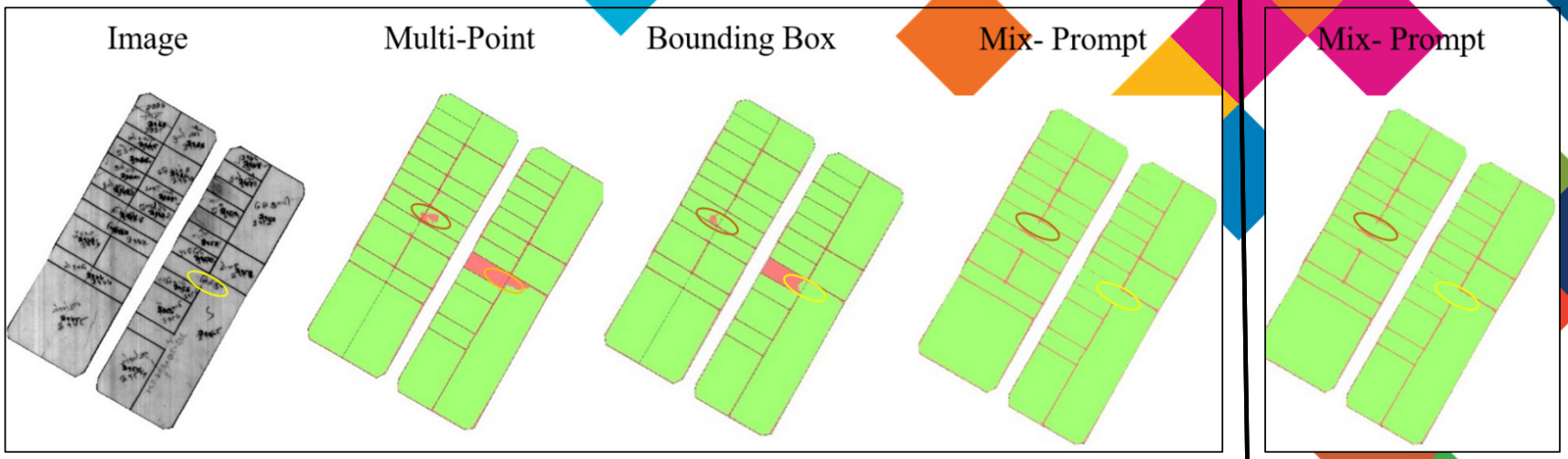


SAM-2

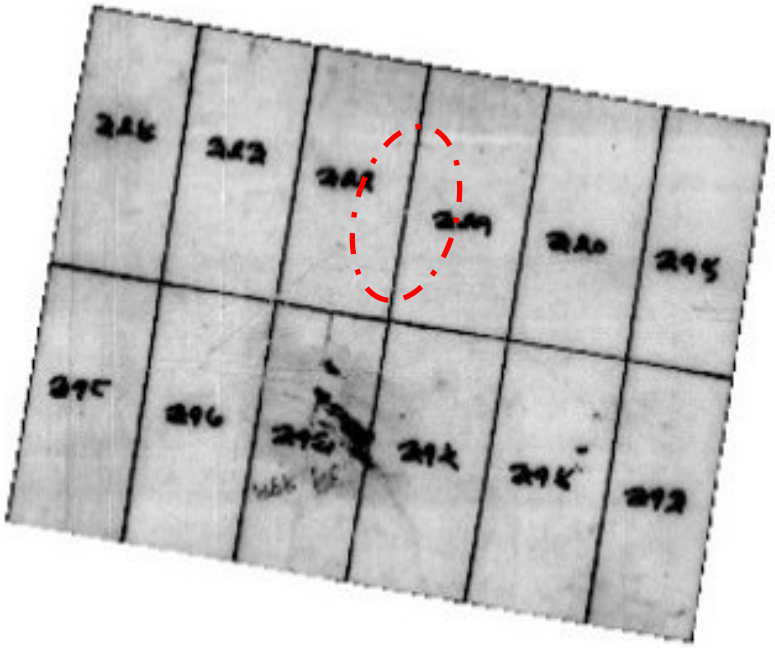
Result and Analysis: Noise

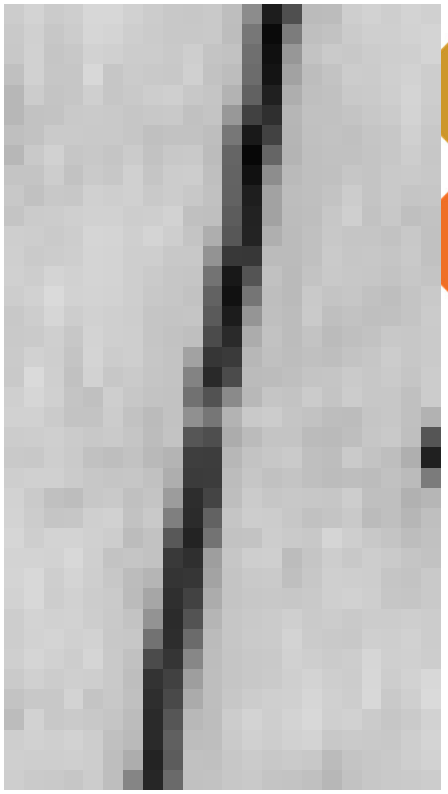
Noise within boundary – didn't impact performance

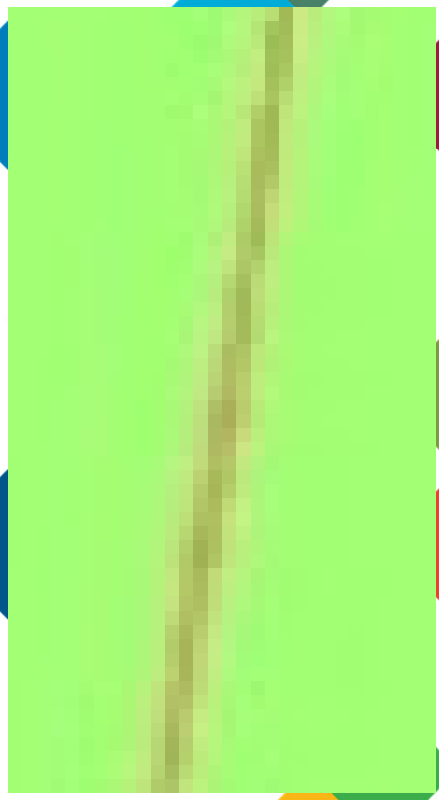
Noise adjacent to boundaries – significantly decrease accuracy



Scanning Resolution





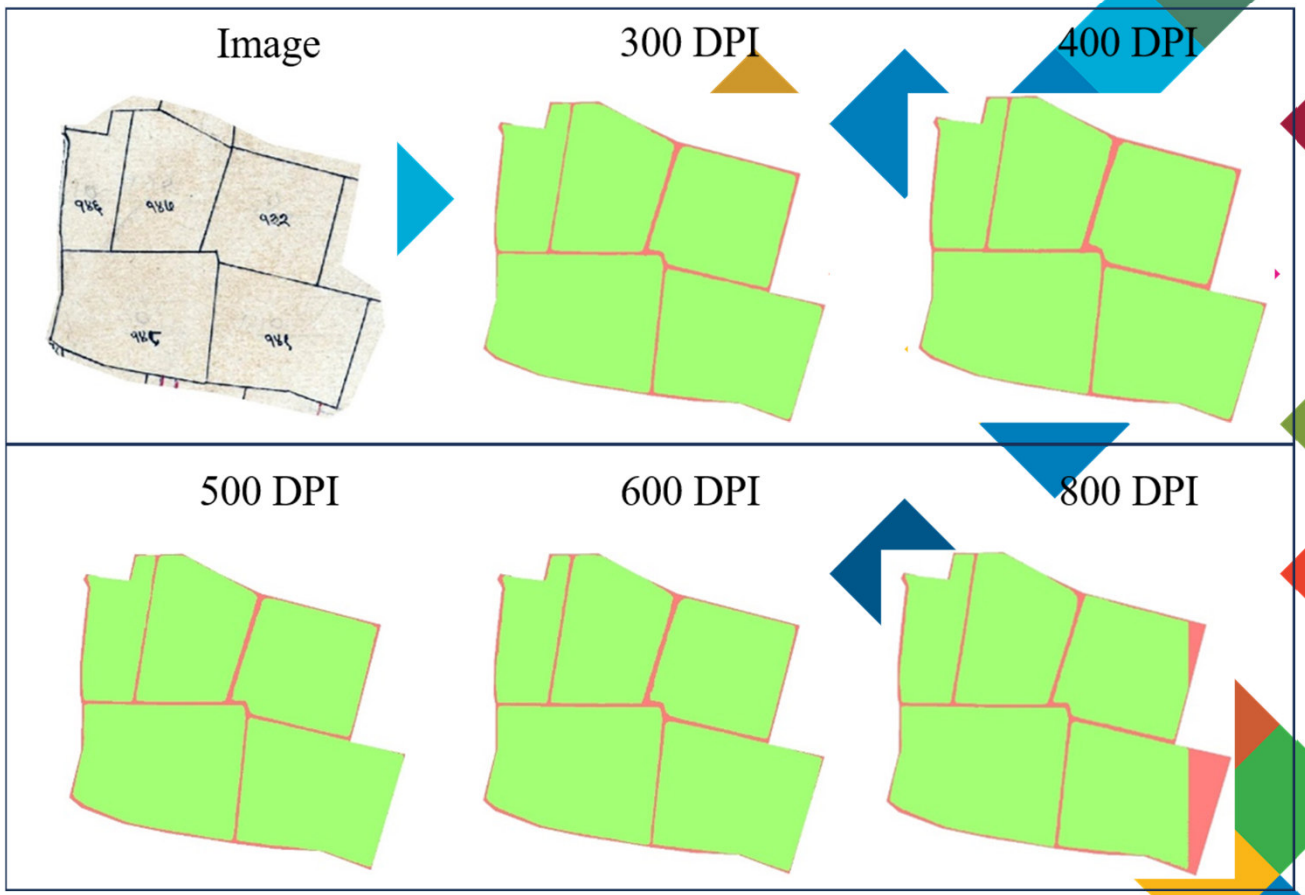


Result and Analysis: DPI

Increasing the scanning resolution – **didn't increase** accuracy

Delineation capability **further decreased with higher scanning accuracy**

Reduction in performance – increased heterogeneity in higher resolutions

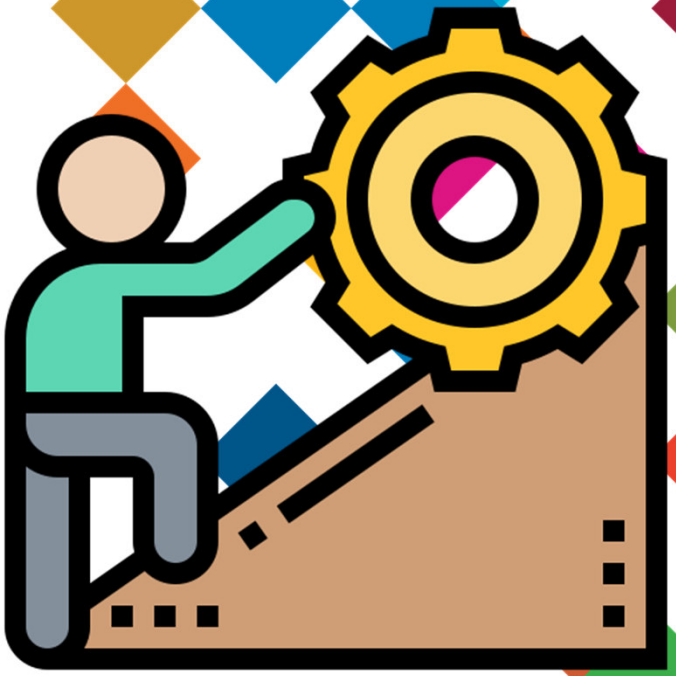


Conclusions

- **zero shot segmentation** capabilities of SAM and SAM-2 for cadastral data extraction from **scanned historical cadastral maps** under various **scenarios and complexities**
- **Combination of base prompts** consistently outperforms individual base prompts in the zero-shot learning approach across all datasets.
- Introduction of **SAM-2 enhanced the performance** of SAM especially towards **small parcel extraction**

Challenges/Limitations

- Faces challenges when **handling noisy data near boundaries** and areas with **complex parcel configurations**
- Occurrence of **false positives** between segmented parcels remains a **persistent issue**.
- **initial experiment** was **limited** to exploring SAM and SAM-2's **zero-shot capabilities**



Recommendations

- On evaluating SAM's and SAM-2 model **one-shot segmentation** capabilities
- need for **GIS with SAM, along with human oversight**, to ensure the creation of accurate and complete cadastral databases

The most relevant SDGs related to the presentation and theme of this session

1st relevant SDG

2nd relevant SDG

3rd relevant SDG

SUSTAINABLE DEVELOPMENT GOALS

International Federation of Surveyors supports the Sustainable Development Goals

Thank You!

Any Questions?

Source: Nepal Tourism Board