Economic Growth and Environmental Sustainability: Insights from Ghana

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Presentation to the Hewlett Foundation Conference on Population, Reproductive Health, and Economic Development

8-9 December 2007

Arusha, Tanzania

Urbanization and Environmental Quality: Insights from Ghana

ABSTRACT: The paper offers a policy-oriented discussion of the relationship between population, environment and economic development. Our particular focus is on the relationship between urbanization and environmental change. Their impact is often represented as strongly negative. We examine the relationship between nutrient levels in coastal lagoons, examining the degree to which these impacts are linked to population density in the watershed. We supplement this with information about environmental attitudes collected from a stratified, clustered random sample of households in six coastal districts of the Central Region. We conclude with some speculations about the implications for environmental change in the years after the Johannesburg Summit.

The Overall Research Team
(working together for several years)

- Multiple Institutions
  - University of Cape Coast, Ghana
  - Brown University
  - Graduate School of Oceanography, University of Rhode Island
- HEED Theme
  - Health
  - Environment
  - Economic Development
- Interdisciplinary Collaboration
  - Demographers
  - Sociologists
  - Ecologists (Estuarine Biology)
  - Microbiologist
  - Geographers
  - Anthropologists
- Support
  - NIH HEED
  - MacArthur Foundation
  - Mellon Foundation
  - Luce Foundation

Multiple Institutions, Multiple Disciplines

- University of Cape Coast Ghana, Department of Geography
  - Kofi Awusabo Asare
  - Akwasi (Kay) Kumi-Kyereme
  - Foster Frempong
  - Emanuel Mensah (UCC)
  - And many others
- Others in Ghana
  - Mamaa Entsua-Mensa (WRI)
  - O. Ansa Asare (WRI)
  - Ebeneze Mensah (UST)
  - Eva Tagoe-Darko (UST, GH)
- University of Rhode Island, Graduate School of Oceanography
  - Scott Nixon
  - David Smith
  - Steve Granger
  - Betty Buckley
- And from Brown
  - Catherine Stiff Andrezewski
  - Arpita Chattopadhyay
  - Justin Buszin
  - Nadia Diamond-Smith
  - Lori Hunter
  - Rodney Knight
  - Nugyen Liem
  - Stephen McGarvey
  - Salut Muhidin
  - Zarah Rahman
  - Holly Reed
  - …and others

Take Home Message

1. Discussion of pop-env needs to move beyond POP as undifferentiated aggregate.
2. Transitions
    1. Urbanization: hasten demographic transition
    2. Urbanization: anthropogenic impact on lagoons
    3. Some suggestion of Enviro-Kuznets curve.
3. Attitudes: preconditions for enviro change may exist
4. Environmental Transition
    1. worry less about overall pop/city growth; more about the detailed growth patterns
    2. Economic growth → environmental dividends
    3. What Path?

Presentation Overview

- Project Background & Motivation
- Research site and design
- Selected Results

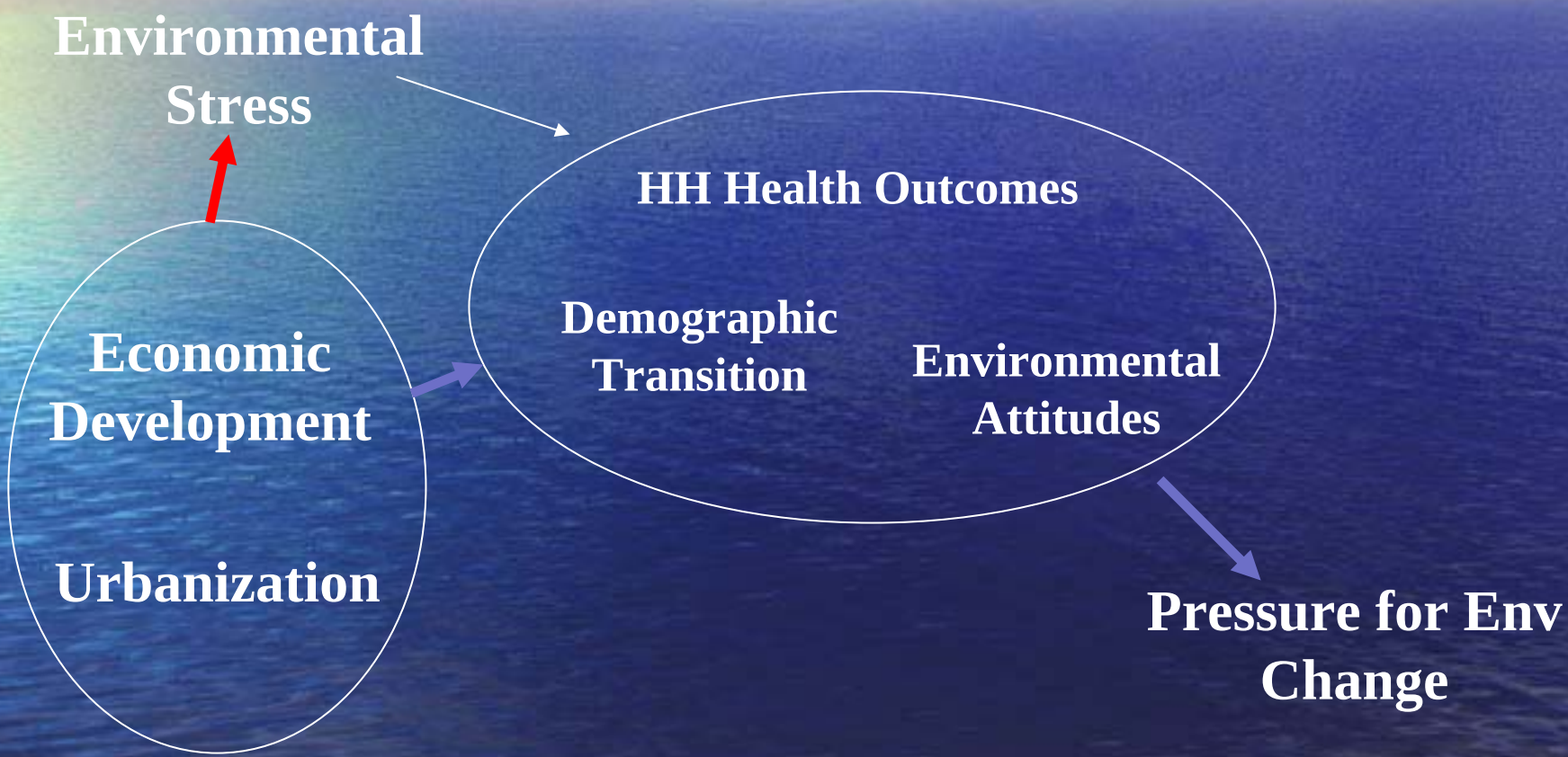
  A. Demographic Dynamics (Urban → Fertility)

  B. Lagoon Water Quality & Urbanization

  C. Environmental Attitudes

  D. ~~~ Drinking Water Quality (in 2 UAPS posters)
- Concluding comments & thinking exercise

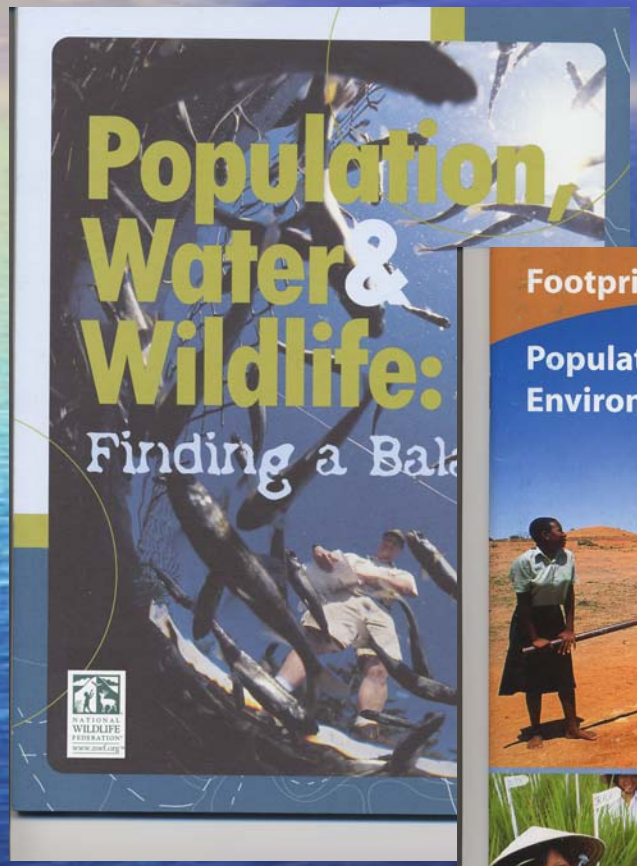
1. Background and Motivation: Some Key Links

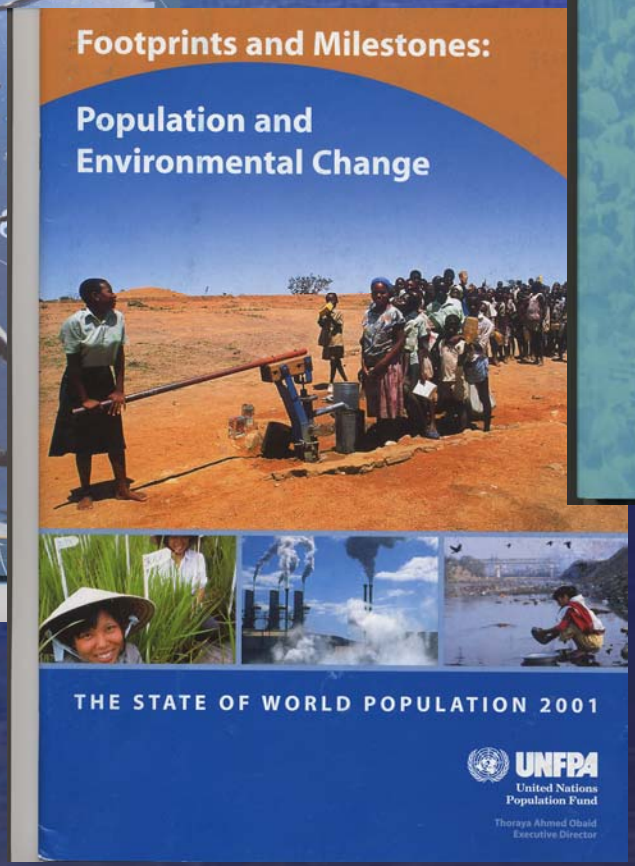


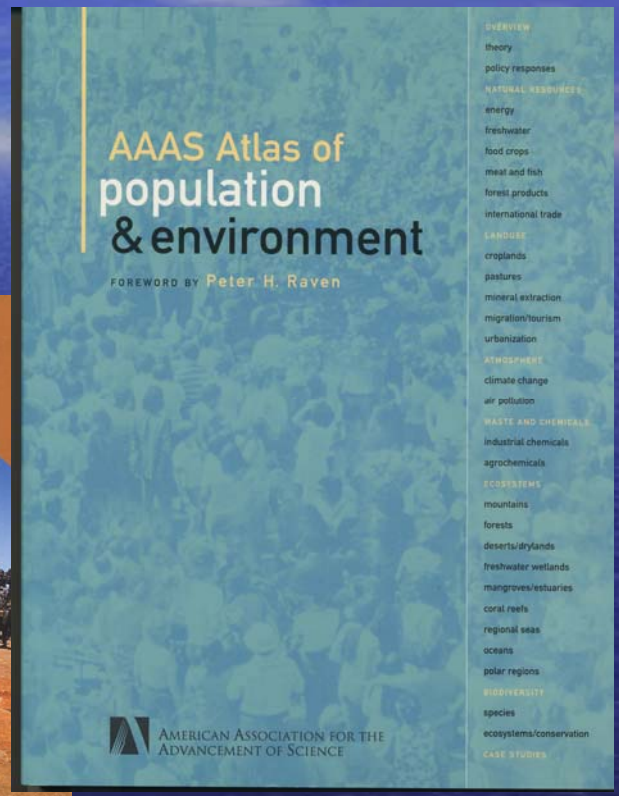
IPAT?....Still?

- IPAT: Impact=(POP)(Affluence)(Technology)
- “A sizable segment of the literature on population and environment during the past 25 years has take the ubiquitous I=PAT equation as the starting point.” [Martine, 1996, p. 7]
- “Despite its inadequacies, the IPAT formulation continues to be frequently cited by policy-making institutions.” [Martine, 1996, p. 9]

Motivation: Is Population THE problem?





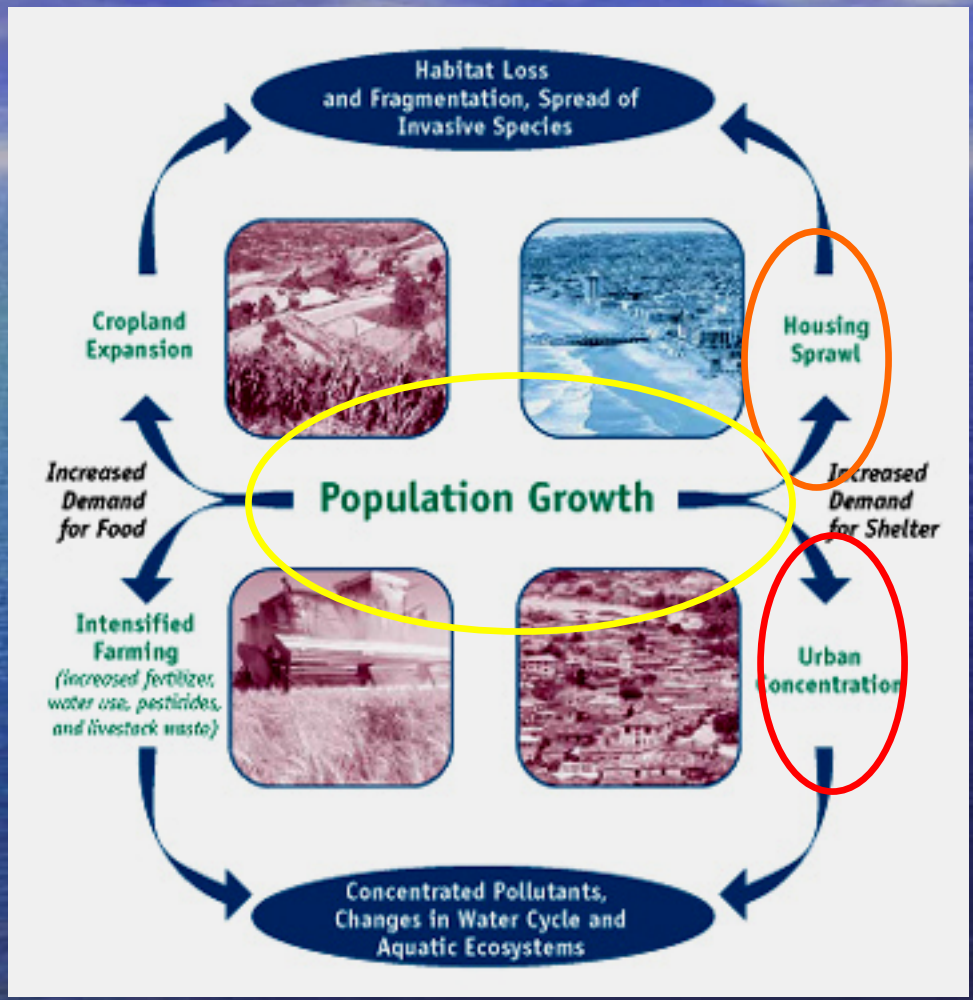


… how population size and growth, environmental change and development interact on each other is **not well established**. UN, *Population, Environment, and Development: The Concise Report (2001) emph added*

Motivation: “The Discourse”

- Jared Diamond *Collapse*
  - Haiti vs. Dominican Republic: two countries, same island, vastly diff. enviro outcomes
  - “…the unsustainability of a world in which the Third World’s large population were to reach and maintain current First World living standards.” p. 496
  - “…for the most part we “just” need the political will to apply solutions already available.” p. 522

Population Growth and Urbanization often seen as Deleterious



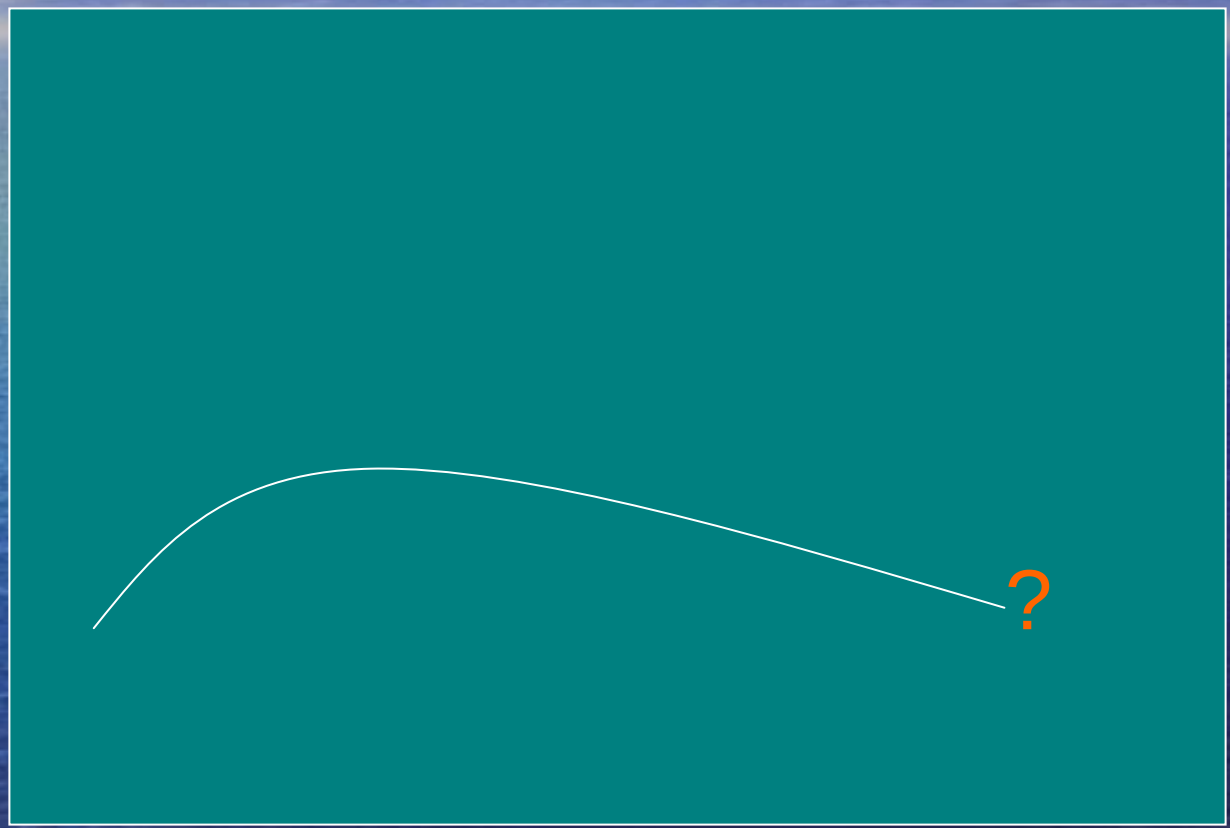
Cincotta, Richard and Robert Engleman. *Natures Place*. Washington, DC: Population Action International, 2000.

Policy: Before and after the Johannesburg WSSD

Developing countries cannot reasonably be expected to restrict their future emissions without being assured of a fair allocation scheme **that will not impair their ability to develop.**

Science "Equity and Greenhouse Gas Responsibility" (Sept 2000) emphasis added

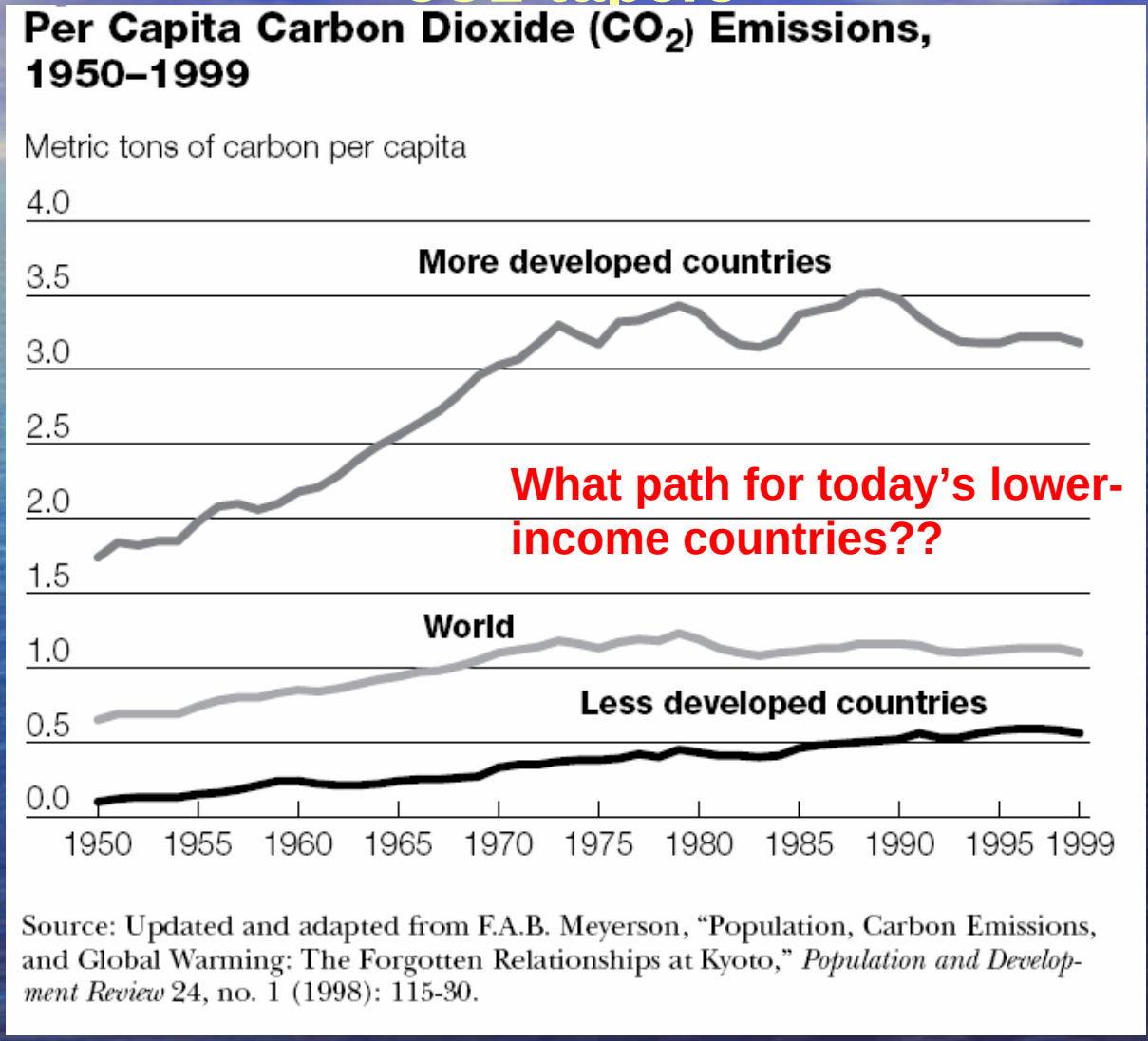
An Environmental Transition? Could rising incomes result in environmental amelioration?



AKA the Environmental Kuznets Curve – some evidence…no consensus

Environmental Transition?

CO2 tapers



De Souza, Roger-Mark, John S. Williams, and Frederick A.B. Meyerson. *Critical Links: Population, Health, and the Environment*. Washington DC: Population Reference Bureau (Population Bulletin 58:3, September 2003).

2. Research Site & Design

- Coastal Zones
  - Ecologically sensitive (Rio)
  - Rich, diverse ecology
  - Econ & Pop growth
  - Key management issues
- Ghana
  - Tropical ecology
  - LDC health issues
  - Trajectory of Political Economy vis-à-vis SSA
  - Demographic Dynamics
  - Land Area = UK

Ghana: Significant Coastal Resources, Natural and Historic

The Ghana HEED Project Research Design Overview

- Lagoon Measurements (2001-2)
  - Monthly samples for 1 year
  - **8 Coastal Lagoons, varying settings; 1-8 km^2**
    - Dissolved Inorganic Nitrogen
    - Phosphorous, Ammonia, Salinity, …
- Household Survey (Random sample of Pop in 6 Coastal Districts of Central Region)
  - 2002: ~1300 HH, ~**2500 Adults**;
    - Standard QN + **Environ Attitudes + Demog Calendar**
  - 2004: ~700 HH's (repeat survey)…plus
  - Drinking Water Quality measurements at HH & Comm level
- Qualitative Data analysis (2004-present)
  - In-Depth Interviews
  - Focus Groups

3. Selected Empirical Results

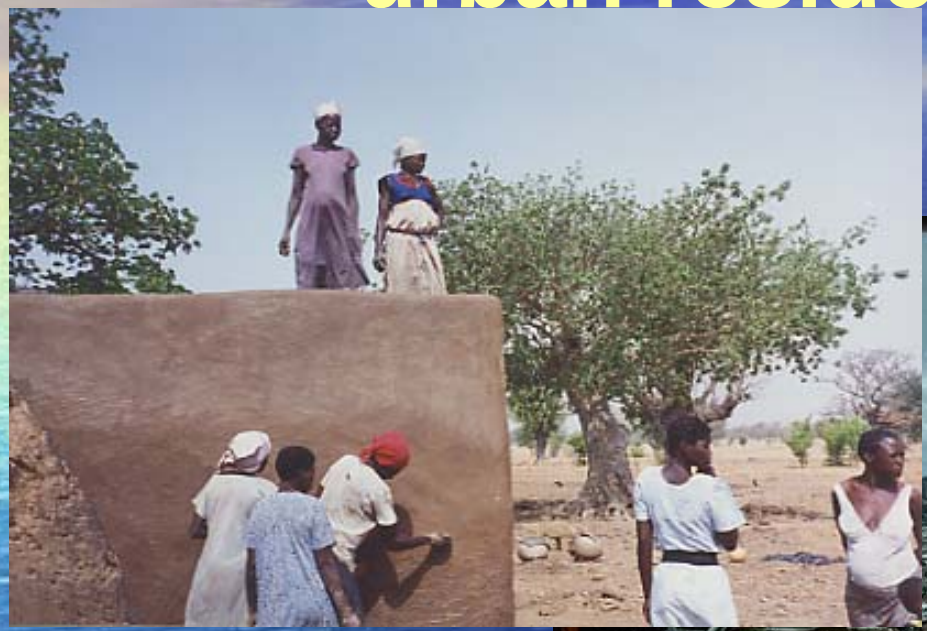
A. Demographic Dynamics: urban residence and fertility

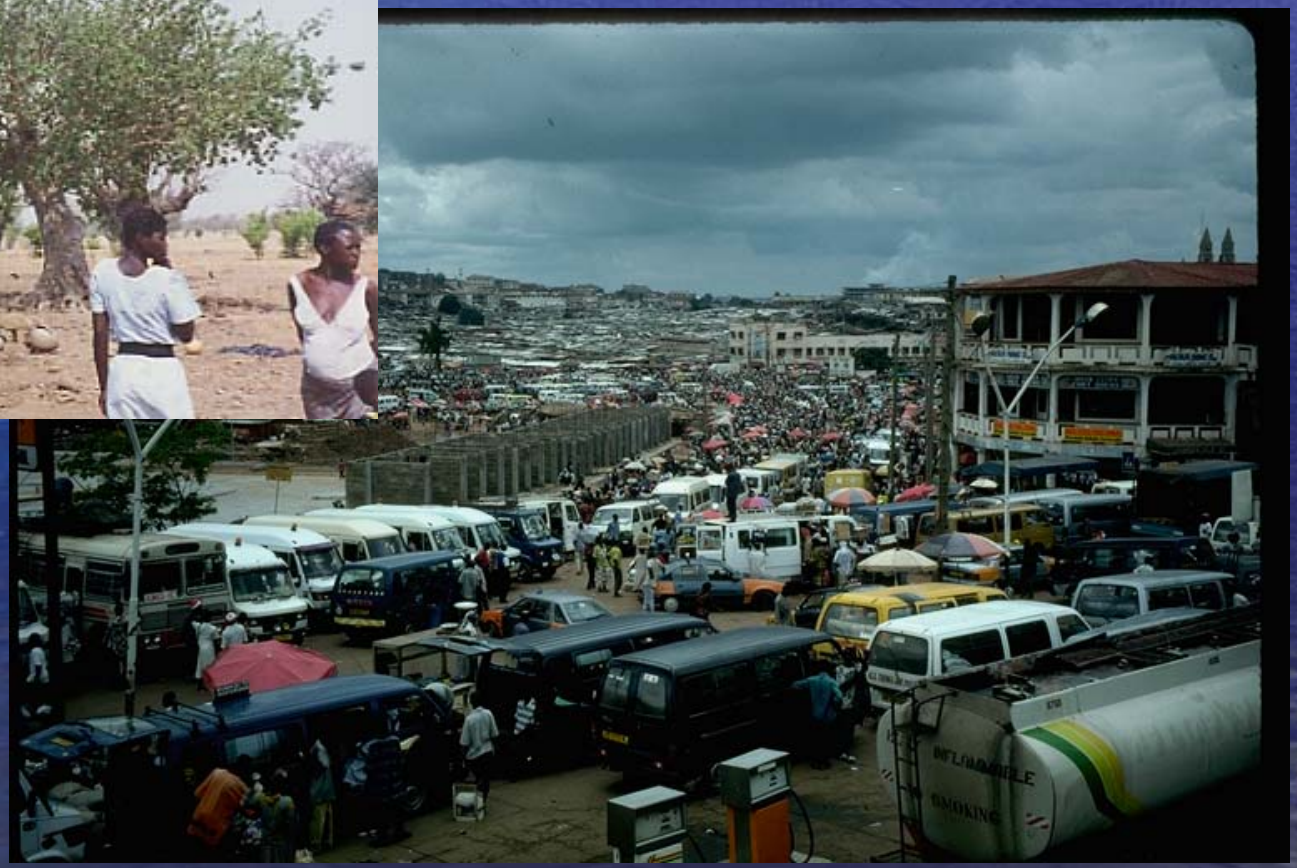
B. Lagoon water quality and population density

C. Environmental Attitudes

D. ~~Drinking Water Quality in UAPS posters

A. Results:
Demographic Dynamics
urban residence and fertility

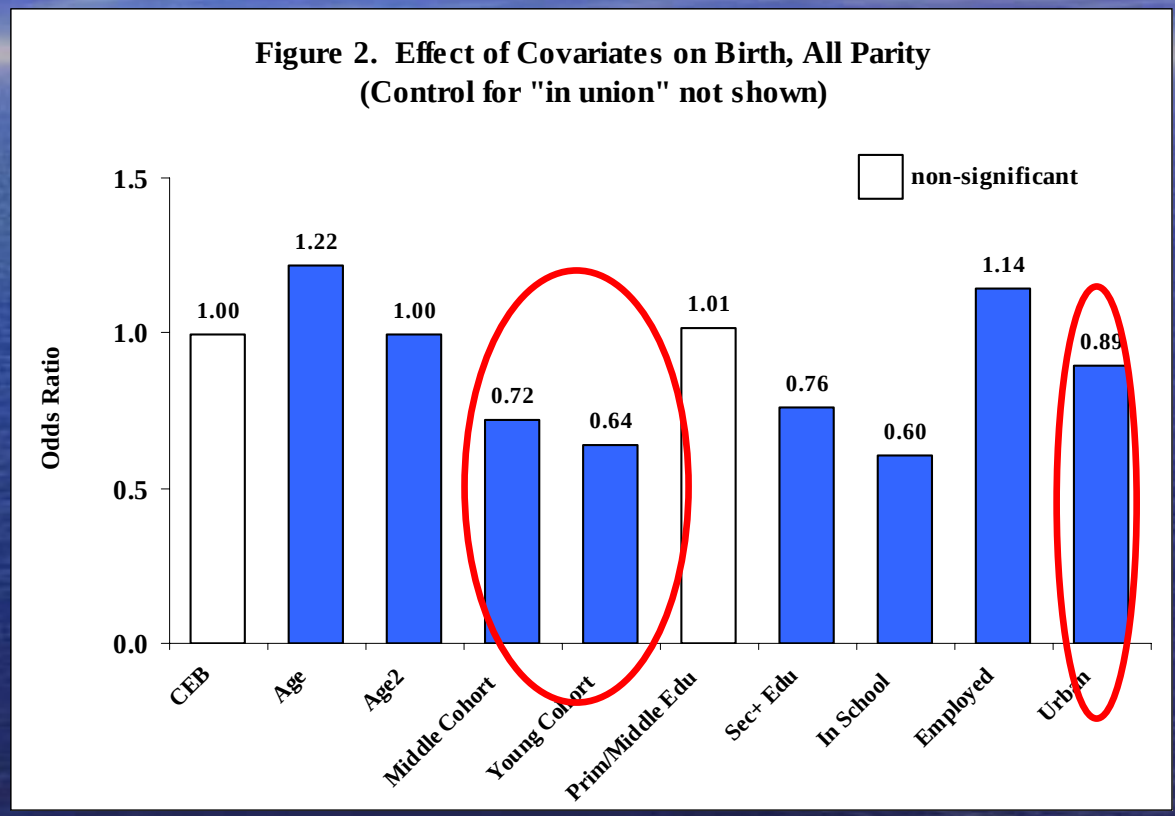




Urbanization and Demographic Transition: urban residence *slows* childbearing

[RRR's for multivariate discrete hazard model]

- Continuous urban residents bear children at a 11% lower rate, net of other personal traits
- Cohort, Education, etc also matter..)

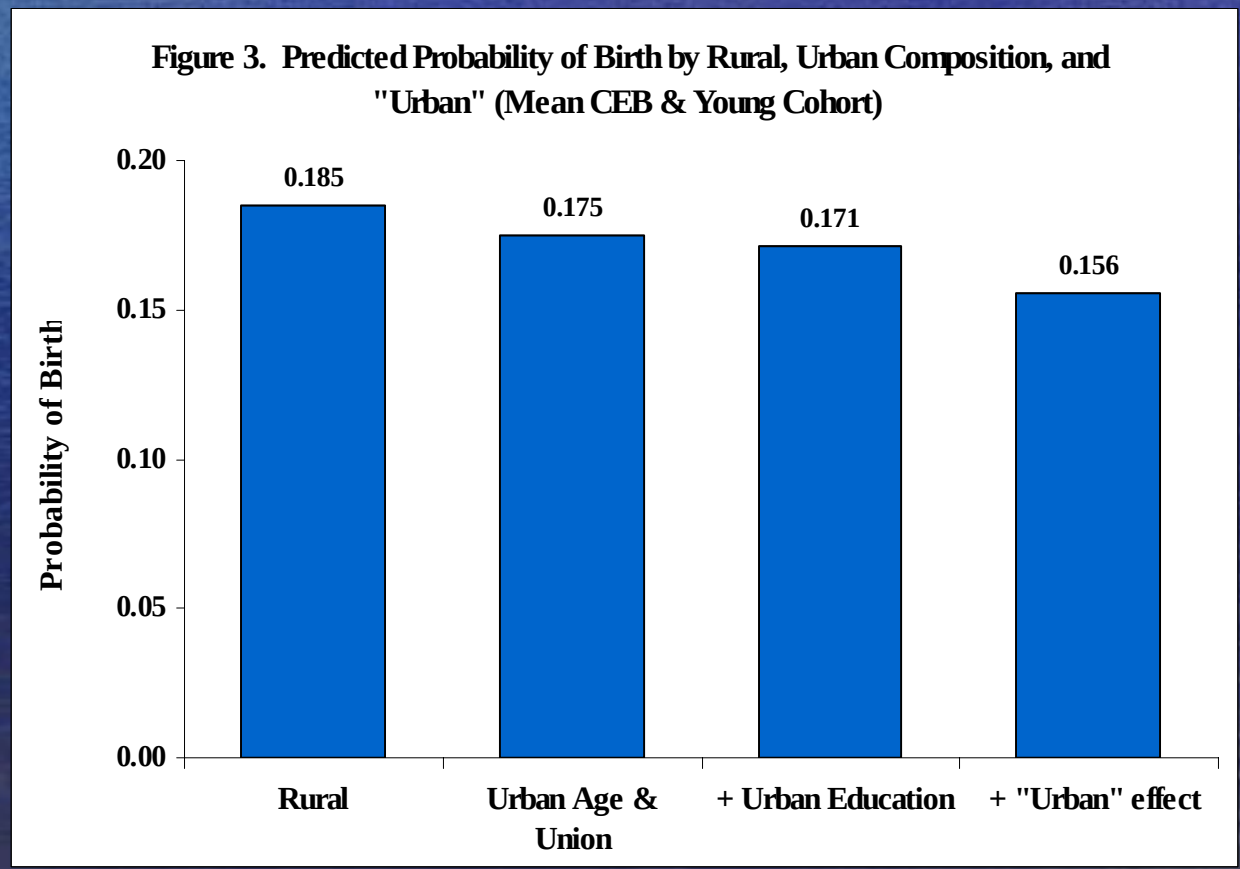


Discrete time event history model :Log[p/(1-p)] = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots$;

Where p=Pr {birth this year, given no birth at parity k up to this point}

A simulation shows…

- cumulative impact of urban composition
  - Age
  - Union status
  - education
- *Plus* urban residence itself.



B. Results: Pollution in Coastal Lagoons

Lagoon variability in size, shape, watershed connectivity with Ocean

Sample 2 lagoon locations monthly for a year

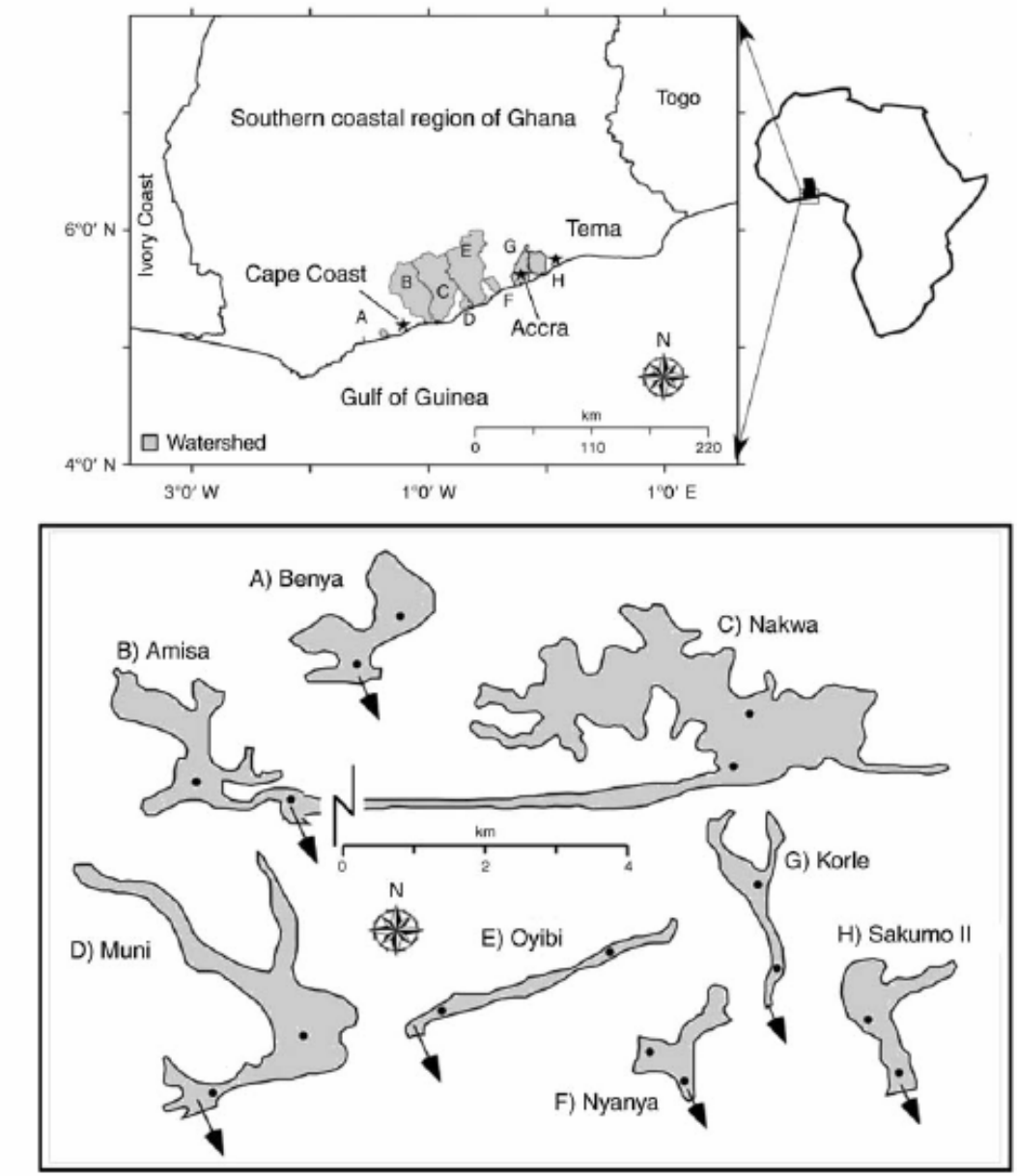
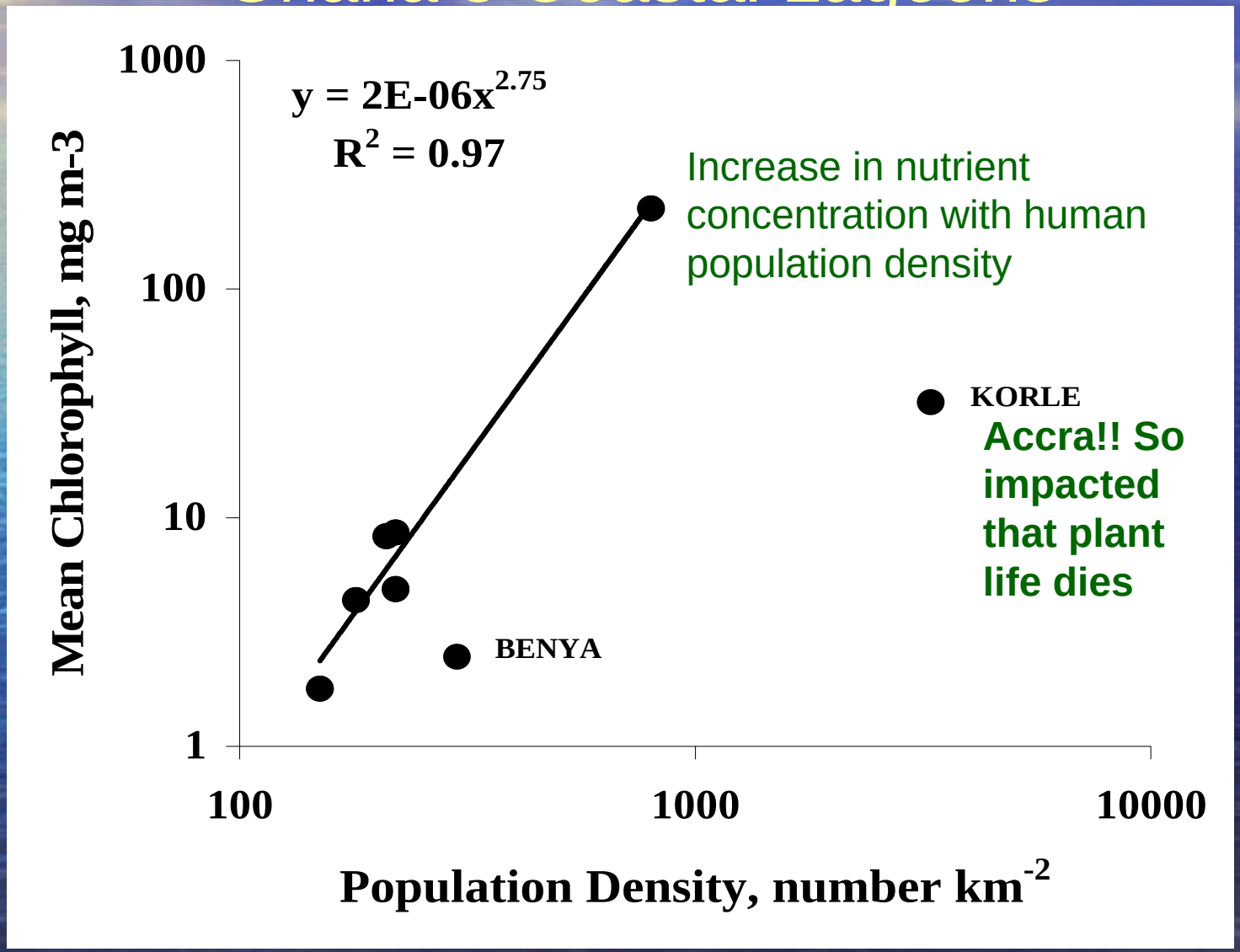


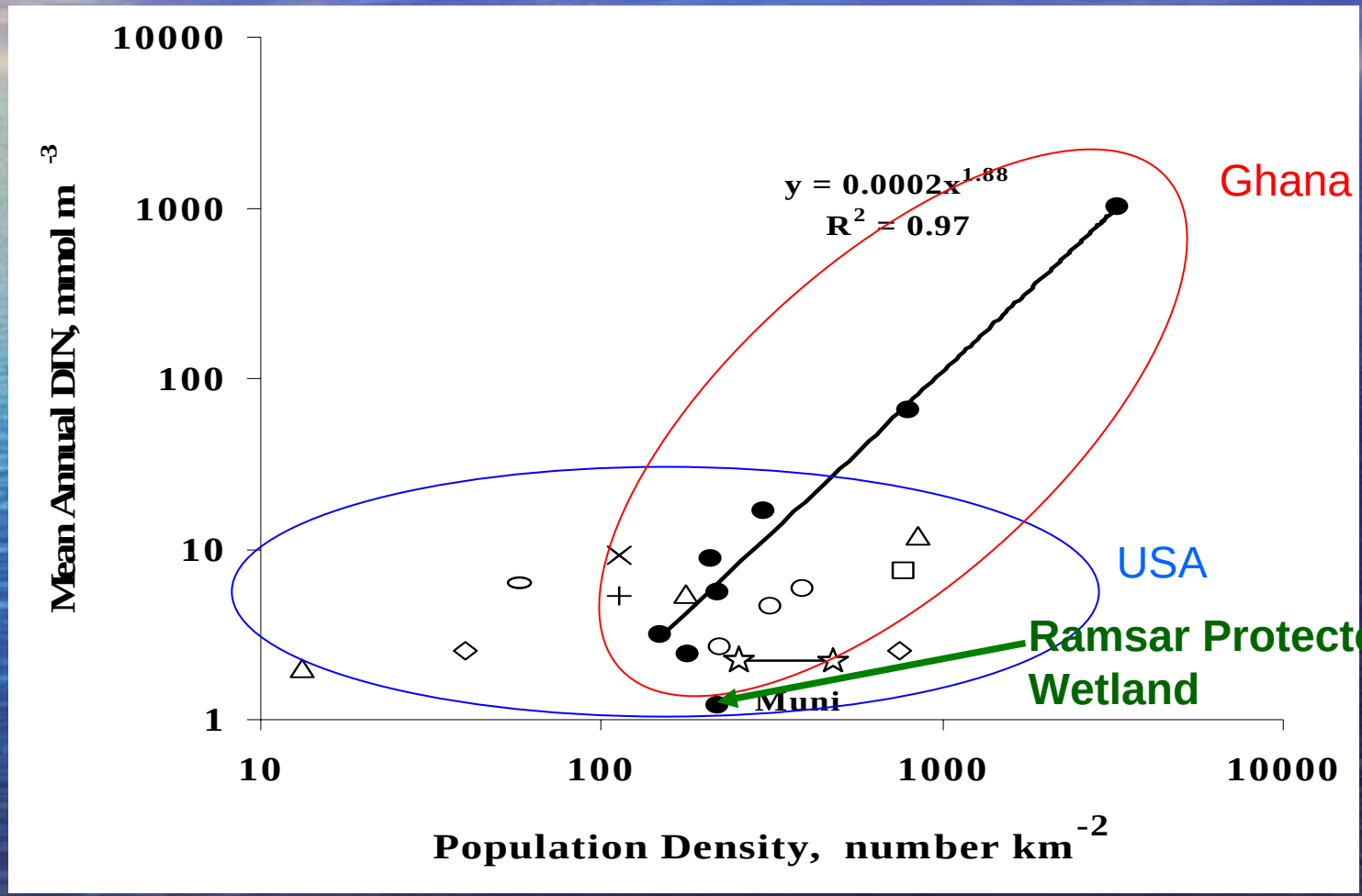
FIG. 1. Location of the eight coastal lagoons in Ghana, West Africa. The locations of the inner and outer sampling stations are shown for each lagoon in the lower portion. Heavy arrows show the location of the channel connecting each lagoon with the sea.

Chlorophyll Impact Increases with Density, Ghana 8 Coastal Lagoons



Population Density *not* clearly tied to Nutrient Concentration in all settings:

US (blue) vs. Ghana (red)

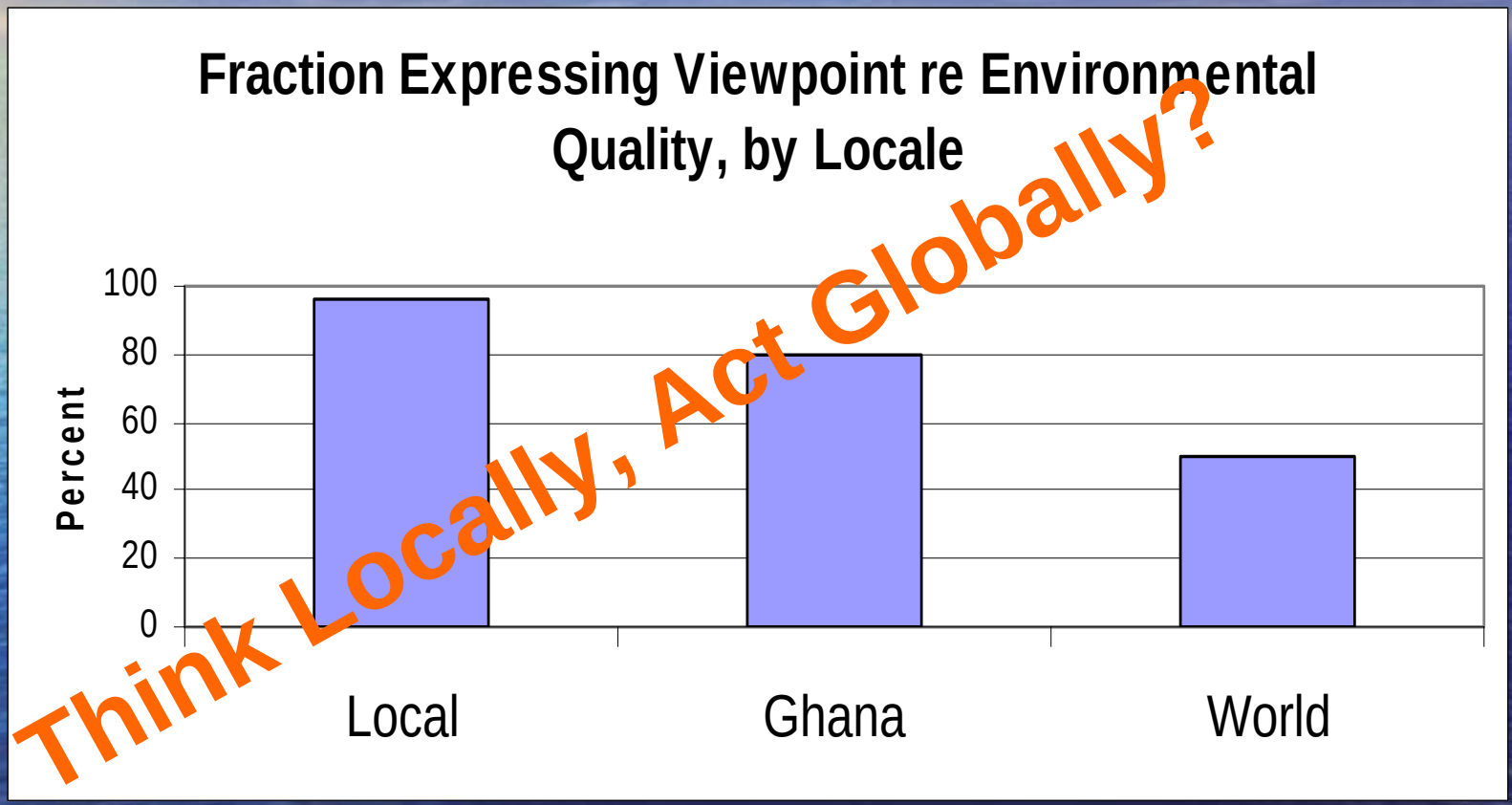


NB: Mean annual concentrations of dissolved inorganic nitrogen in the coastal lagoons of Ghana (solid circles) and some coastal lagoons on the Atlantic coast of the US (open symbols, X, and +) as a function population density in the watershed.

Temperate vs. Tropical
High vs. Low Income

- … there are large differences between the DIN concentrations of the temperate and tropical lagoons associated with the most densely populated watersheds (Fig. 17). It is possible that there are more efficient nitrogen removal processes in temperate watersheds that lead to lower DIN concentrations, but ***our hypothesis is that the difference is due largely to differences in the handling of human metabolic waste*** in coastal Ghana and the northeastern U.S. [Nixon et al, *Ecological Applications*, forthcoming]

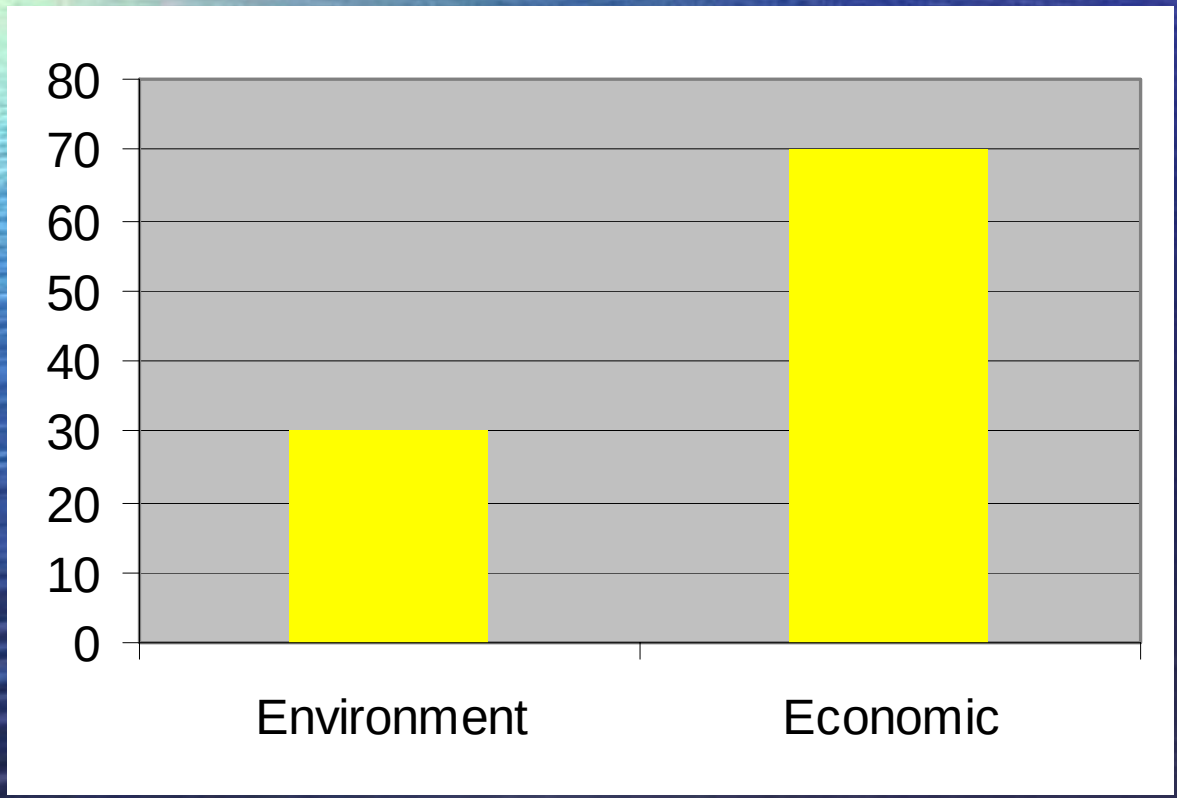
C. Results: HH Survey
Environmental Awareness, by Locale



Percentage of respondents expressing an opinion about environmental conditions (=1-DK%); Population and Environment Survey 2002 N=2505. Percentages weighted for sampling. Source: White & Hunter, 2007.

Relative Priority: Logit Model Protect Environment (1) vs. Economic Growth (0)

- **AVG: economics outweigh environmental priority**

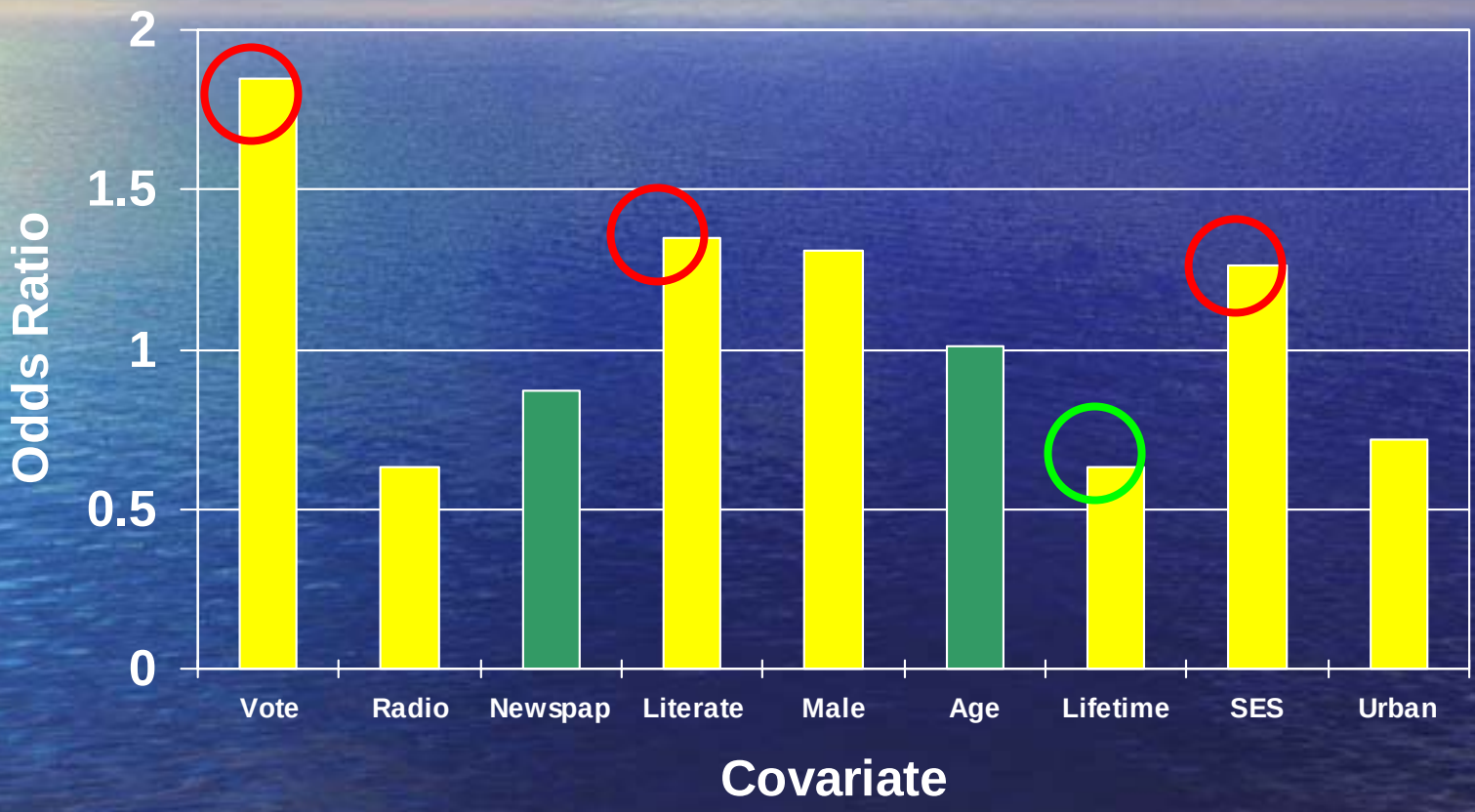


Factors predicting environmental concern

Voted in last election	0.60	***
Listen to radio	-0.47	***
Read newspaper	-0.13	
Literate	0.29	**
Male	0.26	**
Age	0.00	
Life-time resident	-0.45	***
Possessions Index	0.08	***
Urban community	-0.33	***

Attitudes: Logit Regression predicting "Environment a Priority"

Ghana PCE HH survey 2002

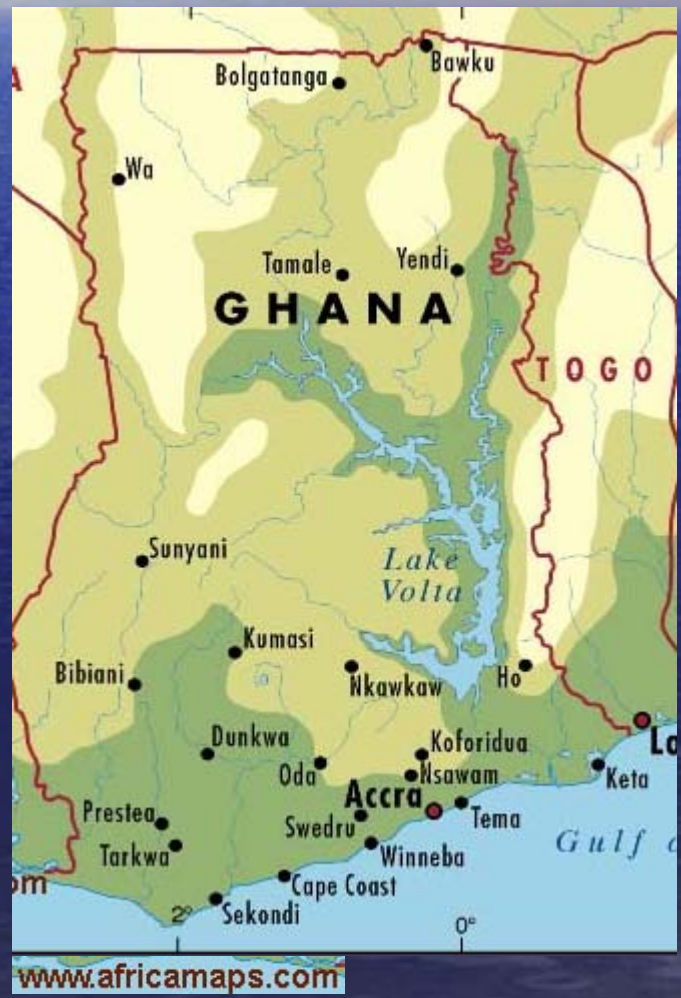


Logit regression model; Response "yes" to "environment is a priority" over economic growth; N=2506 adults; yellow bars indicate statistically significant at p<0.05; SES effect is 3units*coeff.; Age effect 10*coeff; others 1 unit. Standard Errors adjusted for household clustering; Base frequency 70% prefer Econ a priority.

Implications for Sustainable Policies

- Think beyond aggregate Population
  - We may overestimate effect of aggregate POP
  - We under-appreciate composition & dynamics
  - Urbanization presents environmental challenges, but surely is associated with
    - economic growth (& env cleanup)
    - deceleration of population growth
    - environmental health transition
- LDC *policies matter*, e.g. Muni Ramsar
- Rephrase the question: What path?
  - Development may augment some preconditions (educ, urban) → Environmental Transition
  - More attention to human *behavior* and *institutions*

A thinking exercise
What Path Ghana?



What Path Ghana?

Env path as Pop & $$ increase?

Indicators	Ghana	UK
Land Area (thousand sq mi)	92	94
Total Population (UN est 2007)	23.0	60.0
Income ($GNI-PPP-PC)	1,910	23,550
Population Urban % (est UN 2007)	49.0	90.0
Total Fertility Rate (est UN 2007)	3.9	1.7
Pop with "improved" drinking water (%)	64	100
Energy Use (PC kg oil equiv)	377	3,871
1990-2000 Change in Forest Area (1000 hectares)	-1,200.0	170.0

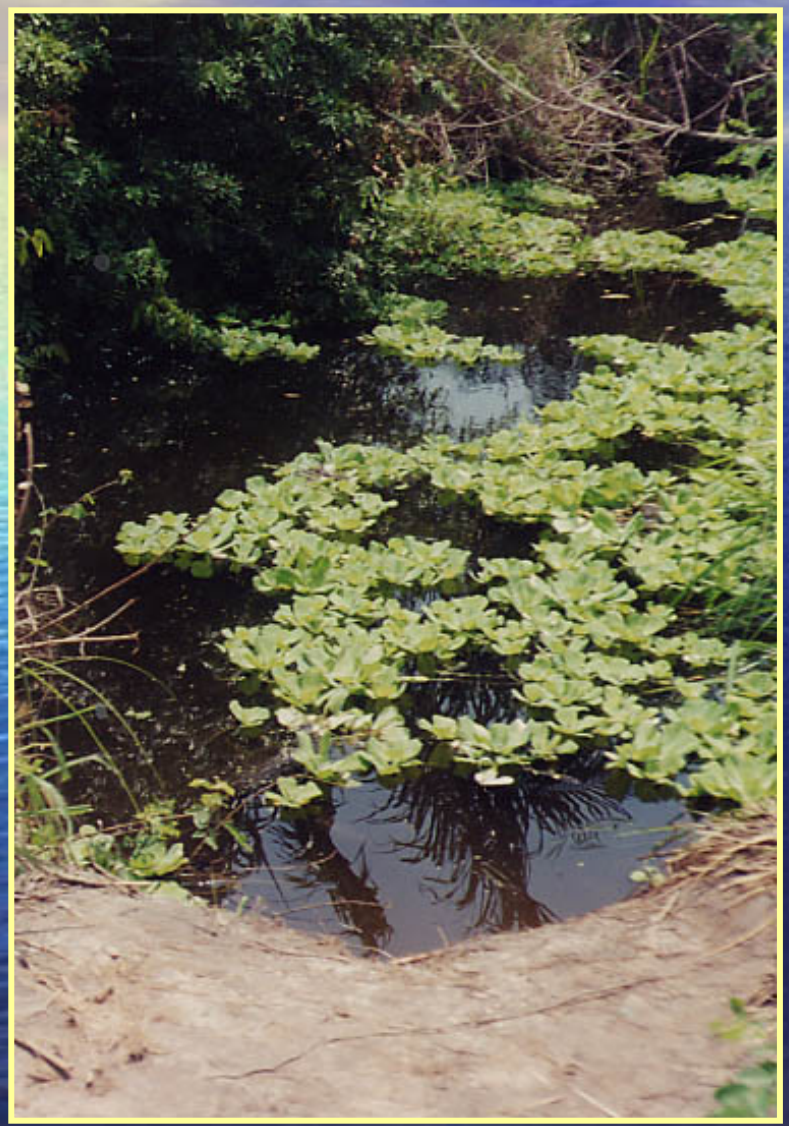
Source: PRB, *Population, Heath, Environment* (2002); UN 2007

The Future?

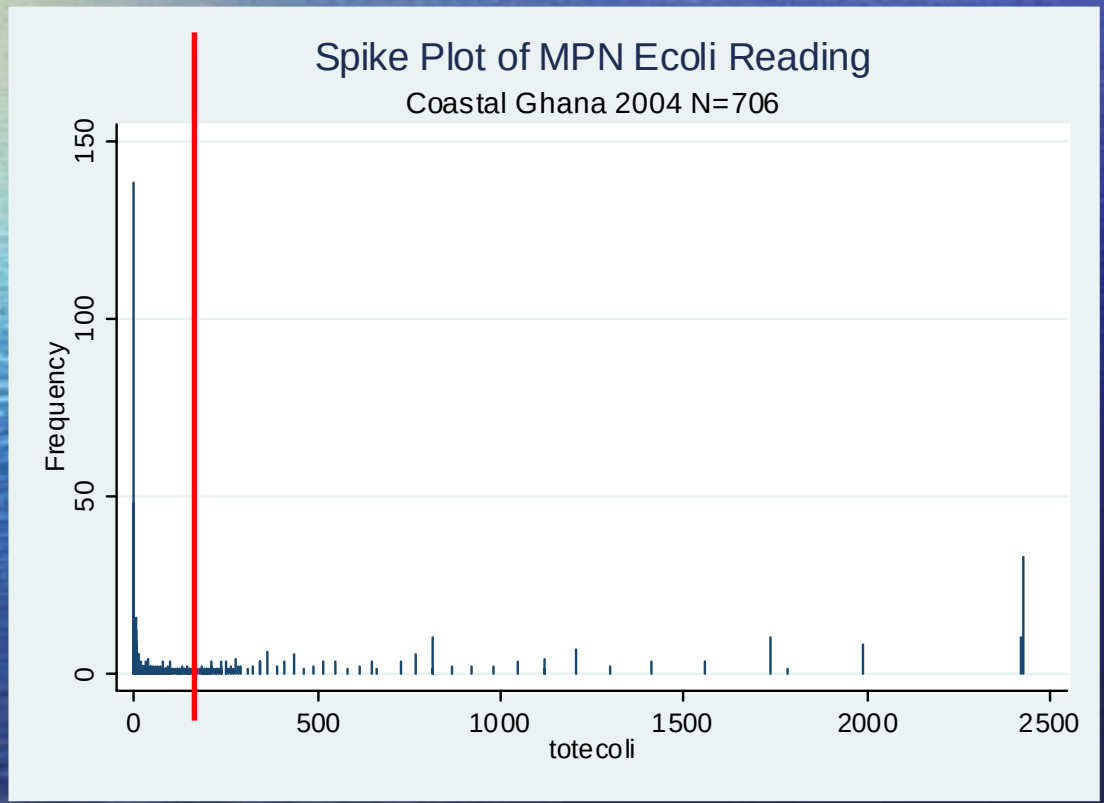
Economic Development, Wetlands Protection, Demographic Dynamics, Institutional Change

Merci…. Thanks….. Medase!

D. Results:
HH Drinking Water

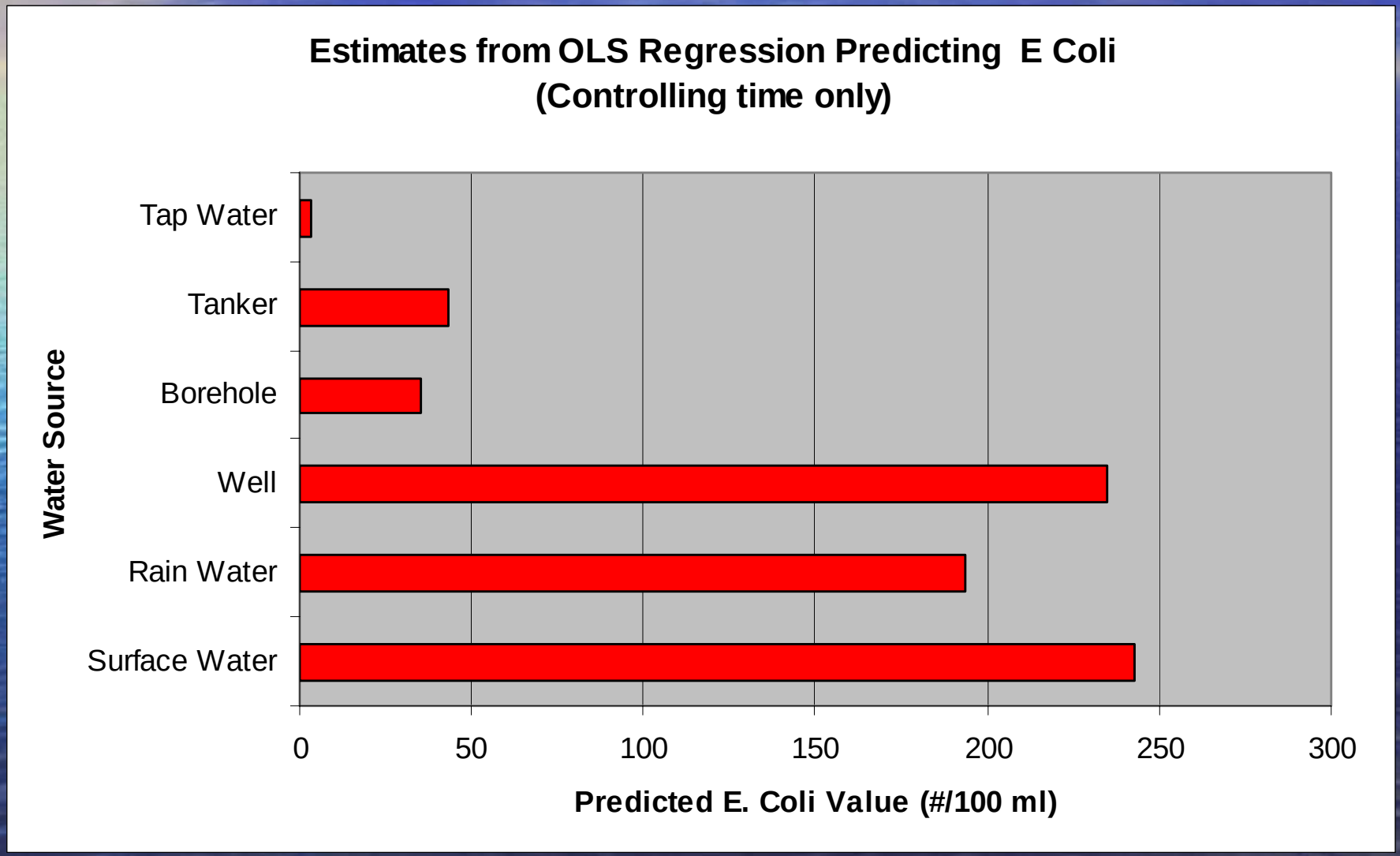


Results: Drinking Water Quality

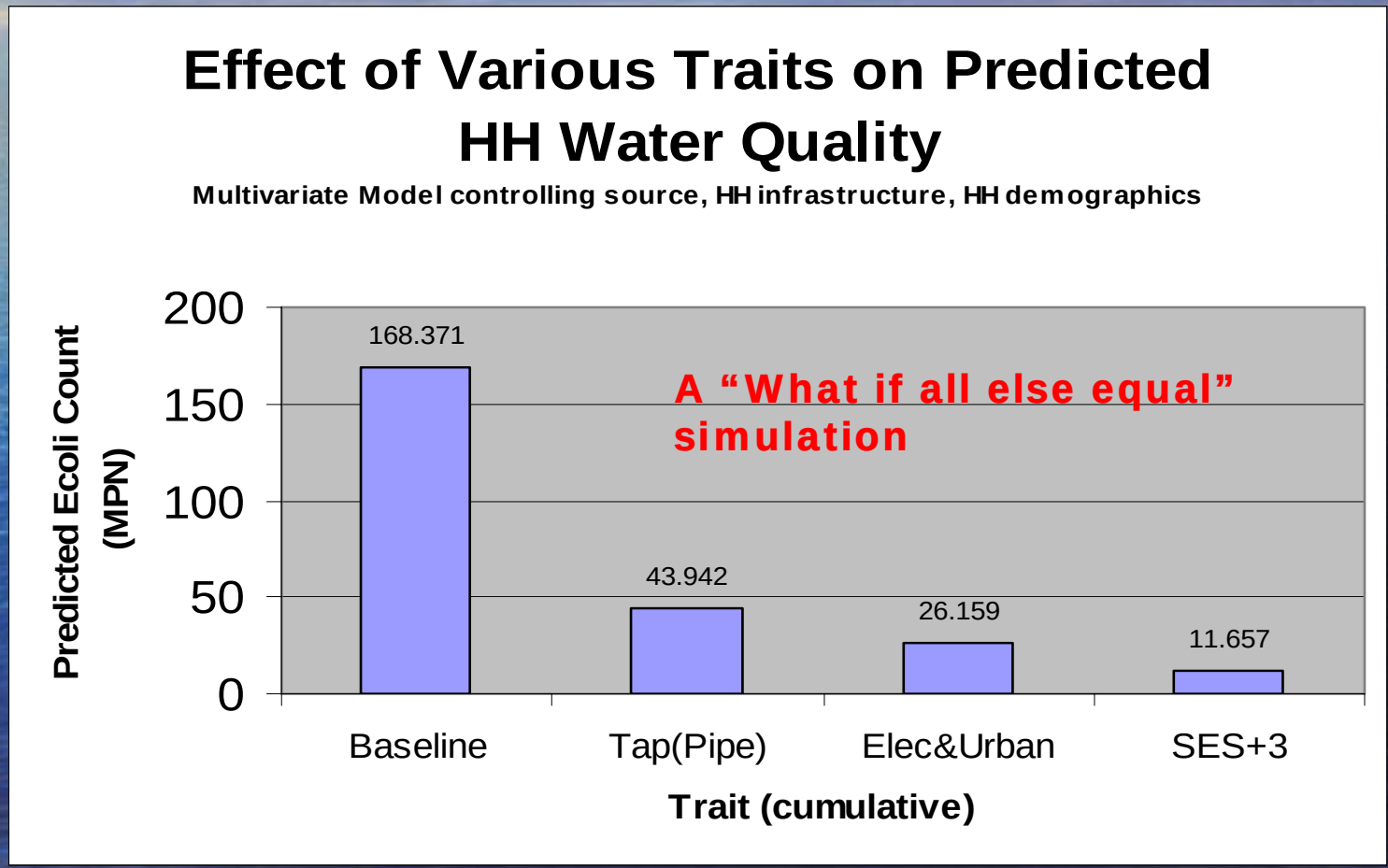


- 19% of HH obs with MPN=0
- 35% with MPN <=5
- 26% with **MPN>200** (~beach closed!!)
- Water *as used* in HH

Appreciable Variability in HH water contamination by source



Source, Residence, and HH Traits *ALL* Matter – Predictions from MV Results



Further Results for Community Drinking Water Sources

Areas closer to the regional government center (Cape Coast) have more water source improvements

High population-density areas not more likely to have better water (Cape Coast may not have much contamination but the other major city, Winneba, has high levels of ammonium and nitrate)

Wells and surface water have the highest levels of contamination overall, taps/pipes have the lowest

Boreholes have low levels of sewage contamination but high levels of fertilizer contamination