



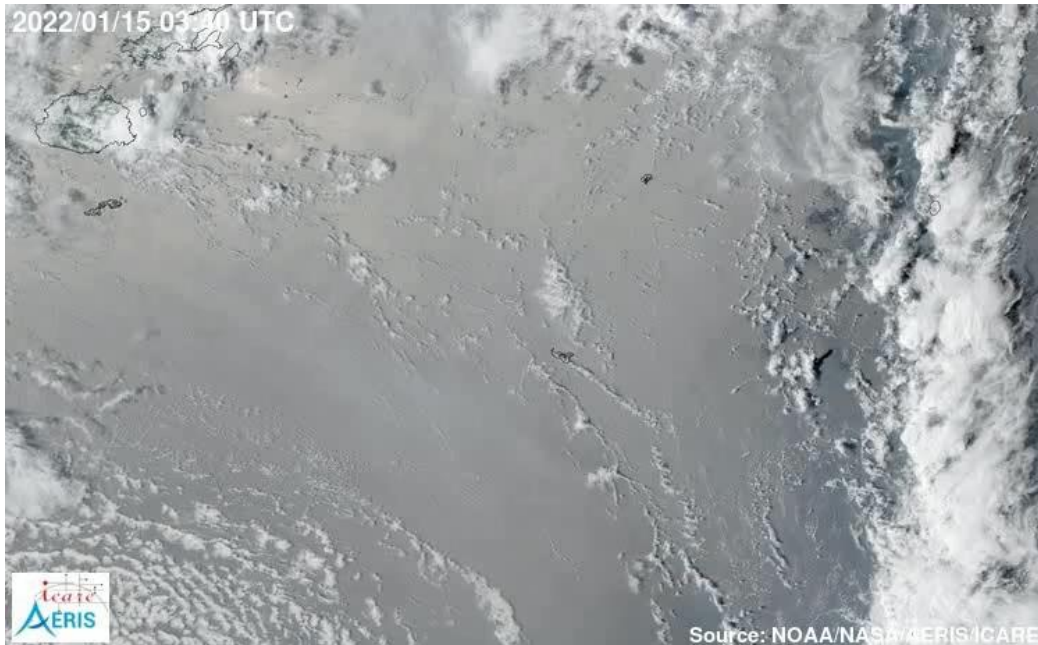
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GNSS Enhancing Tsunami Early Warning System

**International Collaboration and Support:
Hunga Tonga Hunga Ha'apai**

Viliani Folau: Tonga



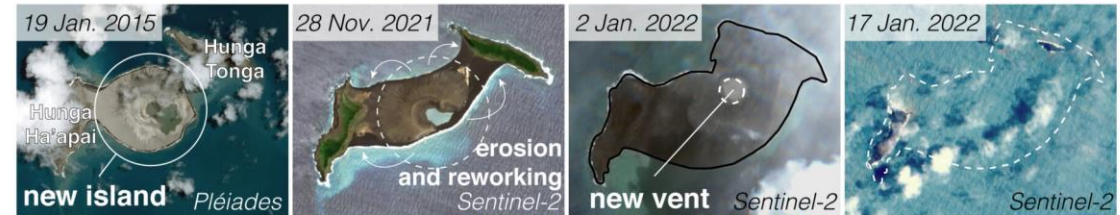
Hunga Tonga volcano – 15 Jan. 2022 eruption

2015–2022 evolution of volcanic island from satellite imagery

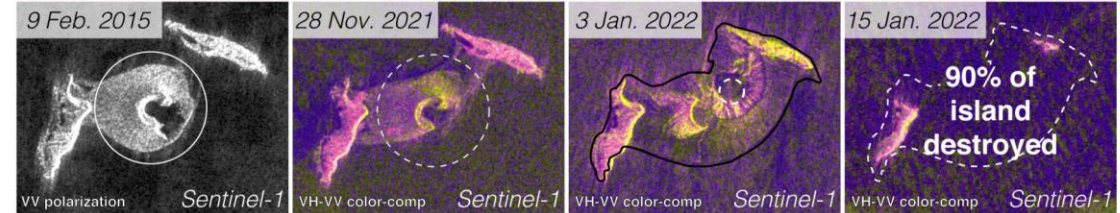


After 2014-2015 eruption Before 2021-2022 eruption During 2021-2022 eruption After 15 Jan. 2022 explosion

Optical imagery



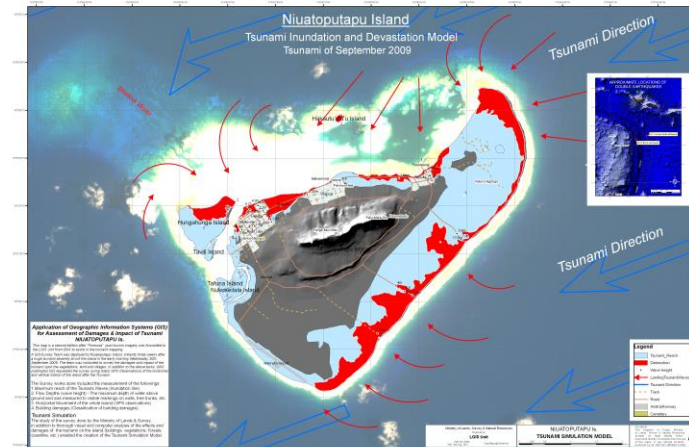
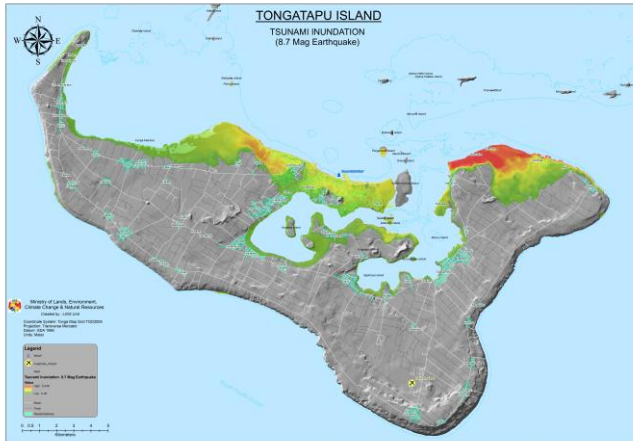
Radar imagery



- Tonga is one of the most vulnerable country in the world.
- The Hunga Tonga–Hunga Ha‘apai volcano erupted with an energy equivalent to around 61 megatons of TNT.
- The explosion was bigger than any other volcanic eruption so far in the 21st century. Huge quantities of particles, including dust and water vapor, were released into the atmosphere.
- Tonga was not prepared for such a disaster in this magnitude

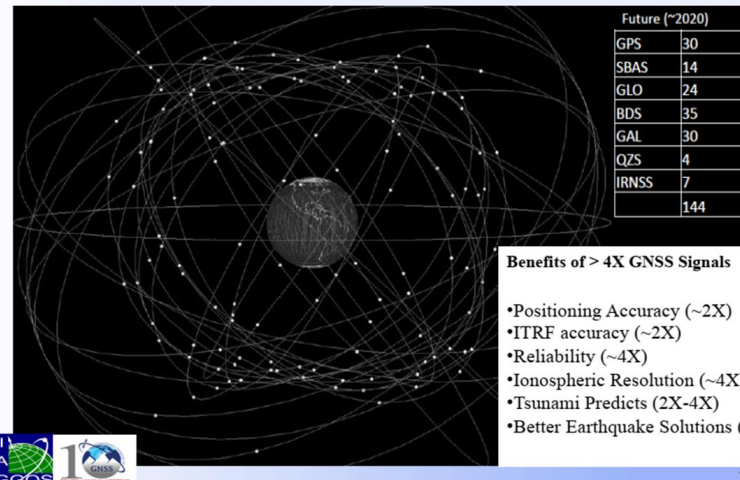
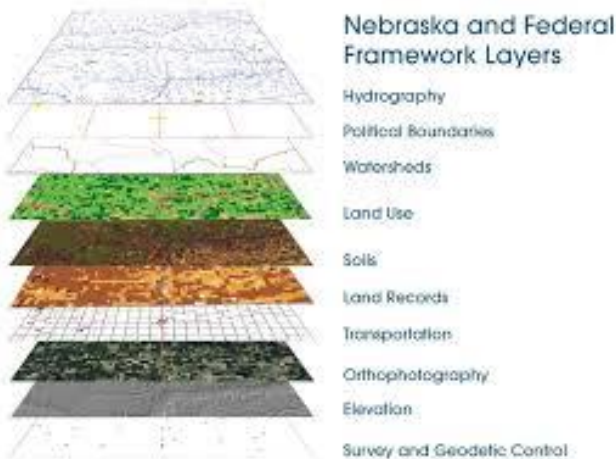


- Tsunami Early warning system was fully in place
- The islands were hard hit, with ocean surges washing over low-lying areas including four islands including part of the main island.
- The volcanic eruption itself also caused damage, including to agriculture and a sea bottom fiber optic cable, but most of the \$118 million (USD) in damages in Tonga were due to the tsunami.



- Risk assessment: Identifying high-risk zones based on geographical factors
- Vulnerability mapping: Highlighting regions prone to specific types of disasters
- Hazard prediction: Using historical data to forecast potential disasters
- Protection Natural Resources, Ecosystem, Ecology,
- Land Use Planning
- Real-time monitoring: Tracking the progression of ongoing events for immediate response
- Enhancing Tsunami Early Warning System

GNSS Satellites and Signals will increase more than 400% in This Decade



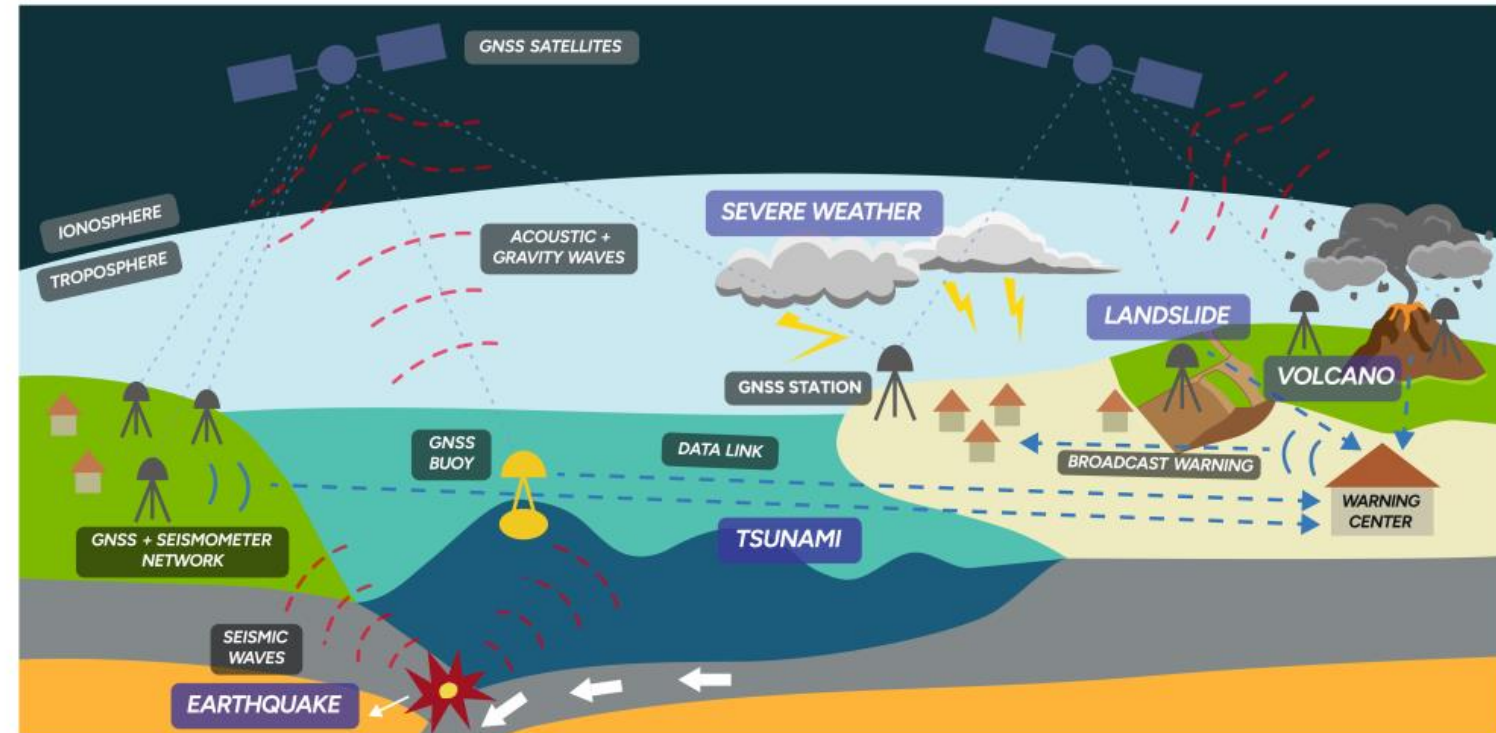


After the Tsunami discussion was conducted on how to enhance current early warning system:

1. UN Sub Committee on Geodesy
2. International Union of Geodesy and Geophysics (IUGG)
3. Geophysical Risk and Sustainable Working Group (IUGG)
4. GNSS Enhancing Tsunami Early Warning System (GTEWS)
5. Central Washington University (Donating GNSS)
6. GTEWS Oceania
7. GTEWS Tonga

- **GTEWS**

- The application of advanced GNSS real time processing for positioning and ionospheric imaging provides very significant improvements to ~~Tsunami Disaster Early Warning~~.
- Unique powerful capabilities of GNSS real time positioning and ionospheric imaging for the GNSS enhancement for Tsunami Early Warning Systems (GTEWS).



EARTH OBSERVATION WITH GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS)

Supporting the Sendai Framework for Disaster Risk Reduction

Geodetic Observations to Prepare and Respond to Disasters

GEO supports implementation of Sendai Framework targets E, F and G through engagement with UNDRR.

E: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;

F: *Substantially enhance international cooperation to developing countries* through adequate and sustainable support to complement their national actions for implementation of the present framework by 2030;

G: Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

Connecting United Nations Initiatives with GGOS: GNSS Enhanced Tsunami Early Warning Systems

Geodesy has demonstrated a clear role in reducing the risk of disaster through improved awareness of environmental risk, early warning, and response. Real time GNSS observations are an especially critical tool.

GGOS-Geohazards Working Group published a supporting paper for the 2019 UN Global Assessment Report on Disaster Risk Reduction (GAR19) of the UN Office for Disaster Risk Reduction.

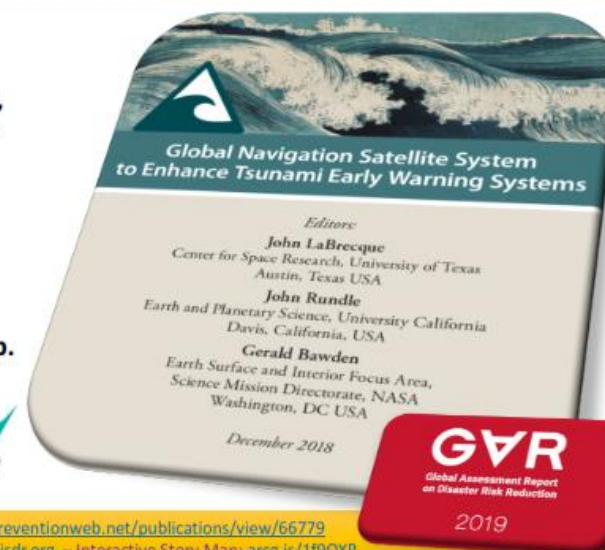
The GGOS paper embodies the report and recommendations of the GTEWS 2017 workshop.



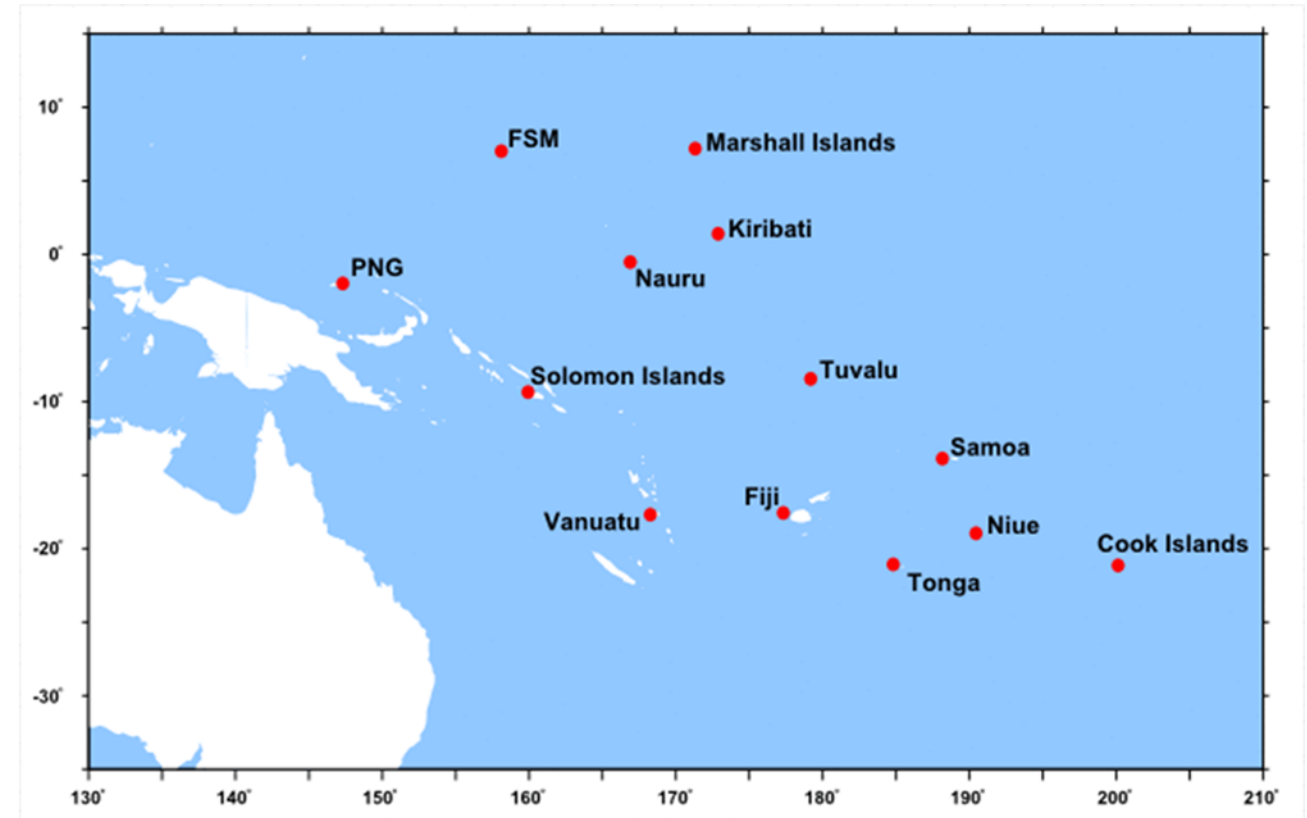
global platform for disaster risk reduction
Geneva, Switzerland, 13-17 May 2019



UN World Conference on Disaster Risk Reduction
2019 Sendai, Japan



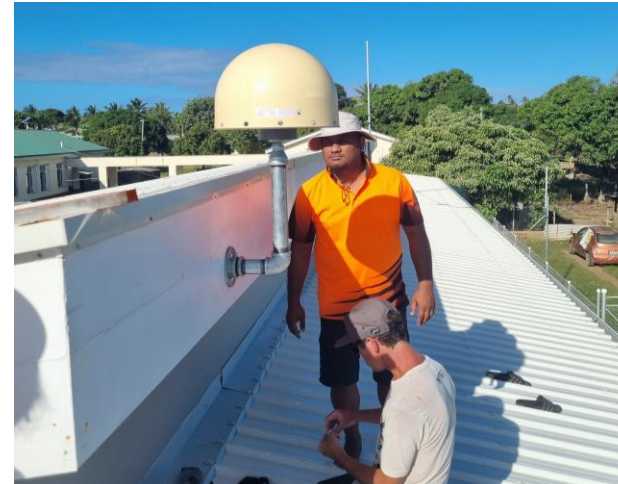
- The primary goal of GTEWS_Oceania Initiative is to establish a governing entity to coordinate the development of GNSS enhancements to existing tsunami early warning systems throughout Oceania.
- GTEWS_Oceania will guide development of regional continuous GNSS networks to provide real-time satellite observations and constraints to support the existing warning systems.
- At least one GNSS Station per Island Country.
- GTEWS will add more stations.



Installation of new GNSS-Tonga



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Tsunami is so REAL now

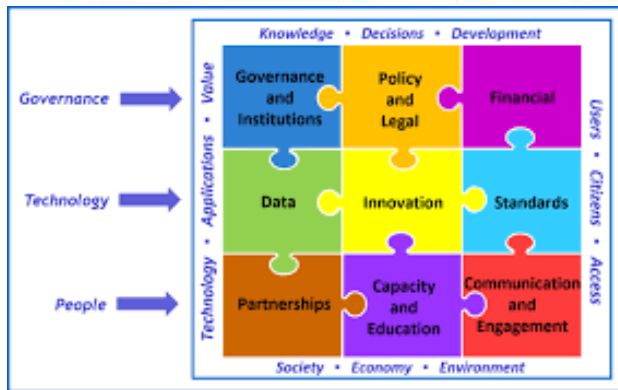
1. Barriers GTEWS in Tonga

- Right Expertise and Qualification in GNSS
- Political will
- Financing and maintenance.
- Accessing satellite data



No one can do this alone!

1. When we talk about natural disaster and hazards we talk about urgency, action now, global and regional partnership and collaboration, knowledge, expertise and resource sharing, we also talk about ownership and taking responsibilities for sake of others.
2. We need collective effort, partnership, concerted, coordinated, coherent approach.



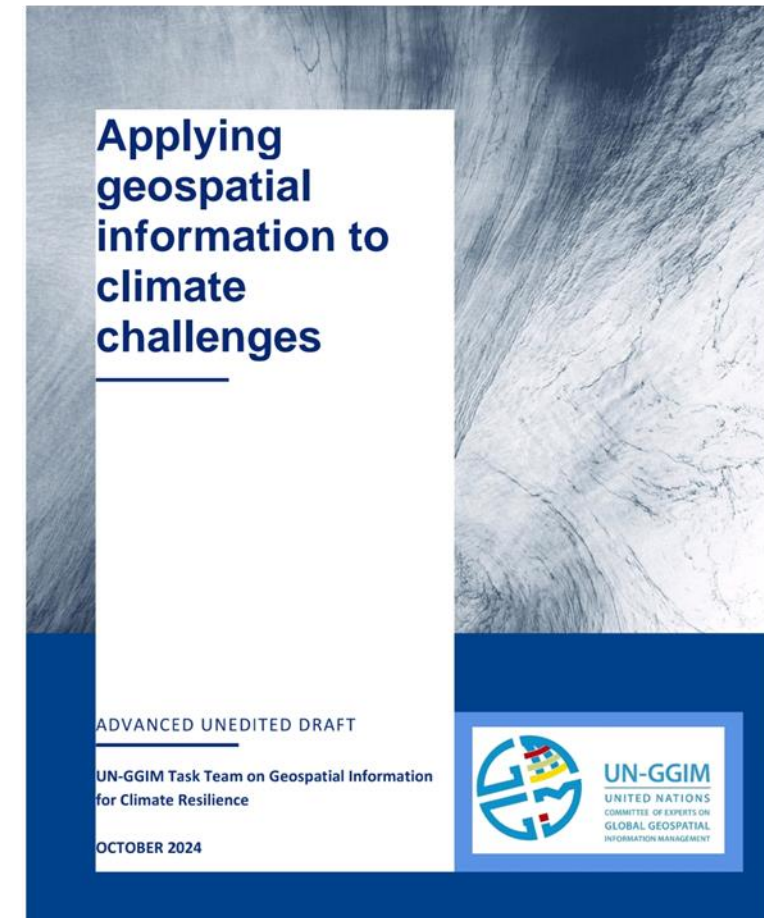
KINGDOM OF TONGA

STRENGTHENING ARRANGEMENTS TOWARD AN INTEGRATED GEOSPATIAL MANAGEMENT



5 Strategic Goals of UN GGI:

1. Developing Leadership and Collaboration
2. Addressing National Priorities
3. Progressing Geospatial Knowledge
4. Enabling Innovation and Technological Advancement
5. Enhancing Communication and Awareness





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**“If everyone is moving forward
together, then success takes care of
itself”**

Henry Ford



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THANK YOU