



A Deep Learning application towards transparent communication for Payment for Forest Environmental Services (PES)

PROPOSAL TRACK

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Climate change and deforestation

- ▶ Forests as a “carbon sink” ~approx 7.6b metric tonnes of CO₂ annually (Harris et al., 2021)
- ▶ Source of livelihood for 1.6b people globally and 80% of global terrestrial biodiversity (IUCN, 2021)
- ▶ 1990 – 2005: Deforestation accounts for more than 20% of global emission (IPCC, 2019)



Source: IUCN (2021). Forests and climate change
<https://www.iucn.org/resources/issues-briefs/forests-and-climate-change>
Masson – Delmotte et al. (2019). Climate Change and Land. IPCC.

Harris, N.L., Gibbs, D.A., Baccini, A., Birdsey, R.A., De Bruin, S., Farina, M., Fatooyinbo, L., Hansen, M.C., Herold, M., Houghton, R.A. and Potapov, P.V., 2021. Global maps of twenty-first century forest carbon fluxes. *Nature Climate Change*, 11(3), pp.234-240.

PES/REDD+ as a solution

- ▶ REDD+ (Reducing emissions from deforestation and forest degradation) as the activity with the largest potential for reducing AFOLU emissions (0.4–5.8 GtCO₂-eq yr⁻¹) (UNFCCC, 2019)
- ▶ Payments for environmental services (PES): an effective market-based instrument to provide financial incentives for forest owners, particularly poor and indigenous households in developing countries
- ▶ Problems
 - i) Weak monitoring and evaluation
 - ii) Indigenous inaccessibility to e-banking and complying with procedural and administrative paperwork to receive payments



Our proposal: an end-to-end and user-to-user communication for PES

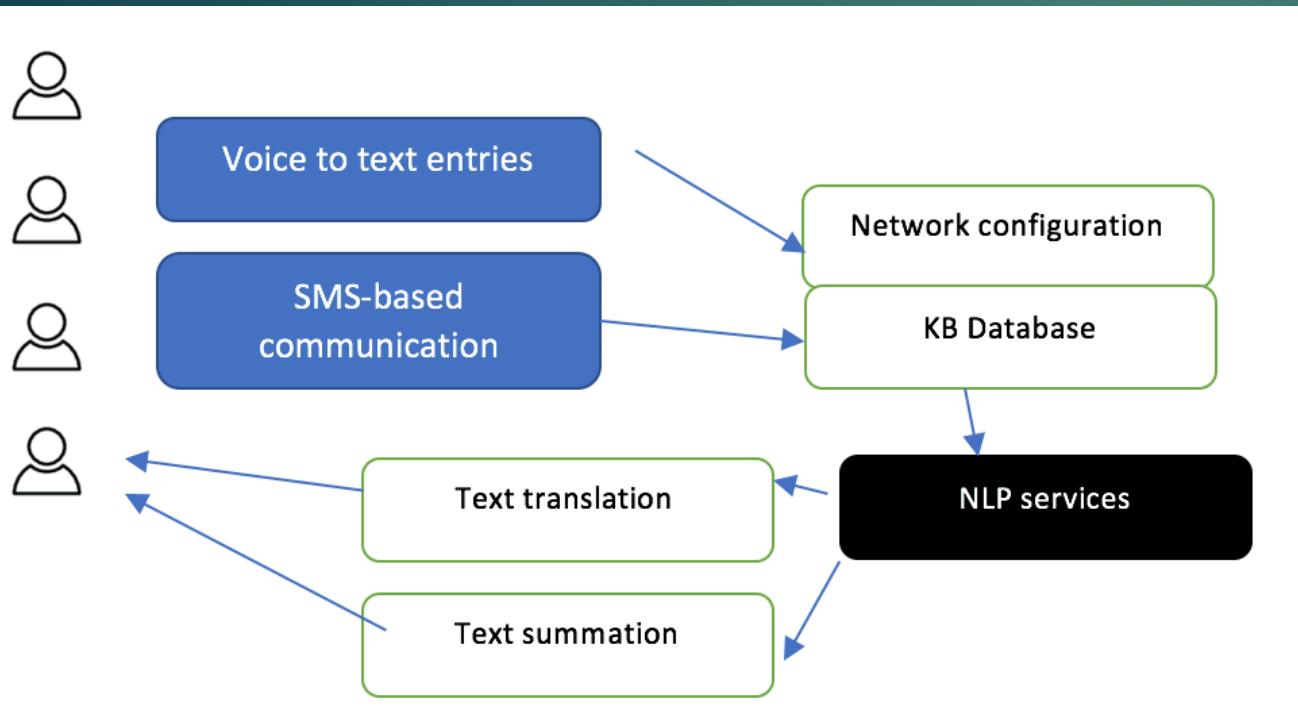
- ▶ Machine Learning techniques to
 - ▶ i) provide adaptive tools for local context and local language and based on local needs to assist indigenous people with diverse educational background to complete paperwork requirement related to PES payment system
 - ▶ ii) improve transparency and accountability of PES as well as enhance PES outcomes in reducing emissions from deforestation and degradation



Reducing language barriers via NLP

Initial data source: Template sentences Voice-to-text to process voice entries into text-based messages

- Sequence to sequence learning for auto translation to other languages, such as from landowners to buyers in different geographical areas



Outputs: an end-to-end pipeline for communication across different users

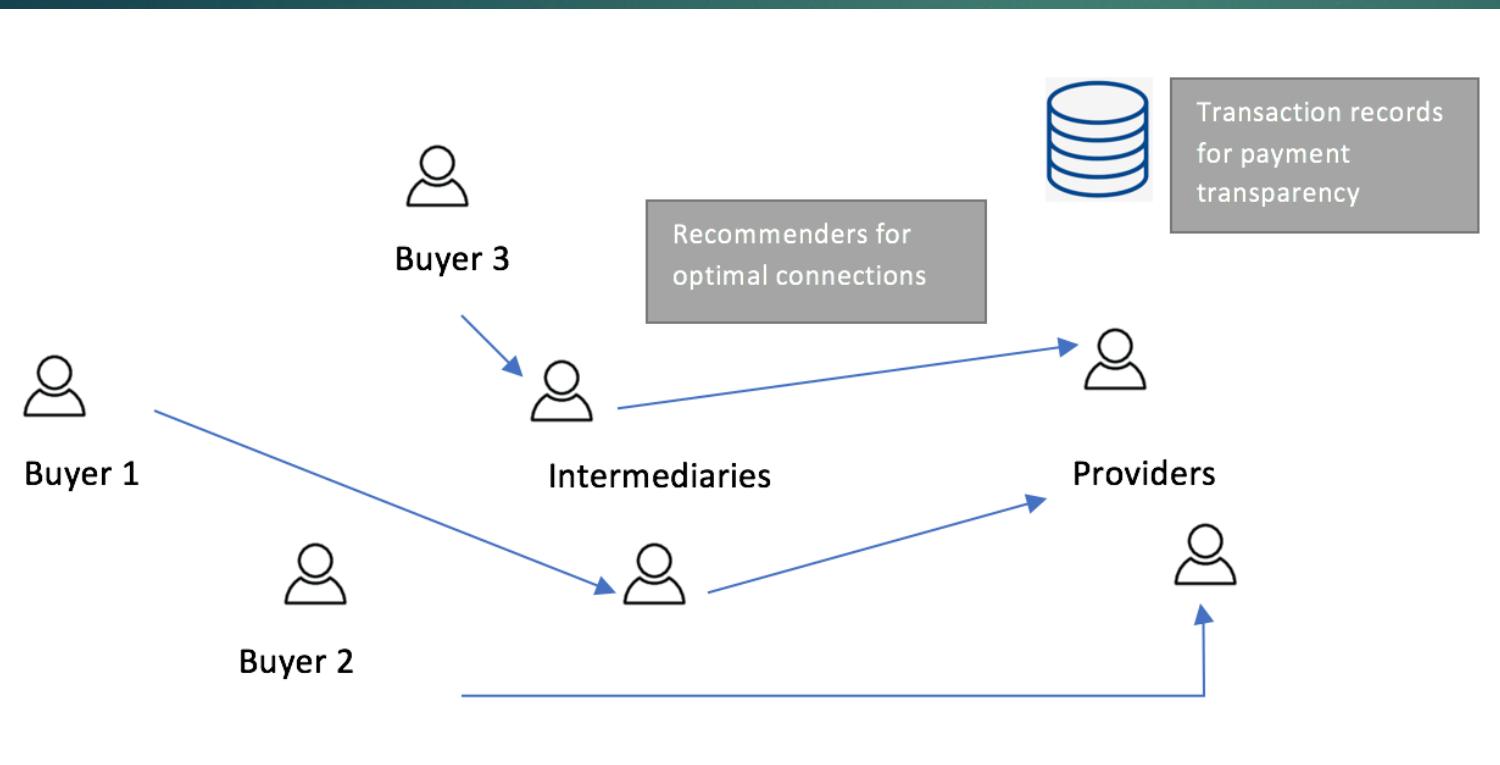
Additional consideration: intermittent or poor Internet/mobile network access and low-memory devices: cloud-based processing and SMS-based communication.

Stakeholder linkages

Multi-modal Knowledge and Transaction enabled by Graph Neural Network (GNN)

Knowledge generation:

- Geo-tagging the user location and roles with verification
- Predictive stakeholder network and link types using Graph Neural Network
- Predictive carbon sequestration and storage to predict transaction volumes and values



Optimisation component:

- Automated stakeholder mapping
- Recommender system to make suggestion of optimal routes for transactions (including direct buyers – providers and buyers – intermediaries – provides based on the costs incurred for buyers and providers).

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