



AMAZALERT PROJECT

Deliverable 4.3: Inputs for early warning system

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1. Introduction

The AMAZALERT project, and particularly the stakeholder engagement activities related to scenario development and policies in WP4, yielded a wealth of information on socioeconomic, institutional and political context, plausible future outlooks of these aspects, and (un)desirable policies and other actions that could or should be taken. Together, all this information provided a rather complete picture of the types of actions and policies that should be taken in the (near) future in order to successfully attempt to reduce deforestation. This has been documented in various Deliverables, importantly Deliverable 1.2 and Deliverable 4.1 and 4.2. With the exception of some of the information in Deliverable 4.2 where the results needed to run the land use change model are quantified, this information does not translate directly into quantitative indicators and indices that could be measured and monitored. Yet, meaningful input to the AMAZALERT Early Warning System can only be provided when translated to measurable units. This Deliverable provides some first indications of what variables could be measured and why they should be considered for the Early Warning System. What follows is first a short overview of the main conclusions from Deliverable 1.2 and subsequently an overview of the indicators and indices that could be considered, finalising with some overall conclusions.

2. Main findings from stakeholder engagement activities: What social and economic issues are important?

Within AMAZALERT, stakeholders have been engaged in a process of knowledge co-creation in three different ways. First and foremost, two workshops were organised in Brazil where scenarios for the future of the Amazon were developed and detailed accompanied by sets of policies that would need to be implemented. This was complemented by a set of stakeholder interviews, broadening the stakeholder-base. Thirdly, a workshop in Brussels was organised to gain insight in possibilities to reduce deforestation by EU policies and other actions. From these activities, it was concluded that discussion on deforestation and land use change cannot be meaningfully conducted without an integrated analysis of all major aspects that influence the problem. Here, we are mostly interested in the social, political, and economic aspects, on which the following was concluded:

Social:

The Brazilian workshops had a strong focus on social development and therefore touched upon many social problems, including rural exodus to peri-urban areas with accompanying violence and poverty; a decrease in demand for manual labour; isolation of INCRA settlements; and weak policies for family planning. It was concluded that the current model might not be capable of promoting sustainability, as long as it seeks solutions focused on market and consumption, treating people out of the market as invisible. Proposed essential solutions included to revitalise cities; a diversification of the local economy; increase capacity for municipalities, and promote local economic activities; and integrate social and environmental policies. These results were supported by the interviews. The European workshop likewise strongly emphasised social issues (and solutions) in Europe and argued for a focus on strengthening civil society and social cohesion.

In short, social development is regarded the cornerstone to combat deforestation in Brazil.

Economic:

Land-use activities, the agricultural sector, mining, and timber together determine a very large part of the total GDP of Brazil. Consequently, land use change and deforestation cannot be discussed without giving major importance to economic issues. In the discussion of the current situation, Brazilian stakeholders discussed the role of agriculture and forestry, besides a number of other sectors. Both from the workshops and the interviews, however, it became clear that stakeholders see the role of these “traditional” sectors as decreasing, to be replaced by energy (hydro dams, mining), tourism, and other industrial activities. When discussing future solutions, the key words were “diversification”, “sustainable”, and “a different model of development”. The latter relates to a new model that abandons the focus on production increase and agricultural expansion, towards a system in which existing forests and related ecosystem services are valued, though mechanisms such as Payment for Ecosystem Services and an integration with agroforestry systems.

In short, safeguarding economic development is important but should be accomplished through other means and follow a new development model based on valuing ecosystem goods and services.

Political:

Perhaps the most important objective of all stakeholder engagement activities was to arrive to a list of strategies, policies, and other actions that would need to be implemented or taken in order to reduce deforestation in the Brazilian Amazon. A large variety of local, national, and international policies/policy recommendations were listed, sometimes building on existing policies, but sometimes suggesting new initiatives.

3. What social and economic indicators should be considered?

From the above, we concluded that by and large social and economic factors are the underlying driving forces behind change. Policies are obviously crucial instruments in the process of actually reducing deforestation. Yet, in the “bigger picture” of discussing tipping points, they are less essential, particularly because specific policies might change, or be replaced over short time intervals. The remainder of this Deliverable, therefore, focuses on social and economic elements, acknowledging that there is a (large) role for concrete policies in the actual implementation of change in almost all tipping elements.

3.1 Available data and data needs

Overall, there is a wealth of social, demographic, economic, institutional, health, etc. indicators that is already being collected, monitored and analysed. In general, however, indicators are measured either infrequently, or at very long intervals. Also, they are usually based on interviews, samples, or otherwise not directly useful for monitoring purposes. Lastly, the spatial detail differs but is generally rather coarse, with many indicators available only at national level.

An important prerequisite for any of the following variables to be included in a monitoring system would be to closely analyse the quality of the data and possibilities to increase frequency of measurement and/or sample and/or spatial detail. This holds particularly for social and institutional variables, and only to a lesser extent for economic variables. In general, the minimum level of detail for any variable to be considered is:

- Geographic scale: Spatial extent: Legal Amazon; spatial resolution: state level.
- Temporal scale: Measure every 1-5 years, depending on rate of change.

In general, as little as possible should be based on new monitoring systems and as much as possible should be derived from existing (or improved) systems.

3.2 Preliminary list of indicators

In drafting a first, preliminary list of indicators, we used three important criteria. First, the issue needed to have been mentioned in the stakeholder workshops or interviews. Secondly, it could be seen as an indicator of a tipping element and thus be useful to consider in Early Warning System. Thirdly, it should be straightforward to quantify and collect data. We, for example, did not include social indicators such as “cultural identity” or “happiness”, which might be important, but for which simple indicators are lacking.

3.2.1 Economic indicators:

- GDP growth (% per year) – to monitor total performance of Brazilian economy.
- GVA Agriculture (% of total GDP) – to monitor the contribution of agriculture in total GDP.
- GVA Forestry (% of total GDP) – to monitor the contribution of forestry in total GDP
- National and Foreign direct investments in large infrastructure plans, roads, water, gas/oil (USD) – to monitor foreign investment and interest in further exploitation of the Amazon
- Inflation rate (%) – to monitor the strength of Brazilian Real and thus of potential for export increase
- Export of Amazon products (USD value of soy, milk, beef, etc.) – to monitor pressure on Amazon forests
- Payment of Ecosystem Services (% of total income) – to monitor the potential economic effect of PES.

In general, a wealth of information is available to monitor the (changes in) economic values of sectors that are exploiting the natural resources in the Amazon, importantly agriculture, forestry, and mining.

3.2.2 Social and institutional indicators:

- Rural/urban population growth (persons) - to monitor rural exodus.
- Labour force (persons) – to monitor manual labour as opposed to mechanisation and intensification
- Legal structure and property rights (% of municipalities that have cadastre complete) – to monitor degree to which land ownership is officially documented.
- Control of corruption index (-) – to monitor degree to which corruption and thus illegal activities change
- Crime rates (number) – to monitor illegal activities
- Rate of literacy (% of population above 18) – to monitor education

- School enrollment (% of population below 18) – to monitor education
- Gini coefficient – to measure inequality
- Percentage of people below poverty line (% of total population) – to monitor income distribution as well as people without options to conserve forests
- Life expectancy at birth (years) and other health indicators – to monitor health aspects of quality of life
- Involvement of civic society (membership of NGOs; sports clubs etc.) – to monitor overall social capital; often used as one of the proxies for ‘happiness’.

Overall, this list includes many crucial, slow variables that are often considered steering transitions and determining tipping elements. If social and human capital degrade, there will be less basic support for sustainable policy making, a new economic model, and/or investments of ecosystem services. Particularly when e.g. national policies and foreign investments can mask the lack of local/national support, the decrease of social capital indicators can lead to a potential tipping point towards strongly accelerated deforestation. Although most indicators are simple and easy to measure, they interact in complex ways and resulting human behaviour is complex and might call for either indirect or composite indices of parameters that need to be monitored. As such, this list will need (much) more discussion.

3.3 Key indicators to monitor

In summary, there are many economic indicators that can be measured and could be monitored. Indicators will mostly provide information on short-term or medium-term changes in pressure on the Amazon forests through economic exploitation of its resources. Likewise, there are many social, demographic and institutional indicators that could be measured at least indirectly and that could then be monitored. Social indicators will mostly provide information on slow, long-term changes. Within tipping point concepts, understanding slow variables is essential in understanding when tipping points might occur. Thus, arguably it is essential that particularly social indicators are included in the Early Warning System to monitor long-term trends in e.g. poverty, crime, education, and health.

4. Towards input for the Early Warning System

The Deliverables on the Early Warning System (see WP5 output) will elaborate further on how indicators can be used to monitor critical change. Here we provide some initial formulation from indicators to tipping elements and associated features and critical values. The information in Table 1 is based on Lenton et al. (2008) that introduce “tipping elements” rather than “tipping points”.

4.1. Some terminology

To understand Table 1, it is essential to understand the difference between the various terms. Note that terms are used similar but not identical to Lenton et al. (2008), as properties of the global climate system do not translate completely to Amazon-wide social and economic systems.

Tipping element: Components of the system that might pass a tipping point

Critical value: the point at which the system might tip.

Feature of the system: What is the element that is crucially changing?

Indicator: how is the feature quantified?

Control parameter: what is the main means of intervention?

Transition timescale: what is the estimated time interval before critical value might be reach given current trends

Table 1. Potential future tipping elements in the socioeconomic system related to deforestation and the functioning of the Amazon.

Tipping element	Feature of system (direction of change)	Indicator	Control parameter	Critical value of indicator ¹	Transition timescale	Key impacts
Economic importance of Brazil	Total assets	GDP growth	Production, investments	Sustained below 1% per year	10-30 yrs.	Lack of financial resources for sustainability measures
Agricultural importance in Amazon economics	Areal extent (+)	GVA agriculture	International trade	10% at national level	10-30 yrs.	Clear cut deforestation
Forest cover	Opening of forests (+)	GVA Forestry	International trade	Unknown. Mostly included in agriculture.	10-30 yrs.	Forest degradation
Economic importance of Amazon	Exploitation of natural resources (+)	Investment rates	International corporations	Difficult to estimate. Related to other indicators.	10-30 yrs.	Natural resource depletion
Export	Production in Amazon (+)	Inflation rate	International (meat) demand	Hyperinflation (~2000%)	10-30 yrs.	Clear cut deforestation
Export	Production in Amazon (+)	Production of ag. products	International (meat) demand	Difficult to estimate. Related to yield.	10-30 yrs.	Clear cut deforestation
Forest cover	Value of standing forests (-)	PES	Ecosystem services valued	Unknown. Relative to value of agriculture.	10-30 yrs.	Lack of forest protection
Urban system	Urban population density (-)	Rural outmigration	Urban pull	Difficult to estimate. Depends on city planning.	20-40 yrs.	Increase in inequality and poverty
Rural system	Emptying of countryside (+)	Labour force	Differentiation of economy	Unknown. Related to social capital.	20-40 yrs.	Lack of social fabric in countryside
Legal system of protection	Illegal land ownership and deforestation (+)	Property rights	Government control	Sustained <50%	10-30 yrs.	Lack of control
Legal system of protection	Illegal activities (+)	Control of corruption	PPCDAm	Difficult to estimate.	50-100 yrs.	High rates of illegal activities
Legal system of protection	Illegal activities (+)	Crime rates	Government control	Difficult to estimate.	20-40 yrs.	
Education	Education of adults (0)	Illiteracy rate	Government programs	Close to 100%; regional breakdown needed.	30-50 yrs.	Behavioural change towards sustainable thinking
Education	Education of youth (0)	School enrollment	Access to school system	Sustained below 80%	50-100 yrs.	Behavioural change towards sustainable thinking
Inequality	Income differences (+)	Gini coefficient	Multiple	Sustained above 40%	20-40 yrs.	Rural poverty
Income level	Low income (0)	Poverty line	Economy	Sustained above 20%	30-50 yrs.	Poverty
Health system	Health status (+)	Life expectancy	Multiple	Sustained below 75 yrs.	30-50 yrs.	Affects quality of life
Social capital	Quality of life (0)	Civic society involvement	Multiple	Difficult to estimate	50-100 yrs.	Affects quality of life.

1: These values are very preliminary and serve as indications rather than values that can be used directly.

4.2. Conclusions

The following main conclusions can be drawn:

- There are many potential future social and economic tipping elements
- The list is very preliminary and subject to change
- It is close to impossible to assess tipping elements in terms of critical values. Much depends on (temporal, spatial, and thematic) system boundaries.
- The diversity across the Amazon is large. It might therefore be necessary to zoom in to smaller areas, particularly in forests that are currently under pressure.
- It is evident that many potential elements act over (very) long time scales and might be very difficult to reverse once critical values are exceeded.
- Thus, despite many unknown and the preliminary character of this analysis, it is clear that social and economic aspects need to specifically be considered when designing an Early Warning System.

5. Reference

Lenton, T.M., Held, H., Kriegler, E., Hall, J.W., Lucht, W., Rahmstorf, S., Schellnhuber, H.J. 2008. Tipping elements in the Earth's climate system. PNAS 105(6): 1786-1793.