

# Programa de Educación Ambiental y Conservación de la Biodiversidad (PEACB)

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**Fundación “Antonio Núñez Jiménez”  
de la Naturaleza y el Hombre**



# "Permaculture's Use of Water in Times of Climate Change - the Cuban Experience"

**International Permaculture Conference,  
Jordan, September 17, 2011.  
Roberto Pérez Rivero,  
PEACB-FANJ Director**

**Total Population : 11.2 million**

**More than 4,000 islands, keys y islets.  
More than 6,000 Km. of costal line  
Total land area: 110,860 km<sup>2</sup>  
Island of Cuba: 104,945 km<sup>2</sup>**

**Lenght of Main Island: 1,200 Km.  
Maximum width: 191 Km.  
Mínimum width: 31 Km**

**246 Human Stettlements  
3.5 millones people  
coastal. 60% of total  
population impacts it.**



**Total insular Plataform:  
67,832 Km<sup>2</sup>  
Average depth: 6-8 m**

**The Cuban Archipelago. Main Geographical Features**

# Main Marine Ecosystems

## **Coral Reefs:**

length 3.200 Km.  
60 species/15 families.



## **Mangroves:**

5,321 Km<sup>2</sup> (4.8% of land surface). Present in 70% of the coast

## **Sand Beaches:**

336 localities.  
16% of the coastal line  
Más de 900 Km. de playas



1st contact with Europeans in 1492. **Until 1505:**

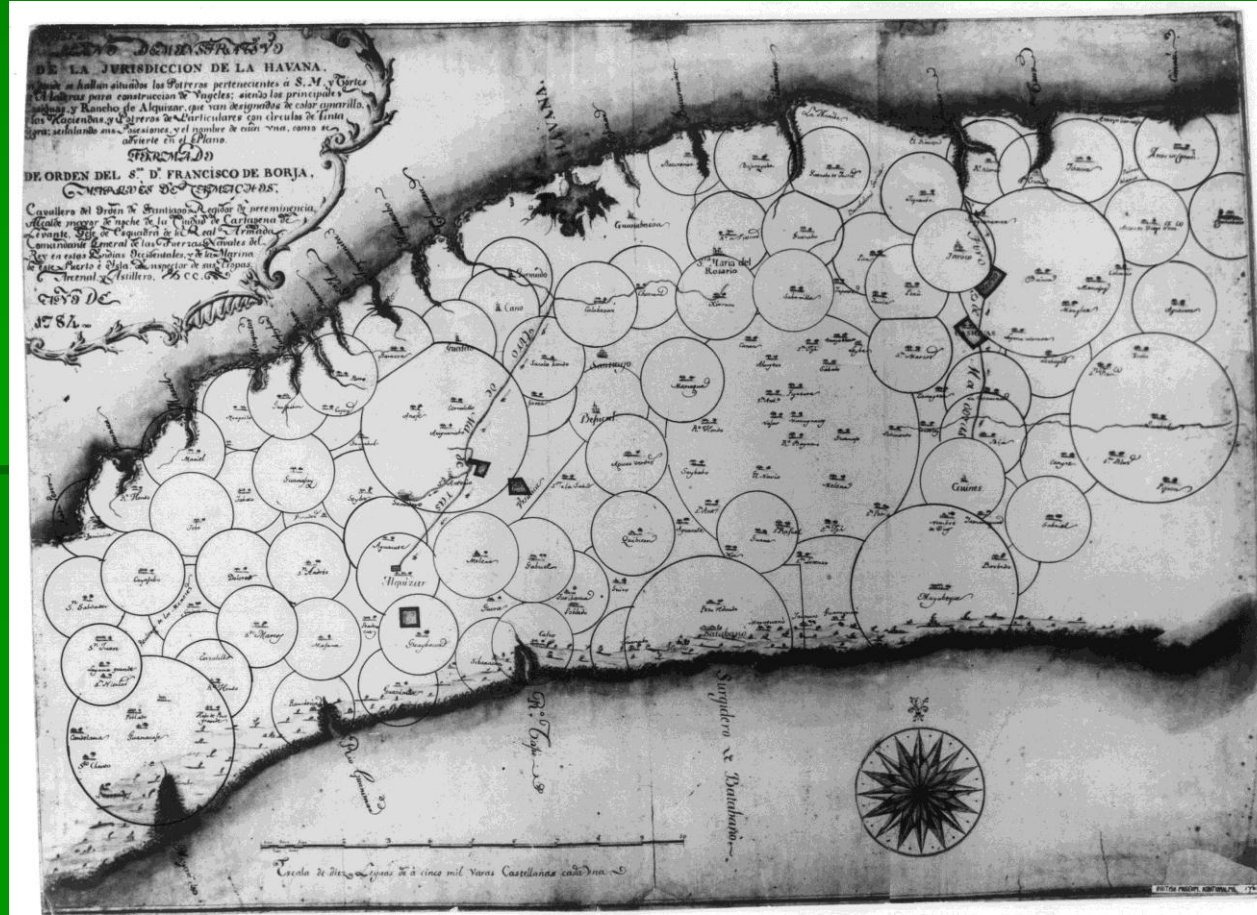
- 95% covered by climax forests (35 types identified)
- Arowac aboriginal population (250 000 inh estim)
- Very little neolithic agriculture (based in cassava)
- Sustainable use of natural resources



31/03/2003

# Colonial Period 1500-1900

- Plantation agriculture for export (tobacco, coffee, sugarcane).
- Extermination of aboriginal population.
- Slave labour from Africa, later from China as coolies.
- Services for the Spanish Fleet in early times.
- Low land use.
- Low population.
- Very few farmers.
- Some deforestation.
- Decisions taken in Spain.
- Some US property.
- 30 years of Independence wars destroyed 30% of population
- And the Agriculture.





**Figure 1**

The woods in Cuba from 1812 to 1959 (C.I.F., 1985)

# Crops and Forests by 1816





# Post Colonial Republic 1900-1960



- Plantation agriculture expanded (citrus added).
- Marginal production of food.
- Massive deforestation.
- 85% of the land own by less than 10% of the population and American Companies.
- Total misery in Cuban countryside.
- Conventional Agriculture not present.
- Cheap Labour from migrants.

# Conventional Cuban Agriculture Model (1965-1991)

- Monocrops continued and expanded for export.
- Small farmers occupy 15% of the land.
- Cooperatives occupy 10% of the land.
- Green Revolution style Scientific agro development.
- Deforestation of selected areas, specially old orchards & flatlands.
- High dependence of external inputs (lots of fuel, machinery, chemical fertilizers, pesticides, transportation)
- Population became urban (1956, 56% rural; 1989 28 %)
- Land degradation in 75% of the soils
- Massive imports  
Of food >70% .
- More than 13 MMT  
Fuel oil imported  
(for the whole  
Country, agriculture  
> 35%).



# 1991 East Block collapses

## Sudden Reduction of :

- Purchase capacity 60 %
- Q. fertilizers imports 75 %
- Pesticides 60 %
- Animal food 70 %
- Export market 80%
- Sugar price US\$ 0.05
- Only 35% oil available  
(3,4 MMT fuel oil)
- GDP down by 70%

*American Blockade reinforced  
(laws Torriceli 1992  
Helms Burton 1996)*



# Government measures



- Foreign investment.
- Double currency.
- Self employment.
- Tourism warped.
- Decentralization.
- Redistribution of land.
- Urban Agriculture.
- Agroecology in rural.
- Free farmers market.
- New environmental law.
- More Reforestation.

## Article 27

### Constitution of the Republic of Cuba

**“The State protects the Environment and the Natural resources of the country. Recognizes the close link between the economic and social sustainable development in order to improve Human life and ensure survival, wellbeing and security of present and future generations. Is the role of the relevant institutions to apply this policy. Is the duty of citizens to contribute to the protection of water, atmosphere, soil , flora, fauna and any other potential use of the Nature”.**

# **Cuba: Main Environmental Problems (NES; 2005)**

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- Land Degradation.
- Affectations to the Forestry Coverage.
- Contamination (Pollution of water, air and land).
- Biodiversity Loss.
- Lack of Water.

# Land Degradation



# LAND DEGRADATION

*Provinces with less productive lands:*





# Land degradation (facts)

- Agricultural surface of the country 6.65 MMHa (60.56% of emerged lands). Of this the 54.02% is cultivated.
- Permanent crops occupies 2.39 MMHa, (sugar cane 69.72%)
- Temporary crops (rice 207.4 MHa)
- Erosion affects 2.5 MMHa, High acidity 3.4 MMHa, salinity (sodicity) 1 MMHa, compaction 2.5 MMHa, bad drainage 2.7 MMHa. (2005)
- 60% of the country (11.1 MMha) is affected by processes (one or more) of land degradation that can lead to desertification.

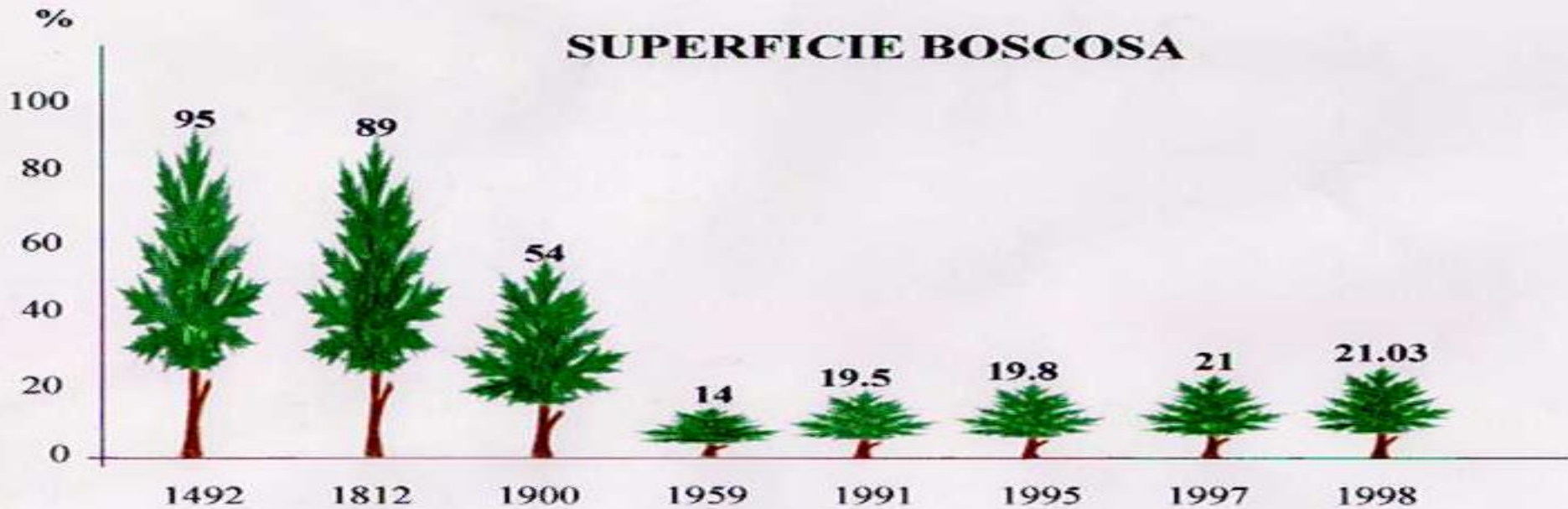
## **Main factors of land degradation (2009)**

- **Erosion 2,9 MMha**
- **Acidity 2,7 MMha**
- **Salinity and/or Sodicity excess 1,0 MMha**
  - **Low Fertility 3,0 MMha**
  - **Bad drainage 2,7 MMha**
  - **Compaction 1.6 MMha**
- **Low content of Organic Matter 4,6 MMha**

# **Affectations to the Forestry Coverage(facts)**

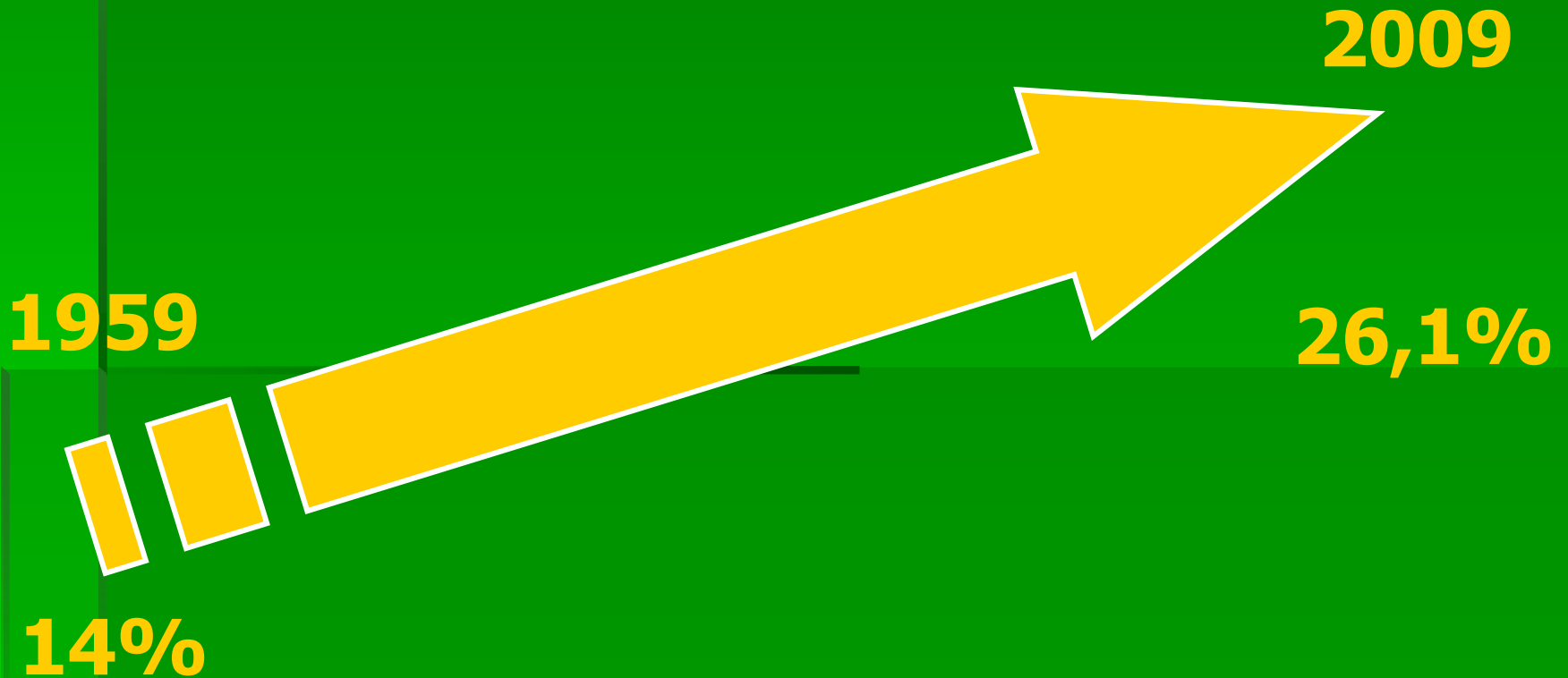
- Deforestation (1511-1958) of 86% old growth forests that once covered 95% of the country surface.
- In 50 years was possible to revert the trend and achieve in 2010 27% of total (3 MM Ha) of forests .
- Bad quality of the reforestation, low survival, low diversity, poor management, foresters (timber production centred) mind.
- Threats like forest fires, drought, invasive species and diseases.

# SUPERFICIE BOSCOSA



**Forest Surface**

# FOREST SURFACE



# Contamination (facts)

- Affects soil, fresh and salt water and atmosphere
- Obsolete technologies, concentration of urban and industrial facilities on the same sites, use of superficial streams and coastal zones as receptors of crude or partially treated wastes, technological indiscipline, lack of clean technologies and best practices.
- Lack of financial resources.
- Deficient sewage and treatment, the main pollutant charge comes from domestic sources.
- No monitoring system for emissions and pollution levels.



**Bays: 3%**

**Water Basins 3,8%**

**Mountain areas: 17%**

La Habana

**Reduction of the Contaminant Load in Significant Ecosystems**

# **Biodiversity Loss (facts)**

- Island country with diverse of landscapes, high endemism, fragility and vulnerability of coral reefs, mangroves, rainforests and other special forms.
- Bad practices of fishing, cropping, hunting, land degradation, logging, introduction of exotic and invasive species
- Over exploitation of forestry and fisheries.
- By 1959, 86 of climax ecosystems were wipeout.
- Insufficient regulatory framework and enforcement
- climate change as generator of extreme conditions of rain, drought, hurricanes, high temperatures, sea penetration and others.



# Flora



- 17 different types of forest formations,
- 7 shrub-like and 4 herbaceous,
- 921 moss species,
- 500 ferns,

6519 superior plants -

Gymnosperms: 19 species  
Angiosperms: 6500 species

# Fauna

- 16516 reported species
- 50% of total are invertebrate
- 42% is endemic
- Endemic are: 15 mammalian, 22 of birds, 43 amphibian and 91 of reptiles



52,4% are endemic







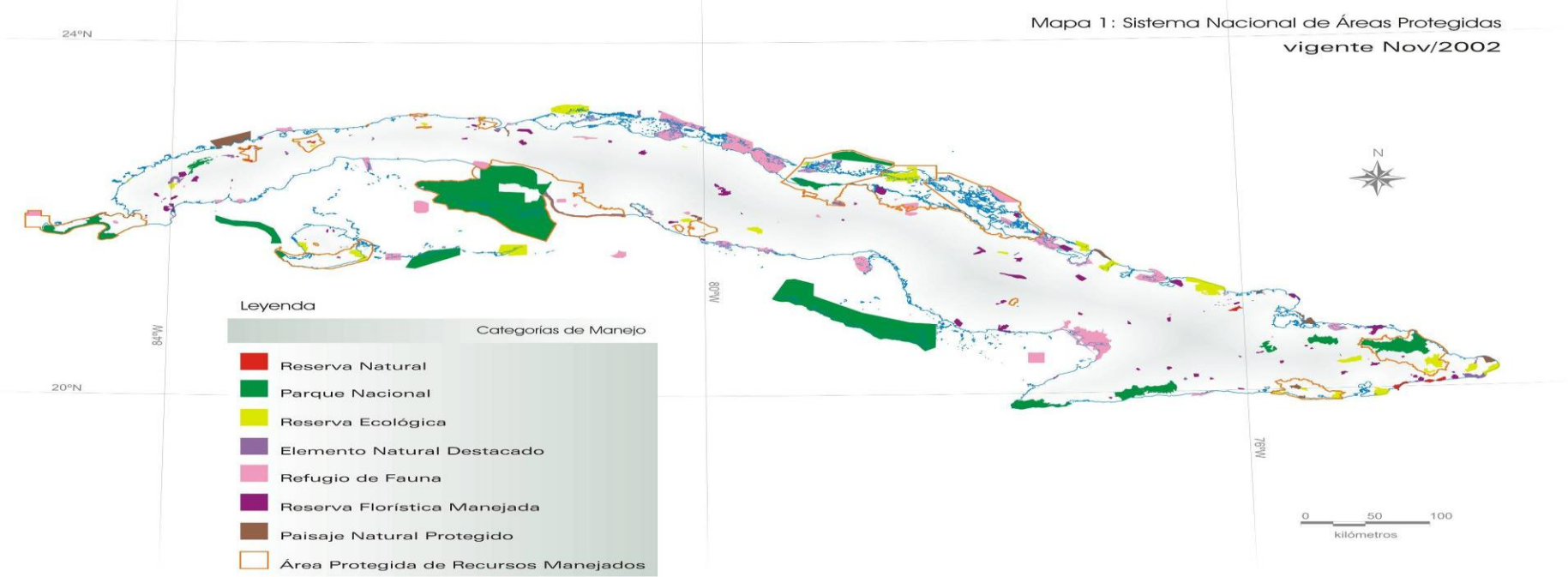






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# PROPOSAL OF THE NATIONAL SYSTEM OF PROTECTED AREAS



**242 – Protected Areas**

**80 – Protected Areas of National Significance**

**155 – Protected Areas of Local Significance**

**7 – Special Regions of Sustainable development**

**22% of national territory**

# Reserves of the Biosphere

Mapa de reservas de Biosfera de Cuba





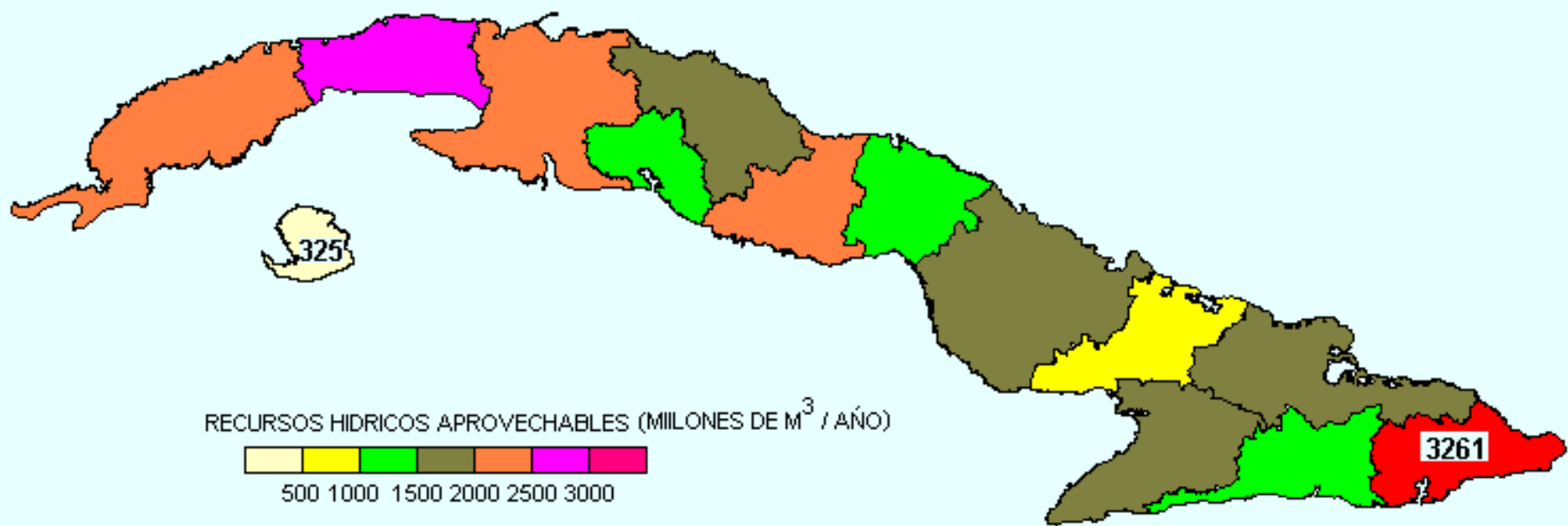
# Lack of Water (facts)

- Hydraulic Development of the Country (from 48 to 9600 MMm<sup>3</sup> of reservoirs) and infrastructure for use underground water (freatic) allows 1220 m<sup>3</sup> / inhabitant/ year what is insufficient and is considered internationally a hidrical stress situation.
- Overuse, droughts, variations of seasons, saline intrusion, pollutions and others as the main causes.
- Other factors, lack of forests, salination, bad planning, almost no reuse or recycling, bad infrastructure, and no culture of saving and rational use.
- The problem has different incidence according to the regions of the country.

- Complex hidrogeology and karst. 75% limestone.
- Risky earth works. Too close to sea.
- Lack of funding and machinery resources.





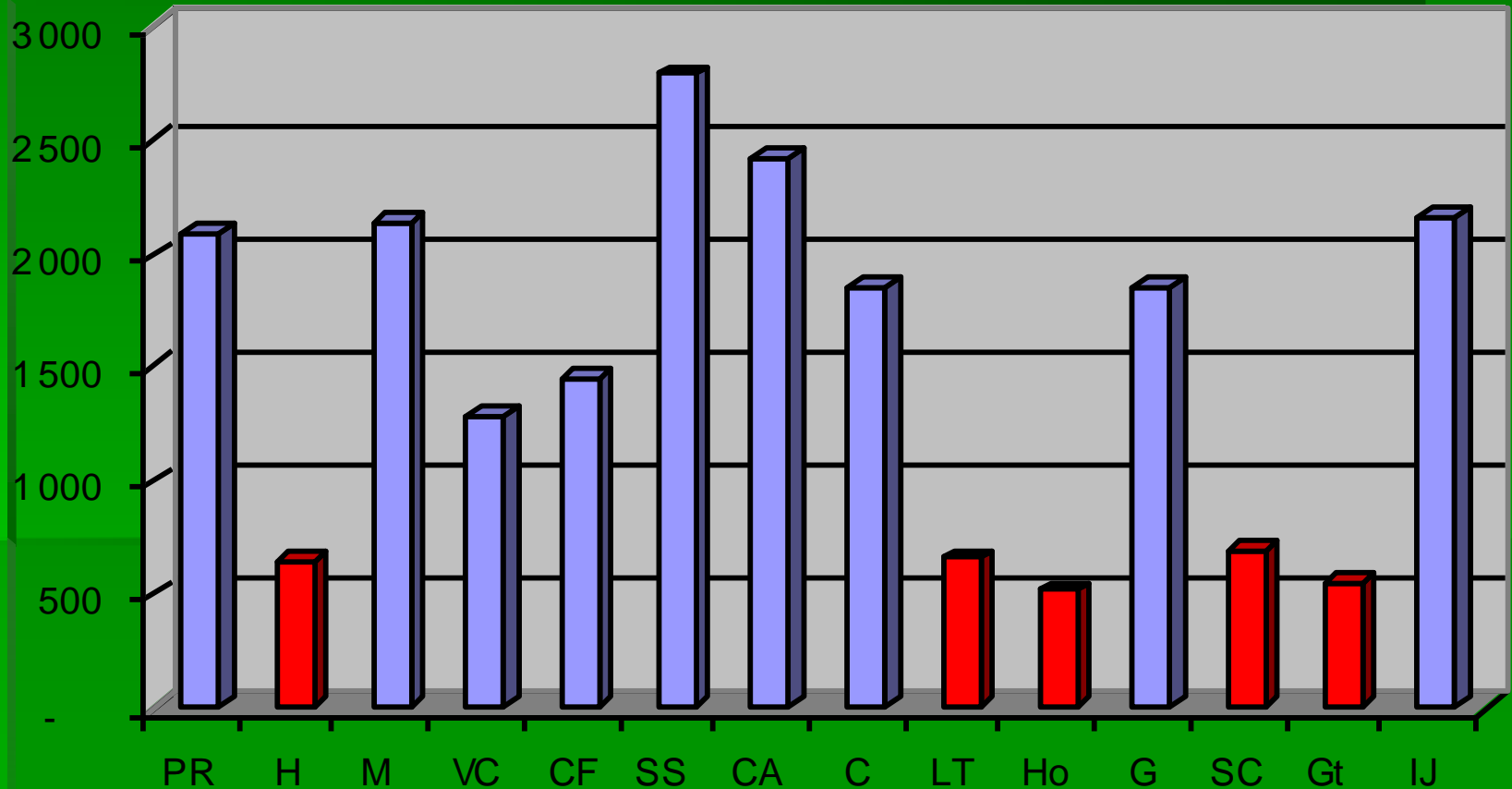


# WATER RESOURCES & AVAILABILITY



# Water per capita by provinces

m<sup>3</sup>/hab/año





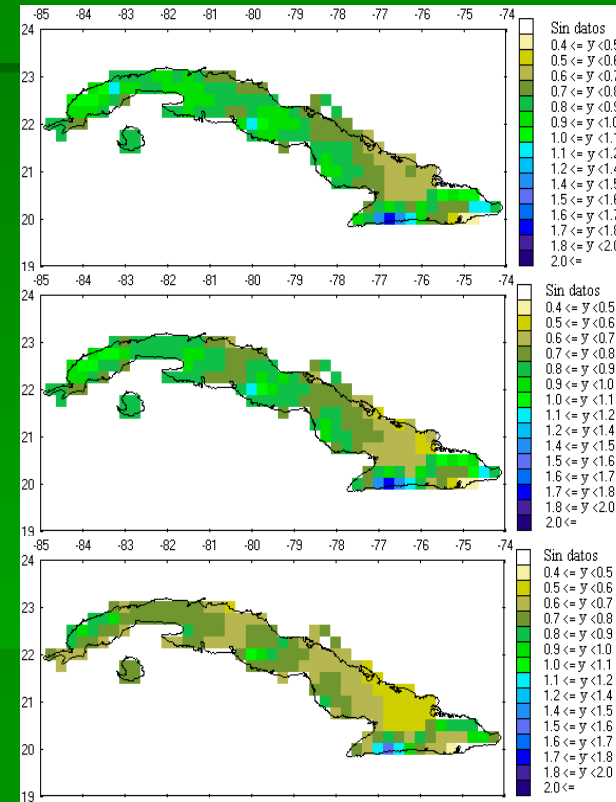
**Less fresh water going to the shoreline, means drastically less production of coastal ecosystems.**

**No point in Cuba is more than 60 km from the sea.**



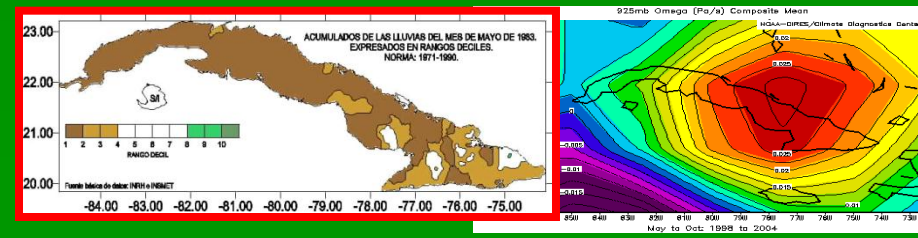
# CLIMATE CHANGE ADDS A THREAT TO SUSTAINABLE DEVELOPMENT OF CUBA

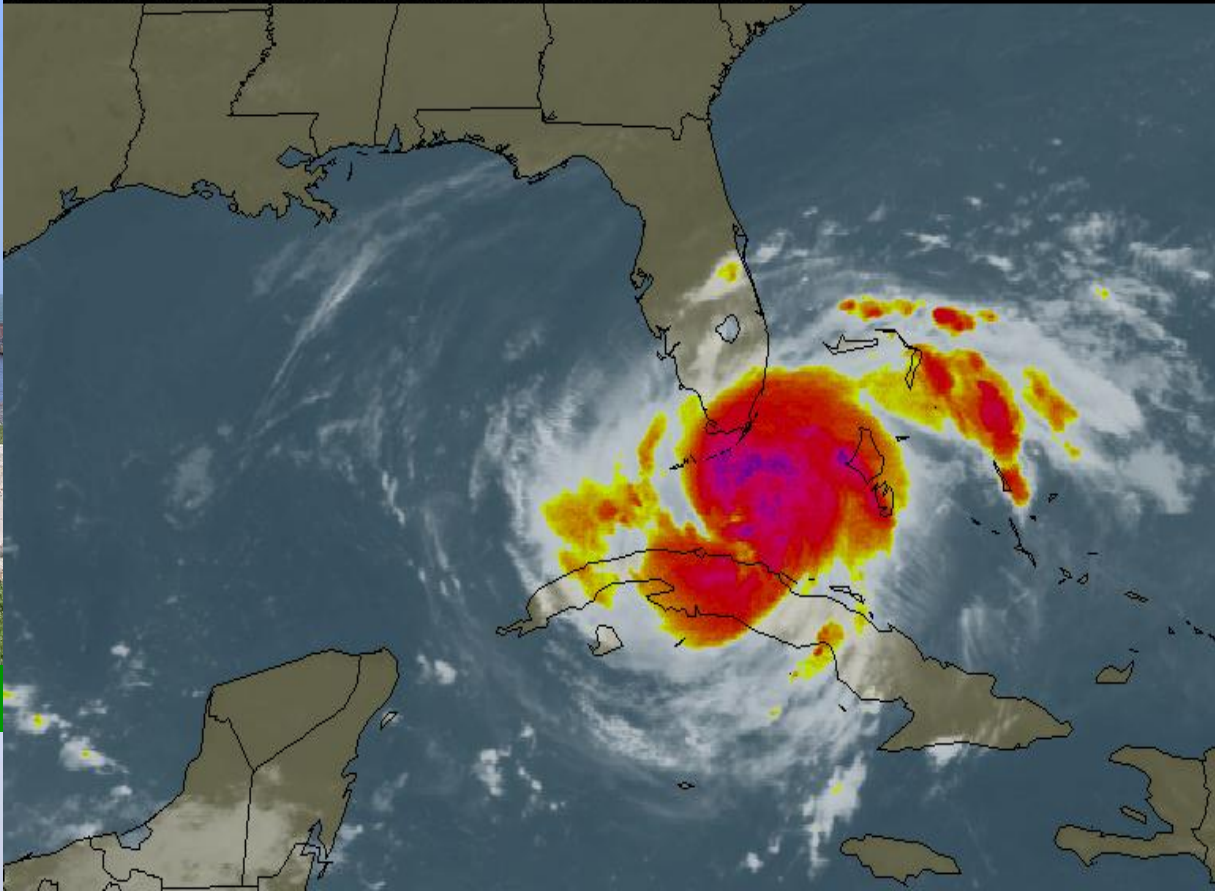
- Reduction of forest areas ;
  - Loss of biodiversity;
  - More frequent and intense hydro- meteorological events;
  - Loss of agricultural productivity;
- Reduction of farming areas ;
  - Reduction of the quality & availability of water;
- Harmful effects to mangroves and coastal ecosystems ;
- Increase of vulnerability of coastal settlements.



2010

2100







# Climate change impacts for hidrology in the Caribbean

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- Less fresh water available.
- Almost all the anual rainfall in fewer months.
- Dry «wet» seasons and wet «dry» seasons.
- Severe Droughts locally with «humidity».
- Flash Floods.
- More and stronger hurricanes.
- More evaporation and saline intrussion.

# What governments do...

- More conventional solutions (damps, pumps, canals, aqueducts, reservoirs...)
- Watershed (basin) ecosystem approach.
- Put drought and land degradations as the main environmental problems in NS.
- Sustainable land management and anti desertification program.
- Raising awareness and research.
- Water saving campaigns.

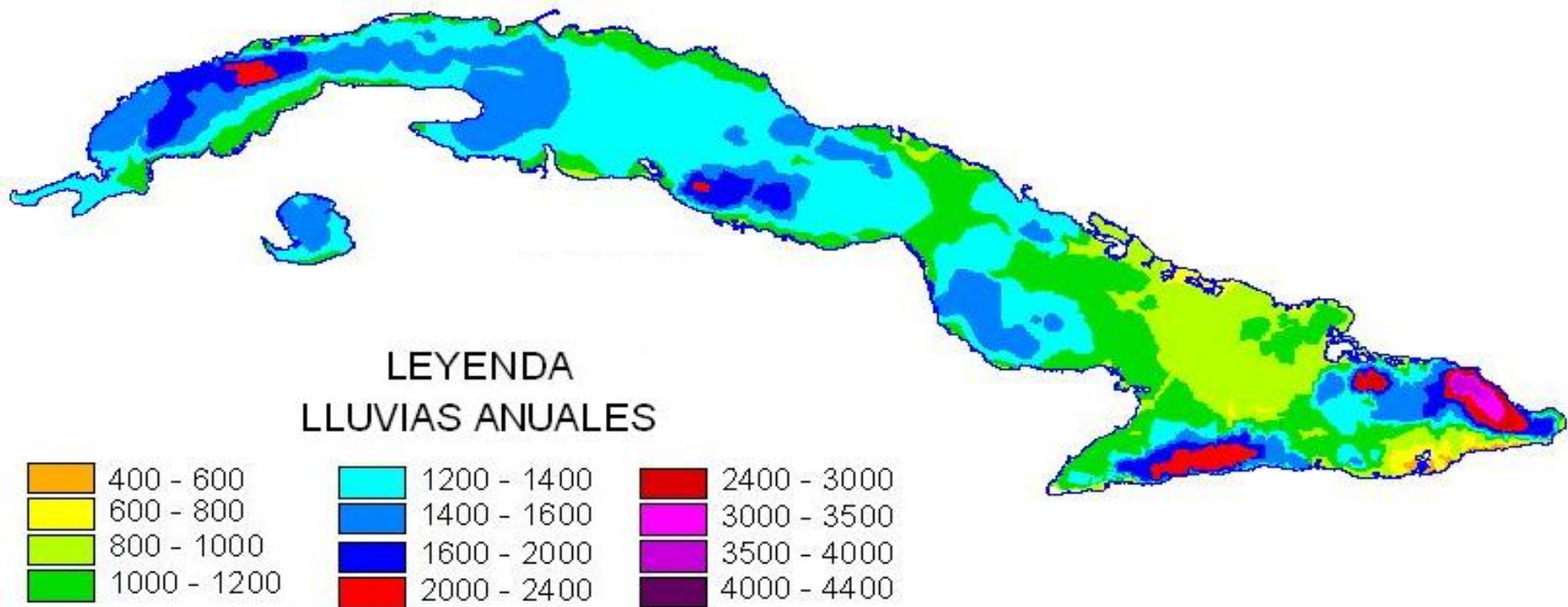
# Global Impact of threats (1993-2002)



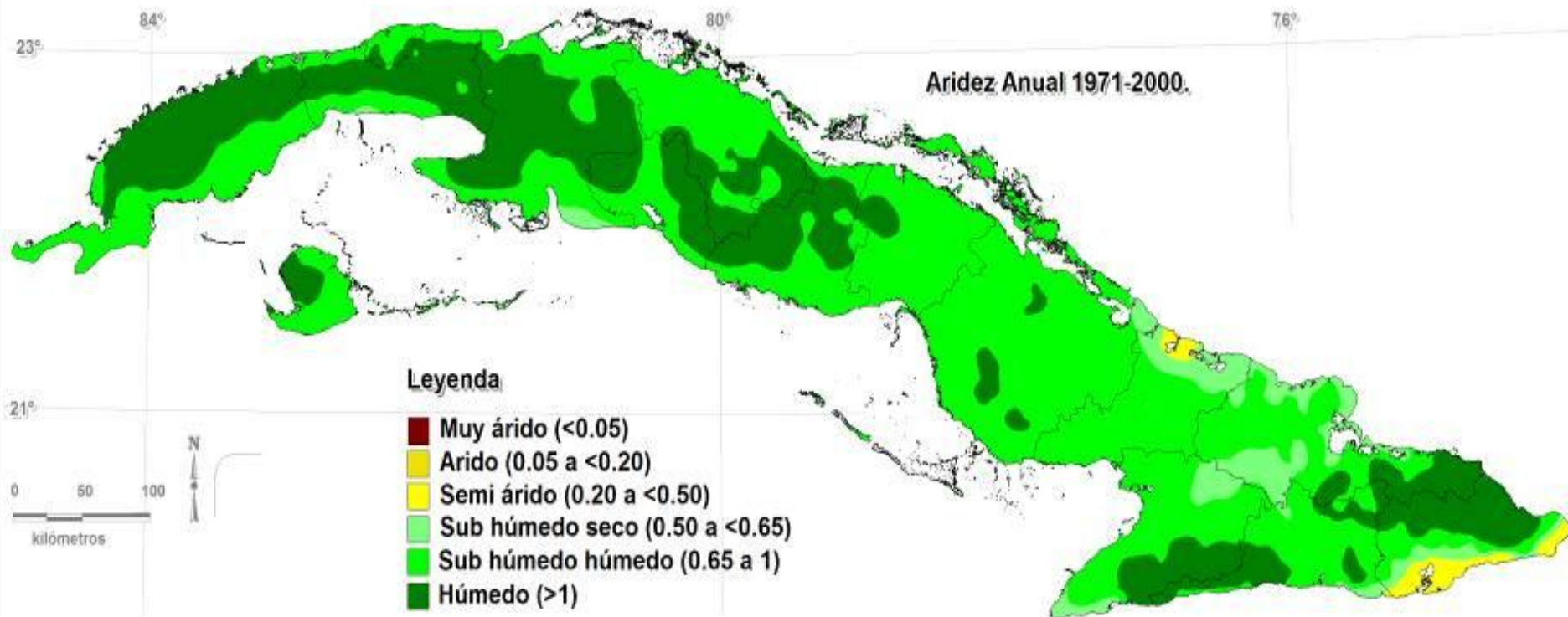
Fuente: OMM, 2004

# What Happens in Cuba?

## Average Anual Rainfall 1961-2000



# Aridity per year 1971-2000



# Local Problems

**Sequía**



**Deforestación**



**Erosión**



**Salinidad**





## Actions Taken in Eastern Cuba



# Water Social Justice in a poor country with conventional methods

- Supply covers 95,1%
- Sanitation covers 94,3%
- 227.9 MM m<sup>3</sup> of Black water treated, 40.01%.
- National Program For Sanitation and potable water. Focused on local solutions and low costs.



# Potable Water Coverage, 2000

Sector	Población servida %	Conexión domiciliaria %	Servicio público %	Fácil acceso %
Urbano	98.5	81.8	6.4	10.3
Rural	79.4	38.0	13.5	27.9
<b>Total</b>	<b>93.8</b>	<b>70.9</b>	<b>8.2</b>	<b>14.7</b>

# Sanitation coverage

Sector	Total servida %	Alcantarillado %	Fosas y letrinas %
Urbano	93.6	44.3	49.3
Rural	82.5	11.0	71.5
<b>Total</b>	<b>90.8</b>	<b>36.0</b>	<b>54.8</b>

Situación ambiental cubana  
1998

**Cuba signed in 1994 and ratified in 1997 UNCCCD.**

**National Group against Desertification and drought created in 1995 (24 institutions)**

**2002: National Program against Desertification and drought finished.**



Ministerio de Ciencia, Tecnología y Medio Ambiente  
Agencia de Medio Ambiente  
CITMA



Documento elaborado por el Grupo Nacional de Lucha Contra la Desertificación y la Sequía bajo la coordinación del Centro de Información, Gestión y Educación Ambiental (CIGEA) y los auspicios de la Secretaría de la Convención de las Naciones Unidas de Lucha contra la Desertificación y la Sequía. (CCD), la Organización para la Agricultura y la Alimentación (FAO) y el Fondo Internacional de Desarrollo Agrícola (FIDA)



# Types of Drought:

. **METEOROLÓGICA**, CUANTÍA DE LAS PRECIPITACIONES MUY INFERIOR A LO ESPERADO EN UNA AMPLIA ZONA Y PARA UN LARGO PERÍODO DE TIEMPO.

. **AGRÍCOLA**, CANTIDAD DE PRECIPITACIÓN Y SU DISTRIBUCIÓN, LAS RESERVAS EN AGUA DEL SUELO Y LAS PÉRDIDAS POR EVAPORACIÓN SE COMBINAN PARA CAUSAR DISMINUCIONES CONSIDERABLES DEL RENDIMIENTO DE LOS CULTIVOS Y DEL GANADO.

. **HIDROLÓGICA**, DEFICIT CONTÍNUO EN LA ESCORRENTÍA EN SUPERFICIE INFERIOR A LAS CONDICIONES NORMALES O CUANDO DISMINUYE EL NIVEL DE LAS AGUAS SUBTERRÁNEAS.

. **SOCIAL O ECONÓMICA**, ESCASEZ DE AGUA INDUCIDA POR UNA FALTA DE BALANCE EN EL SUMINISTRO Y LA DEMANDA DE ESTE RECURSO.



# What permies do in Cuba...

- Agriculture not only low energy, chemical free and low income...also low water resilient.
- Alternative solutions. Less evaporation.
- Forests as «factories» of water.
- Appropriate technologies for water.
- Integrate coastal zone with agriculture.
- If climate changes, permies changes and adapt, water management changes.
- Creatively use Water Permaculture Principles
- Alliances, synergies with existing programs.

# Water sustainable management



Increase productivity of  
«blue» water in (40%)

Increase productivity of  
«green» water in (60%)

# What permies do in Practice...

- Rainwater collection and storage.
- Use of grey waters.
- Aquaculture and aquaponics (fish dont drink).
- Constructed wetlands.
- Food forests and tree based systems.
- Renewable energies based water systems.
- Low water resilient agricultural practices .
- Human and nature scale water management.
- Change the existing culture towards water.
- Close the water cycle in smaller spaces.







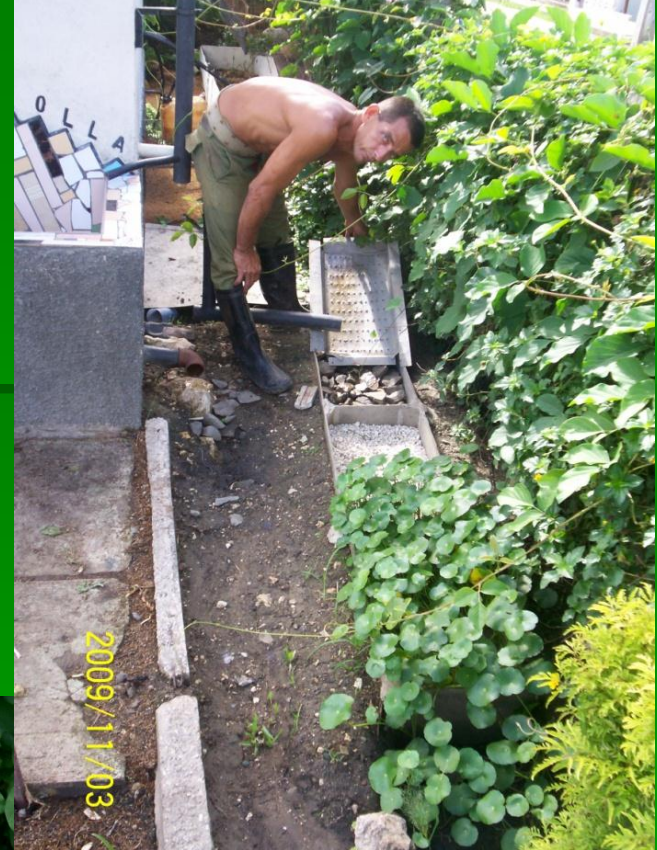
**Compost dry toilettes  
working in 5 provinces of  
the country**







**Dozens of rainwater collecting systems**





# Grey and black water filtering systems

010 26 2007





**Appropriate  
technologies for  
water management**



# Water management practices in use in Permaculture systems against hurricanes and severe droughts

Subsistemas 24	Suelos arropad y sembrad	Produc y conservaci3n de las semillas	Almacen ar agua potable	Proteger los abonos org3nicos	Proteger las abejas y animales	Visita y apoyos a afectados
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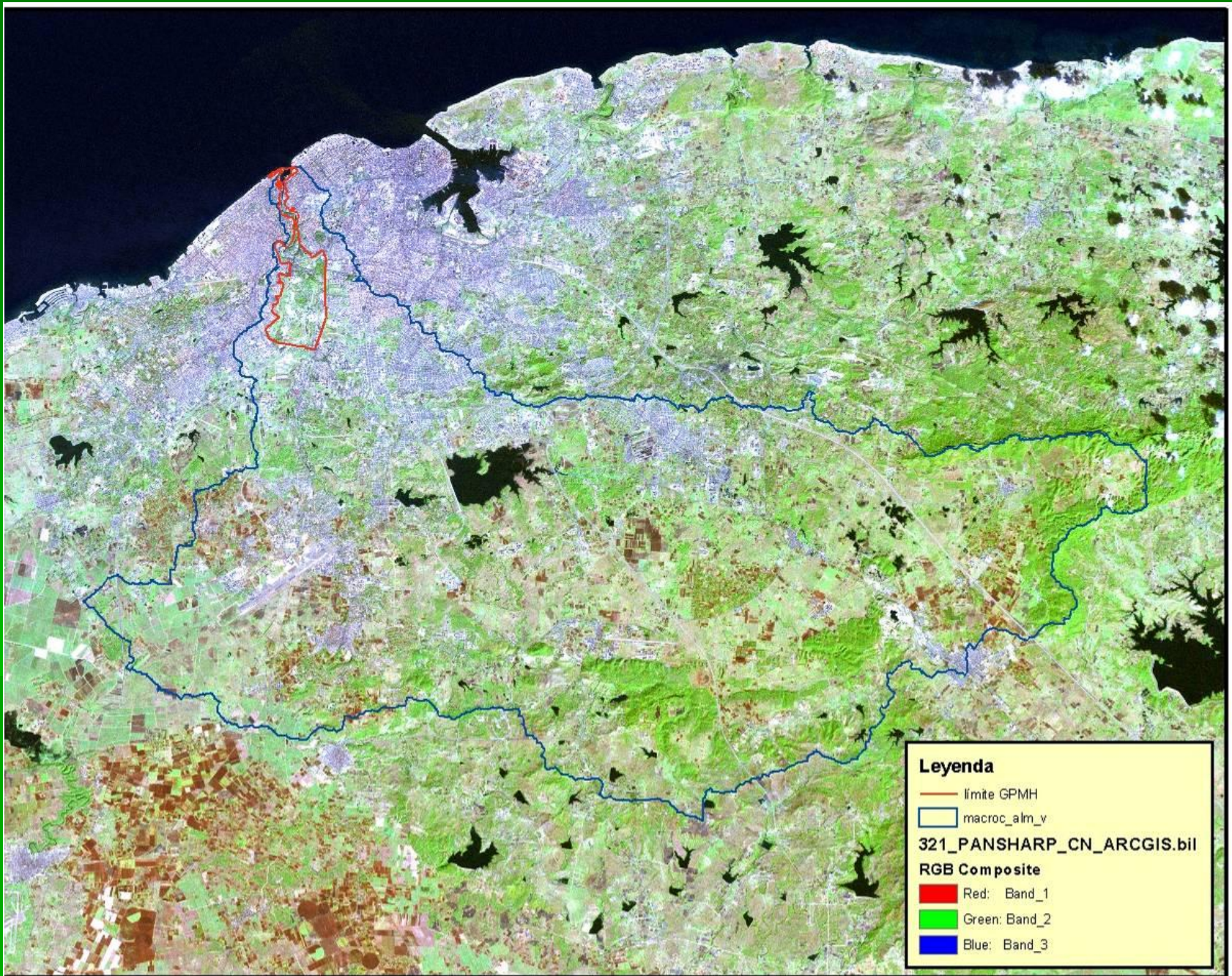
## Medidas contra extremas sequías.

Subsistemas 24	Suelos arropad y sembrad	Produc. y conservaci3n de las semillas	Reservar la mayor cantidad de agua	Siembra de variedades resistente	Cercas vivas y cortinas rompe v.	Empleo de gremios de plantas
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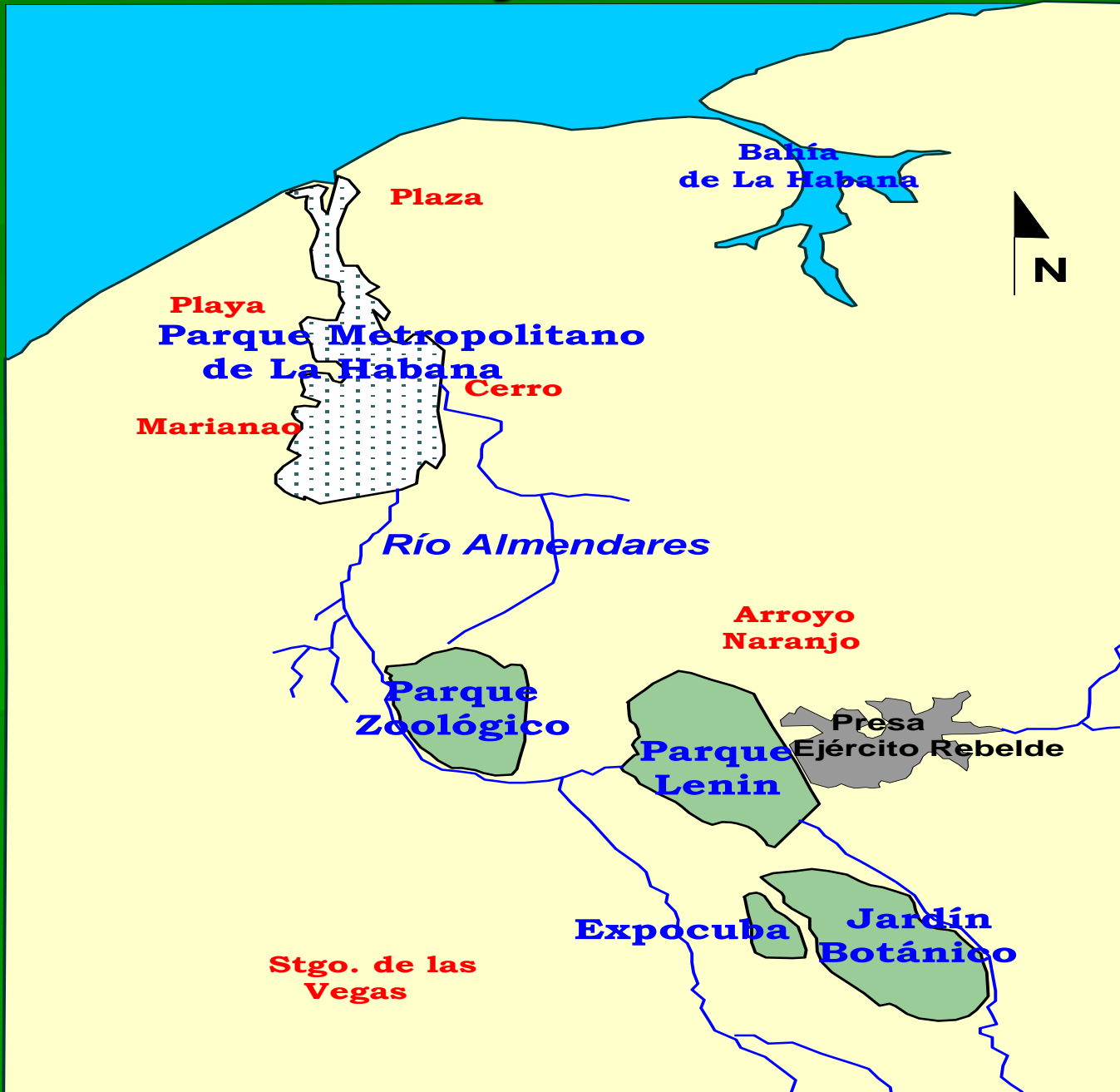








# Big Green Park System for Havana City



# Pogolotti urban constructed wetland. 6 years working



# Palatino urban constructed wetland. Construction and after



# Hybrid System in Finlay. 4 years working



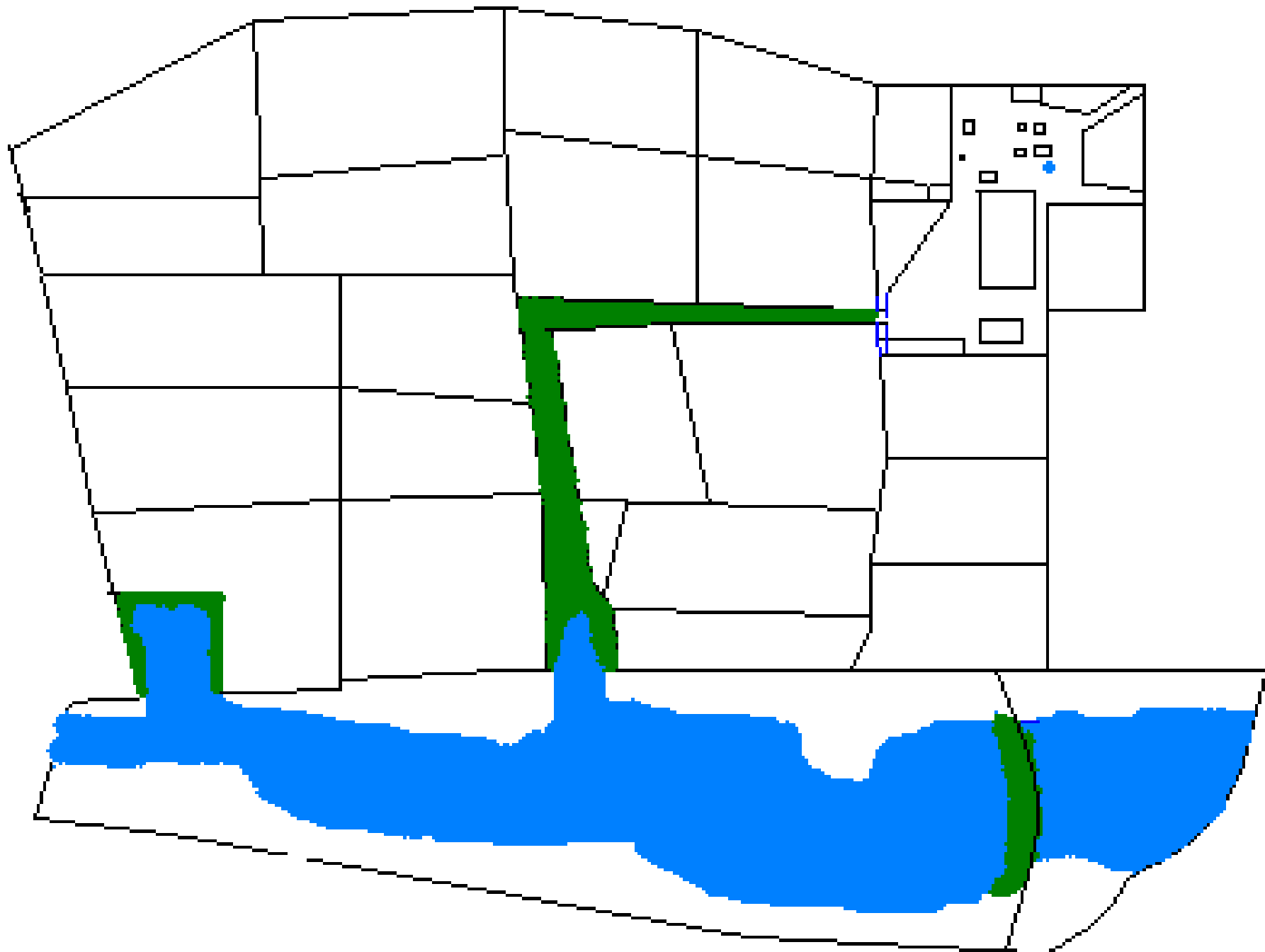
# Challenges ...

- Water as limiting factor for food production.
- Conventional management misuse water.
- Pressure to produce more food in short term.
- Big water macro projects fossil fuels based.
- Need of water resilient food systems.
- Climate change impacts are happening and increasing.
- Mining, oil drilling, and other historical disturbing activities promoted.



# Example of a Cuban Permaculture Site water management











FEB 18 2006



FEB 18 2006



# Lessons learned...

- Agriculture is a thirsty business.
- When there's no water people blame agric.
- Most of the real energy producing potential is neglected at the micro and mini level.
- There are not magical solutions.
- Forest and natural ecosystems are lot more efficient than reservoirs.
- Dignity and social justice is not enough, a new paradigm towards water is necessary.
- Permaculture has a lot to say in water...

“ La Permacultura es contribuir a:

- Transitar por un nuevo tipo de desarrollo más Humano.
- vivir Inmerso en una agricultura.
- Convertir las dificultades en soluciones.
- Promover todas las relaciones ambientales en un sistema Incluyendo a las Persona, las construcciones, las condiciones climáticas.
- El empleo de la energía.
- El fortalecimiento de las relaciones Humanas, aprovechando los recursos Locales.

En síntesis  
- Es una nueva forma de Pensar y de vivir en armonía con la natura<sup>Loza</sup>





# Opportunities for Permaculture...

- New land reform, more than 150 000 Ha.
- Existing Programs and converging initiatives (food sovereignty, climate change, coastal zone, forests, reforestation, desertification and drought, sustainable development, international cooperation).
- New farmers, more Permies...
- Conventional systems can't respond to actual challenges.

SI, Se PUEDE

# **Concluussions**

**Cuban last 20 years Agriculture proves that is possible to have a multistakeholders**

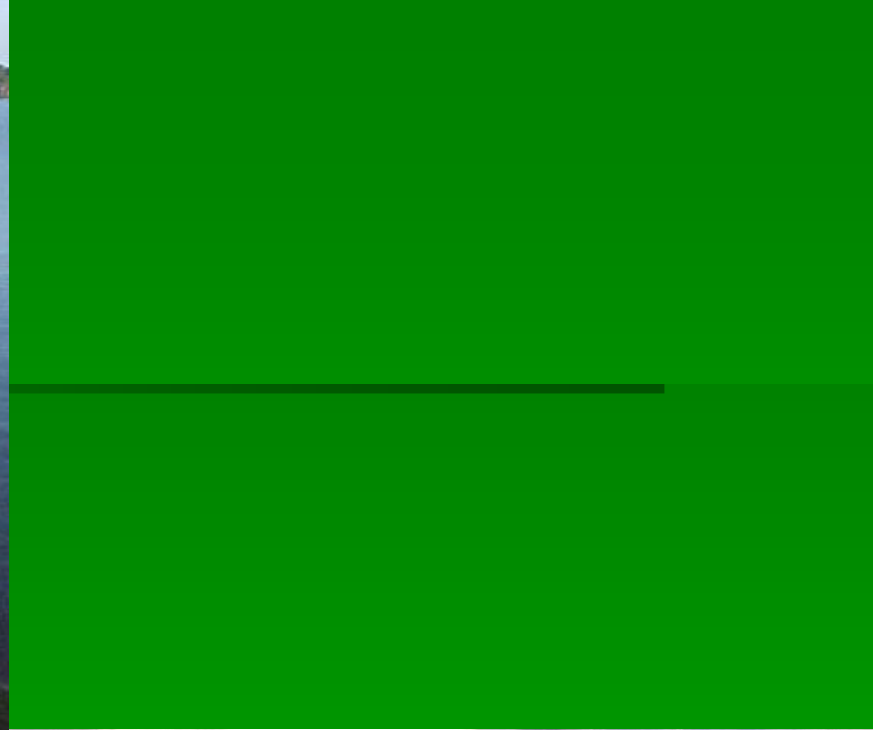
**Agricultural System that can feed sustainably millions, satisfy basic human needs, faces problems and save lifes,**

**With relative little water.**

**Permaculture can feed millions of people without exhaust natural resources and poison the Planet, is a powerful tool to educate people to make peace with water.**



**Cubans are less far from Sustainable Development, WWF report, 2006.**



**Thanks!**