FLOOD INUNDATION MODELLING USING LIDAR AND GIS

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Background

• Flooding is one of the major impacts of extreme weather events which can cause damage to property and loss of life.

• Apalit, Pampanga has been suffering from prolonged inundation which has led to losses in rice production.
Objective

• To showcase the application of LiDAR technology for rice cultivation by developing flood models to identify rice cultivation areas based on depth and duration.
Light Detection and Ranging (LiDAR)

- LiDAR is a remote sensing technology that uses rapid laser pulses to map out the surface of the earth.
- LiDAR data can be used to create high resolution digital surface, terrain, and elevation models which have been used for various applications such as hydrologic modelling.
LiDAR-BASED DIGITAL TERRAIN MODEL
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ELEVATION (meters)
Study Site

- 12 Barangays
- 1st Class Municipality
- Gateway to Pampanga from Manila
Hydrography

- The Pampanga River runs through the municipality and is a source for the irrigation of some of its rice fields.
- The terrain is relatively flat which makes it suitable for agriculture, however it also makes the municipality prone to flooding.
11 of the 12 barangays are rice-producing. Approximately 63% of the municipality is cultivated land grown mostly with perennial crops.
Methodology

1. Obtain flood modelling input data
2. Run LISFLOOD-FP to produce models
3. Validation and calibration of flood modelling results
4. Stack time series images and convert to .img file
5. Calculate mean depth
6. Input mean depth output and inundation time model in Python
7. Clip zone map to rice cultivation extent
8. Rice cultivation zone map
Results
5-YEAR MEAN DEPTH
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FLOOD depth (100-YEAR rain return)

100-YEAR MEAN DEPTH
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MEAN DEPTH (Meters)

- < 0.20
- 0.20 - 0.49
- 0.50 - 0.99
- 1.00 - 1.99
- 2.00 - 4.99
- > 5.00
Results of FGD

Observed Flood Depths (Habagat 2013)
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Max Depth (Meters)
- <0.20
- 0.20 - 0.49
- 0.50 - 0.99
- 1.00 - 1.99
- 2.00 - 4.99
- <5.00

FGD validation points
5-YEAR TOTAL INUNDATION TIME
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Total time (hours)
Value

174,667 150 120 90 60 30 0

0 1 2 4 KM
25-YEAR TOTAL INUNDATION TIME
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Zone Matrix

Increasing Duration

Increasing Depth

Zone 3
(<20cm, <7days)

Zone 2
(<20cm, ≥7days)

Zone 4
(≥20cm, <7days)

Zone 1
(≥20cm, ≥7days)
5-Year Zone Map
25-Year Zone Map
100-Year Zone Map
Map Presentation and Validation

The results were presented and validated on September 24, 2015.

An IRRI representative that was present also provided seedlings of submergence tolerant varieties for farmers of the municipality.
Key Findings

• Increase in affected cultivation areas for both flood inundation time and mean depth as rain frequency increases.

• A decline in yield is possible as cultivation areas decrease due to increasing flood depths and longer submergence periods.

• Potential adaptation—flood tolerant rice varieties
Conclusions

• Fine scale LiDAR data can be used for determining depth and duration of flooding in rice growing areas.
• Participatory method is essential for validating and calibrating flood models.
Pila Learning Laboratory

- 2,197.24 has or 90% of total land area is classified as agricultural land.
- Coastal municipalities surrounding Laguna Lake are vulnerable to flooding.
- Floods of up to 4 months experienced in 2012.
Way Forward

- **ADVANCE**- Advancing Vulnerability Assessment for Agricultural Resilience

- Focusing specifically on smallholder rice farmers and how their cropping activities are affected by flood.
Way Forward

MAIN OBJECTIVE:

• To develop a decision support tool based on analysis of current and future vulnerability of smallholder farmers to flooding as a result of climate change

SPECIFIC OBJECTIVES:

• Characterize and assess the current vulnerability of smallholder farmers
• Analyze current and future vulnerability of smallholder farmers to flood and linking it with risk, loss and damage
• Build/Increase capacity of smallholder rice farmers to adapt to future flood vulnerability
Way Forward

• Key Outputs:
  – Flood models
  – Vulnerability indices
  – Vulnerability maps
  – Rice Cultivation Zone Maps
  – Capacity building activities
Thank You!!!

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