



Academia de Ciencias de Cuba

**Future of the U.S. – Cuba Scientific Cooperation Delegation Workshop in Cuba  
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*Connection between Environment, Climate Change, and Public Health – Challenges and Opportunities*

# Catalyzing Tropical Medicine Research in the Times of the Anthropocene



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*Leading the development and testing of low-cost and effective vaccines against emerging and neglected tropical diseases*

# The 21<sup>st</sup> Century Framework for the Convergence of Global Health

**MDG** **MOMENTUM** **1000 DAYS** of ACTION

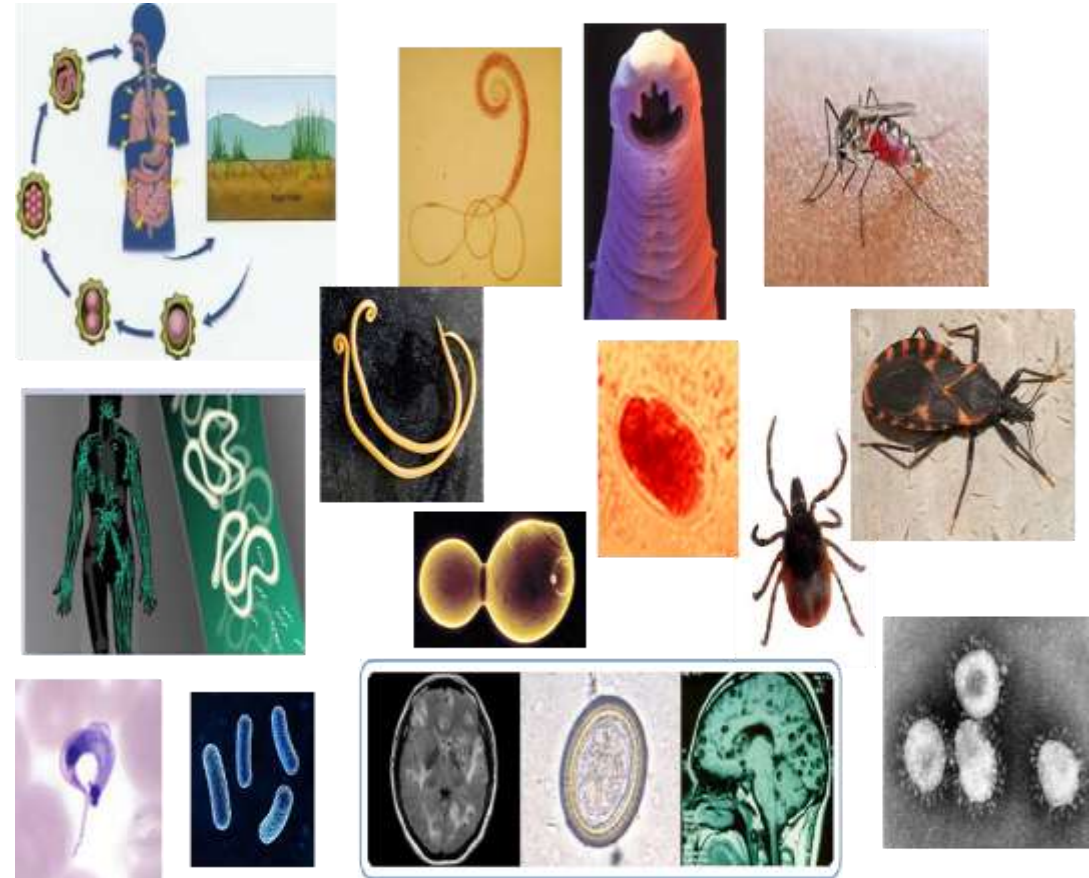


SUSTAINABLE DEVELOPMENT GOALS



# The Neglected Tropical and Emerging Diseases

- ✓ 17 tropical and 20 emerging infections
- ✓ **Highly prevalent among the poor - poverty promoting**
  - ✓ Highly endemic in LMICs and in poor populations living in HICs
- ✓ **Ancient afflictions**
  - ✓ Chronic and stigmatizing
  - ✓ **Disabling (intellectual and growth delays, blindness, disfigurement)**
  - ✓ Major co-factors for other diseases i.e. malaria, HIV/AIDS
- ✓ Leading cause of morbidity >30 M DALYs
- ✓ **Leading productivity losses >US \$8 B**
- ✓ One health ecosystem with complex vectors, reservoir hosts and environmental requirements





# 10 Major Successes + Big Gains for NTDs!



## Mass Drug Administration (MDA)

Lymphatic filariasis  
-52% (2005-15)

Onchocerciasis  
-52% (1990-2013)

Trachoma  
-65% (1990-2013)

Ascariasis  
-20% (2005-2015)

Yaws  
Not determined

## Case detection + Rx + Vector control

African trypanosomiasis  
-78% (2005-2015)

## WASH

Dracunculiasis  
-99% (1990-2013)

## Other approaches

Rabies (Canine)  
-53% (2005-2015)

Cysticercosis  
-21% (2005-2015)

Leprosy

## Elimination targets:

LF

Trachoma

Yaws

African trypanosomiasis

Dracunculiasis

Leprosy (Hansen's Disease)



Source: GBD 2015 and GBD 2013

# 9 Failures or Minimal Gains for NTDs!



## Mass Drug Administration (MDA)

Schistosomiasis  
+30% (1990-2013)

Hookworm  
-5% (1990-2013)

Trichuriasis  
-12% (1990-2013)

## Case detection + Rx + Vector control

Leishmaniasis  
+174% (1990-2013)

Chagas disease  
+22% (1990-2013)

Dengue + Other  
Arbovirus Infections  
+610% (1990-2013)

## WASH

Ebola  
+28,000% (2005-2015)

Coronaviruses

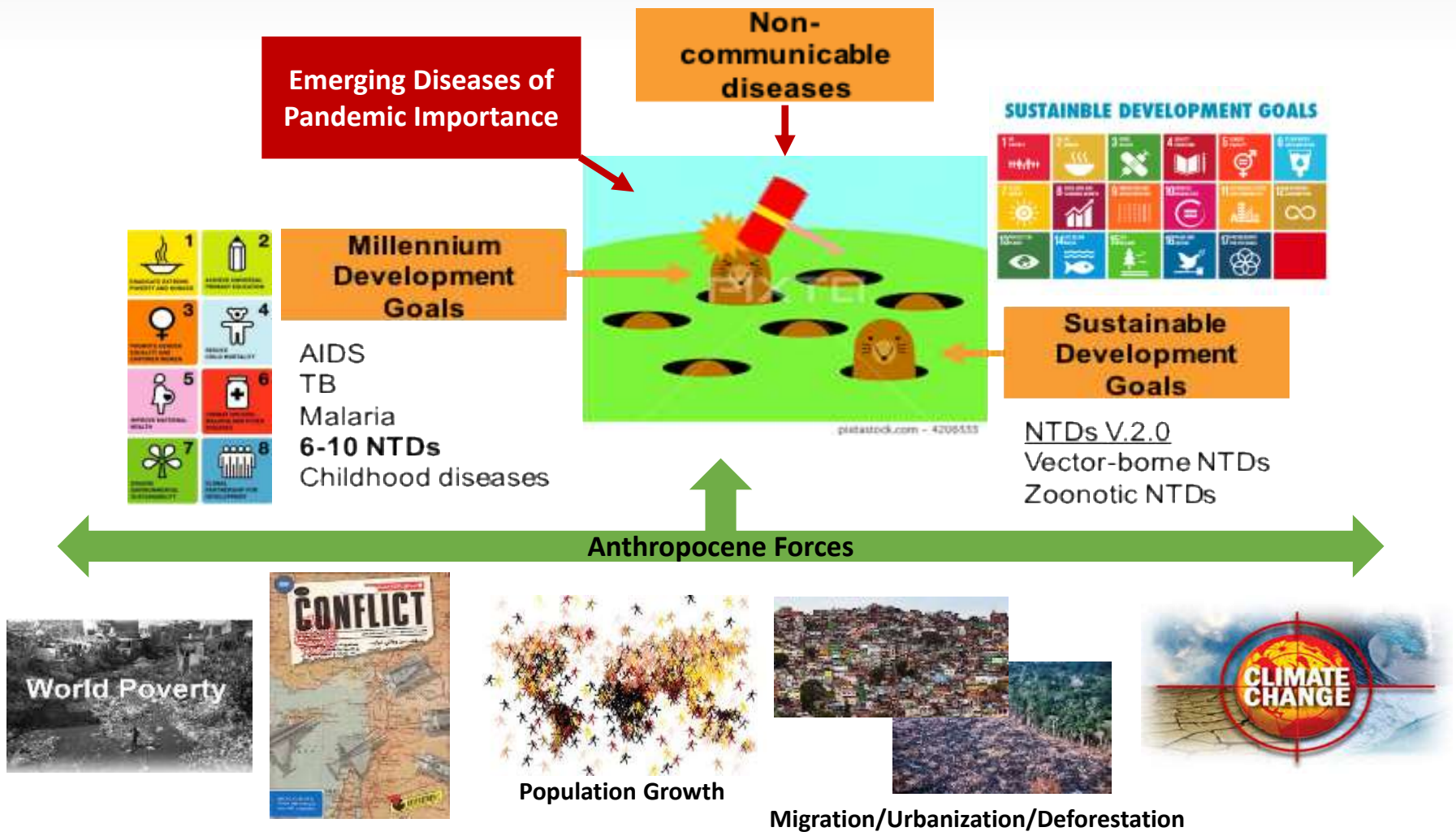
## Other approaches

FB Trematodiasis  
+51% (1990-2013)

Source: GBD 2015 and GBD 2013

Losing the Battle:  
 Vector-borne Neglected Diseases  
 Arthropods  
 Snails  
 Zoonotic Neglected Diseases  
 Viral Diseases

# “The Global Health WHACK-A-MOLE”

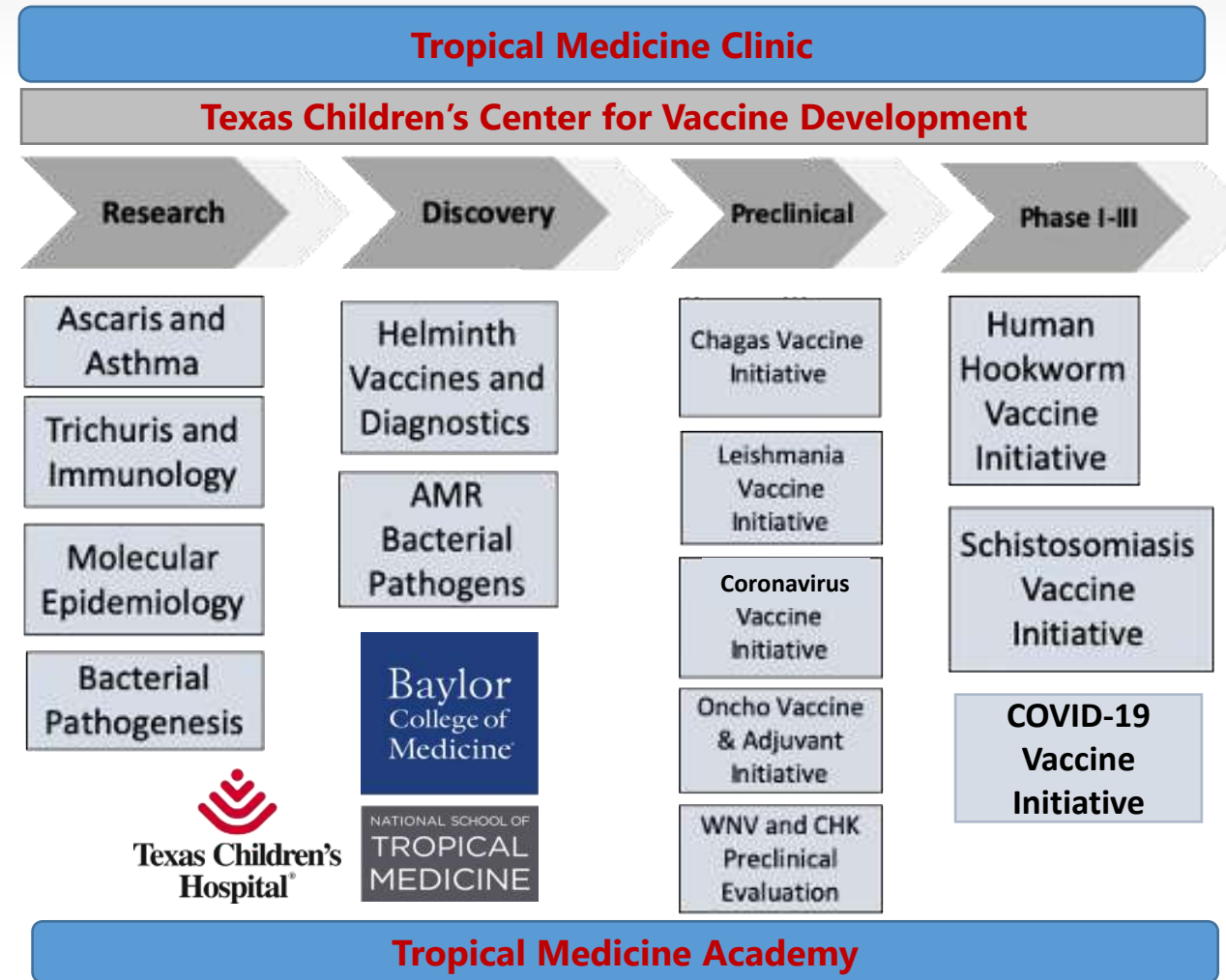




# Crosscutting Tropical Medicine Research

## *A Sustainable and Integrated ONE HEALTH Roadmap*

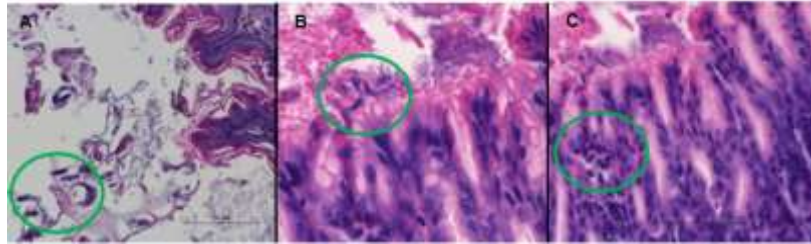
- ✓ Apply global partnership models – build/strengthen capacity in LMICs
- ✓ Integrate technology, population health, regulatory, policy, finance and access strategies
  - ✓ Vaccine-linked to chemotherapy approaches
  - ✓ Search for a greener vision for vector control
  - ✓ Model ecological niches for NTDs based on climate and spatial epidemiology
  - ✓ Transmission dynamics of vector-borne diseases and vaccine development
  - ✓ Epidemiological mapping and outbreak/disaster investigations
  - ✓ Physician/scientists and community training and awareness - an adaptation strategy



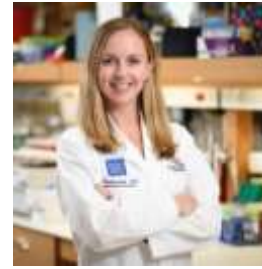
## Ascaris larval migration causes chronic lung disease

- Allergic airway disease (Weatherhead *et al.* Infection and Immunity. 2018)
- Emphysema (Wu *et al.* PLOS NTD. 2020)

*Ascaris* eggs hatch in the stomach using gastric microenvironment (unpublished)



**Figure:** *Ascaris* eggs hatch in the stomach (A), translocate across the gastric corpus (B) and trigger a type-2 immune response with eosinophils (C) NIAID K08 AI143968



Jill Weatherhead



Rojelio Mejia

## Impact of parasites on humans

- Intestinal inflammation
- Intestinal microbiome
- Host parasite interactions



Job Lopez

## Geospatial and molecular tools to better fight some of the world's most deadly vector-borne diseases

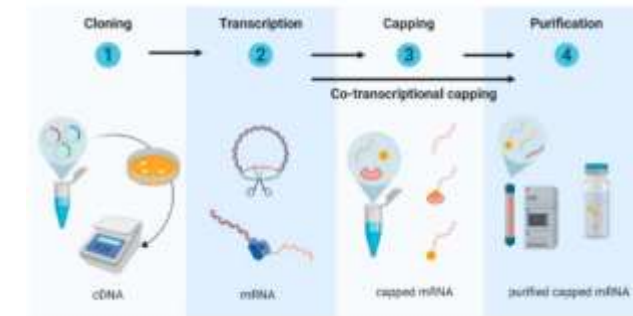
Sarah Gunter



## Developing mRNA vaccines targeting parasites and making high-tech vaccine technology accessible for LMIC



Jeroen Pollet



## Does intestinal helminth infection facilitate persistent HPV infection → cervical cancer?

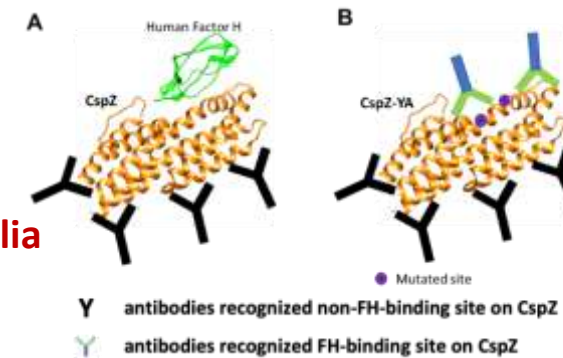


Eva Clark



Wen-Hsieng Chen

## Define the protective mechanisms using the protective antibodies derived from Lyme Borrelia surface protein, CspZ



## Genomics, Pathogenesis, Vector Biology, Ecology and Epidemiology Ticks and Tick-borne diseases



# Case Study: *The Central American and Caribbean Region*

CAC - 94.9 M inhabitants

CAC countries had a cumulative GDP close to \$ 400 billion, making the region the nineteenth largest economy in the world.

10 million people living on <\$2 per day are at risk for acquiring neglected tropical diseases (NTDs).

Leading NTDs are intestinal helminth infections and vector-borne NTDs—vivax malaria, Chagas disease, leishmaniasis, dengue.

Elimination of onchocerciasis and malaria reductions that meet MDGs each represent a powerful success story for the region.

There is a dearth of active surveillance data on NTDs in Central America, which is essential for disease elimination.



<https://www.sciencedirect.com/science/article/pii/S002075191400099X#t0010>

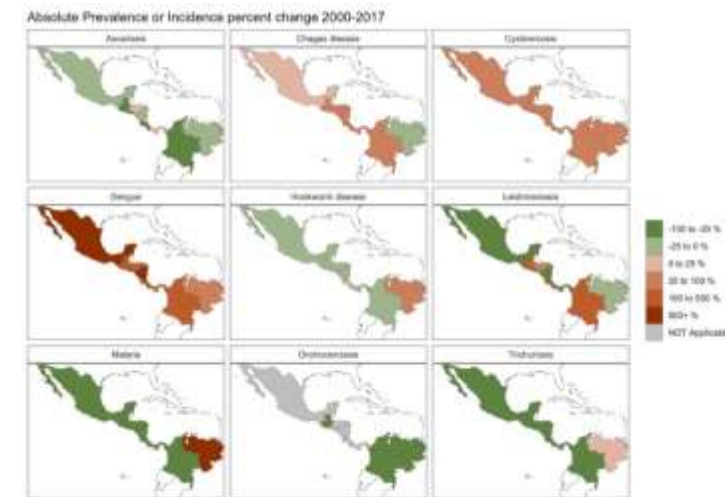
# A Perfect Storm

## Central Latin America and the Roadblocks To Achieve Sustained NTD Control

- ✓ Nine countries a.k.a. the “northern triangle” or “dry corridor” region with ~ 250 million people
- ✓ Large, geographically diverse, with varied economies
- ✓ Some modest gains in STH, malaria control but major increases in dengue (+288%), leishmaniasis (+50%), cysticercosis (+44%) and Chagas disease (+16%)
- ✓ Redistribution, re-alignment, and/or re-appearance of diseases, vectors, reservoir hosts
- ✓ Key vulnerability points:
  - ✓ Prolonged droughts, intermittent/extreme floods
  - ✓ Violence and political instability
  - ✓ Socioeconomic and food insecurity
  - ✓ Human displacements
  - ✓ Urbanization
  - ✓ Marginalization of large indigenous populations

### The incidence or prevalence of NTDs and Malaria in the Central Latin America Countries

| Honduras       | Changes between 2000 and 2017 |
|----------------|-------------------------------|
| Trichuriasis   | -67%                          |
| Ascariasis     | 13%                           |
| Hookworm       | -11%                          |
| Chagas disease | 48%                           |
| Cysticercosis  | 47%                           |
| Dengue         | 179%                          |
| Leishmaniasis  | 83%                           |
| Malaria        | -90%                          |



Compared findings from the Global Burden of Disease (GBD) Study from the years 2000 and 2017

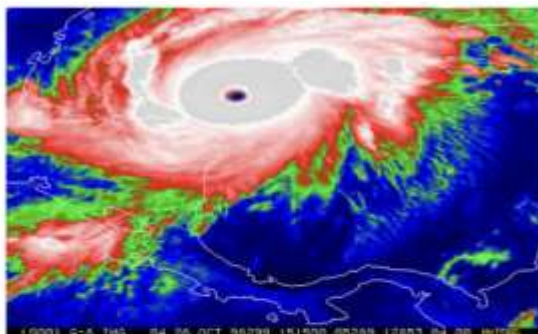
# Honduras - Climate and Pandemic Impact

HONDURAS HOY

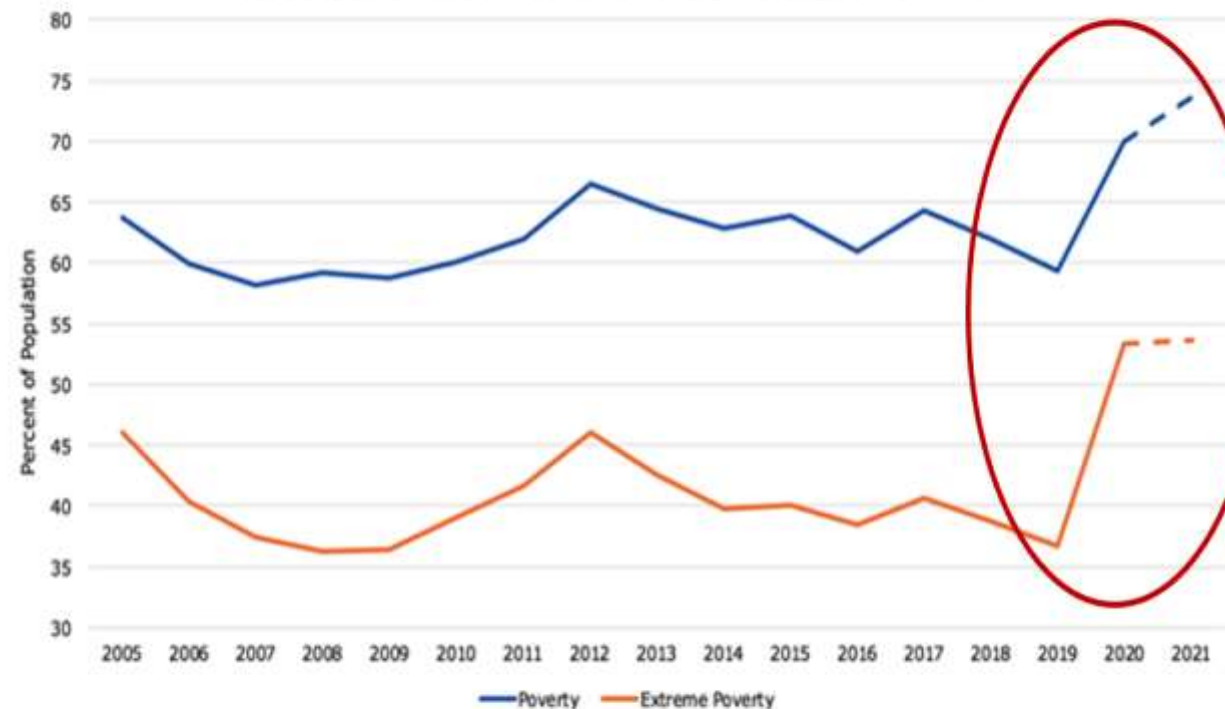
## Huracanes en Honduras 2022, los fenómenos naturales más impactantes en la historia del territorio hondureño

Any Peña  
23 Sep. 2022

Heridas provocadas por el paso de los tres huracanes más impactantes en el territorio hondureño. Aquí los detalles de cuáles fueron.



### Poverty and Extreme Poverty in Honduras, 2005–2021

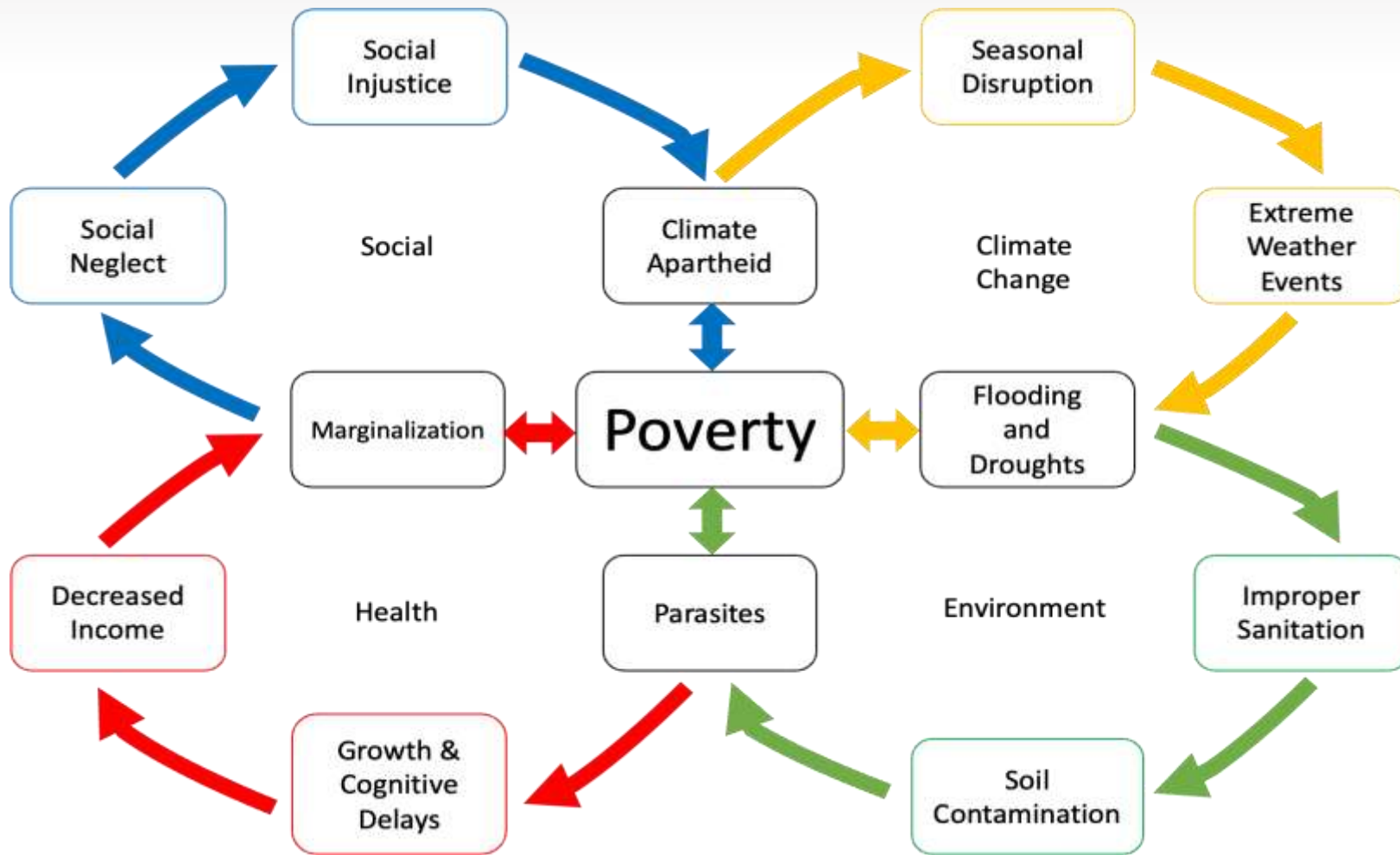


Source and notes: Instituto Nacional de Estadística (INE) & Universidad Nacional de Honduras (UNAH). The Honduran government does not have available poverty figures for 2020; 2020 figures are UNAH estimates. The 2021 figures are INE estimates through July, 2021.

<https://cepr.net/honduras-social-and-economic-indicators-after-12-years-of-national-party-rule/>



# A New Era of 'Climate Apartheid'



*"Climate change threatens to undo the last 50 years of progress in development, global health, and poverty reduction," Alston said. "It could push more than 120 million more people into poverty by 2030 and will have the most severe impact in poor countries, regions, and the places poor people live and work."*

Courtesy Dr. Rojelio Mejia (unpublished)

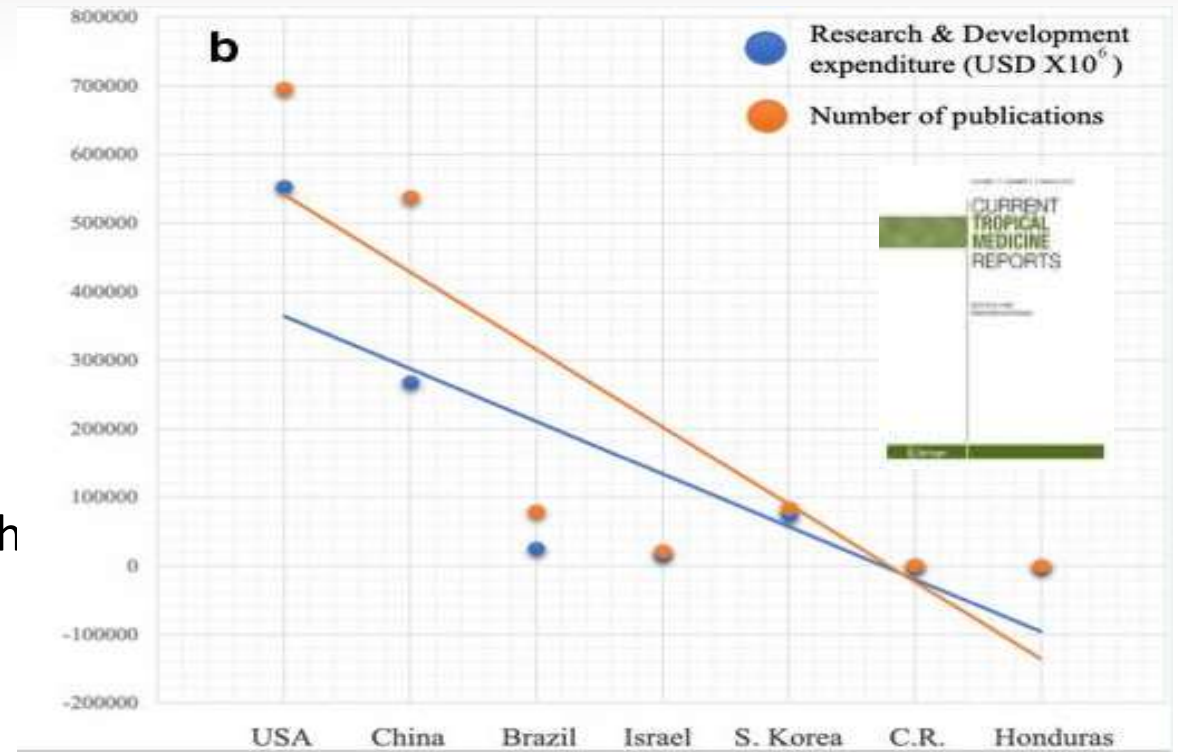
# What Can Central Latin America Do to Strengthen Climate and Pandemic Resilience?

## Country Level

- Create a National Health Research System and Policies and allocate ~ 2% of the GDP towards R&D.
- Seek guidance and promote long-term international cooperation programs
- Ensure fluid and interdisciplinary administrative mechanisms to fund scientific research

## Institutional Level

- Create, revitalize, incentivize and provide stable research infrastructure
- Create faculty streams in Research including physician scientists
- Promote and support training of young researchers within and outside the country
- Create graduate programs institutional or regional
- Promote alliances



Expenditure on research and development and number of publications by country in 2017

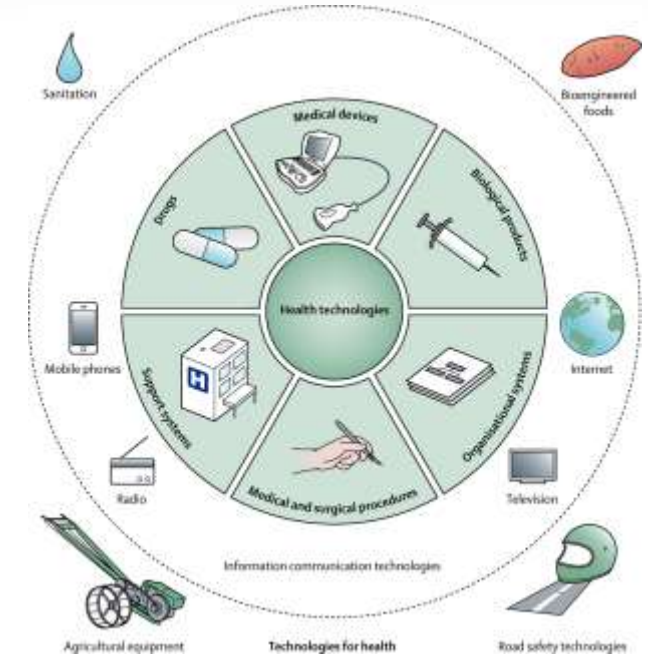
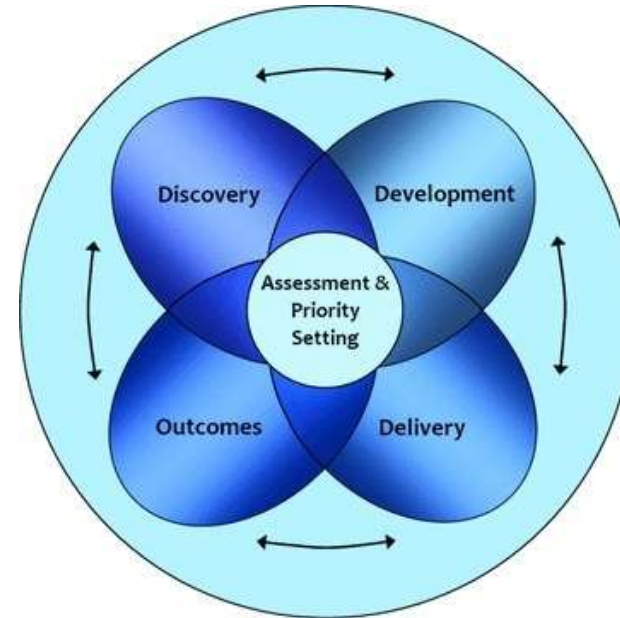


# Build and Strengthen Bio-pharmaceutical Capacity and Collaboration

**Public Health and Epidemiological Intelligence** - National Security

**Scientific Culture** - Strengthen publications, increase communication channels, use of technologies

**Scientific Diplomacy** - alliances, collaborations, investment attraction = economic and social impact



Integration of Disciplines

**Translational Science for Effective Translational Research**

Innovative scientific/clinical approaches

Raise disease awareness

Community engagement





## THE NEW YORKER THE HEAVY TOLL OF THE BLACK BELT'S WASTEWATER CRISIS

*Many rural households in America don't have access to safe sewage systems. In Alabama, entrenched poverty and unusual geology have created a public-health disaster.*



## The New York Times The Parasite on the Playground



Adult hookworms are small, worm-like creatures that live in the soil. The eggs are carried in their feces. Top: © James Stacey/Science Source

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Global Atlas of Helminth Infection (GAHI), which are linked to high-resolution data on climatic and socio-demographic indicators, human population density and settlement patterns.

<http://www.thiswormyworld.org/>



The "polar vortex" responsible for freezing in **Texas**

