



FIELDWORK REPORT (January 20th-February 18th 2010)

VULNERABILITY OF ATOLLS TO COASTAL HAZARDS: A PHYSICAL AND ENVIRONMENTAL APPROACH OF THE SITUATION OF KIRIBATI

Virginie DUVAT-MAGNAN

Professor of Geography, University of la Rochelle-CNRS 6250
Institut du Littoral et de l'Environnement
2, rue Olympe de Gouges, 17 000 La Rochelle, FRANCE
virginie.duvat@univ-lr.fr
<http://lienss.univ-larochelle.fr>

1. REFERENCE RESEARCH PROGRAMME

The present work is included in the research axes “Geomorphology and natural hazards on the coast” and “Vulnerability and quality of coastal areas” of the team AGILE (*Geographical Approach of Islands, Littoral and Environment*) of the research laboratory LIENSs (*Littoral, ENvironment, Societies*), University of la Rochelle-CNRS, UMR 6250 (France).

The **main objectives** of these research axes are:

- (a) To better understand the formation and recent evolution of sedimentary coasts, in particular in tropical islands (Indian Ocean and Caribbean Sea archipelagos¹ have been investigated over the past decade);
- (b) To analyze interrelations between physical processes and human development to determine the nature and extent of anthropogenic impacts, particularly in coral reef environments;
- (c) To evaluate the exposure of islands to coastal hazards related to climate and climate change;
- (d) To analyze stakeholders strategies in the field of coastal hazards management;
- (e) To develop vulnerability indicators and make vulnerability assessments at the local scale to support decision-making.

This first fieldwork session was exploratory, aiming at launching a research programme concerning island vulnerability in the atoll states of Maldives and Kiribati.

¹ From 1996 to 2005, we conducted research work on Indian Ocean archipelagos (Seychelles, Maldives, Mascarene Islands); from 2005 to 2009, we studied the situation of some islands of the Lesser Antilles (Anguilla, Saint-Martin, Saint-Barthelemy, British and US Virgin Islands). More recently (2009), we have started geomorphological surveys in the Eparses Islands (Mozambique channel and north of Madagascar).

2. INTEREST OF KIRIBATI FOR VULNERABILITY STUDIES

The choice of Kiribati for this research work is based upon the following reasons:

- (a) As an atoll state made of numerous low-lying islands, Kiribati is highly exposed to natural coastal hazards related to climate variations and climate change, and it presents a high diversity of situations from North to South. Therefore, it is a relevant territory for vulnerability assessments;
- (b) The location of Kiribati out of the Pacific Ocean cyclone belt offers the possibility to study coastal hazards in a low energy environment. As it can also be observed in the Maldives, low energy environments are nevertheless exposed to some storms or storm waves, and morphologically influenced by storm events in the long term. So, it seems interesting to deal with the following questions: what about coastal erosion and submersion in low energy atolls? What differences between lagoon and ocean sides of atolls? And between atolls on a North/South gradient?
- (c) As a Small Island Developing State, Kiribati offers the possibility to better understand the situation of such countries in face of climate change.
- (d) Considering available studies², it appears that further work can be done, both on other locations than those already studied and also through a more global approach of vulnerability, including island planning, densities, location of major infrastructures...

3. GENERAL OBJECTIVES OF FIELDWORK IN KIRIBATI

This first stay in Fiji and Kiribati pursued **four main objectives**:

- (a) To make a general review of scientific literature, report studies and existing data to identify, firstly, what has already been done on the issue of coastal vulnerability in Kiribati, and secondly, which data are available for vulnerability assessments. Therefore, bibliographical work was done in various libraries (mainly those of the South Pacific University in Suva, Fiji, and of Bairiki in South Tarawa) and institutions (ministries, Kiribati Adaptation Project, SOPAC...). Researchers of the USP were met both in Fiji and Kiribati, as well as administrative officers from various institutions and organizations (see details in *annex 1*).
- (b) To characterize island and coastal morphology both in South Tarawa, the capital, and in an outer atoll, to get a general view on morphology, processes at work, recent coastal evolution and human interferences with physical processes.
- (c) To make an assessment of the vulnerability of islands of the same atolls to coastal hazards.
- (d) To establish a partnership with local institutions to make sure that this research work can be useful to Kiribati and to develop further collaboration.

4. DESCRIPTION OF FIELD WORK DONE IN KIRIBATI

ATOLLS VISITED (see detailed programme in *annex 1*)

Two atolls were visited during this stay:

- (a) Abemama atoll, from January 31st to February 6th;
- (b) South Tarawa atoll, from January 29th to 31st and from February 7th to February 18th.

METHODOLOGIES EMPLOYED

- (a) Systematic field surveys were made on the studied islands, based upon island and reef flat transects as well as coastal morphology description and human occupation analysis;

² In particular, the numerous studies made by the SOPAC on coastal erosion problems since the 1980's and on flooding processes more recently; and the works done by USP researchers.

- (b) Adaptation and application of a methodological procedure which has already been implemented in other coastal areas (Mediterranean and Caribbean seas) based upon a wide range of physical and human indicators determining vulnerability (see *annex 2*);
- (c) Questionnaire surveys among coastal residents exposed to natural hazards (see *annex 3*);
- (d) Interviews of researchers and officials, to get their view on the situation and some advice on site studies, bibliography and data resources.

WORK IN PROGRESS

- (a) Morphological characterization of islands and coasts: survey of island, coastal and reef flat forms; determination of morphological differences between lagoon and ocean sides of islands; morphological analysis of unoccupied islets;
- (b) Survey of the main forms of coastal development and anthropogenic interventions on the coast: buildings, infrastructures, development projects such as aquaculture, reclamation works and mining, coastal defences;
- (c) Identification of the drivers of coastal vulnerability at the scale of the country (main strengths and weaknesses to face coastal hazards and climate change challenges);
- (d) Evaluation of island vulnerability to coastal hazards in South Tarawa atoll;
- (e) Detailed site studies in South Tarawa atoll;
- (f) Analysis of the current responses of coastal residents and of the Government to coastal hazards.

5. MAIN SCIENTIFIC QUESTIONS AND SCHEDULE

QUESTIONS OF INTEREST

Fieldwork revealed the interest of **deepening the study of some keys issues**:

- **The recent evolution of the coastline** to determine the areas of rapid morphological changes and those of relative stability over the past decades. The study will be based on the comparison of aerial photographs from various campaigns (1969, 1984, 1998, 2005). Hypotheses will be set out on the respective roles of natural and anthropogenic factors in the evolution of the shoreline and in coastal hazards aggravation. This work will be complementary of the recent detailed studies carried out by A. Webb on South Tarawa and Abaiang atolls³.
- **The relationships between environment management and coastal hazards mitigation strategies**, as environmental regulations allow all kinds of interventions of private individuals on beaches, on the foreshore and more globally on coastal areas, which contribute to the exacerbation of coastal risks.
- **The role of the land tenure** system as a main driver of coastal vulnerability and a probable obstacle to the implementation of adaptive strategies like building realignment.
- **The pertinent spatial scales for vulnerability analysis**, with a special attention to the scales of atoll (relevant on the basis of common physical and human characteristic), island (which are consistent units in terms of physical and human occupation), and morphological unit (sediment cell).

³ *WEBB A., 2005. *An assessment of coastal processes, impacts, erosion mitigation options and beach mining: Bairiki/Nanikaai causeway, Tungaru Central Hospital coastline and Bonriki runway, South Tarawa, Kiribati*. Technical Report 46, 46 p.

*WEBB A., 2006. *Analysis of coastal change and erosion. Tebunginako village, Abaiang, Kiribati*. Technical Report 53, 10 p.

SCHEDULE

Analysis of bibliographical resources, statistical and field data is in progress. The following schedule can be proposed:

Before the end of May 2010	Detailed analysis of bibliographical resources
Before the end of June 2010	First general analysis of Kiribati vulnerability to coastal hazards and comparison with the situation of the Small Island Developing State of Maldives Scientific papers proposed in the French and English languages
Before the end of August 2010	Achievement of the vulnerability assessment of Tarawa atoll to coastal hazards
Before the end of 2010	Historical analysis of morphological features, coastal development and protection works on the period 1969-2010 First results report

ANNEX 1 – Detailed programme of fieldwork in Kiribati

Date	Site (atoll, island)	Brief description of work
Monday February 25 th to thursday February 28 th	Suva, University of the South Pacific, library	Bibliography
Saturday January 30 th Sunday February 31 st	Bonriki & Temaiku, South Tarawa atoll Manuko, Abemama atoll	Field survey Coastal survey Questionnaire survey 1 (Rotee)
Monday February 1 st Tuesday February 2 nd	Kariatebike, Abemama atoll Kabangani, Abemama atoll	Field survey Questionnaire survey 2 (Tenikoa) Collection of census data
Wednesday February 3 rd	Kariatebike, Abemama atoll	Field survey Questionnaire survey 3 (Aritwke) Questionnaire survey 4 (Ukeniau) Collection of census data
Thursday February 4 th	Kariatebike, Abemama atoll Tabaiang, Abemama atoll	Questionnaire survey 5 (Matang) Interview 1 (Medical assistant) Field survey with reef flat transect Collection of census data
Friday February 5 th	Kariatebike, Abemama atoll	Questionnaire survey 6 (Tebwerei) Collection of census data
Saturday February 6 th Sunday February 7 th	Lagoon side of Bikenibeu, South Tarawa atoll Bangantebure/Abarao, South Tarawa atoll	Field survey Questionnaire survey 7 (Koin Akoi, Abarao) Questionnaire survey 8 (Beia Tiim, Abarao) Questionnaire survey 9 (young lady, Abarao) Questionnaire survey 10 (Diane) Questionnaire survey 11 (man) Interview (Amon, retired from the Ministry of Social Affairs) Questionnaire survey 12 (Bob, Abarao)
Monday February 8 th	Ambo, Eita, Abarao/Tangantebure, South Tarawa atoll	Field survey
Tuesday February 9 th	Bairiki, South Tarawa atoll Bikenibeu, ocean side coast, South Tarawa atoll	Land Management Division: aerial photographs 1998 Kiribati Adaptation Project: interview K. Taburue Field survey Ministry of Environment: contacts
Wednesday February 10 th	Betio, South Tarawa atoll	Field survey Meteorological services
Thursday February 11 th	Bairiki, Ministry of Fisheries, Mineral Unit, South Tarawa atoll Bairiki, Land Management Division, South Tarawa atoll Betio, Ministry of Public Works, South Tarawa atoll	Interview: K. Yeeting Interviews: B. Ukitoori & H. Redfern Interview: E. Kakau
Friday February 12 th to sunday February 14 th	Teirio islet, Abaiang atoll	Field survey with reef flat transect and snorkelling on the outer slopes of the reef
Monday February 15 th	USP campus, Kiribati	Interview: U.N. MacKenzie
Tuesday February 16 th	From Parliament to the west, South Tarawa atoll, Nanikaai, causeway Nanikaai/Bairiki, Bairiki Teoraereke	Field survey Questionnaire survey 13 (Korere, Nanikaai) Field survey
Wednesday February 17 th	Ocean side of Bikenibeu, South Tarawa atoll Buota	Field survey Field survey + Questionnaire survey 14 (Bamita)

ANNEX 2 – Methodological procedure for coastal vulnerability assessment

The methodological procedure that is to be applied in Kiribati is based upon 10 categories of criteria that are listed below. For each criterion, 3 to 5 levels of vulnerability are described. The total score determines the vulnerability level.

This procedure applies to consistent island or coastal units characterized by homogenous physical and human features. Thus, the dimension of units can vary from one site to another.

Physical criteria

1. Island type
2. Morphological description of the site
3. Presence or absence of a protection zone, either terrestrial or on the foreshore
4. Level of exposure of the coast to waves and associated currents
5. Recent evolution of the coastline

Human criteria

6. Development scheme
7. Level of exposure of transport facilities and production units to coastal hazards
8. Level of exposure of key services and infrastructures to coastal hazards
9. Level of exposure of main urban centres and densely populated areas
10. Mitigation strategies of coastal stakeholders for reducing vulnerability

ANNEX 3 – Questionnaire survey carried out among residents

1. What are your home island and your home village?
2. When did you leave your home island and where did you live then (personal itinerary up to now)?
3. What's your job and where do you work? What is your husband's/wife's job?
4. Do you live on your own land?
5. Is it easy (availability and cost) to buy land here?
6. How many people are you living together on your land, and who are they?
7. How do you get fresh water (well, water tank...)?
8. Do you or members of your family go fishing?
9. Do you sell and/or buy fish?
10. What do you grow for eating?
11. Do you grow pigs and/or chickens?
12. What do you buy for eating?
13. Do you sometimes get food or water from neighbours?
14. How much does it cost you approximately to buy food at the store each month?
15. Is your land exposed to high tides or to storm waves?
16. Are you exposed to droughts? If yes, how do you cope with droughts?
17. Are you exposed to water shortage? If yes, how do you cope with it?
18. What is the most important thing for you that you want to preserve for your children?
19. Concerning climate change, have you noticed some changes?
20. Are you worried about climate change either for Kiribati or for your own family?
21. What would make your life easier here in Kiribati?