

Traditional Ecological Knowledge and Climate Change: Implications for Public Health

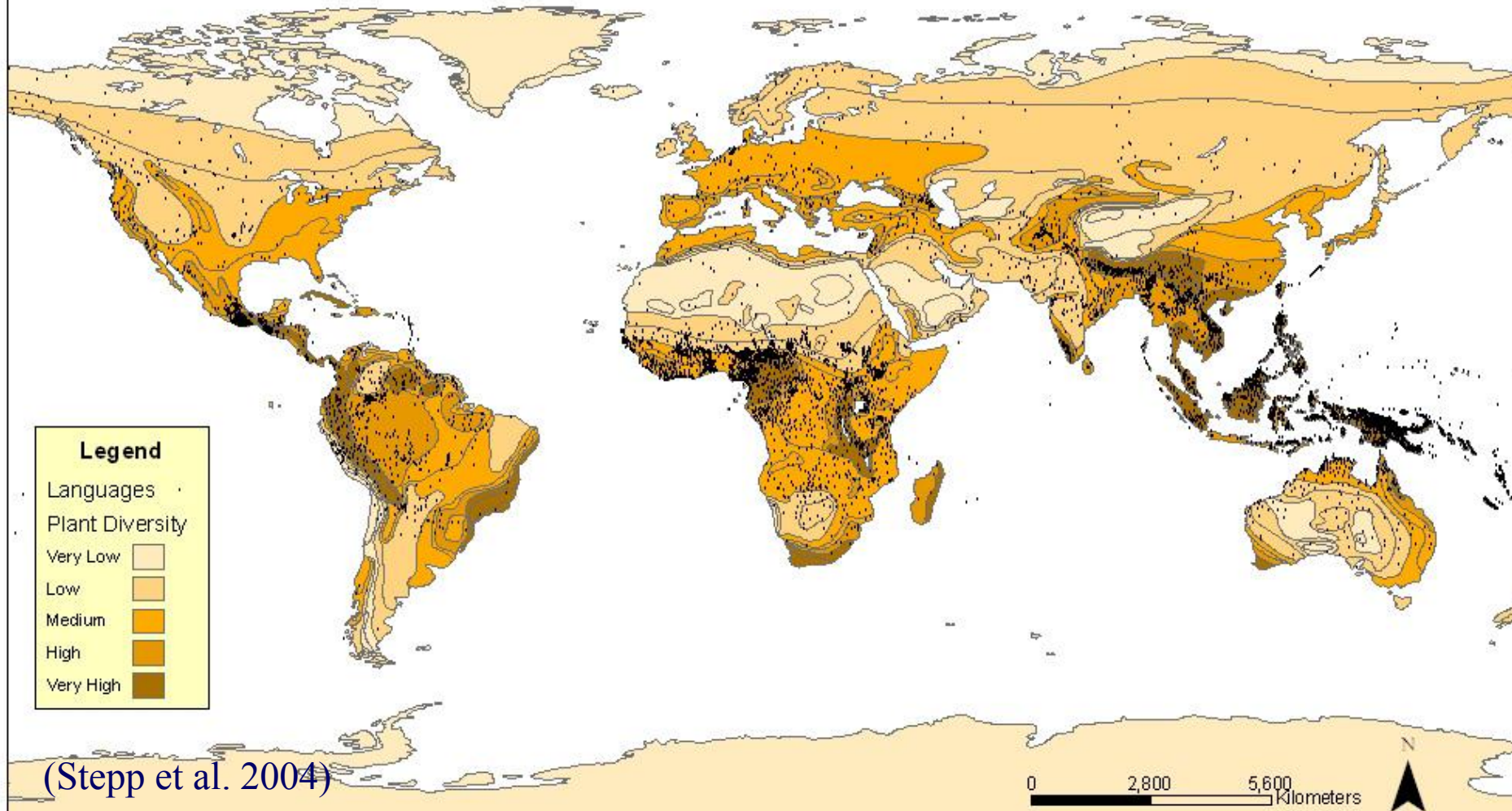
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Biodiversity and Cultural Diversity

- strong positive correlation between biodiversity and linguistic diversity
- Single largest predictor of number of languages in an area are the number of plant species
- Traditional ecological knowledge is the bridge between culture and environment

Plant Diversity and Language Distribution



(Stepp et al. 2004)

Medicinal Plant Use

- 2/3 of the entire world's population (80% of the population in 'developing countries') relies on medicinal plants for their primary health care (World Health Organization 1985)
- A significant sub-set of any flora is used medicinally, these plants are subject to effects from climate change



Southern Mexico and
Maya Region

**Tzotzil
Maya**

**Tzeltal
Maya**



Plant Species Richness in the Highlands of Chiapas, Mexico

- Chiapas overall, 9000 vascular plant species (Breedlove et al. 1981, 1986)
- 40-50 tree species per hectare in mesophyll mountain forest (González-Espinoza et al. 2009)
- 70% of flora predominates in non-forested areas

Knowledge and Utilization

- Most traditional ecological knowledge is highly generalized across the population
- Highly reliant on cultivated and wild plant populations for food and medicine
- Knowledge shows a high degree of persistence

Medicinal Plants in Highland, Chiapas

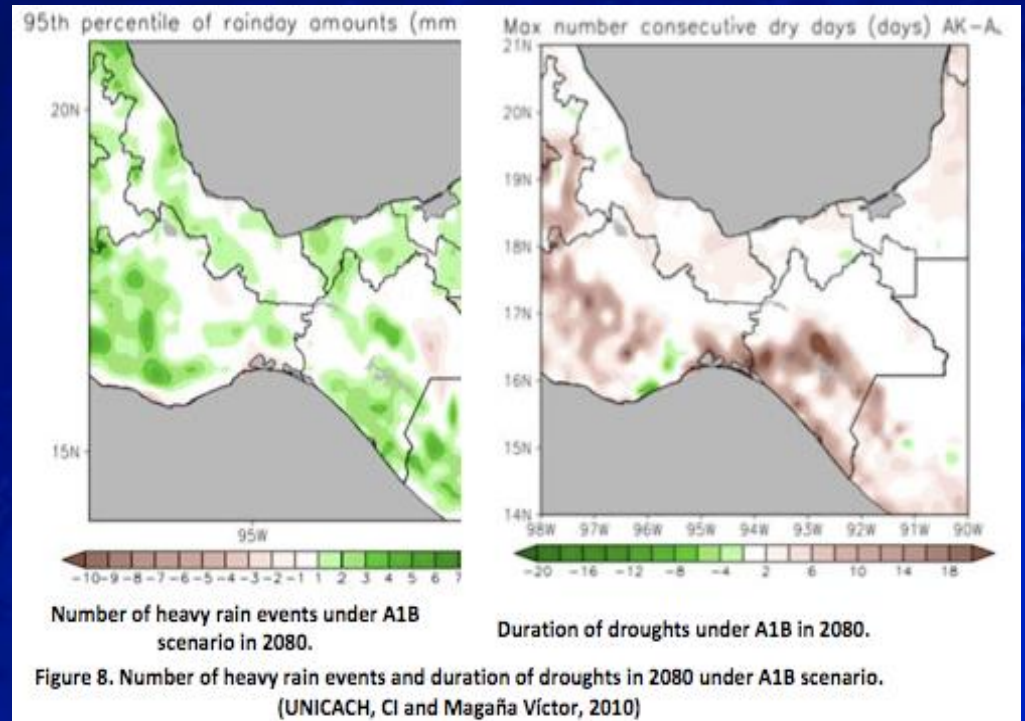
- Widespread distribution of medicinal plant knowledge found for ~600 species with over 1500 species noted as medicinal (Berlin and Berlin, 1996, Stepp 2002, 2004, 2010)

Climate Change in Highlands

- Coffee belt will shift upward by 100 m per .8 degree celsius rise in temperature (Schroth et al. 2009)
- 1.6 degree celsius increase by 2030 (World Bank 2014)
- 2-3 degree celsius rise overall under medium high emission scenario (UNICACH and Victor 2010)

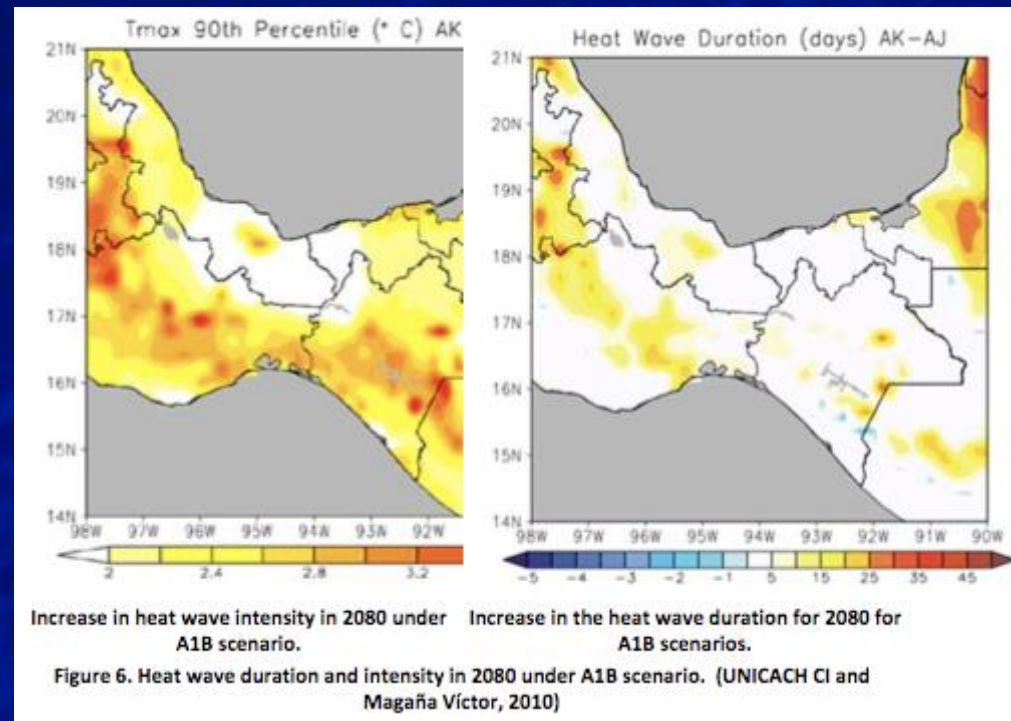
Scenarios for Rainfall

- More intense rainfall but shorter season, longer dry season



Scenarios for Temperature

- Heat wave increase for 10-20 days



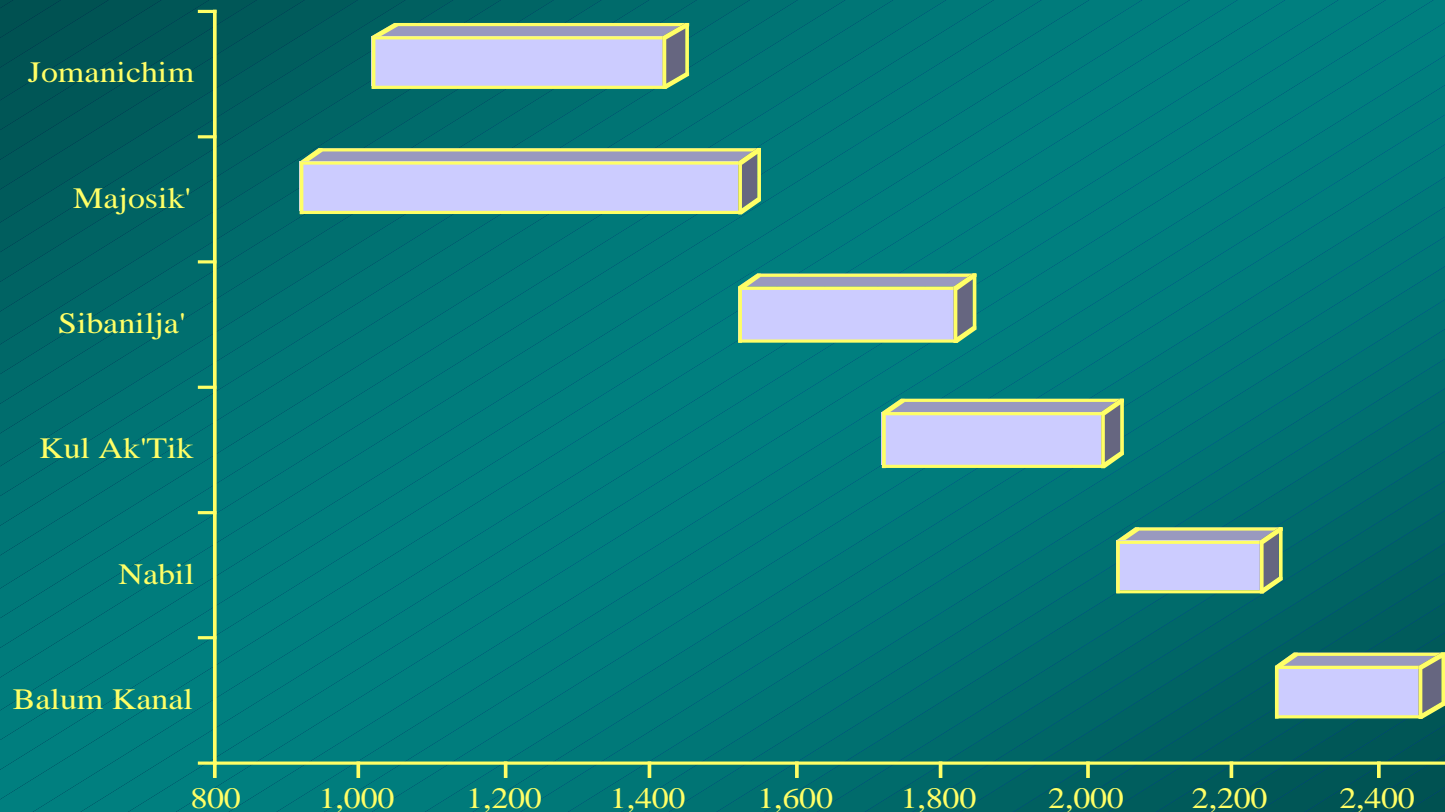


Context of Tenejapa

- 80% monolingual Tzeltal Maya speakers
- Patchy mosaic of different successional stages
- Almost equally divided into three major ecological zones
- Ideal site to study effects of climate change on medicinal plants



Elevation range of study communities (in meters)



Tzeltal Broad Landscape Classifications

- Based on altitudinal and climatic variation
- Three Zones
 - sikil k' inal (Cold Country) ~2900-1800 meters
 - sikil htebuk k' inal/k' ixin htebuk k' inal (Temperate Country) ~1800-1400 meters
 - k' ixin k' inal (Hot Country) ~1400-0 meters

Tzeltal Landscape Classifications Based on Degree of Human Modification

- k' altik (Milpa)
- k' ajbenal (First Year Fallow)
- wank' altik (Second Year Fallow)
- unin k' inal (3-7 Year Secondary Growth)
- k' inal (6-12 Year Secondary Growth)
- te' tikil (Young Secondary Forest)
- tojol k' inal (Old Secondary Forest)
- **ja' mal (Mature Forest)**



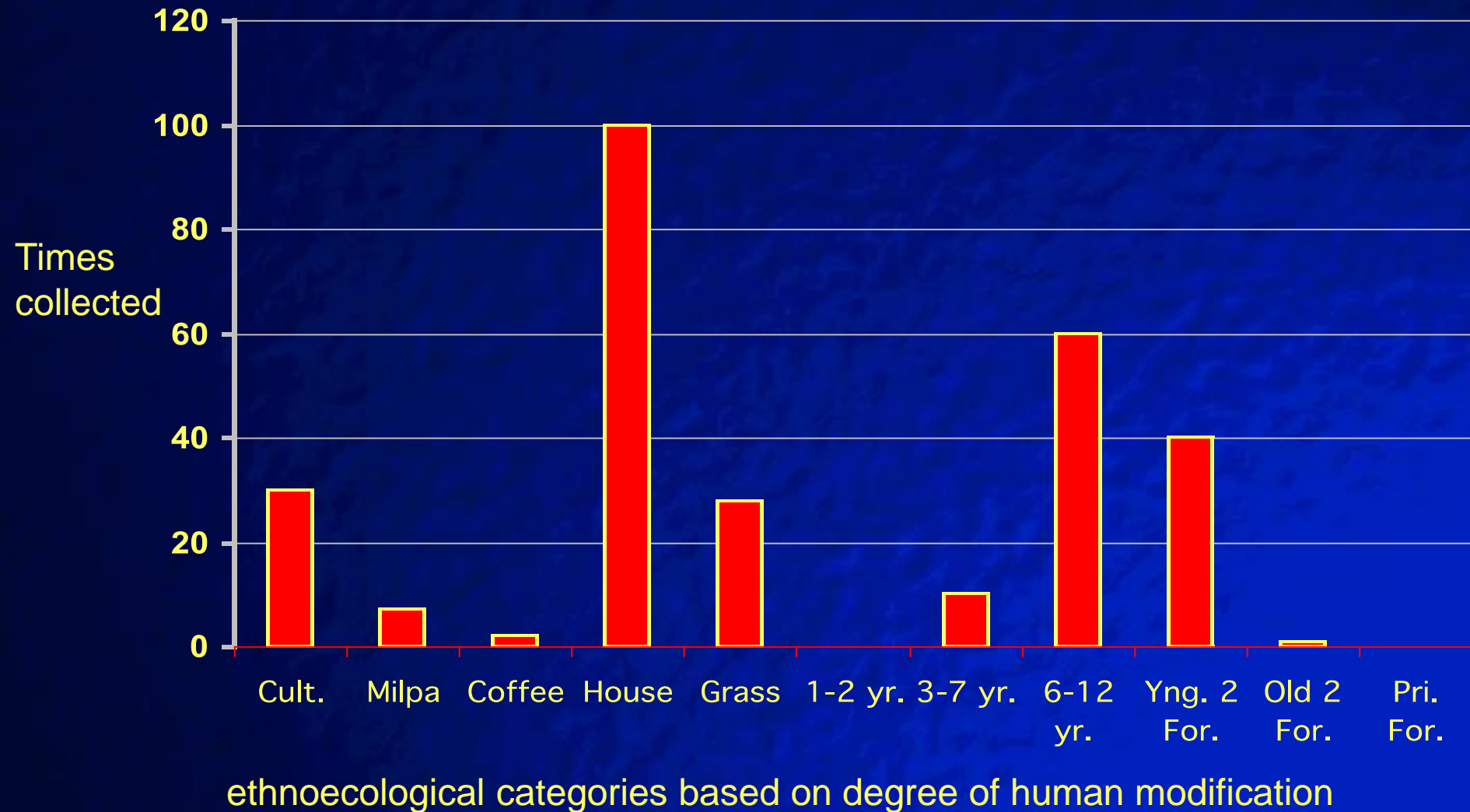
Where Are Medicinal Plants Found?

- 70% of entire medicinal flora grows in all three major zones based on altitude
- disturbed and cultivated areas were utilized the vast majority of the time with little use of secondary forest and no use of primary forest

How Far Do People Travel for Medicinal Plants?

- 93 percent of medicinal plant procurement is within a 2 km radius
- 71 percent within a 1 km radius
- 16 minutes average time spent

Tzeltal Maya Medicinal Plant Procurement



Diversity of Medicinal Plant Use by Community

- mean Shannon-Weiner index for medicinal plants used for 25 illnesses
 - Intra-community $H'=.53$
 - Inter-community $H'=2.97$
 - Intra-ecological zone $H'=1.81$

(Stepp 2016)

Diversity of Medicinal Plant Use by Community

- Amount of variation greatly increases at the inter-community level, suggesting transmission takes place mainly within each community
- Intra-ecological zone variation is also high even though communities may be located close by

Climate Change and Medicinal Plants

- Communities are adapted to particular elevations
- Medicinal flora will move up in elevation, will TEK follow?
- Dynamic and innovative aspects of TEK
- Need for sharing of TEK between communities

Climate Change and Medicinal Plants

- Beyond access to medicinal plants, how will plant chemistry be affected?
- Overlap between medicinal plants and food plants
- Need to focus on plant quality and not just plant yields (Ahmed and Stepp 2016)
- Higher CO₂ levels can impact nutrient quality of plants (Myers et al. 2014)

Conclusion

- Indigenous communities have shown tremendous resilience in the past, climate change will be yet another challenge to face

