

**Climate Change in Timor Leste**

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Date: 2003

Published by: UNDP, CARE and CIDA

 **Summary**

The CSIRO regional climate model implies that there could be less rainfall in the wet season and more rainfall in the traditional dry season which may affect the planting and harvesting cycle for non-irrigated crops. In general, it is expected that there may be increase in the intensity of extreme precipitation such as droughts and floods. This may result in decreased agricultural production, damage to infrastructure and loss of life.

Climate Change may also result in increasingly intense and more frequent tropical cyclones, but these have rarely affected Timor Leste. The most important concern is the possible link between climate change and El Nino events which may be more severe in the future.

Climate change may result in the rise of mean sea-levels between 9 and 88 cms by year 2100. This may adversely affect low lying coastal areas. It may also damage public and private infrastructure, agriculture and freshwater resources. While this is not seen as a short-term problem for Timor Leste, it may be advisable this early to consider planning codes for likely future sea level rise.





## Resumo

### Mudança clima em Timor Leste

Impacto das alterações climáticas importantes sobre Timor-Leste

O modelo regional climático CSIRO implica que haverá menos chuva na época húmida e mais chuva na época tradicionalmente seca, o que pode afectar os ciclos de plantação e colheita de culturas não regadas. De uma forma geral, espera-se que haja um aumento na intensidade das precipitações extremas tais como as secas e cheias. Isto pode resultar na diminuição da produção agrícola, estragos a infra-estrutura e perdas de vida.

A alteração climática pode também resultar em ciclones tropicais cada vez mais intensas e frequentes, mas estes não tem afectado Timor-Leste. A preocupação principal é a possível ligação entre as alterações climáticas e o El Niño que pode ser mais grave no futuro.

As alterações climáticas podem resultar na subida no nível médio do mar em 9 a 88 cms até ao ano 2100. Isto pode afectar seriamente as zonas costeiras baixas. Pode também destruir infra-estruturas públicas, privadas e recursos agrícolas e florestais. Embora isto não seja um problema imediato para Timor-Leste, é bom começar já a fazer as leis de modo a prevenir a futura subida do nível de mar.



## Rezumu

### Mudansa klima iha Timor Leste

impaktu husi alterasaun klimátiku importante ba Timór

Iha modelu rejionál klimátiku CSIRO, implika katak sei iha udan ne'ebé menos iha tempu (époka) úmidu no udan aumenta tradizionalmente iha tempu bailoron. Ida ne'ebé bele fó efeito negativu ba síklu ai-horis no tempu kolleita ba kultura ka ai-han ne'ebé la rega. Forma ne'ebé loos liu oinsá iha intensidade udan ne'ebé aumenta, hanesan iha tempu bailoron no la iha inundasaun, tanba bee barak liu kapasidade, ida-ne'e fó rezultadu bele hamenus produsaun agríkola, estraga infraestruturá sira no balun lakon nia vida.

Alterasaun klimátiku bele mós fó rezultadu iha siklone tropikal dala ruma intensa (maka'as ka barak liu) no frekvente, maibé ida-ne'e la fó efeito negativu ba Timor Leste. Preokupasaun prinsipál mak iha possibilidade ligasaun entre alterasaun klimátiku no EL Niño, ne'ebé bele grave liu iha futuru.

Alterasaun klimátiku bele fó efeito ba tasi, hanesan aumentu iha nivel médiu tasi nian, iha 9 to'o 88 cms até tinan 2100. Ida-ne'e bele fó efeito negativu ba zona sira ka rai-tetuk liuliu tasi-ibun. No bele mós estraga infraestruturá públiku, privada sira no rikusoin to'os nian (agríkola) ho floresta ka ai-laran. Maski ida-ne'e la'ós sai hanesan problema ne'ebé imediatu/sedu liu ba Timor Leste, maibé di-ak liu hahú agora halo lei ka regulamentu hodi bele prevene atu iha futuru nivel tasi-klarán labele aumenta.

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This is a project of the University of Évora, made possible through a grant from the USAID, East Timor. info: [Shakib@uevora.pt](mailto:Shakib@uevora.pt)

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## Climate Change in Timor Leste

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This discussion is extracted from: Jon Barnett, Suraje Dessai, and Roger Jones. 2003. *Climate Change In Timor Leste: Science, Impacts, Policy and Planning. Briefing to Government, civil society, and donors, República Democrática de Timor-Leste*. The University of Melbourne and CSIRO, Melbourne. Available December 2003.

### 1. Introduction

Since the industrial revolution around 200 years ago, human activities (such as the burning of oil and coal, and deforestation) have increased the concentration of the gases in the atmosphere that trap heat from the sun. This has meant that more of the sun's heat remains within the atmosphere, causing warming. This warming causes changes in climate, weather patterns, and the hydrological cycle. These changes are known as *Climate Change*. This short paper discusses the likely changes in future climate in Timor Leste in general. It begins by discussing the present climate in Timor Leste, and discusses possible future changes. It is important to stress that this discussion of changes in climate is not a prediction, but rather is based on scenarios of future changes in energy and greenhouse gases and the possible implications of this for the climate. The techniques for producing these scenarios of change are imprecise, particularly at the scale of small islands like Timor Leste..

### 2. Climate in Timor Leste

It is difficult to examine present climate risk in Timor Leste because of the lack of consistent climate data. During the Portuguese period several stations measured rainfall/climate data for varying periods from 1914 to 1975, but many of these records are incomplete. It is unclear how much data was recorded during the period of Indonesian control from 1975 to 1999. Since 1999 there have been no meteorological or hydrological services available in Timor Leste. In November 2000, 50 rain gauges were distributed around the country by the Department of Agriculture and funded by AusAID, however little data has been collected from these gauges. Automatic weather stations have been installed at the main airports (Dili, Baucau and Suai) by the Australian Bureau of Meteorology (Darwin). Weather or seasonal climate forecasts have only been used sporadically by the National Disaster Management Office, and these were based on information available from the internet. Furthermore, there are currently no means to communicate this information to the users that require it. The Australian Bureau of Meteorology will be providing weather forecasts for Timor Leste for as long as

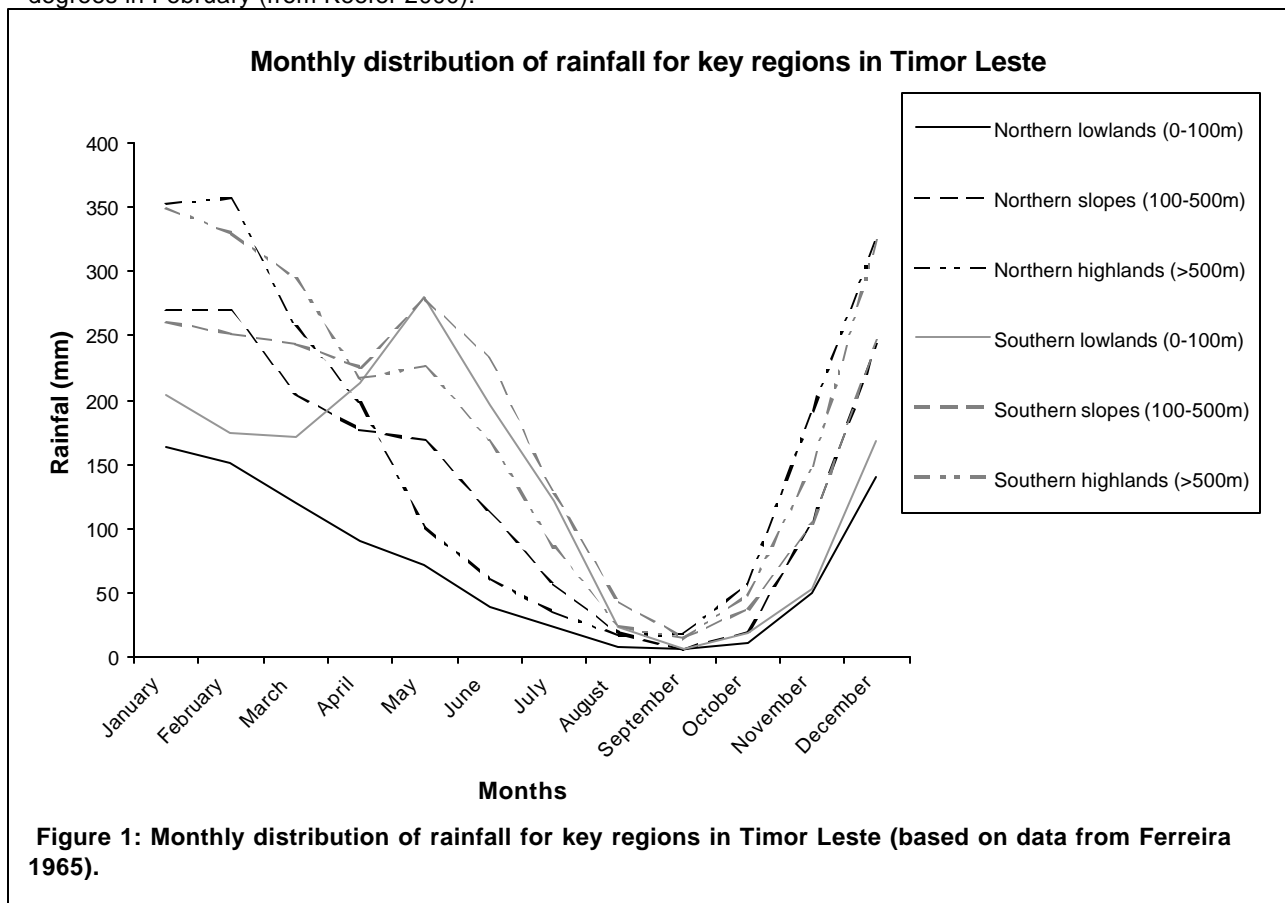
Australian forces are present in the territory (see [http://www.bom.gov.au/reguser/by\\_prod/aviation/](http://www.bom.gov.au/reguser/by_prod/aviation/))

As well as this lack of data about temperature and rainfall, there does not appear to be any data on a range of climate related processes like river runoff, tides, floods, and groundwater levels. This lack of data means that it is very difficult to say if climate is changing in Timor Leste. It also means there is insufficient data on which to base scenarios of future climate changes and its impact on environmental and social systems. Nevertheless, some broad conclusions about climate change in Timor Leste can be drawn and these will be discussed in the following pages.

Timor Leste is predominately influenced by the monsoon climate. There are two distinct rainfall patterns: the Northern Monomodal Rainfall Pattern produces a 4-6 month wet season beginning in December which affects most of the northern side of the country and tapers to the East; and the Southern Bimodal Rainfall Pattern which produces a longer (7-9 month) wet season with two rainfall peaks starting in December and again in May which affects the southern side of the country (Keefer 2000: 11). Rainfall can be broadly described as being low to very low along the northern coast of Timor Leste (<1000mm/annum), low to moderate throughout the central and elevated areas (1500-2000mm/annum), and relatively high (>2500mm/annum) in high altitude areas which are mostly in the west. In common with most tropical locations, extremely heavy rainfalls occasionally occur over Timor Leste during relatively short time intervals.

As is characteristic of the tropics, there is little temperature variation from month to month in Timor Leste. Keefer (2000: 10) reports that at any given place monthly mean temperatures vary by no more than 3 degrees Celsius between the coolest months of July and August to the warmest months of October and November. Diurnal (daily) temperature variations range from 7 to 13 degrees Celsius (Keefer 2000: 10). The most striking temperature variations occur with altitude. Temperature decreases with altitude: for example in Maubisse which is 1400 meters above sea level the mean monthly temperature is approximately 17 degrees in July and 24 degrees in November, compared with Liquica which is 25 meters above

sea-level where the mean monthly temperature is approximately 25 degrees in August and 31 degrees in February (from Keefer 2000).



**Figure 1: Monthly distribution of rainfall for key regions in Timor Leste (based on data from Ferreira 1965).**

Variability in Timor Leste's climate is significantly influenced by the El Niño Southern Oscillation which, in El Niño years, changes the timing and volume of rainfall (BMRC 2003). In some places, such as Ainaro, Lolotoe, Lore, and Los Palos annual rainfall is up to 50% less than average in El Niño years. In others, such as Bacau and Oecussi, annual rainfall in El Niño years is greater than average. In all places El Niño causes reduced rainfall in the January – March wet season, with some places experiencing only 25% of the rainfall usually received in these months. In general the wet season is delayed by two to three months in El Niño years, with implications for crop planting and food security. In the year following an El Niño rainfall can be higher than the annual average, with implications for flooding. In addition to drought caused by El Niño events, Timor Leste also appears to experience drought every four years (Dolcemascolo 2003). In these times the November wet season begins at the usual time, but rainfall is significantly less.

**3. Future climate scenarios in Timor Leste**

The identification of future climate change is generally done with the use of coupled atmosphere-ocean global climate models (AOGCMs), which provide a comprehensive, but still uncertain representation of the climate system. Lal et al. (2001) have only rated a few AOGCMs to have some skill in simulating the broad features of present-day climate and its variability over Asia. These models are still very uncertain in particular for a small and mountainous island like Timor Leste where higher spatial resolution models are required.

Table 1 shows the potential changes for temperature and rainfall in South East Asia. It shows that on an average seasonal basis Timor Leste is likely to be both warmer and wetter in the future. Within years the increase in temperature will be slightly greater in winter than in summer. These increases in temperature and rainfall are smaller than increases in all of Asia and across the globe.

Using the CSIRO regional climate model that has one grid point above Timor Leste, and our own interpretation of the model, Figure 3 compares

past rainfall with a plausible future rainfall scenario. Under this climate change scenario precipitation decreases from January to March and increases between September and November. This implies that compared to the

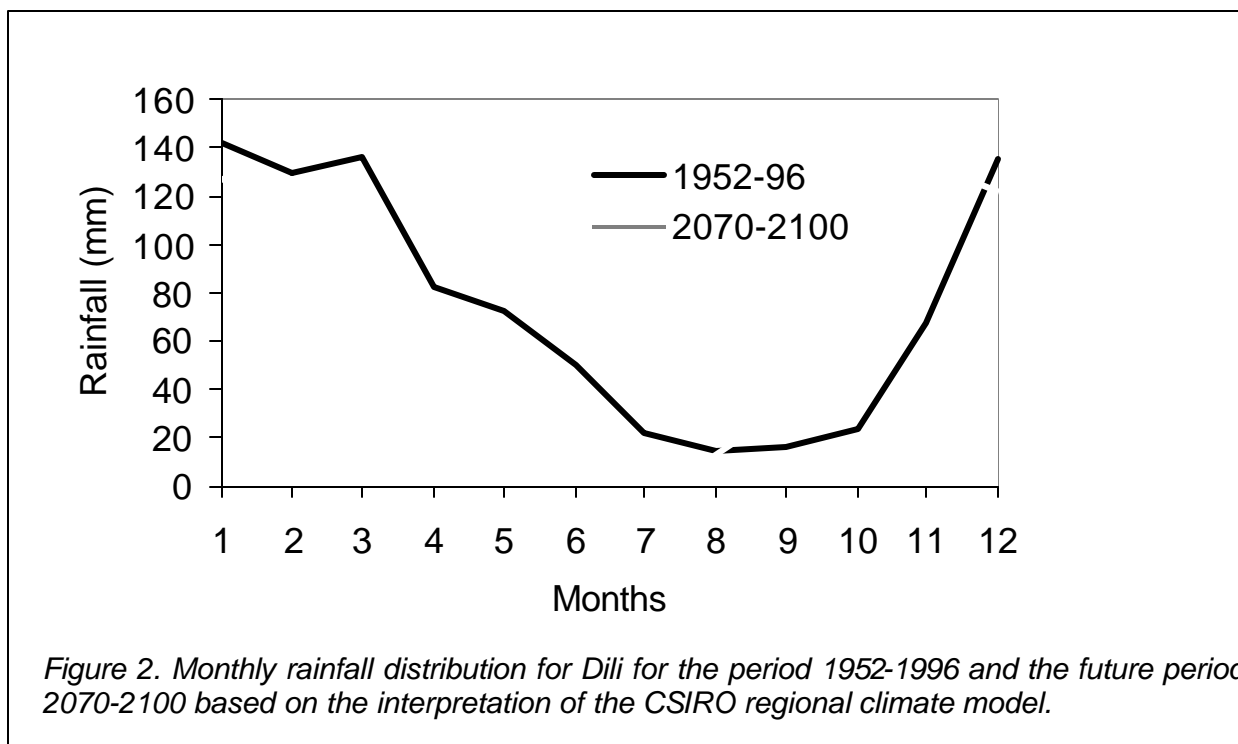
present there could be less rainfall in the wet season and more rainfall in the traditional dry season. This may affect the planting and harvesting cycle for non-irrigated crops such as maize.

	2020s			2050s			2080s		
	Annual	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer
Temperature change (°C)	1.05	1.12	1.01	2.15	2.28	2.01	3.03	3.23	2.82
Precipitation change (%)	2.4	1.4	2.1	4.6	3.5	3.4	8.5	7.3	6.1

**Table 1. Plausible changes in area-averaged surface air temperature and precipitation over South East Asia as a result of future increases in greenhouse gases (under IS92 emission scenarios), as inferred from an ensemble of four AOGCMs.**

The AOGCMs that are used to provide these estimates of future climate change are less reliable in predicting extreme climate events such as drought and flood. In general it is expected that there may be an increase in the intensity (frequency is less certain) of extreme precipitation events such as droughts and floods. Given that Timor Leste already experiences damaging droughts and floods which result in decreased agricultural production, damage to infrastructure

and loss of life, this increase in intensity and possible frequency of extreme events in the future may be the most serious implication of climate change for Timor Leste. It is also thought that climate change may result in increasingly intense and possibly more frequent tropical cyclones, however these have rarely affected Timor Leste. Of greater concern is a possible link between climate change and El Nino events which may be more severe in the future.



*Figure 2. Monthly rainfall distribution for Dili for the period 1952-1996 and the future period 2070-2100 based on the interpretation of the CSIRO regional climate model.*

It is thought that climate change may result in mean sea-levels rising by between 9 and 88 cms by the year 2100. There has been no research on the implications of this for Timor Leste. However, low lying coastal areas, including Dili, may be adversely affected if the rate of rise is high. Public and private infrastructure, agriculture and

freshwater resources may all be at risk. It is important to note though that sea-level rise is not a short-term problem for Timor Leste, and while it may be advisable for planning codes to take into account likely future sea-level rises, it is the aforementioned changes in climate and extreme events that are of greater concern.

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## OPEN FORUM: SESSION 1

**Q1** Influence of global climate change – understand the greenhouse effects/global warming, but what about influence of greenhouse gas in reality in Timor-Leste? How do we decrease the greenhouse effect globally and in Timor-Leste?

### Dr. Rodel Lasco:

- Timor Leste has little emissions so what can we do? This is Timor-Leste's issue – a collective decision between CSO's, NGO's and government should be made as to how to address emissions.
- Regarding the Kyoto Protocol mechanism – if Timor-Leste signs UNFCCC, it can participate in CDM – considering the important concepts of additionality and incremental change.

**Q2** Comment: Agree that agriculture and the environment go hand in hand!

**Q3** Many climate change models have been presented but all are a little different. What are the different models, which models should be used, and what are the margins of error?

**Q4** The government must be involved on a community level. What measures can we implement to support customary law (*tara bandu*)?

### Dr. Jose Augusto F. Teixeira

- While *tara bandu* is part of the government's forestry program, the problem in Timor-Leste is not law, but education and awareness and community participation.
- Timor-Leste needs laws but community practices also regulate themselves.
- The government talks a lot about the environment but must also talk about community based management of natural resources.
- However, there is not yet adequate donor support here – we need investment in this sector.
- Regarding natural resource management, there is currently a lack of mechanism in Timor-Leste; ministries need to better work together to create integrated and coordinated systems to approach this issue.

**Dr. Estanislao Alexio da Silva**  
**Minister of Agriculture, Forestry and Fisheries**

- Timor-Leste now has many problems regarding the impacts of climate change – related to, for example, wildlife, coral reefs, rivers – more detailed studies will be carried out in these areas in the coming year.
- We currently don't have good meteorological data and to collect this data, we require more support along the lines of equipment and trained personnel.
- We need to develop the capacity first; we currently don't have enough knowledge.
- Having the *tara* without the *bandu* doesn't work!
- While the community must be integrated and actively participating, we must provide alternatives to current bad practices (i.e. burning).
- Indonesian laws are in place but our judicial system doesn't support them and lawmakers cannot implement them.

**Dr. Jon Barnett**

- The IPCC recognizes 4 models that reasonably estimate climate change in tropical Southeast Asia; the range of uncertainty is not known.
- Data for East Timor is based on a model for the region but with the problem that it is based on only one data point in Dili.
- The model shows that it will rain less in the wet season and more in the dry season.
- Regarding climate change as an interrelated issue with agriculture, this is a complicated issue and government and civil society must work together to integrate an environmental management system - EVERY country faces this issue.
- Most countries that join the UNFCCC form a team of about 10 people consisting of representatives from each sector. This is a very useful way of forming networks and processes that work across ministries, making implementation of the convention easier across many sectors related to natural resources.

**Q5** There is much uncertainty about how climate change will affect people's well-being. Concerning the small scale of Timor-Leste, who is contributing? It is the BIG countries, while the SMALL countries suffer. We therefore need better dialogue between countries. Given the lack of awareness of the issues in Timor-Leste, what ideas, approaches and recommendations can be made for Timor-Leste to avoid going in the wrong direction?

**Q6** Focusing on the future, what might the impacts be on Timor-Leste's push for development? What potential activities by people/animals in the community might be helpful to create change? What do you see in the future? And with regards to tourism?

**Q7** We know development is not separate from environment. In Dili, there are many cars and therefore increasing CO<sub>2</sub> emissions. Does the Department of Environment have plans to control vehicular and industrial emissions? Regarding destruction of the marine environment, what plans have the Ministry of Agriculture for watershed management?

**Dr. Jon Barnett**

- We know placing the responsibility on developed countries for emissions is absolutely correct. Historically speaking, the bulk of the emissions of the richer countries have come from the clearing of their own forest/land in industrialization and the inherent use of fossil fuels. By this process they generate a lot of wealth and income.
- It is unfortunate, but well recognized, that the poorer countries feel the effects and impacts of the decisions of the richer countries.
- The UNFCCC is the result. It recognizes the responsibility of developed countries and asks them to do something about it. It recognizes inequalities and seeks to reduce emissions in developed countries by imposing targets – this is not much but a first step. The UNFCCC doesn't impose these targets on developing countries and instead assists them to develop well (i.e. with renewable energy systems).
- Most developed countries have signed the Kyoto Protocol, therefore agreeing to reduce emissions, however, Australia, U.S.A. and Russia have not.
- The agreement also recognizes different developing countries – specifically 'least developed countries' – and assists them in adaptation by providing programs for research, preparation and capacity building (i.e. programs like the 'national adaptation plan of action' which provides members up to US\$300,000 in funds). Many developing countries are using this program to prepare to adapt to climate change.
- Therefore, joining the convention gives Timor-Leste the opportunity to build capacity, gain technical assistance and technology, and garner funding to assist in adapting to climate change. Importantly, renewable energy projects funded through the convention provide many possibilities for Timor-Leste – i.e. reducing need for wood for cooking.

- Regarding the future impact on development, we must consider two situations: one, global issues and external influences, and two, community issues and internal influences

**Dr. Jose Augusto F. Teixeira**

- Timor-Leste does not have big chemical industries – only smaller industries, though there is significant burning of forests. The Department of Environment wants to implement Environmental Impact Assessment Law and pollution control laws but is currently still using Indonesian laws and standards. Manufacturers and industries in Dili (particularly in Komoro) must be controlled, but quantification is difficult. We need more capacity to establish environmental laboratories and equipment for measuring emissions. Equipment currently held is non-operational.
- A lot of Timor-Leste's emissions come from vehicles. Many vehicles come from Singapore and are using unleaded fuel – in Timor-Leste we use any kind of fuel – poor fuel – and this leads to bad emissions. This must be considered too.
- We need to fulfill requirements under Indonesian laws but must also consider difficulty in implementation due to financial investments.

**Summary**

**Dr. Benjamin Corte Real**

- The people of Timor-Leste have the ability to deal with climate change issues.
- People's activities will affect the environment and climate changes.
- We can see people's impacts by what has happened in developed countries - we can learn from that!
- We need studies to establish better methods before development – considering causes and effects related to health, human attitudes, agricultural practices, etc.