



# Leptospirosis in the Americas – Surveillance and Drivers



**Cristina Schneider, DVM, MSc, ScD**  
**Advisor Animal Human Health Interface**  
**PAHO Health Emergencies Department**  
*GLEAN Meeting, Malaysia October 2016*



**Pan American  
Health  
Organization**

# Leptospirosis framework from an outbreak perspective in the Americas Since 2011



<http://www.paho.org/english/ad/dpc/cd/eer-ihrs.htm>

IHR

PAHO Core Data



<http://www.glean-lepto.org/>



One Health

Natural disaster analysis

[http://www.izs.it/vet\\_it/aliana/2012/48\\_2/193.pdf](http://www.izs.it/vet_it/aliana/2012/48_2/193.pdf)



Americas



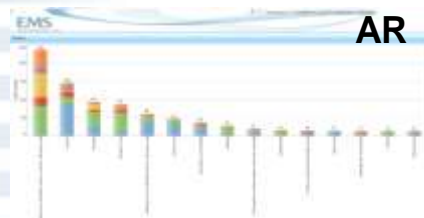
WHO Burden of Leptospirosis



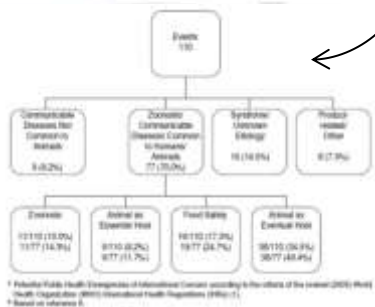
<http://www.who.int/zoonoses/diseases/lerg/en/index4.html>

Risk and drivers analysis

<http://www.mdpi.com/1660-4601/9/11/3883>



AR



Importance of the animal/human interface

[http://new.paho.org/journal/index.php?option=com\\_docman&task=doc\\_download&gid=250&Itemid](http://new.paho.org/journal/index.php?option=com_docman&task=doc_download&gid=250&Itemid)



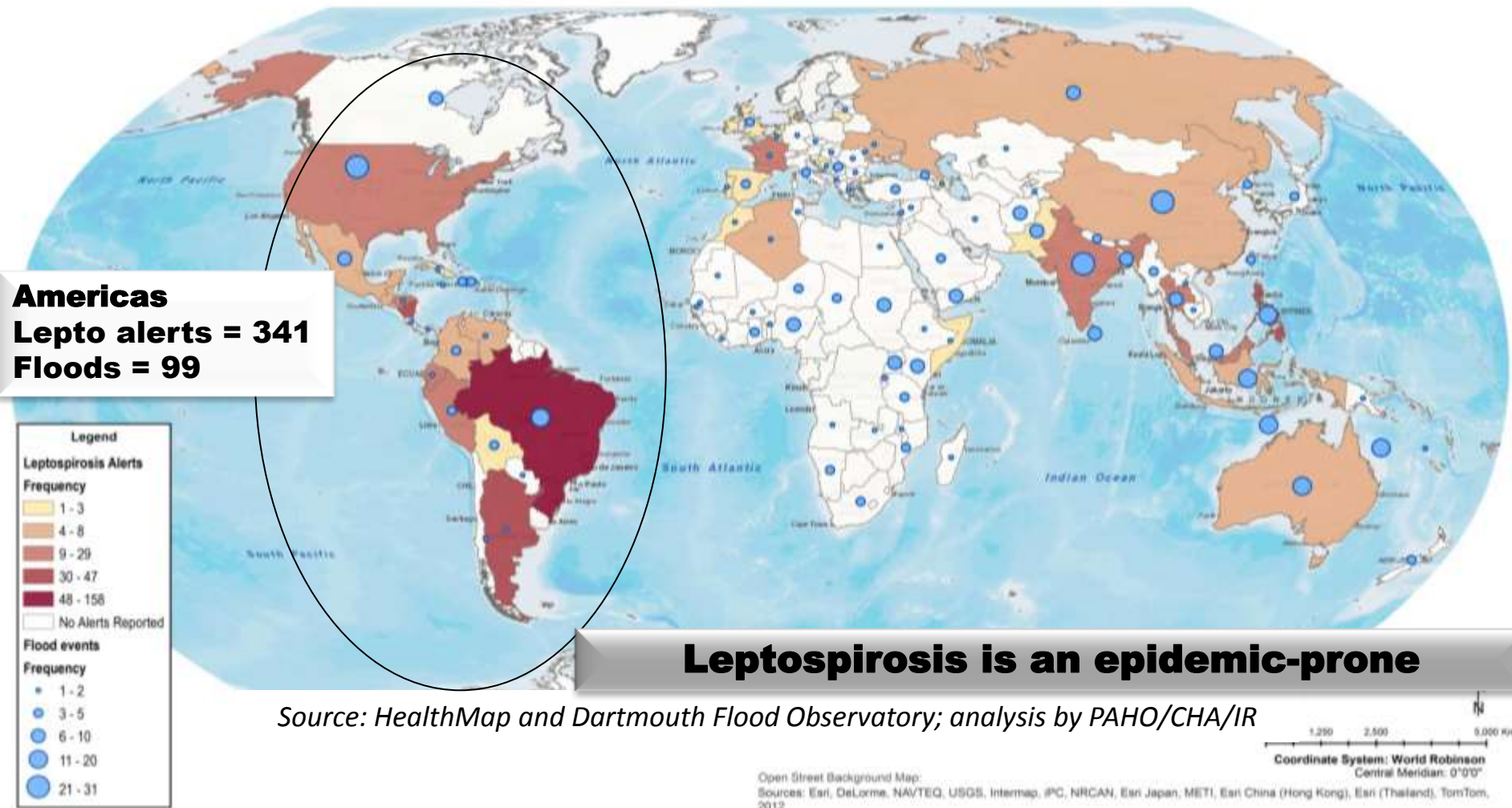
# Work objectives

Support countries to **predict, detect, prevent and respond** to outbreaks of leptospirosis, thereby reducing mortality and severe cases during outbreaks, as well as reduce the number of cases in risk areas, especially related to the environment.



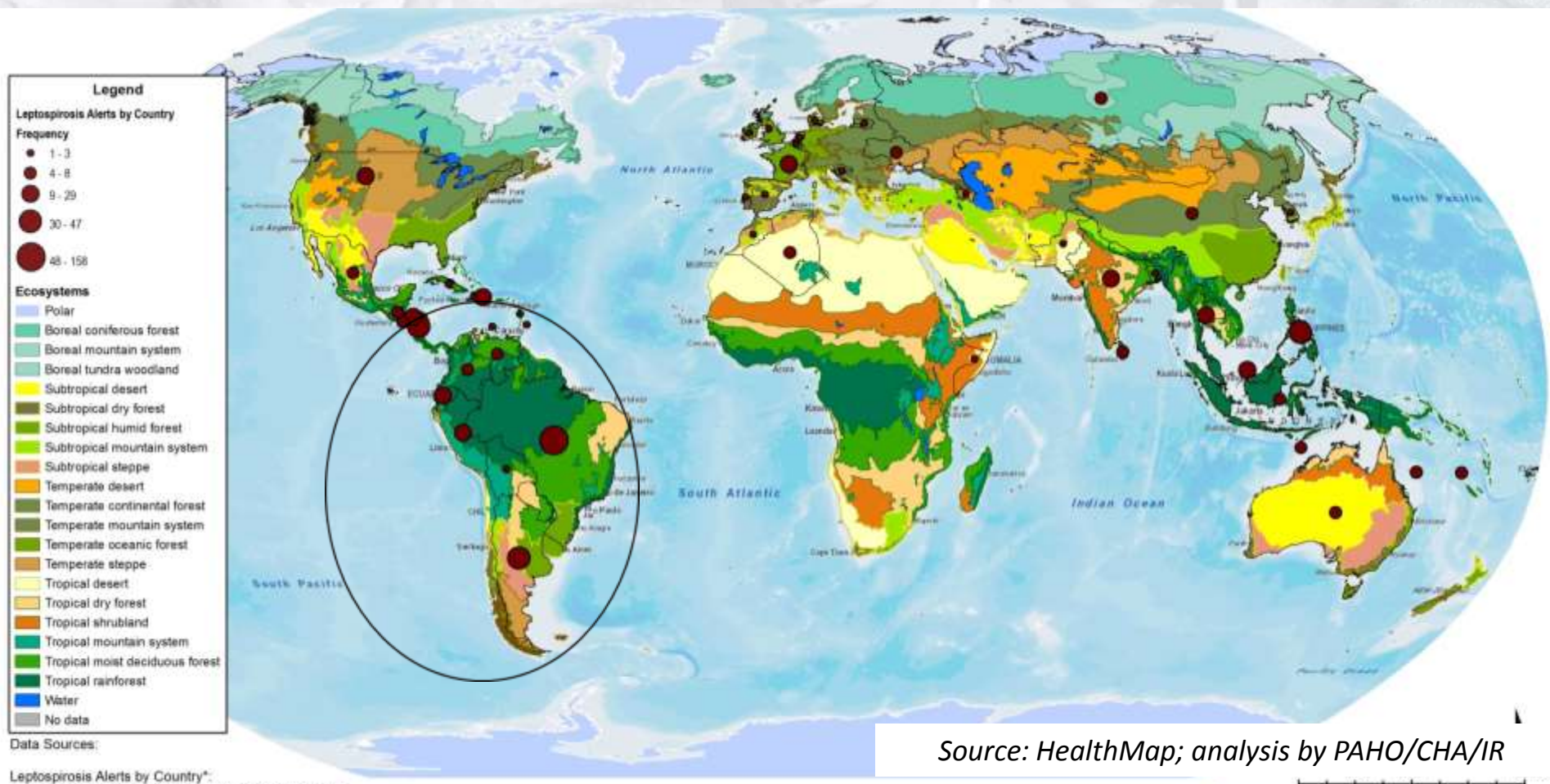
Photos: SILAIS Chinandega, Nicaragua

# Global Situation of Leptospirosis



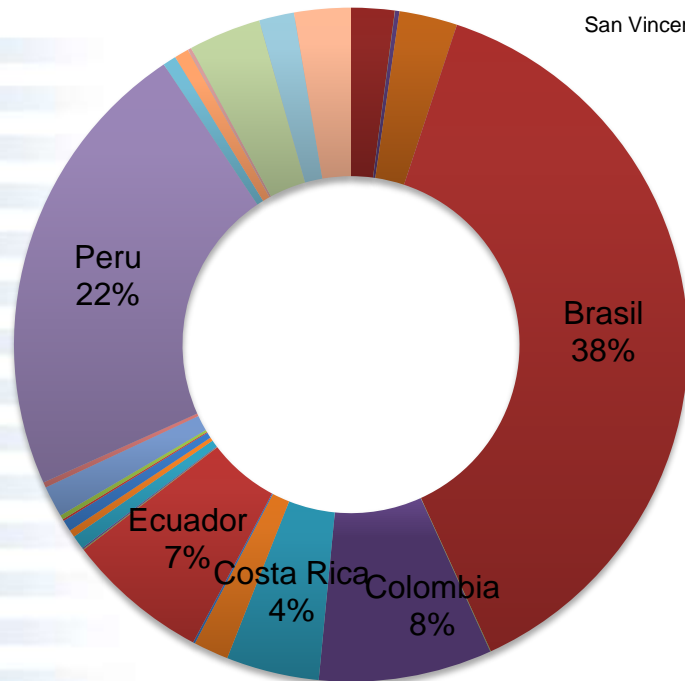


# Leptospirosis alerts

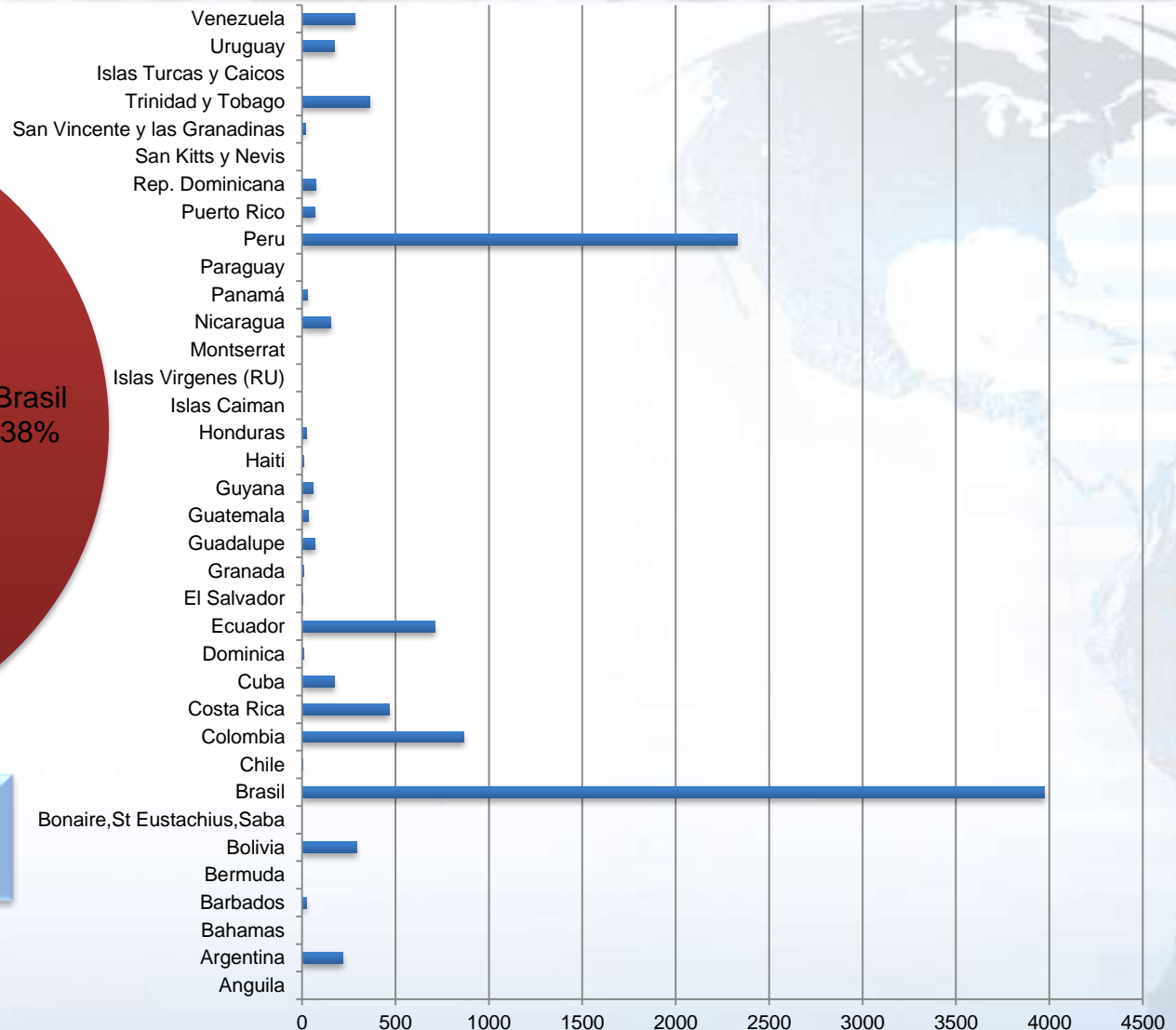


- **535 alerts for leptospirosis in HealthMap (outbreak monitoring and real-time surveillance of emerging public health threats) from 2010-2014**
- **More than half (341 alerts) were in the Americas, particularly in Brazil (165 alerts), Nicaragua (45) and Argentina (43)**

# Cases of Leptospirosis in Latin America and the Caribbean, 2014



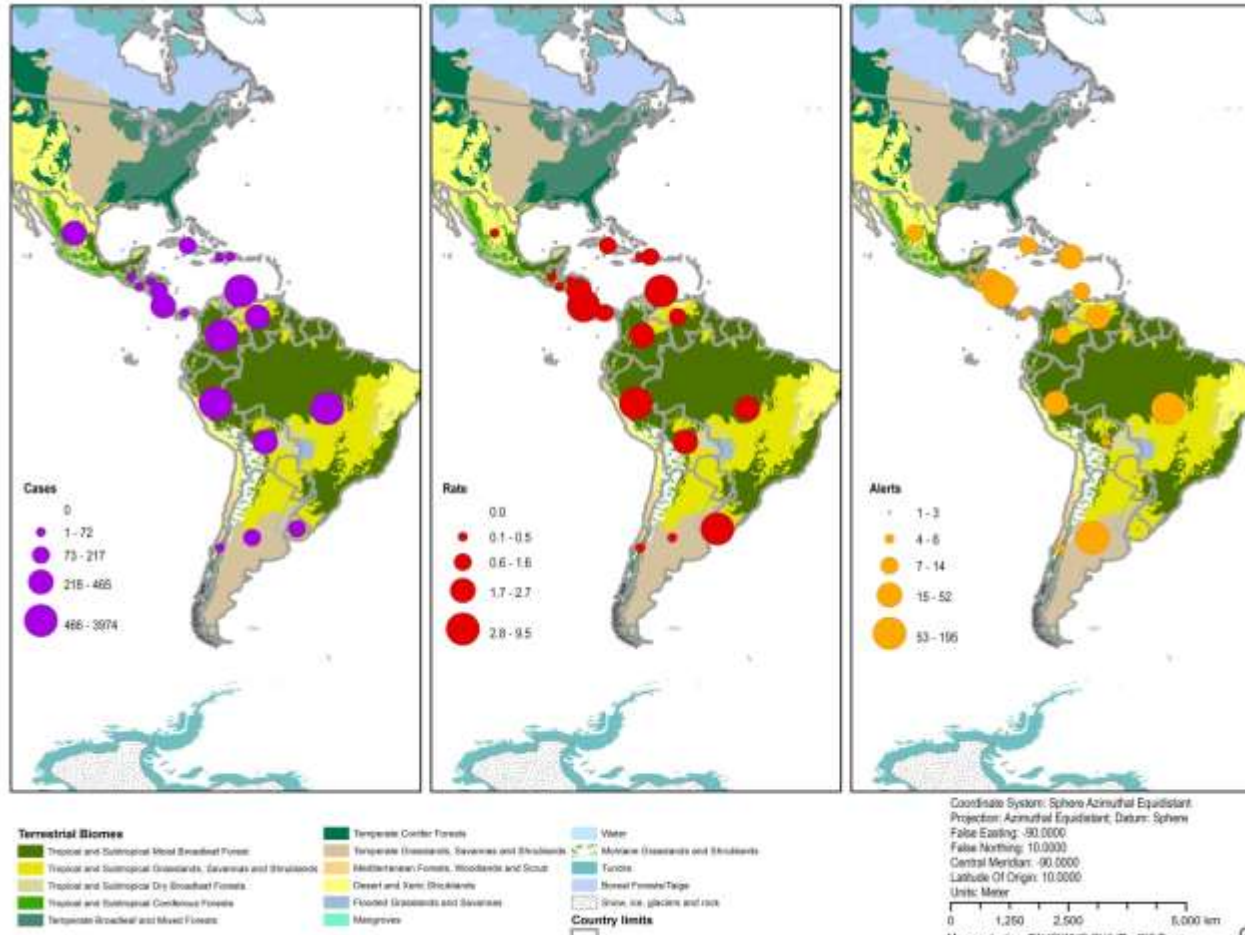
Total: 10,702 cases (95% reported in Latin America)



Source: PAHO Core Data, based on country official information

# Latin Americas: Leptospirosis Situation

Leptospirosis human cases (2014), cumulative incidence rate (2014), and leptospirosis alerts (2010-2014), Latin America over ecoregions background



Cases: 10,000/year  
Rate = 2 per 100,000 pop

**This 3 indicators were used as criteria to select priority countries for technical cooperation**

Schneider MC at all.  
Leptospirosis in Latin America: Exploring the first set of regional data. Pan American Journal of Public Health. Accepted.

**Sources:** Human cases: PAHO based on country information. Cumulative incidence rates: calculated by authors. Alerts: HealthMap. Terrestrial ecoregions: FAO



# Countries Profiles

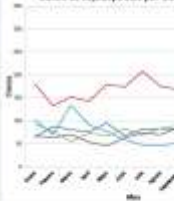
## LEPTOSPIROSIS: COLOMBIA

Fernando Antonio Mendigaglia Paz  
Communicable Diseases Branch, Ministry of Health and Social Protection,  
Analysis PAHO

### Perfil de País

El flujo de información se genera desde la unidad primaria generadora de datos, hacia el municipio y del municipio hacia el nivel nacional e internacional, y desde el nivel nacional se envía, respectivamente a los departamentos, de los departamentos a los municipios, así como desde cada nivel se envía información a las aseguradoras.

Cases of Leptospirosis by mes, 2010-2014



Defecciones por Leptospirosis

Año	Defecciones
2010	10
2011	15
2012	12
2013	18
2014	14

Cases of Leptospirosis by primer nivel



Cases of Leptospirosis by primer nivel subnacional, 2010-2014



Cases of Leptospirosis, por zona 2010-2014



### Country Profile

The flow of information is generated from the primary data generated unit, to the municipality and from the municipality up to the national and international level, and from national level, feedback is sent to the departments, from the departments to the municipalities, and from each level information is sent to the insurers.

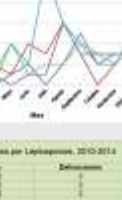
Cases of Leptospirosis by month, 2010-2014



Defecciones por Leptospirosis

Año	Defecciones
2010	10
2011	15
2012	12
2013	18
2014	14

Cases of Leptospirosis by primer nivel



Cases of Leptospirosis by primer nivel subnacional, 2010-2014



Cases of Leptospirosis, por zona 2010-2014



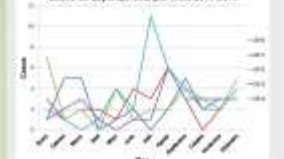
## LEPTOSPIROSIS: PANAMA

Hector Cedeño  
Epidemiology Department, Ministry of Health  
Analysis PAHO

### Perfil de País

En Panamá la Leptospirosis es una enfermedad de notificación e investigación obligatoria. Según Decreto 1017 del 27 de octubre de 2014 en su artículo 1 establece y categoriza los niveles de salud pública de notificación e investigación obligatoria, según los tipos de vigilancia epidemiológica, la vigilancia zoonótica y la vigilancia de zoonosis para su notificación. Los Departamentos de la Dirección General de Salud Pública atienden la Leptospirosis, y los laboratorios involucrados en la investigación de esta enfermedad, Epidemiología, la Agencia Epidemiológica, la Subdirección de Atención a la Población, la Atención de las Afecciones, Control de Infecciones, Zoonosis, Salud Ambiental, Calidad de Agua, Promoción de la Salud y los métodos de Prevención y Control.

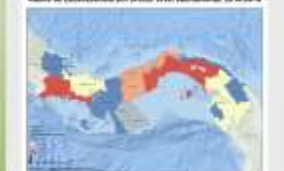
Cases of Leptospirosis by mes, 2010-2014



Defecciones por Leptospirosis, 2010-2014

Año	Defecciones
2010	10
2011	15
2012	12
2013	18
2014	14

Cases of Leptospirosis by primer nivel subnacional, 2010-2014



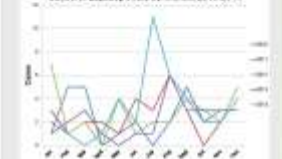
Cases of Leptospirosis, por zona 2010-2014



### Country Profile

En Panamá Leptospirosis es una enfermedad de notificación e investigación obligatoria. Según Decreto 1017 del 27 de octubre de 2014 en su artículo 1 establece y categoriza los niveles de salud pública de notificación e investigación obligatoria, según los tipos de vigilancia epidemiológica, la vigilancia zoonótica y la vigilancia de zoonosis para su notificación. Los Departamentos de la Dirección General de Salud Pública atienden la Leptospirosis, y los laboratorios involucrados en la investigación de esta enfermedad, Epidemiología, la Agencia Epidemiológica, la Subdirección de Atención a la Población, la Atención de las Afecciones, Control de Infecciones, Zoonosis, Salud Ambiental, Calidad de Agua, Promoción de la Salud y los métodos de Prevención y Control.

Cases of Leptospirosis by month, 2010-2014



Defecciones por Leptospirosis, 2010-2014

Año	Defecciones
2010	10
2011	15
2012	12
2013	18
2014	14

Cases of Leptospirosis by primer nivel subnacional, 2010-2014



Cases of Leptospirosis, por zona 2010-2014



## LEPTOSPIROSIS: HONDURAS

Reina Velasquez  
Zoonosis Surveillance, Health Surveillance Unit, Ministry of Health of Honduras;  
Analysis by PAHO

### Perfil de País

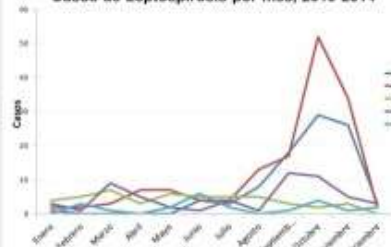
El programa de Leptospirosis en Honduras está bajo la coordinación de la Vigilancia de Enfermedades Zoonóticas de la Unidad de Vigilancia de la Salud. Existen 20 regiones de salud que realizan acciones de prevención y control de leptospirosis y notifican a zoonosis.

Dentro de las medidas de prevención y control implementadas están:

**Medidas de Prevención:** 1) Promoción de la salud (Educación para la salud, participación social, comunicación educativa); 2) Saneamiento básico; 3) Protección de grupos de riesgo; 4) Protección de animales domésticos y de interés económico.

**Medidas de Control:** 1) Diagnóstico y Tx oportuno del los enfermos; 2) Estudios y procedimiento para confirmación de casos e reservorios de la enfermedad; 3) Medidas de control aplicables a la población; Tx específico de casos, búsqueda de contactos, realizar medidas preventivas.

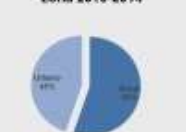
Cases of Leptospirosis by mes, 2010-2014



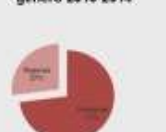
Cases of Leptospirosis by primer nivel subnacional, 2010-2014



Cases of Leptospirosis, por zona 2010-2014



Cases of Leptospirosis, por género 2010-2014



### Country Profile

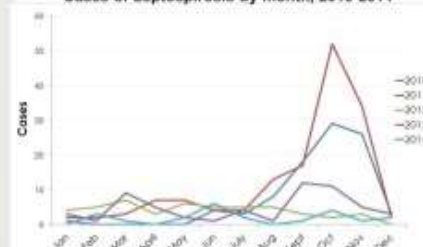
The Leptospirosis program in Honduras is under the coordination of the Zoonotic Disease Surveillance Unit. There are 20 health regions that perform actions of prevention and control of leptospirosis and notify to the zoonosis unit.

Among the prevention and control measures are:

**Prevention measures:** 1) Health promotion (Health Education, social participation, educational communication); 2) Basic sanitation; 3) Protection of groups at risk; 4) Protection of domestic animals and of economic interest.

**Control Measures:** 1) Timely diagnosis of patients; 2) Tests and procedures for the confirmation of cases and disease reservoirs; 3) Measures to monitor the population. Timely screening of specific cases, search for contacts, take preventive measures.

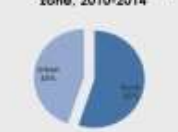
Cases of Leptospirosis by month, 2010-2014



Cases of Leptospirosis at the first sub-national level, 2010-2014



Cases of Leptospirosis by zona, 2010-2014



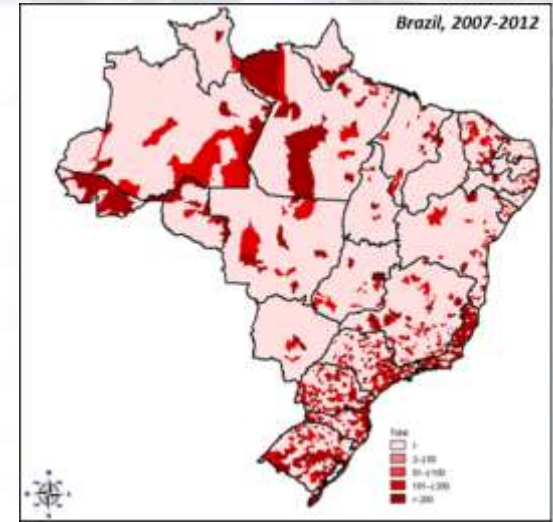
Cases of Leptospirosis by gender, 2010-2014





# Regional strengths and challenges

- Several countries already recognize leptospirosis as a public health problem and have programs in place
- Several countries already coordinate efforts among health, agriculture and others sectors



- Complex cycle with many species involved in a favorable transmission condition
- Limited surveillance in humans and in animals
- Misdiagnosis with dengue and other diseases
- Not yet a “tool ready” disease

**Outbreak simulation exercise Health and Agriculture, Choluteca/Honduras, October 2013**

# One Health approach



Photo: O Chaves

Indirect exposure through water and soil contaminated by urine from infected animals is the most common route of exposure of this worldwide disease, which is a perfect example of the animal-human-ecosystem interface.





# Leptospirosis Outbreaks in Nicaragua: Identifying Critical Areas and Exploring Drivers for Evidence-Based Planning

Maria Cristina Schneider <sup>1,\*</sup> ✉, Patricia Nájera <sup>1</sup> ✉, Sylvain Aldighieri <sup>1</sup> ✉, Jorge Bacallao <sup>2</sup> ✉, Aida Soto <sup>3</sup> ✉, Wilmer Marquiño <sup>3</sup> ✉, Lesbia Altamirano <sup>3</sup> ✉, Carlos Saenz <sup>4</sup> ✉, Jesus Marin <sup>4</sup> ✉, Eduardo Jimenez <sup>4</sup> ✉, Matthew Moynihan <sup>1</sup> ✉ and Marcos Espinal <sup>1</sup> ✉





# Objective

Document the known areas of outbreaks and analysis possible drivers in Nicaragua.

# Methodology

- ✓ Ecological-type study by second subnational level (153 municipalities), from 2004 to 2010
- ✓ Secondary sources and data, sources from the country's information system, the 2005 Nicaragua Census, and other different sources
- ✓ Definitions and criteria
- ✓ Description of the epidemiological situation and risk stratification
- ✓ Created from scratch a database (GIS) with cases, socioeconomic and environmental variables (by municipality)
- ✓ Exploratory analysis (statistic and GIS)

# Monthly distribution of precipitation and cases of leptospirosis, Nicaragua, 2004-2010

Total # of cases:  
1980

Cases after the  
month of highest  
precipitation were  
close to 10x  
higher.

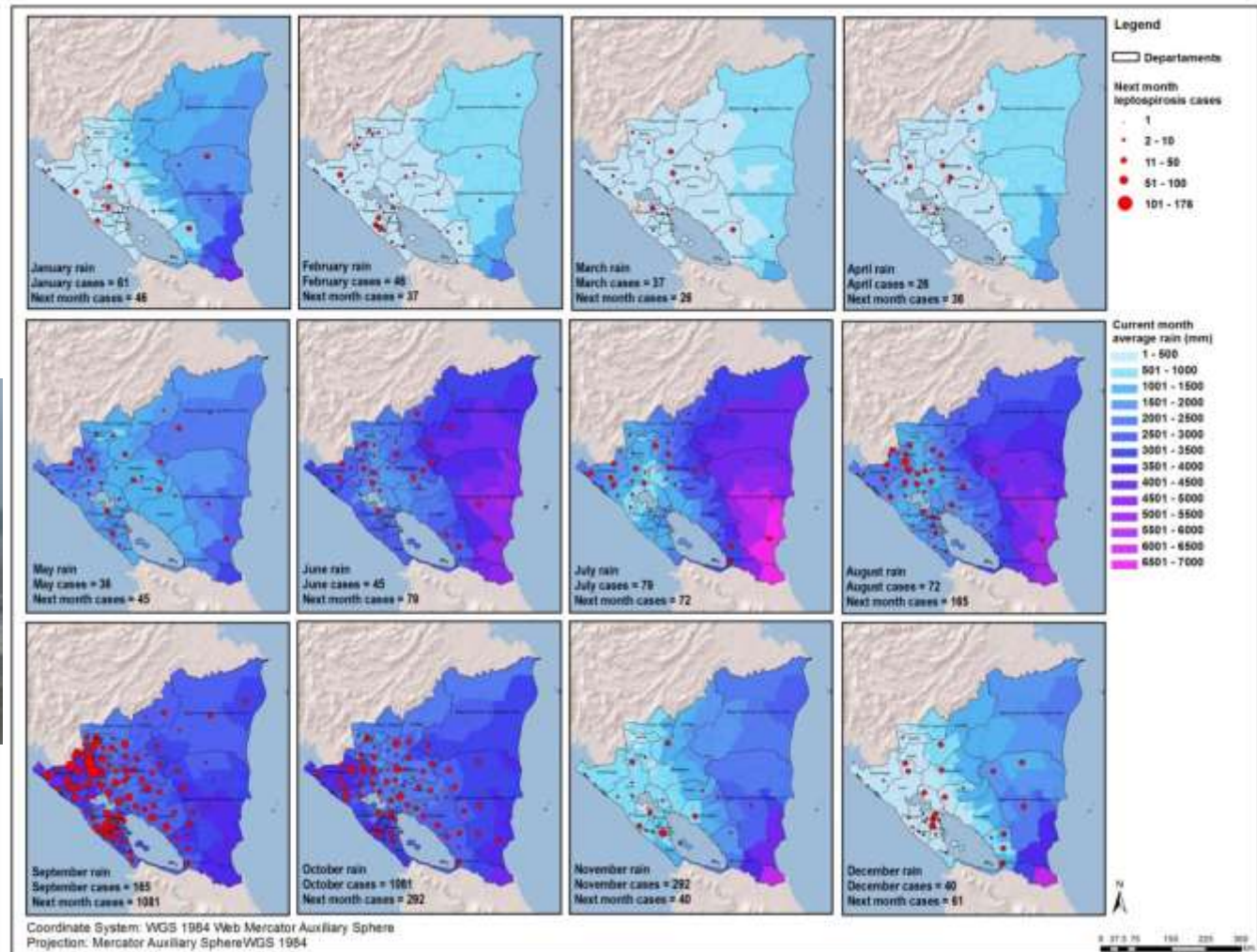


Photo: G Moreno

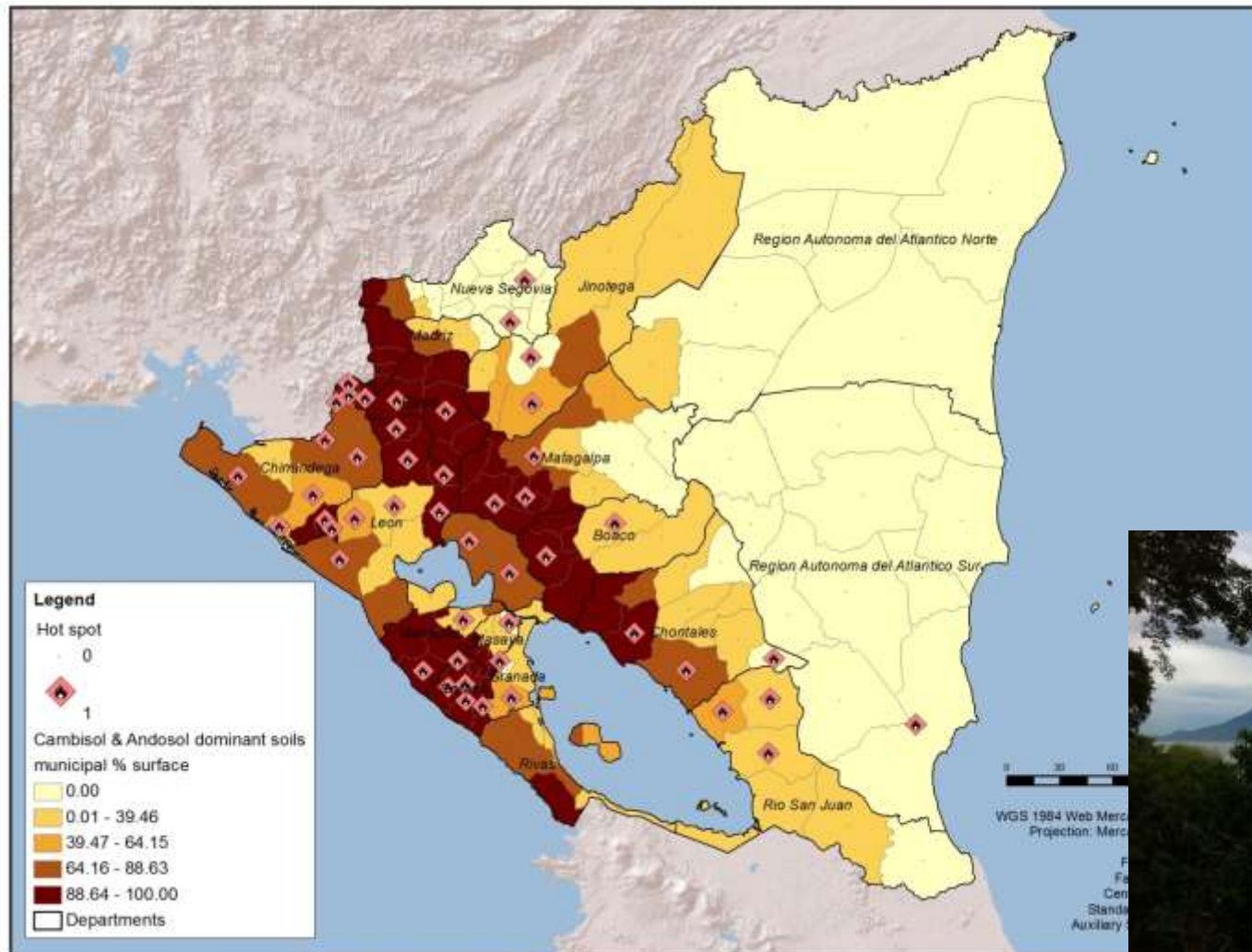
Corr:  $p < 0.01$

Poisson:  $p < 0.01$



# Critical areas and drivers of leptospirosis in Nicaragua, by municipality, 2004-2010

*% of municipal surface area covered by cambisol and andosol soils*

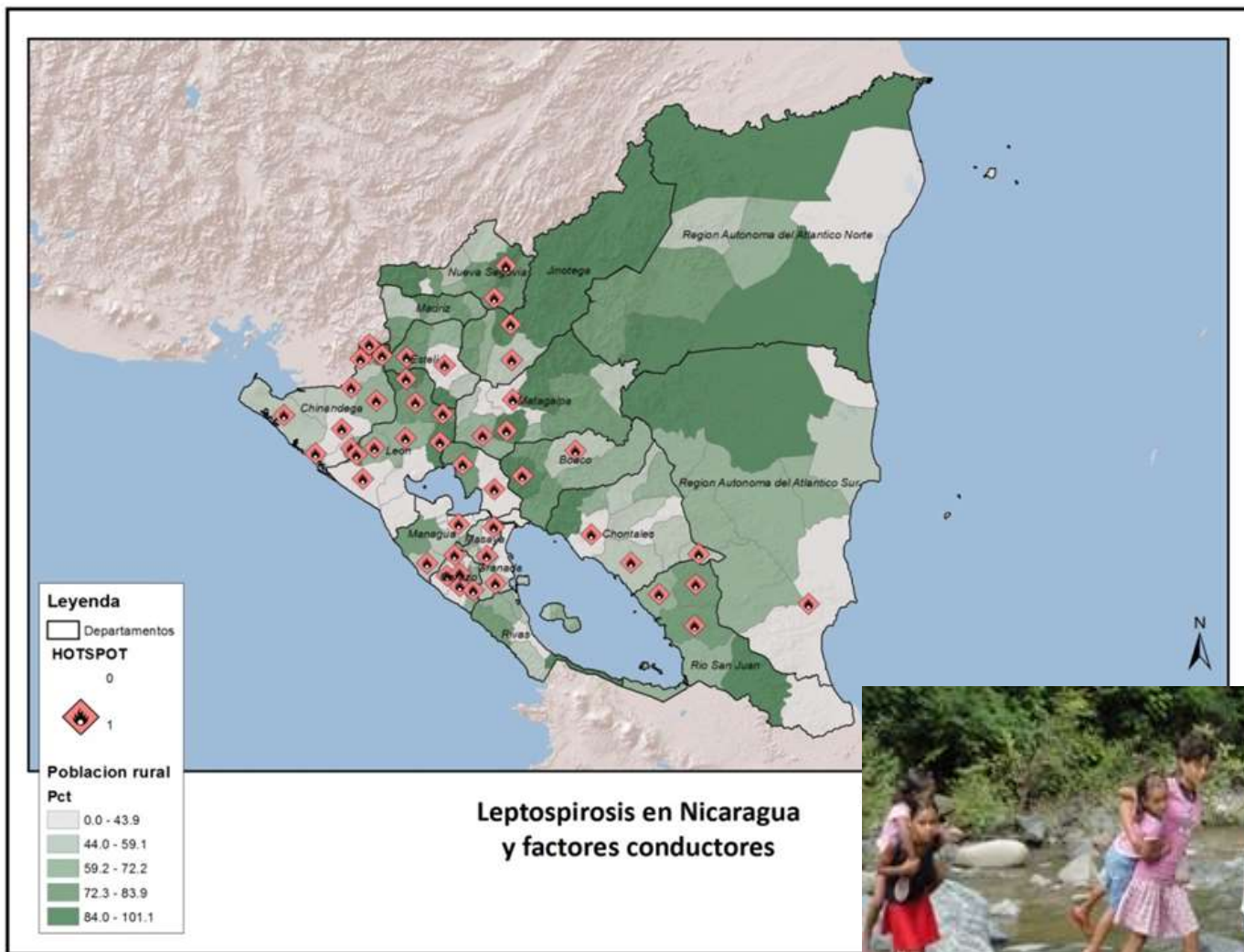


Corr:  $p < 0.01$   
Poisson:  $p < 0.01$



# Critical areas and drivers of leptospirosis in Nicaragua, by municipality, 2004-2010

*% of rural population*



Corr:  $p < 0.01$   
Poisson:  $p < 0.01$





# Conclusions and recommendations

- Outbreaks do not occur on a yearly basis and the risk is different between the departments and municipalities
- Some possible drivers were suggested
- This methodology use in the country Plan and could further assist other countries
- Addition studies suggested
- The limitations of ecological study are highlighted
- Importance of multidisciplinary study team and One Health approach

# Possible Socioeconomic Drivers



**Rural poverty  
and lack of  
sanitation  
Slums in urban  
areas**



**Productive process:  
Agriculture and  
livestock**

## **Rice paddy**

World = 740 million tons  
Americas = 360 million tons  
(48.6%)



## **Cattle raising**

World = 63 million tons  
Americas = 30 millions tons  
(47.6%)





## Study 2



*Int. J. Environ. Res. Public Health* **2014**, *11*(8), 8301–8318;  
doi:10.3390/ijerph110808301

Open Access

Article

# Socioeconomic Factors and Vulnerability to Outbreaks of Leptospirosis in Nicaragua

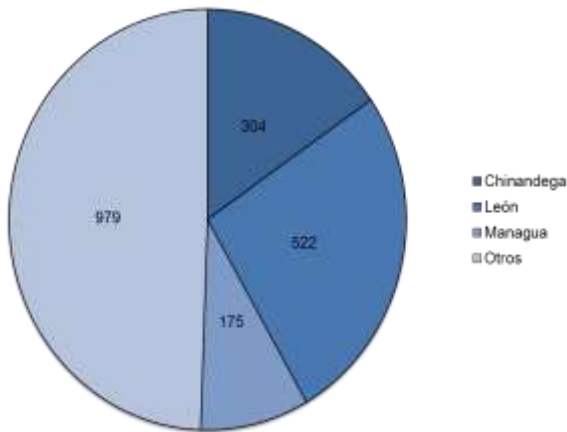
Jorge Bacallao<sup>1,\*</sup> ✉, Maria Cristina Schneider<sup>2,\*</sup> ✉, Patricia Najera<sup>2</sup> ✉, Sylvain Aldighieri<sup>2</sup> ✉, Aida Soto<sup>3</sup> ✉, Wilmer Marquino<sup>3</sup> ✉, Carlos Sáenz<sup>4</sup> ✉, Eduardo Jiménez<sup>4</sup> ✉, Gilberto Moreno<sup>4</sup> ✉, Octavio Chávez<sup>4</sup> ✉, Deise I. Galan<sup>2</sup> ✉ and Marcos A. Espinal<sup>2</sup> ✉

# Study Objective

To construct and validate a vulnerability index based on municipal socioeconomic indicators that could be used as a criteria to identify priority areas for intervention in the high risk departments.

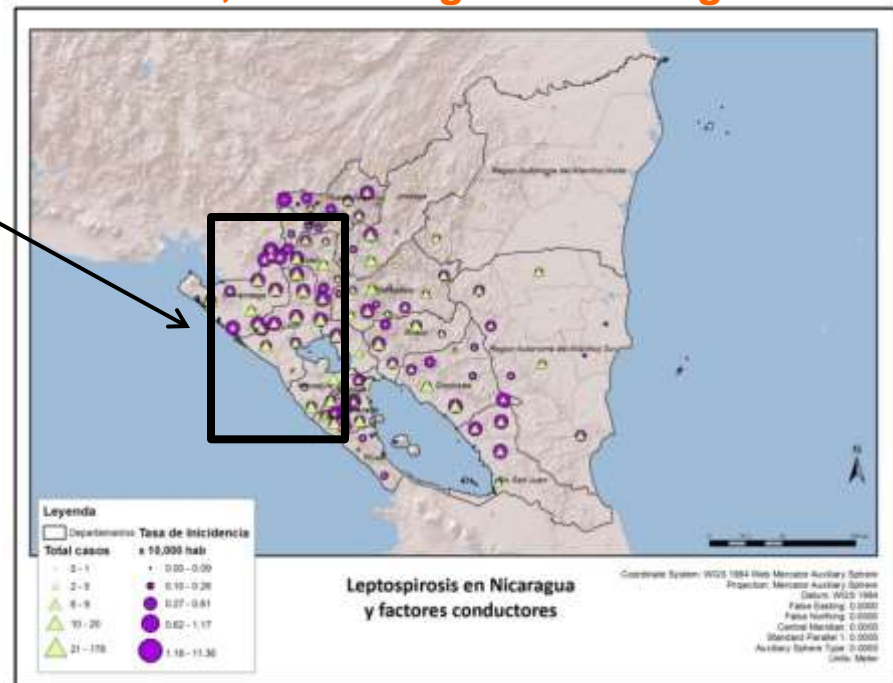
## Methodology

Departments investigated in the study:  
León, Chinandega and Managua



Leptospirosis cases, Nicaragua, 2007 to 2010

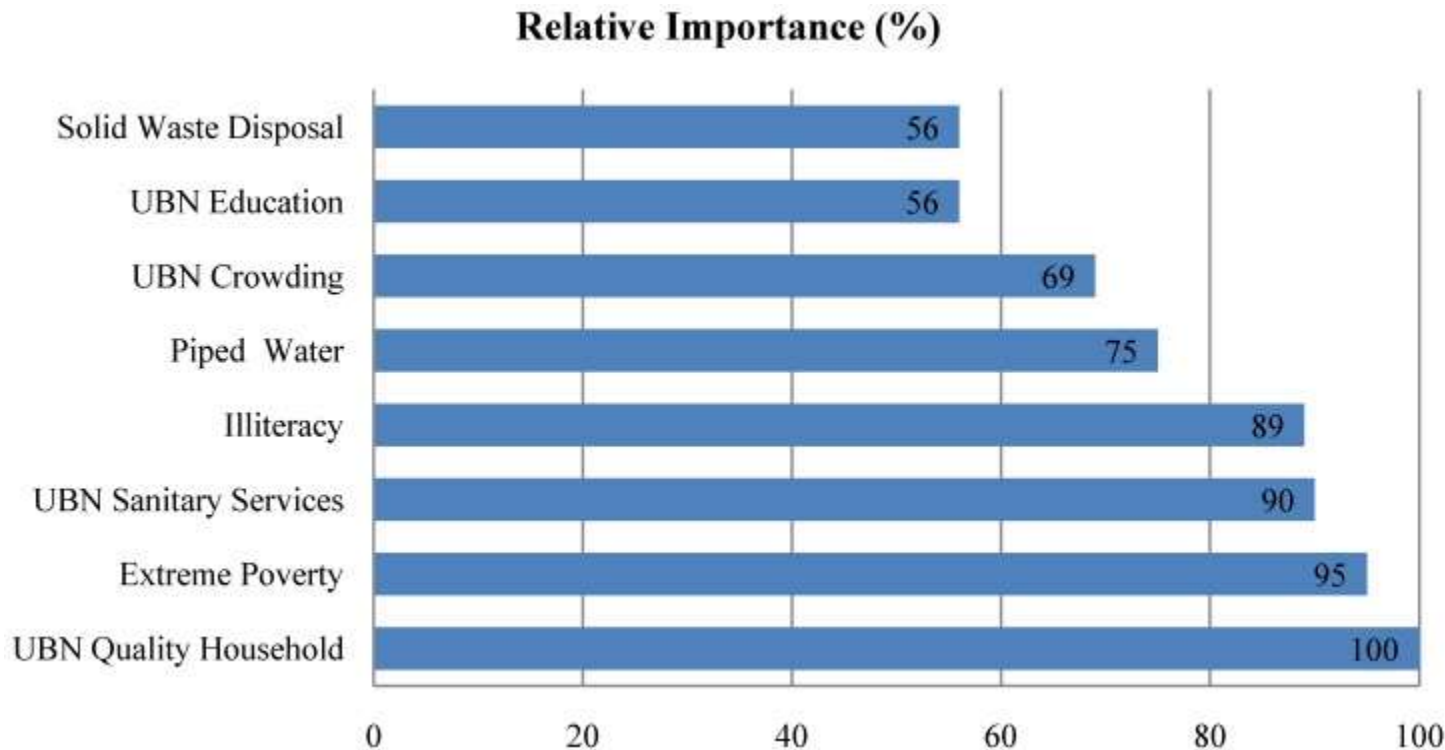
Source: Cases MINSA/NIC; analysis authors





# Results

## Relative importance of the variables in defining the clusters



The Unsatisfied Basic Needs (UBN) of Quality of Household was the variable with the highest relative importance, followed by poverty.

**Legend:** Solid Waste Disposal: households with solid waste disposal; UBN Education: unsatisfied basic needs- access to education; UBN Crowding: unsatisfied basic needs- crowding; Piped Water: households with piped water; Illiteracy: illiteracy; UBN Sanitary Services: unsatisfied basic needs- access to sanitary services; Extreme Poverty: extreme poverty; UBN Quality Household: unsatisfied basic needs- quality of the household.

The model explains 56% which is considered very good.

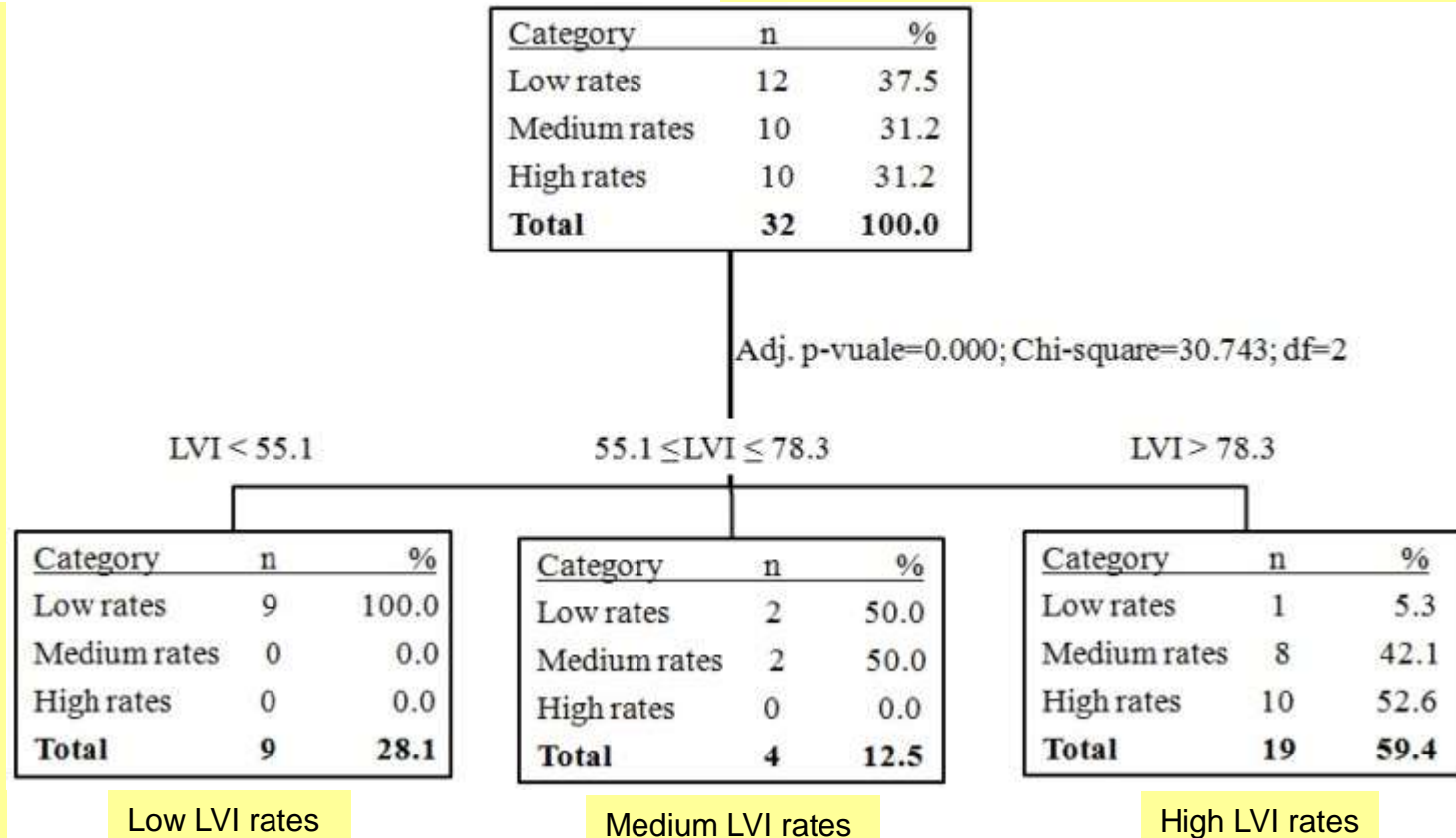
# Results

## Classification tree according to the local vulnerability index (LVI)

- 12 mun. low incidence rates for leptospirosis
- 10 mun. medium incidence rates
- 10 mun. high incidence rates
- 32 total municipalities

Out of the 32 municipalities analyzed, none with a low or medium LVI presented with high incidence rate for leptospirosis

The municipalities with the high LVI presented high or medium incidence rates for leptospirosis (with one exception)





# Conclusions

1. The underlying distinction between risk (given mainly by environmental factors) and vulnerability to risk (given mainly by socioeconomic conditions) was reinforced
2. This distinction also applies to the “causes of outbreaks” and “causes of cases”
3. The basic components of the index were the unsatisfied basic needs in relation to:
  - ✓ the construction material conditions of the household
  - ✓ access to sanitary services
  - ✓ extreme poverty.



## Study 3

# Leptospirosis in Rio Grande do Sul, Brazil: An Ecosystem Approach in the Animal-Human Interface

Maria Cristina Schneider , Patricia Najera, Martha M. Pereira, Gustavo Machado, Celso B. dos Anjos, Rogério O. Rodrigues, Gabriela M. Cavagni, Claudia Muñoz-Zanzi, Luis G. Corbellini, Mariana Leone, Daniel F. Buss, Sylvain Aldighieri, Marcos A. Espinal



# Objectives of this study

Analyze the distribution of human cases of leptospirosis in the State of Rio Grande do Sul, Brazil, and to explore possible drivers.

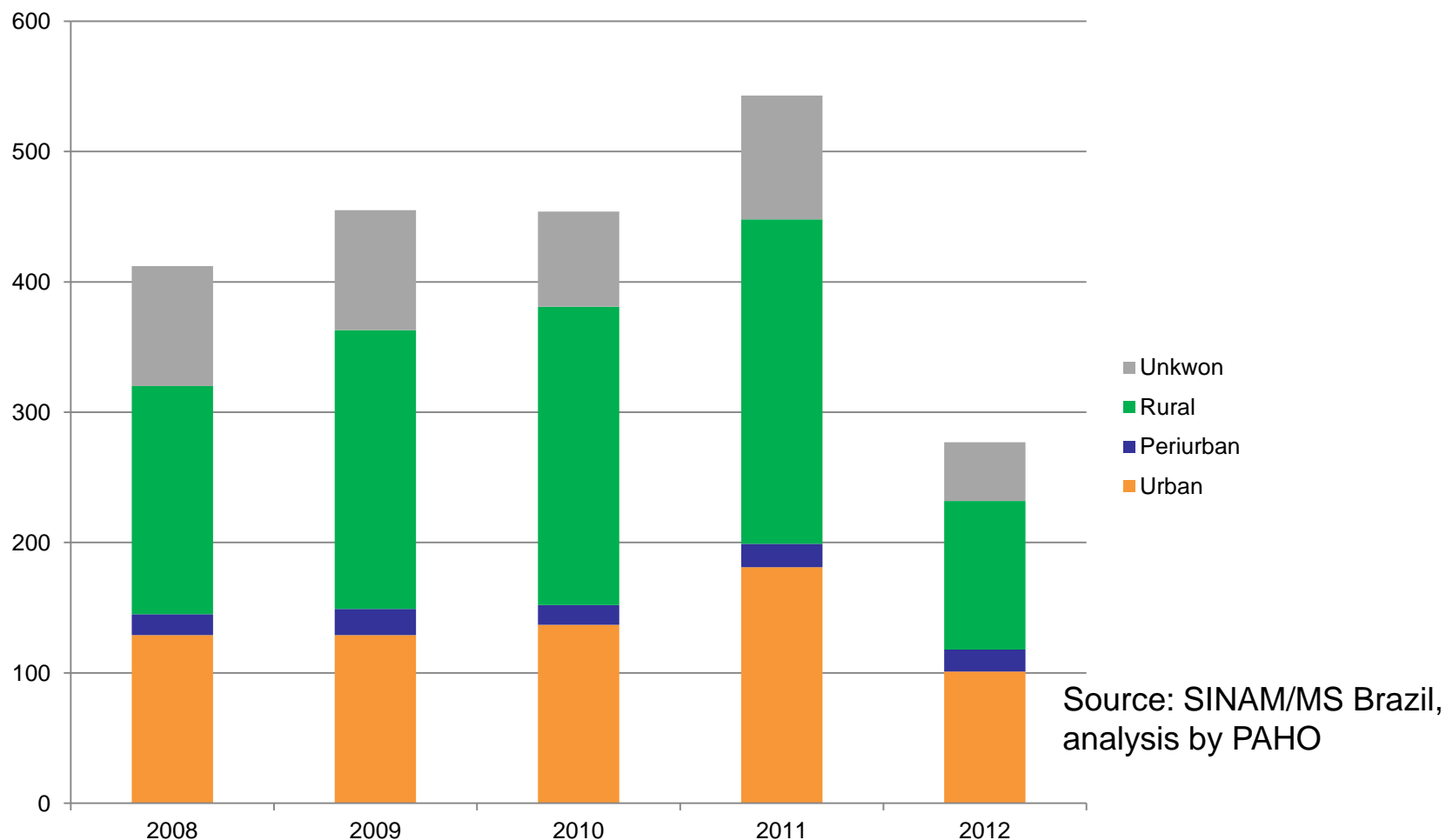
Additionally, provide further evidence to support interventions and to identify new research topics at the human-animal-ecosystem interface.

## Methodology

- Ecological type study, all state, by second subnational administrative level (496 municipalities)
- Using only secondary data
- Created a data base (GIS) by municipality (26 independent variables)

# Results

## Human cases of leptospirosis by area, Rio Grande do Sul, 2008-2012



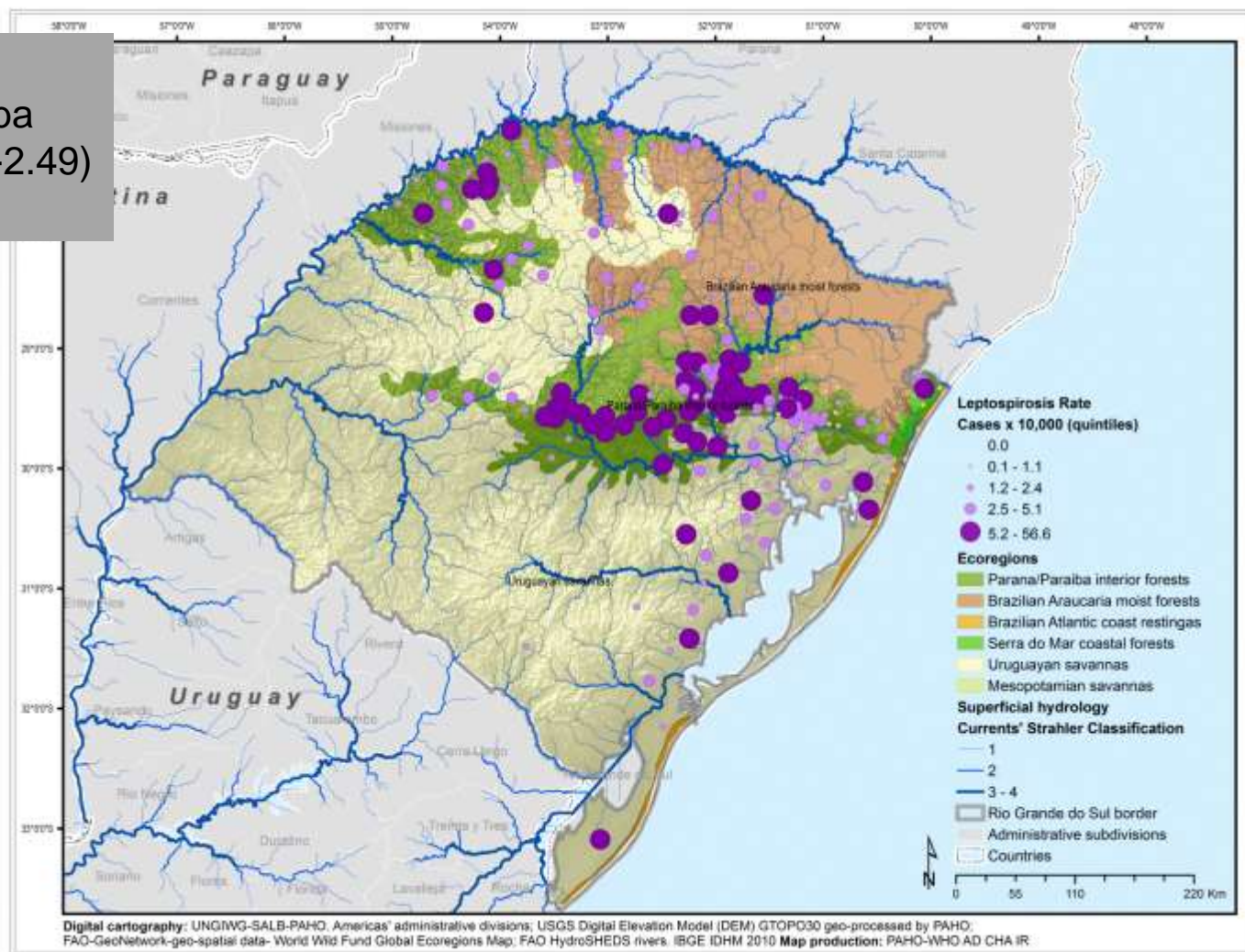
**Total of cases = 2141; average by year = 428 cases; 46% rural area**



# Results - Environmental

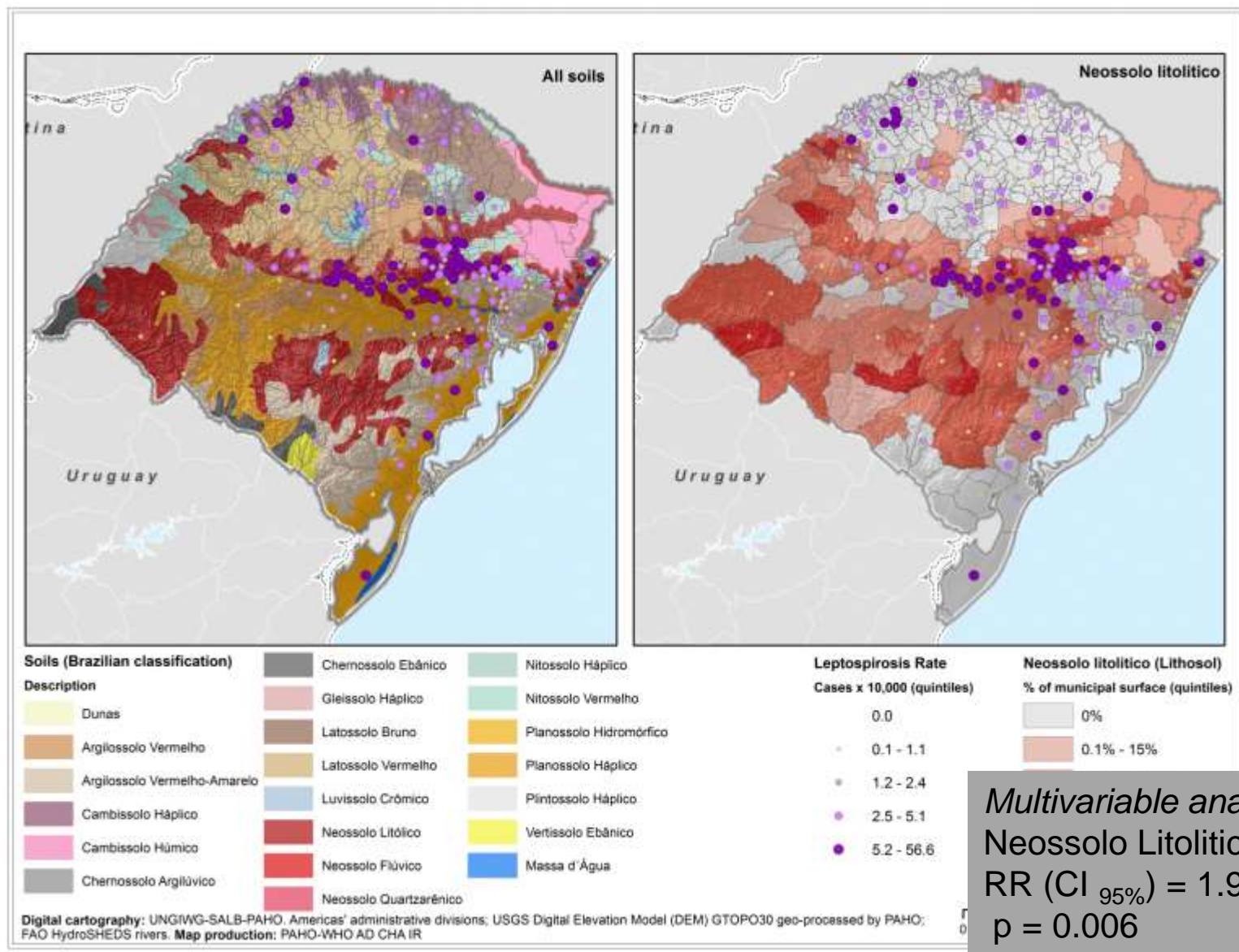
Incidence rate for leptospirosis and ecoregions, Rio Grande do Sul, 2008-2012

*Multivariable analysis:*  
Ecoregion Parana-Paraiba  
RR (CI<sub>95%</sub>) = 2.25 (2.03-2.49)  
p<0.001



# Results- Environmental

Incidence rate for leptospirosis and type of soil, Rio Grande do Sul, 2008-2012



*Multivariable analysis:*

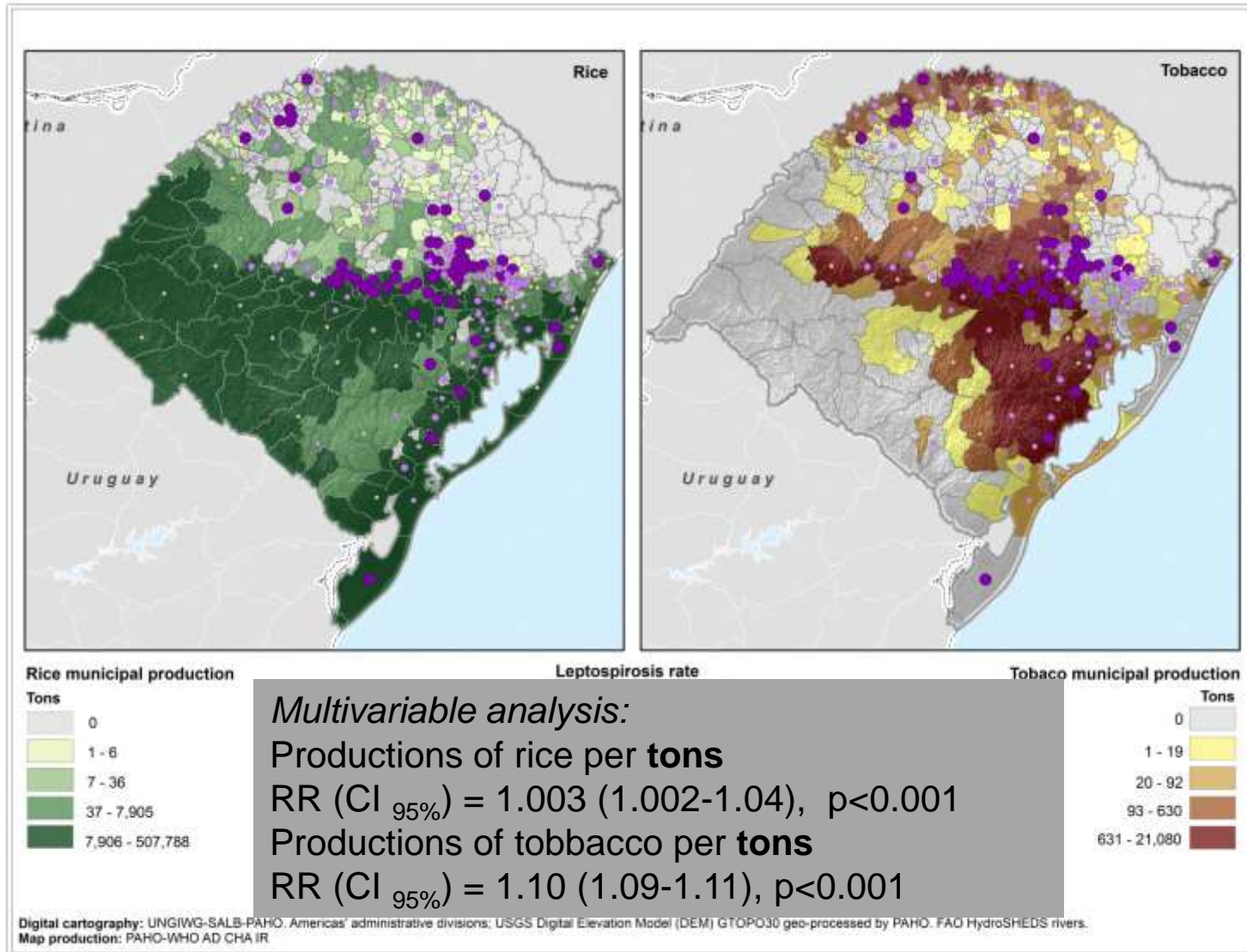
Neossolo Litolítico

RR (CI<sub>95%</sub>) = 1.93 (1.26-2.96)

p = 0.006

# Results- Productive Process

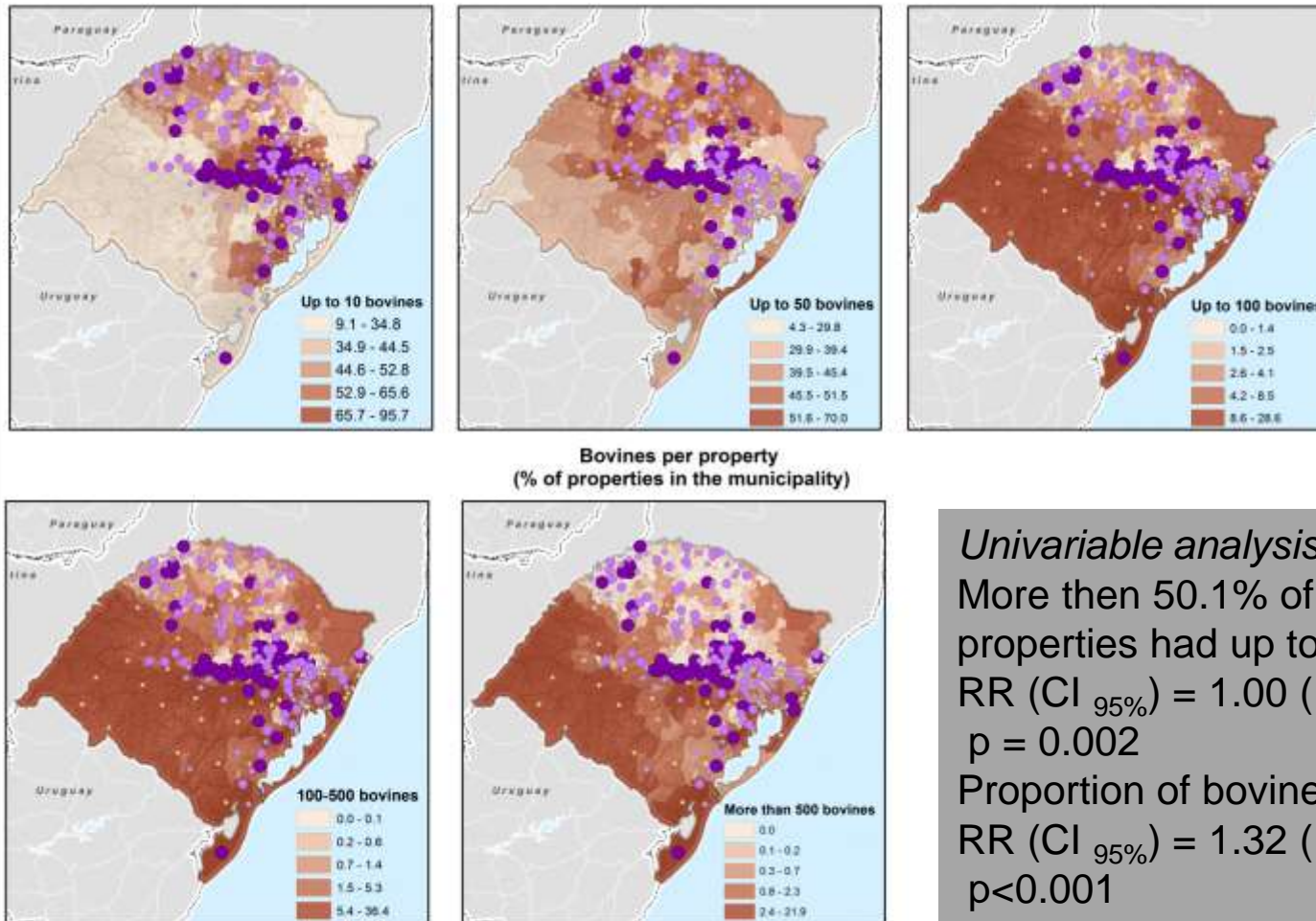
Incidence rate for leptospirosis and rice paddy plantation, and tobacco plantation Rio Grande do Sul, 2008-2012





# Results - Productive Process

Incidence rate for leptospirosis and number of bovines per property,  
Rio Grande do Sul, 2008-2012



## *Univariable analysis:*

More than 50.1% of municipality's properties had up to 10 bovine  
RR (CI<sub>95%</sub>) = 1.00 (1.00-1.00)  
p = 0.002

Proportion of bovine farms per km<sup>2</sup>  
RR (CI<sub>95%</sub>) = 1.32 (1.13-1.55)  
p < 0.001

# Conclusions/Recommendations

- Average of 428 human cases of leptospirosis annually. Risk in rural populations is 8 times higher. Urban cases are more in the metropolitan region of the state capital
- For this areas save lives and reduce the number of severe cases are the major goal. Collaboration with Civil Defense and Natural Disaster team
- The rural cases are more concentrated in certain type of productive process. Collaboration with Agriculture and civil organization related to rice and tobacco plantation and small farmer is suggested to prevent cases
- Major drivers identified in this study were related to environmental and production processes that will continue to be present in the state. Development of a vaccine is urgently needed to prevent cases in high risk areas

# Acknowledgments to PAHO team:

Sylvain Aldighieri, Deputy Director PHE  
Patricia Najera, GIS Analyst  
Deise Galan, Consultant



**Health Topics**  
**Publications**  
**Data and Statistics**  
**Projects and Programs**  
**Links**  
**PAHO in maps**  
**PAHO in One Click**  
**Press Room**  
**Multimedia**  
**Leptospirosis**

**Home**  
**Detail Information**  
**Fact Sheet**  
**Current situation in selected countries**  
**► National Forum of Leptospirosis of Nicaragua**  
**► International Meeting of Countries that are Facing Leptospirosis Outbreaks in the Americas**  
**Publications and Documents**

## Leptospirosis

Leptospirosis is a zoonotic disease with epidemic potential, especially after heavy rainfall. It occurs throughout the world and is emerging as an important public health problem in both tropical and subtropical countries, affecting mostly vulnerable populations (WHO 2010; WHO 2011).

Humans usually acquire leptospirosis through direct contact with the urine of infected animals or a urine-contaminated environment. [Read More](#)

Credits: O. Chavez, Nicaragua

Last Updated on Friday, 25 January 2013 20:51

**Fact Sheet: Leptospirosis**  
[Click here to get more information](#)

**Current situation in selected countries**

- National Forum of Leptospirosis of Nicaragua
- International Meeting of Countries that are Facing Leptospirosis

[Read More...](#)

**Related Sites**

- WHO: Leptospirosis website
- WHO: Zoonoses and Veterinary Public Health - Leptospirosis
- PAHO: Member States websites

[Read More...](#)

**Publications and Documents**

- WHO. Human Leptospirosis: Guidance for Diagnosis, Surveillance and Control, 2003
- PAHO. Zoonoses and Communicable Diseases Common to Man and

International Meeting of Leptospirosis - Nicaragua (Spanish only)



WHO. Human Leptospirosis: Guidance for Diagnosis, Surveillance and Control, 2003



### Latest News

#### La leptospirosis atenta contra la salud (Spanish only)

Del 14 al 16 de agosto de 2012, el Ministerio de Salud y la Organización Panamericana de la Salud realizaron el Foro Nacional y la Reunión Internacional sobre brotes de

# Thank you very much!