Autonomous and Planned Adaptation: The Low Watershed of the Lempa River

El Salvador, Central America

UNFCCC-UNDP WORKSHOP ON ADAPTATION METHODOLOGIES

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Estimates of likely future adaptations should be an essential ingredient in impacts & vulnerability assessments. They will depend both on exposure to changes in climate (linked to climate sensitivity) and on the ability of the impacted system to adapt.

Adaptive capacity is the potential or ability of a community, region or system to adapt to the effects of climate change, by adjustments in response to climatic stimuli. Adjustments refer to changes in processes, practices or structures to moderate or offset potential damages, or to take advantage of opportunities associated with changes. As far as communities are concerned, adaptation involves adjustments by individuals and the collective behavior to reduce vulnerabilities to climate variability or change.

The characteristics of communities, countries and regions influence their propensity or ability to adapt to present and future climate impacts. The determinants of adaptive capacity relate to economic, social, technological and institutional conditions that facilitate or constrain the development and deployment of adaptive measures. Autonomous or spontaneous adaptations are considered to be those that take place without the directed intervention of a public agency.

Climate change vulnerability studies rarely go beyond identifying options that might be possible including economic costs and benefits. It will be necessary to do research on the dynamics of adaptation in human systems, the processes of adaptation decision making, conditions that facilitate or constraint adaptation and the role of nonclimatic factors. Cost-effectiveness analysis are important, but to determine the appropriateness of an adaptation measure, more research should be done on autonomous adaptations and on the roles and responsibilities in adaptation of individuals, communities, local governments and NGOs, private and public entities and international co-operation agencies.
1. Introduction.

According to the TAR, planned adaptations are deliberate policy decisions on the part of public agencies, and autonomous adaptations are initiatives that occur naturally by private actors without intervention of public agencies. It is also proposed that autonomous adaptation forms the baseline against which the need for planned anticipatory adaptation can be evaluated.

In developing countries, processes involving adaptation decisions are complex and quite different from those taking place in developed countries. Traditionally, governmental social and environmental legal frameworks and programs have been very weak, therefore, contributing to generate current vulnerabilities.

Due to international financial constraints along with national political decisions, many developing countries launched processes viewing public administration reform, mainly through the adoption of new economic models based on privatization, descentralization and public entities reduction. Those reforms have been launched arguing quality services improvement, lower prices and the enlargement of covering.

In El Salvador, privatization included some key services, namely, education, health, energy, financing, water supply, technical assistance, communications, public works, retirement regimes and other services which traditionally had been governmental duties. The role of the public administration was reduced to just rule and control private activities. Even traditional planning activities, such as defining national or sectoral policies or indicative plans or programs, were almost eliminated.

Becoming private services, traditional public services have to be paid by any socio-economic sector at market conditions. Thus, a relevant percentage of the population can not enjoy the benefits of those services. In some cases, privatization turned out in the enhancement of private oligopoles or monopoles, followed by prices increases. Thus, original goals could not be accomplished.

As far as poor populations are concerned, either they do not receive those services or they manage on their own or with local NGOs support. For many decades, those NGOs have been working on the ground helping communities to finance their local programs or projects and to obtain technical assistance from international co-operation.

According to the aforementioned local circumstances, up to now, private actors, namely, local communities, NGOs and associations, are assuming a large range of policy and planning decisions which should have been assumed on the part of the public administration. Thus, establishing the baseline would be far more complex, if we are to capture what is actually happening in some developing countries.
It could be expected that within that development policy context, many decisions would generate a future economy far more vulnerable than it is today. More likely than not, the inclusion of planned adaptation policies in current national or sectoral policies could be seen as contradictory within the spirit of recent economic reforms.


Hydrometeorological and tectonic events have been well documented in the region, even prior to colonisation.

Regional climatology is influenced by the anti-cyclonic system from the North Atlantic along with the migration of the inter-tropical convergence zone, as well as by the occurrence of the Southern Oscillation extremes, referred to as El Niño/La Niña, and by hurricanes surge in the Caribbean Sea, which sometimes occur simultaneously with the rainy period along the Pacific coastline.

The orographical systems present a predominant north-south orientation, the central range of mountains divide the region in two interdependent geosystems influencing the climatic and hydrological patterns. These conditions initially led to a prevalence of agricultural activities close coastlines.

The region is located over regional and local-scale tectonic faults, with a dense chain of volcanoes. It also has a lot of alluvial valleys close to large and torrential hydrographic watersheds.

Damages, losses and human deaths linked to those events, as well as social and institutional reactions with regard to the impacts, have been wide disseminated through many generations. However, neither at the regional nor at the national level, there have been alternative options to current development models which have produced additional socio-natural hazards.

In Central America, the “disaster management and relief” issue, is still to be included as a priority in national and regional agendas, and still to be implemented at both levels. However, there have been some moves during the last five years, namely, the endorsement by the presidents of the region, of the Strategic Framework for Disasters Prevention and Mitigation and the Regional Plan.


In the case of El Salvador, climatic parameters present no relevant variation with respect to mean values. However, there are inter-seasonal, inter-annual and long-term climatic anomalies producing negative socio-economic impacts, such as: intense rainfall, thunderstorms, droughts, dog days, etc. Climate variability is actually linked to the ENOS occurrence.
Climate extremes, namely, cold/warm fronts, tropical storms, hurricanes, severe convergences, and the climate-related events such as floodings, droughts, mudslides, hot waves, fires, frost, etc. often produce huge devastations. Sometimes extreme events are magnified by their inter-action with other complex phenomena (inter-annual or inter-decadal oscillations), as was the case with hurricane Mitch.

4. Climate risks in the Lempa watershed:

- The Lempa low watershed.

Even if El Salvador has no coastline in the Atlantic ocean, it shares the central range of mountains-related events, particularly those generated by the Lempa river which goes across Guatemala and Honduras, before determining about 49% of the Salvadoran territory, and defining the large alluvial valley in the Pacific coastline.

The high annual population increase rate\(^1\) has produced human settlements covering almost the whole national territory\(^2\). Most of the population live in tectonic and climate hazards prone areas. Economic activities have generated additional socio-natural disasters risks.

Alluvial coastal valley has been populated during the 90’s, as if it were geologically concluded and stable, while each year it has been documented that there has been many hydrometeorological, tectonic or volcanic events.

According to the National Emergency Committee, the Lempa low watershed, referred as to the Low Lempa, is a high risk area considered as a priority due to several reasons, namely: a) existance of a lot of communities located in prone to floods and drought areas, b) occurrence of frequent disasters inflicting losses and damages to infrastructure, assests and agriculture, displaced and death people and environmental degradation, and c) lack of streamflows and hydropower plants monitoring, increasing disasters risks.

- Floodings, droughts and sea water temperature increases.

The low Lempa region is the natural flooding plain of the Lempa river, containing fundamentally alluvial materials. Upstream of the Low Lempa is located an hydropower dam\(^3\), which plays a streamflow regulation role during intense rains and often discharging large amounts of water.

According to records, floods related to maximum discharges can be classified in four categories as follows:

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1 1998-2015: 1.7%  
2 1992: 243 inh/km\(^2\).  
3 Referred as to “15 de septiembre”. 
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a) Areas prone to frequent floodings during the year, they are affected by discharges up to 1,500 m$^3$/s and are located along both sides of the river close to the outlet.
b) Areas flooded about four times a year, they are affected by discharges no less than 2,800 m$^3$/s.
c) Areas flooded in average once a year, they are affected by discharges up to 3,600 m$^3$/s.
d) Areas flooded in average each ten years, they affected by discharges up to 6,700 m$^3$/s.

Taking into account records of a 30 year-series of discharges in two hidrometeorological stations (Tables 1 and 2), it is evident that the Low Lempa region is periodically at risk of floodings. Many communities located in those areas from the beginning of the 90’s, are under permanent threat.

**Hidrometeorological Station “San Marcos Lempa”**

*(Discharges, 1961-1982)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Discharge (m$^3$/seg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1962</td>
<td>3302</td>
</tr>
<tr>
<td>1962-1963</td>
<td>3912</td>
</tr>
<tr>
<td>1963-1964</td>
<td>2726</td>
</tr>
<tr>
<td>1964-1965</td>
<td>3797</td>
</tr>
<tr>
<td>1965-1966</td>
<td>2880</td>
</tr>
<tr>
<td>1966-1967</td>
<td>2190</td>
</tr>
<tr>
<td>1967-1968</td>
<td>1940</td>
</tr>
<tr>
<td>1968-1969</td>
<td>2160</td>
</tr>
<tr>
<td>1969-1970</td>
<td>8921</td>
</tr>
<tr>
<td>1970-1971</td>
<td>4815</td>
</tr>
<tr>
<td>1971-1972</td>
<td>4448</td>
</tr>
<tr>
<td>1972-1973</td>
<td>2238</td>
</tr>
<tr>
<td>1973-1974</td>
<td>5246</td>
</tr>
<tr>
<td>1974-1975</td>
<td>7694</td>
</tr>
<tr>
<td>1975-1976</td>
<td>5472</td>
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<tr>
<td>1976-1977</td>
<td>5470</td>
</tr>
<tr>
<td>1977-1978</td>
<td>3336</td>
</tr>
<tr>
<td>1978-1979</td>
<td>3600</td>
</tr>
<tr>
<td>1979-1980</td>
<td>3191</td>
</tr>
<tr>
<td>1980-1981</td>
<td>2283</td>
</tr>
<tr>
<td>1981-1982</td>
<td>4600</td>
</tr>
</tbody>
</table>

Source: Ortega & CLASS, 1999

**Table 2**

Floodgates and turbines: “15 de Septiembre” hydropower

*(Máximo discharges, 1984-1997)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Q vert m$^3$/seg</th>
<th>Q gen. m$^3$/seg</th>
<th>Discharge (m$^3$/seg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>29 set</td>
<td>2416.6</td>
<td>660.0</td>
<td>3076.5</td>
</tr>
<tr>
<td>1985</td>
<td>31 ago</td>
<td>2561.6</td>
<td>660.0</td>
<td>3221.6</td>
</tr>
<tr>
<td>1986</td>
<td>4 jul</td>
<td>410.9</td>
<td>660.0</td>
<td>1070.9</td>
</tr>
<tr>
<td>1987</td>
<td>29 jul</td>
<td>2537.4</td>
<td>660.0</td>
<td>3197.4</td>
</tr>
<tr>
<td>1988</td>
<td>15 set</td>
<td>3294.4</td>
<td>660.0</td>
<td>3954.4</td>
</tr>
<tr>
<td>1989</td>
<td>23 set</td>
<td>3507.9</td>
<td>660.0</td>
<td>4167.9</td>
</tr>
<tr>
<td>1990</td>
<td>15 set</td>
<td>3598.4</td>
<td>660.0</td>
<td>4258.4</td>
</tr>
<tr>
<td>1991</td>
<td>12 oct</td>
<td>1600.0</td>
<td>660.0</td>
<td>2260.0</td>
</tr>
</tbody>
</table>
Every year the low Lempa region is affected by droughts, with moderate to severe intensities. During the occurrence of El Niño event, fisheries suffer from temperature increases of the sea water along the Pacific coastline. Those climatic events inflict damages in crops and fisheries, generating serious socio-economic problems to rural families. Most of them have not still adopted irrigation technologies to address frequent droughts. There exist some experimental irrigation projects using different technologies, which up to now have succeeded to afford droughts and are likely to be sustainable due to the additional income related to the moment they sell their crops in the market.

5. Vulnerabilities

- Natural resources and environment:

The ministry of environment and the environmental law were created in 97 and 98 respectively. Therefore, the institutional framework is still weak and the fully implementation of the law has not yet been accomplished.

Before the 90’s there were no environmental criteria nor rules to develop any project. Environmental impact assessments were not required to have a project activity approved by relevant authorities.

Between 1950–1979, cotton was the third main export product in el Salvador. In order to expand cotton and livestock farms, 15,000 ha of natural forests were cut down in the coastal valley of the Low Lempa. Deforestation has magnified the impacts of floodings and droughts.

Currently, sugar cane farms still continue to fumigate pesticides from the air with airplanes, polluting land, crops, rivers and causing health damages.

Most of the soils have a low infiltration speed and low permeability when they are humid. Local communities are concinced that agrological potential of soils is very high, however, flooding and drought risks, soils conditions and rains patterns are constraints to agrological attributes.

- Social conditions.

- Economic activities
6. Autonomous and Planned adaptations.

Adaptations adopted:

- Organization for local development:

  Communities located in the Low Lempa area, have clearly stated that they want to remain living there. They argue that special conditions of the site allow them to obtain additional benefits and to take advantage of the great amount of natural resources. At the same time, they have been addressing their need to minimize losses and damages linked to frequent droughts and floods, through the adoption of different strategies and measures.

  Organization for local development through the establishment of local entities, inter alia, NGOs, associations and networks, has been one of the strategies to afford their problems.

  Pending

- Early warning systems and disasters management:

  The COEN has promoted the organization of local early warning systems (EWS) and local emergency plans in places at risk. The EWS in the LL is limited to a radio network including local NGOs, the NHMS and the hydropower dam located upstream.

- Irrigation technologies to address droughts

- Reforestation, natural forest conservation and agroforestry:

- Local productive initiatives

  Programs and projects foresee that the benefits of living and working in that area more than compensate for risks. That is the case with irrigation.

- Housing location and typology.

  According to the local flooding typology and taking into consideration housing location and design, about 25% of communities would have some level of protection because their houses are built 30 to 60 cm above ground. Some communities are located in areas under permanent threat, on that matter after the Mitch, the government committed to relocate those communities, up to now, actions are limited to buying the land.

- Public regional and national initiatives:
How climate risks have been taken into account?

- Flood control dams and drainages construction (MAG).

The Ministry of Agriculture has been taking steps to obtain the financing and to construct mitigation works, to minimize floodings impacts, namely, the design and construction of dams and drainages in the Low Lempa and other two sites.

In the Low Lempa, dams are being built along the two margins of the river, as well as drainages. Those works will alleviate problems linked to some categories of floodings, however they could worsen the risks once the discharges are above the maximum design discharge. During the hurricane Mitch, the maximum discharge in San Marcos station was 12,500 m$^3$/s.

- Hydrometeorological parameters monitoring and forecasting.

Climate data? Hidrometeorological institutions?

Records of climate events are not described in terms of local damage or adaptation parameters. There are no records of local parameters, such as, speed of the flood waters, return periods, etc. Climate records are not in the computer compatible formats necessary for in-depth analysis of climate statistics for adaptation studies. They need to be digitised.

Meteorological Services are not offering climate information in a timely manner and in the formats users need. They are disseminating climate data that not include user-friendly parameters, relevant to address climate hazards.

Local emergency plans and early warning systems should be complemented with national monitoring mechanisms of relevant climate parameters and environmental variables.

- Climate and other natural phenomena risks management policies are included in national/regional agenda, policies, programs and plans?

- Political agreements.

  Agenda 21 together with the UNFCCC and other related international agreements.

- Programs and projects

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4 About 8500 m$^3$/s.
7. Strategies to overcome barriers to adaptation:

- Resetting development priorities.

The resetting of development priorities through a consultative process, taking climate change and other issues into account.

The process started in Rio, has to be resumed and strengthen. Countries acquired commitments within Agenda 21, which include, inter alia, the launching of sustainable development planning processes and implementation, and the establishment and strengthening of national sustainable development commissions.

- Strengthening hydrometeorological Services and making linkages to climate change.

- Regional experiences exchange

- Institutional arrangements

  National Climate Change Comission & National Sustainable Development Comission

- Public awareness campaigns
- National capabilities creation and strengthening
- Scientific and technological research and development