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Amazonia Security Agenda

Strengthening the water, energy, food and health security nexus in the region and beyond

Summary of Findings and Initial Recommendations

Authored by

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CIAT
Centro Internacional de Agricultura Tropical
Desde 1967 / Ciencia para cultivar el cambio

This document is based on the following reports:

Water Security in Amazonia produced for this project by Mark Mulligan[1], Jorge Rubiano[12], Sophia Burke[3] and Arnout van Soesbergen[1] of the [1]Department of Geography, King's College London, [2]Department of Geography, Universidad del Valle, Colombia and [3]AmbioTEK Community Interest Company, UK.

Energy Security in Amazonia produced for this project by André F. P. Lucena, Alexandre Szklo, Roberto Schaeffer, Rafael Soria, and Mauro Chavez-Rodriguez of the Energy Planning Program, COPPE, Federal University of Rio de Janeiro (UFRJ), Brazil.

Food Security in Amazonia produced for this project by Rodomiro Ortiz of the Swedish University of Agricultural Sciences.

Health Security in Amazonia produced for this project by Ulisses Confalonieri[1] and Anna Flávia Quintão Fonseca[2] of the [1]Oswaldo Cruz Foundation, Brazilian Ministry of Health and the [2]School of Public Health, State of Minas Gerais, Brazil.

Climate Change and Land Use Change in Amazonia produced for this project by Jean P. Ometto, Gilvan Sampaio, Jose Marengo, Talita Assis, Graciela Tejada, and Ana Paula Aguiar of Earth System Science Center (CCST), National Institute for Space Research (INPE), Brazil.

Land Use Status and Trends in Amazonia produced for this project by Alejandro Coca-Castro[1], Louis Reymondin[1], Helen Bellfield[2] and Glenn Hyman[1] of the [1]International Centre of Tropical Agriculture (CIAT) and [2]Global Canopy Programme (GCP).

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1. A new security agenda for Amazonia

A nexus of securities under threat

Amazonia's abundant natural resources underpin water, energy, food and health security for the people and economies of the region and far beyond. At the heart of this nexus of securities is water. So abundant in the region, but now under increasing threat as industrial and agricultural pollution increases, and extreme droughts reveal a once unthinkable water vulnerability.

Huge wealth continues to be generated from Amazonia's vast natural resources, but with high environmental and social costs. And even as many of its nations seek to produce more energy, minerals, metals and agricultural commodities from the region to meet increasing national and global demand, Amazonia's own citizens do not share equitably in the benefits.

This large-scale economic development in Amazonia has always been predicated on deforestation. But by compromising Amazonia's ecosystems, deforestation is now threatening not only the wellbeing and rights of the region's people, but also the economic sustainability of the very industries that it has enabled.

Climate change as a threat multiplier

Climate change will multiply these threats, as increasing temperatures, changing rainfall patterns and more frequent and intense extreme events further impact water, energy, food and health security.

The droughts, floods and fires of the last decade could provide an early indication of the challenges and opportunities that lie ahead.

A new security agenda

This calls for a new security agenda for Amazonia. Not one focused only on national security in a traditional sense, but rather one that acts to strengthen the fundamental underpinnings of a flourishing society – sustained access to water, energy, food and good health for all. These 'securities'[1] are under increasing threat, both individually and in combination, creating significant risks for people, governments and industry.

In other parts of the world, the impacts of environmental degradation are already exacerbating human and economic insecurity on a large scale. As a continent, South America has been least affected by this dynamic – perhaps in large part because of its dependence on a healthy Amazonia.

The opportunity for decision-makers

The countries of Amazonia may have differing visions for the region, but they have joint dependence on its natural resources and joint exposure to regional-scale risks. For their leaders, the opportunity is clear: work together to mitigate threats to water and the other securities, and incentivise the transition to a more sustainable and equitable economy that will flourish in a changing Amazonia.

Given overlaps with existing regional processes and priorities, the political and logistical difficulties are many. A new perspective on the problem is urgently needed – one that recognizes that fundamental issues of national prosperity and regional security are at stake, and can offer a new platform for action.

Initial policy recommendations are therefore laid out in section 6, to serve as building blocks for nationally-focused discussions that are planned in Bolivia, Brazil, Colombia, Ecuador and Peru.

2. Abundant Amazonia

Greater Amazonia

Amazonia is a heterogeneous mosaic of ecosystems and populations without clear geographical boundaries. Definitions vary widely between countries and contexts[2], and have been based, among other things, on ecological criteria, altitude, watershed, and political-administrative boundaries. This study follows ACTO-UNEP's definition of 'Greater Amazonia', derived by including the maximum possible area across hydrographic, ecological and political/administrative criteria[3].

	AREA KM²	% SHARE OF AMAZONIA	% OF COUNTRY IN AMAZONIA
BOLIVIA	724,000	9.8	65.9
BRAZIL	5,034,740	67.9	59.1
COLOMBIA	477,274	6.4	41.8
ECUADOR	115,613	1.6	40.8
PERU	651,440	8.8	50.7

Based on ACTO-UNEP (2009). Country data are not available for the Greater Amazonia region and therefore are presented using the political-administrative defined region.

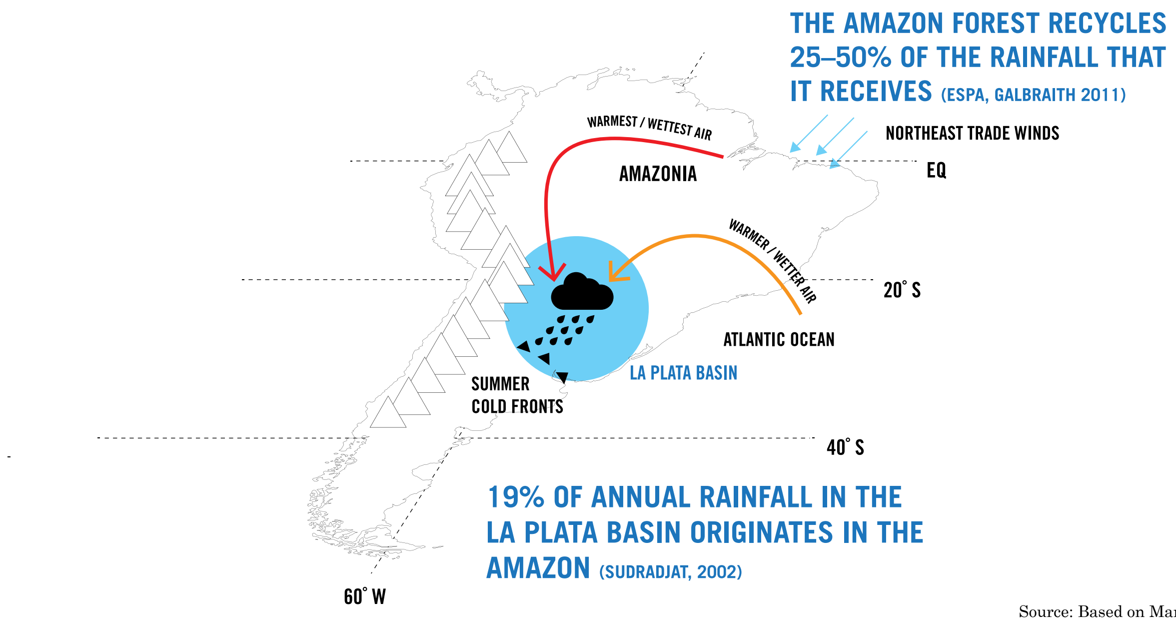
Ecosystem services underpin security

Rainforest is the most extensive among Amazonia's ecosystems, but rivers, lakes and wetlands, and savannas are also significant[4]. Together, these ecosystems, with their rich biodiversity, provide a wide range of services which underpin water, energy, food and health security for the people of the region and beyond.

Water security in particular is dependent upon the forest's rainfall recycling and water regulation and purification services[5]. Other forest ecosystem services that are vital at different scales include the provisioning of food and medicinal resources; nutrient recycling, erosion regulation, and moderation of extreme events; climate regulation and carbon sequestration and storage[6].

Amazonia not only supports the economy and human wellbeing within the region itself, but also those far beyond its boundaries. The Amazon releases 8 trillion tonnes of water vapour into the atmosphere each year[7], recycling water from the Atlantic across the forest and transporting it over thousands of kilometres[8]. Around

FIGURE 1: AMAZONIA UNDERPINS REGIONAL WATER SECURITY



Source: Based on Marengo, J.A. et al 2004 one fifth of the rain that falls in the La Plata Basin, a region which generates 70% of the GDP for the five countries that share it[9], comes from the Amazon[10]. In other words, Amazonia's ecosystem services underpin water security far beyond the forest, feeding agriculture and hydropower, and providing water for industry and people. The estimated value of this is in the order of tens of billions of dollars annually[11].

Interdependence

Water, energy, food and health security are interdependent in Amazonia, and ultimately all depend on its ecosystems.

Water security is central to this nexus. It is essential for hydroelectric power generation and the riverine transport of liquid fuels to rural communities (supporting energy security); for agricultural production and fishery productivity (supporting local and regional food security); and the provision of clean drinking water, mitigation of droughts and floods, and regulation of water-borne diseases (health security). In turn, both large-scale agriculture and energy generation in the region negatively impact water security through pollution and flow disruption, with further impacts for food and health security of local populations.

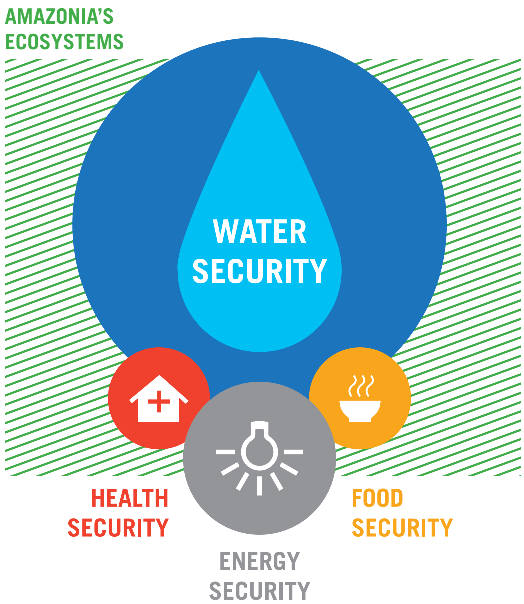
Today, this interdependence between the securities multiplies threats. If better understood and accounted for, this could inform and strengthen strategic policymaking at sub-national, national and regional levels.

FIGURE 2: WATER, ENERGY, FOOD AND HEALTH SECURITY IN AMAZONIA ARE INTERDEPENDENT

WATER SECURITY INTERACTIONS:
AGRICULTURAL PRODUCTION
FISH PRODUCTIVITY
HYDROELECTRIC POWER GENERATION
AVAILABILITY OF CLEAN DRINKING WATER
PUBLIC HEALTH

ENERGY SECURITY INTERACTIONS:
MECHANISED AGRICULTURE
COMPETITION WITH CROPS FOR LAND AND WATER
POLLUTION FROM EXTRACTIVE INDUSTRIES
PROVISION OF HEALTH SERVICES

FOOD SECURITY INTERACTIONS:
COMPETITION WITH BIOFUELS FOR LAND AND WATER
POLLUTION THROUGH USE OF AGROCHEMICALS
NUTRITION FOR HEALTH



3. The economic and human landscape in Amazonia

3.1 Huge wealth is being generated for the countries of Amazonia

The scale of current economic activity in Amazonia is often underestimated. The region's natural abundance in resources is being monetised on an industrial scale. Its direct financial value is in the order of magnitude of many $10s of billions annually. Some key points:

- **Oil and natural gas** are mainstays of the economies of Bolivia (45% of total national exports[12]), Ecuador (55%[13]), and Peru (11%[14]). In Ecuador 99% of the country's oil[15], enabling $8.9 billion of crude oil exports[16], comes from Amazonia. In Colombia, 23% of the country's oil comes from Amazonia[17].

- **Amazonian hydropower** supplies a high percentage of national electricity needs: 39% in Ecuador, 35% in Bolivia, 22% in Peru, and 11% in Brazil[18].

- **Amazonian produce** feeds the region: 37% of Brazil's beef herd is in Legal Amazonia[19] (83.5% of all Brazilian beef is consumed domestically[20]). 24% of Colombia's fresh-water fish catch is from Amazonia[21], and 22% of Bolivia's rice[22].

- **Amazonian agricultural commodities** are exported at scale. Soyabean grain and beef from Brazil's Legal Amazonia generated $7 billion and $1.6 billion respectively in export revenues in 2012[23].

- **Amazonian metals** generate huge revenues: Brazil's Pará state alone produces iron ore worth c. $8.8 billion annually, 28% of the country's total[24]. Madre de Dios region of Peru produces 14% of the country's gold[25], a key national export worth $9.5 billion in total in 2012[26].

Demand for these commodities is increasing as national and global populations grow larger and richer. Chinese demand in particular has driven the expansion of Amazonian soya in recent years[27], accounting for some 70% of Brazil's soyabean exports in 2012, up by almost a factor of ten since 2000[28].

And national plans and concessions aim towards accelerated development in the region. For example:

- 30 new dams are planned for the Brazilian Amazon by 2020[29], and 59 across the Andean Amazon[30]. The potential for new hydropower in the region is gigantic (in the Peruvian Amazon, which already supplies 22% of the country's electricity, less than 1% of technical potential has been exploited[31]).

- Bilateral agreements to meet Brazil's growing energy needs have been proposed or agreed with other Amazonian nations (Bolivia for gas, and Bolivia and Peru for hydropower[32]). These are proving controversial.

- Brazil plans to increase national soya exports by 39% and beef exports by 29% by 2021[33].

- 21% of Amazonia is under some form of mining exploitation or concession, and 14% under some form of oil exploitation or concession[34].

- Amazonia is being integrated into national and international transport networks. This includes 57 transport projects supported by the IIRSA initiative valued at more than US$ 6 billion[35].

This export economy is dependent on Amazonia's water and energy security. Hydropower generation and agricultural commodity production, rely directly on the region's abundant rainfall. Similarly mining, oil extraction and thermo-power generation all require abundant and clean water.

Today's industrialised Amazonian economy also relies on energy supply at scale. Mechanised agriculture, oil extraction and mining all have high energy needs. Energy provision for industry in the region is often closely tied to hydropower (and thus water security) – the Tucuruí dam, for instance, was in significant part developed to power the energy-intensive mining and metallurgical industries in the region[36].

FIGURE 3: AMAZONIA'S EXPORT ECONOMY

BOLIVIA

CONTRIBUTION TO NATIONAL PRODUCTION FROM AMAZONIA

- 39% ELECTRICITY FROM HYDROPOWER
- 41% BEEF HERD BENI AND PANDO DEPARTMENTS
- 24% NATURAL GAS FROM COCHABAMBA AND SANTA CRUZ DEPARTMENTS

INTERNATIONAL EXPORT REVENUES THAT DEPEND ON AMAZONIA

- US$940 MILLION FOR SOYA, 2012
- US$3.8 BILLION FOR NATURAL GAS, 2011

BRAZIL

CONTRIBUTION TO NATIONAL PRODUCTION FROM AMAZONIA

- 17% NATURAL GAS FROM AMAZONAS STATE
- 11% ELECTRICITY FROM HYDROPOWER
- 37% BEEF HERD
- 28% IRON ORE FROM PARA STATE

INTERNATIONAL EXPORT REVENUES FROM LEGAL AMAZONIA

- US$7 BILLION SOYABEAN GRAIN, 2012
- US$1.6 BILLION BEEF, 2012
- US$0.5 BILLION TIMBER, 2012
- US$8.8 BILLION IRON ORE FROM PARA STATE, 2012

COLOMBIA

CONTRIBUTION TO NATIONAL PRODUCTION FROM AMAZONIA

- 23% OIL
- 24% FRESHWATER FISH CATCH
- 17% BEEF HERD

INTERNATIONAL EXPORT REVENUES FROM AMAZONIA

- US$94 MILLION OIL PUTUMAYO DEPT, 2000

ECUADOR

CONTRIBUTION TO NATIONAL PRODUCTION FROM AMAZONIA

- 35% ELECTRICITY FROM HYDROPOWER
- 99% OIL

INTERNATIONAL EXPORT REVENUES FROM AMAZONIA

- US$8.9 BILLION OIL, 2010 (US$3.8 BILLION PRODUCTION VALUE CRUDE OIL AND NATURAL GAS)

PERU

CONTRIBUTION TO NATIONAL PRODUCTION FROM AMAZONIA

- 73% OIL AND LIQUID NATURAL GAS
- 22% ELECTRICITY FROM HYDROPOWER
- 14% GOLD PRODUCED IN MADRE DE DIOS REGION
- US$23 BILLION FROM CAMISEA NATURAL GAS PLANT OVER 30 YEAR LIFESPAN

INTERNATIONAL EXPORT REVENUES FROM AMAZONIA

- US$166 MILLION TIMBER 2011
- US$196 MILLION COFFEE FROM AMAZONAS AND SAN MARTIN REGIONS, 2011

3.2 Human landscape: insecurity in a land of plenty

Water, energy, food and health security are also fundamental to people's right to a good quality of life.

While progress has been made in recent years to improve the standard of living in the region, on numerous indicators Amazonia's citizens remain insecure. The wealth created within Amazonia has enriched few Amazonians. Local people have carried the costs of industrial activity such as pollution, and of increased competition for water and energy both in remote rural areas and in Amazonia's fast-growing cities. This raises critical questions of rights and equity which have for a long time beset the region.

The provisioning of clean water, food, raw materials and medicinal resources is especially important for the wellbeing of indigenous and traditional rural communities of Amazonia. Amongst other populations, and especially the 65% who live in urban centres[37], income and thus purchasing power is a key determinant of wellbeing. And despite recent progress in tackling poverty, it remains widespread in the region and a major obstacle to security. As many as 60% of people in the Bolivian Amazon, 37% in Ecuador, 23% in Peru and 17% in Brazil are estimated to be below the extreme poverty line[38].

- **Water security:** Water purification ecosystem services are important for the provision of clean drinking water. However, limited access to a proper water supply, treatment and basic sanitation infrastructure across Amazonia[39], particularly in rural areas, makes water security of Amazonian populations extremely vulnerable to pollution (section 4). This has knock on effects on food security (fisheries) and health security. In Ecuador 30,000 Amazonian citizens are seeking compensation through the courts at the billion US dollar scale over claims of toxic pollution by oil companies in the region[40].

- **Energy security:** amongst rural populations there is high reliance on expensive imports of liquid fuel, and unreliable electricity coverage[41], though progress has been made through rural electrification programs[42]. Firewood is still an important source of energy in rural areas, particularly in Peruvian Amazonia[43].

- **Food security:** Despite poor soils[44] the Amazon supports a wide variety of crops, fruits, and other food sources[45]. Fish and livestock are key sources of animal protein for both rural and urban populations in Amazonia[46]. Where these are unavailable, wild meat is often an important element of the diets of indigenous and rural populations[47]. Food insecurity is a major problem in the region, affecting up to one third of Amazonian citizens[48]. 20% of children in Peruvian and Ecuadorian Amazonia are thought to be malnourished[49].

- **Health security:** Even considering recent improvements, health indicators in Amazonia are still poor, and health services are often basic[50,51]. The forest plays an important role in the regulation of malaria, leishmaniasis and other infectious diseases which are prevalent in the region[52]. Natural medicinal resources are not only important for indigenous and traditional rural communities but are also widely used in urban areas as affordable healthcare[53].

4. Growing threats to the security nexus

The nexus of water, energy, food and health security that both people and economies in the region depend upon is under increasing pressure from both new and evolving threats.

Deforestation

Drivers of deforestation

Historically deforestation rates have been highest in Brazil, although changing patterns associated with improved monitoring and governance have seen a significant decrease from the country's peak in 2004. However, a recent spike raises questions over the permanence of this trend. In contrast a significant increase in deforestation has been seen in the Andean countries, particularly Bolivia, over the past decade[54].

While deforestation drivers vary amongst and within different countries, the key drivers in Amazonia today are conversion to mechanized large-scale cultivation of monocultures and cattle-ranching; mining and hydrocarbon exploitation; illicit crops, infrastructure projects like hydroelectric dams or roads; and smallholder agriculture by emigrants[55]. The development of transport infrastructure can also facilitate further deforestation by increasing access to land and resources unless strict governance controls are in place[56].

In the future, climate change is also expected to be a driver of deforestation. Drier conditions and a more fragmented forest will increase vulnerability and precipitate further forest loss[57]. During the extreme drought in September 2010 there were a high number of forest fires, about 200% higher in comparison to September 2009.

Loss of ecosystem services

The loss of ecosystem services through deforestation undermines the securities and particularly water security that is so pivotal. The forest recycles 20-25% of the rainfall it receives[58], and air travelling over extensive forest cover may generate twice as much rainfall as air over deforested land[59]. Large-scale deforestation is predicted to reduce rainfall by up to 21% by 2050[60], although the science is still uncertain. Furthermore, deforestation is likely to affect water quality through increasing soil erosion and leaching of nutrients and heavy metals including mercury[61].

A recent study suggests that the controversial Belo Monte dam in the Brazilian Amazon, which is projected to supply 40% of Brazil's additional electricity needs by 2019, will have a significantly lower power output than expected due to regional deforestation - up to 13% lower than under a fully-forested scenario, and up to 36% lower by 2050 if current deforestation rates continue[62].

Deforestation and forest degradation reduce resilience to extreme events[63] such as fires, floods and landslides with major impacts across the securities (section 5).

Inequity and conflict

Unequal access to resources as well as wide social and economic discrepancies between Amazonia's poor, wealthy rural landowners and national and multinational companies is being further exacerbated by the dominant model of development and deforestation in Amazonia today.

Mining, large infrastructure projects and agricultural expansion which threaten indigenous territories, small farmers and rural communities have already led to more incidents of violent conflict. In 2009, indigenous peoples' protests over land and resource rights in Bagua, Peru, escalated to extreme violence that left at least 30 people dead[64].

Conflict is likely to increase as competition for land and resources intensifies.11% of oil blocks overlap with officially recognised Indigenous Territories with 33% already in exploration and 1% in production. 18% of mining concessions also overlap with officially recognised Indigenous Territories[65].

FIGURE 4: EXTREME DROUGHT IN AMAZONIA
DROUGHTS ARE PREDICTED TO INCREASE IN FREQUENCY AND INTENSITY UNDER CLIMATE CHANGE, BUT WHEN AND WHERE THEY OCCUR IS UNCERTAIN

2005 DROUGHT

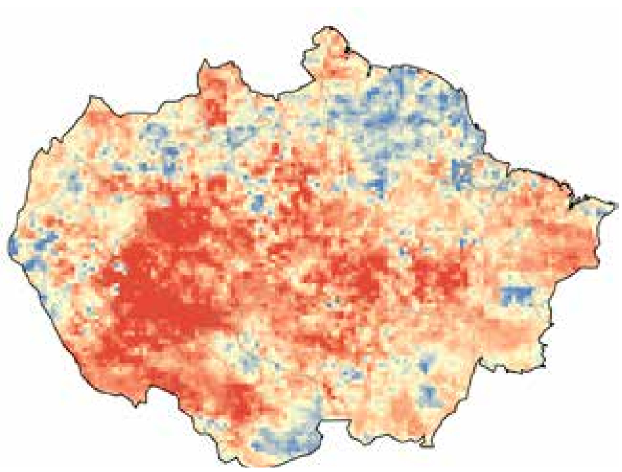
1.9 MILLION KM^2
IMPACTED (SEE MAP)

US$139 MILLION
COST OF CROP LOSSES IN THE BRAZILIAN AMAZON

18.5%
RISE IN COSTS OF HOSPITAL ADMISSIONS FOR RESPIRATORY ILLNESS IN ACRE STATE, BRAZIL

US$100 MILLION
VALUE OF ECONOMIC, SOCIAL AND ENVIRONMENTAL LOSSES IN ACRE STATE, BRAZIL

THE AIRPORT, SCHOOLS AND BUSINESSES SHUT
DUE TO FOREST FIRES IN ACRE STATE, BRAZIL



2010 DROUGHT

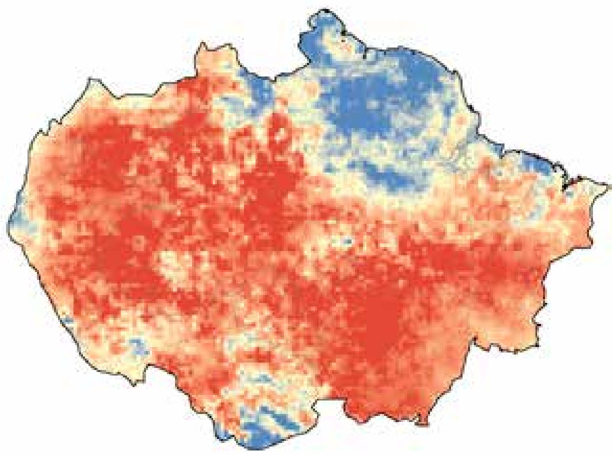
3 MILLION KM^2
IMPACTED AREA (SEE MAP)

600 TONNES OF FOOD AID
TO AMAZONAS STATE, BRAZIL

20% OF NORMAL CAPACITY
FOR RIVERINE SOYA EXPORTS, FORCING CARGILL TO DIVERT EXPORTS 2000 KM BY ROAD

62,000 AFFECTED
IN AMAZONAS STATE, BRAZIL

200%
RISE IN FIRES ON PREVIOUS YEAR



RAINFALL ANOMALY (SD)

- < -2
- -2 to -1
- -1 to 0
- 0 to 1
- 1 to 2

Maps from LEWIS, S. et al. (2011) showing satellite-derived standardized anomalies for dry-season rainfall for the 2005 and 2010 droughts in Amazonia.

Pollution

Pollution particularly from mining, agricultural runoff, oil extraction, and sewage is increasingly impacting water security throughout Amazonia[66]. This is exacerbated by the limited water treatment and sanitation infrastructure throughout the region, especially in rural areas. For example only 55% of Peruvians, 49% of Bolivians and 29% of Ecuadorians in the region have access to a treated water supply[67]. This loss of water quality has impacts on local fish stocks, drinking water, and of course human health among others. In the region of Madre de Dios, Peru, where large quantities of mercury have been used in artisanal gold mining, 78% of adults in the regional capital tested for levels of mercury above international safety limits[68].

While pollution mainly impacts populations local to the point source, it can also have larger-scale regional impacts. A recent oil spill in the Ecuadorian Amazon's Napo River not only contaminated the drinking water supply of cities and local communities in the region, requiring drinking water to be imported, but also contaminated areas downstream in Peru's Loreto region[69].

Indirect threats

There are also many indirect threats to Amazonia's security, and whilst they are not the main focus of this analysis it is important to recognise their role. These indirect threats include; weak governance and law enforcement, land tenure issues, unplanned urbanisation, and a lack of coordination in national planning.

Water governance has been poor across the region for instance, in part because of historic presumptions of water abundance. The first national water authority in the region was only established in 2000, and until 2005 none of Brazil's Amazonian states had a plan for managing water resources[70].

5. Climate Change: a threat multiplier for Amazonia

Looking into the future, it is likely that all these threats to Amazonia's prosperity will be multiplied by anthropogenic climate change exacerbating their environmental, economic and social costs.

The very real impacts of the unprecedented floods and droughts which have hit the region in the past decade offer a useful if still partial view into a climate-challenged future.

Extreme events in Amazonia

These extreme events have had wide-ranging impacts that underline in very real terms the interdependence of the securities: energy blackouts, destroyed crops, mass displacements of people, and outbreaks of water-borne and respiratory diseases[71]. They have also severely disrupted commerce: in August 2010, agricultural giant Cargill's river transport of soyabean was running at 20% of normal capacity due to low water levels in the Madeira River, forcing a 2,000km diversion to southern ports[72].

Extreme events can have serious implications for the energy security of local industries, cities and urban centres outside of the region. Hydropower generation is at risk from drought, and vulnerably configured pipelines and cables crossing vast distances are susceptible to landslides and flooding. Heavy rain in 2004 caused a pipeline leak from the Camisea gas project in Peru[73], and a fire in a substation in the Brazilian Amazon left 53 million people across the North East of Brazil without energy over several days[74].

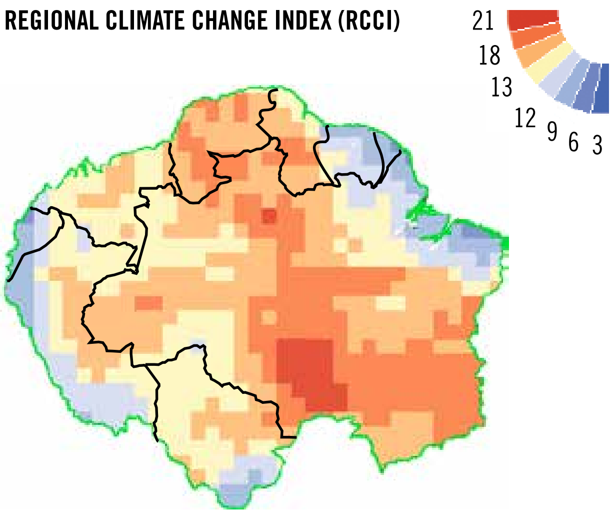
Climate change projections

Climate models for the region, while uncertain, converge on a few broad projections:

- Increasing frequency and intensity of extreme events[75,76]. Amazonia may suffer drought every other year by 2025[77].

FIGURE 5: CLIMATE CHANGE HOTSPOTS IN AMAZONIA
SOUTH-SOUTH-EASTERN AMAZONIA, AN AREA OF HIGH DEFORESTATION, FIRES AND DROUGHTS HAS BEEN HIGHLIGHTED AS PARTICULARLY VULNERABLE TO CLIMATE CHANGE. THIS COULD THREATEN SOYA PRODUCTION WHICH IS PREDOMINANT IN THE AREA.

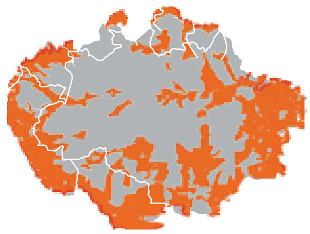
REGIONAL CLIMATE CHANGE INDEX (RCCI)



ARC OF DEFORESTATION

MAIN SOYA CROP AREAS

THE REGIONAL CLIMATE CHANGE INDEX (RCCI) COMBINES CHANGES IN TEMPERATURE AND PRECIPITATION TO IDENTIFY 'CLIMATE CHANGE HOTSPOTS'



POPULATION DENSITY

- All-important rainfall patterns are changing and while uncertain, we may expect a wetter western and drier eastern Amazon by 2050[78,79].

- Rising temperatures, potentially up by a game-changing 3.5°C on average by 2050[80].

Such changes would severely impact all the securities, increasing vulnerability and risk for the region's growing economies and populations. Taken together in combination – as experienced on a still relatively small scale during the droughts and floods of the last decade – they will dangerously stretch the capacity of people, governments and industry to cope:

- Higher temperatures in Amazonia, coupled with drier conditions in some areas, could have a major effect on food security and, particularly in Brazil and Bolivia, on agricultural exports. Soybeans, rice, maize and many other staple crops suffer significantly lower yields when average annual temperatures rise above 30°C, and sensitive crops like beans simply cannot thrive in these conditions[81]. A recent study suggests that continued deforestation and climate change could lead to a 28% reduction in soyabean yields by 2050[82] and higher temperatures could affect pasture and so livestock grazing[83]. This would have direct implications for global supply chains.

- Hydropower generation, especially for run of river dams, will be more vulnerable in the dry season, challenging future energy security across the region, especially given plans to invest heavily in new Amazonian hydropower[84].

- High existing rates of climate sensitive diseases like malaria and dengue increases the vulnerability of Amazonia's citizens to climate change in certain areas. This will be exacerbated by poor health indicators and limited health services[85].

- The unpredictability of droughts, floods and fires increases the risks to human wellbeing and economic activities as discussed above.

- Climate change hotspots, such as SSE Amazonia where drier conditions are predicted[86] and large-scale agriculture is prevalent[87], will suffer greater impacts to water and the other securities[88].

Conclusions

1. Water, energy, food and health security are interdependent, and water security is key. This is a critical nexus for decision-makers, offering new opportunities for impact.

2. Maintaining Amazonia's ecosystems in balance with sustainable economic growth is fundamental to security for people and economies at multiple scales across the region.

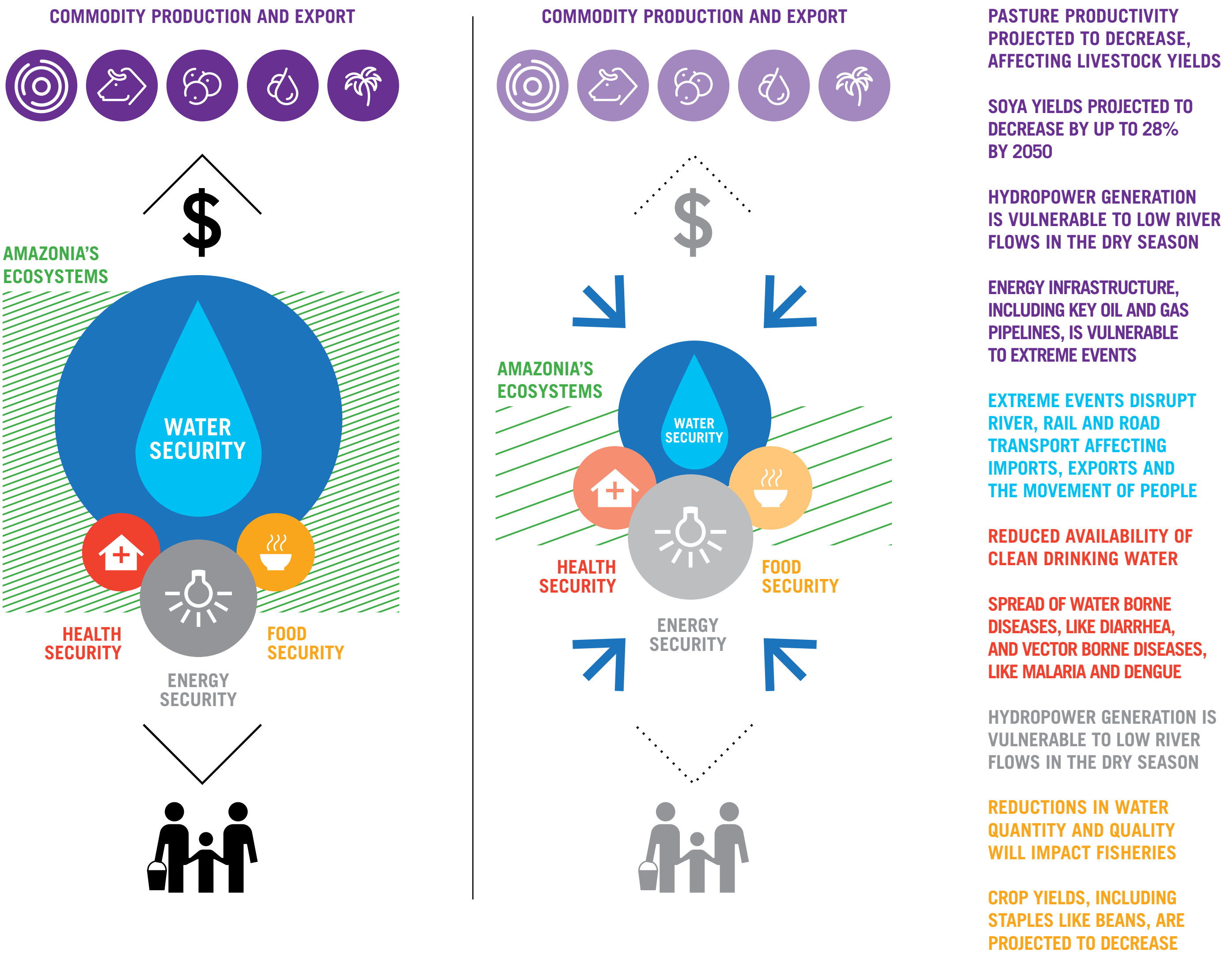
3. Already widespread inequity in Amazonia will be exacerbated by threats to the securities, and is likely to lead to increased social conflict unless addressed.

4. Joint dependence on Amazonia's natural resources and joint exposure to regional-scale risk call for greater regional cooperation, alongside decisive action at the national level.

5. Threats to Amazonia's security are increasing and will be multiplied by climate change with high environmental, social and economic costs. Inaction could create unprecedented challenges for South America's political leaders.

FIGURE 6: THE AMAZONIA SECURITY AGENDA

WATER SECURITY IN AMAZONIA UNDERPINS HUMAN WELLBEING AND ECONOMIC PRODUCTION IN THE REGION AND FAR BEYOND. EMERGING THREATS TO WATER AND THE OTHER SECURITIES WILL BE MULTIPLIED BY CLIMATE CHANGE.



6. Opportunity for decision-makers

Achieving the right balance between economic development and safeguarding vital ecosystems in Amazonia is the key to a secure future. Links between water security and a thriving forest ecosystem have long been recognised – but more work is needed to understand the interdependence between water, energy, food and health security in Amazonia, and to quantify the likely impacts to economies and people.

Questions remain unanswered: How do impacts to Amazonia's water affect the wider region's economies and what could the costs be? Are there 'security hotspots' which critically underpin local communities or industry? Which aspects of development in Amazonia increase security and which most threaten it?

The need for better answers will grow increasingly urgent over the next decade as accelerating climate change in Amazonia multiplies threats to security. But failure to act now on clear early warning signs like the impacts of recent extreme droughts in the region could lead to far greater economic and social disruption in the mid-term, and create unprecedented challenges for South America's political leaders.

If smartly managed, such a scenario can be avoided. Amazonia's natural wealth can provide both material goods and essential ecosystem services. With foresight, Amazonia's industry, infrastructure and cities can evolve to minimise their 'security footprint' and flourish in a changing Amazonia.

To achieve this, two major changes are needed:

i. **A shift in paradigm:** recognition by governments in the region that Amazonia's ecosystems do not only influence global climate change but also underpin the ongoing wellbeing and prosperity of people across the continent.

ii. **Better knowledge of risks to inform better decision-making:** a new set of tools encompassing security indicators, threat monitoring, and an analysis of risks and opportunities for governments, businesses and community leaders.

Political and logistical difficulties cannot be underestimated. This agenda overlaps with complex national processes already underway to reduce deforestation, tackle poverty and adapt to climate change, as well as with the financial and trade imperatives that drive development in Amazonia.

The present analysis cannot offer immediate solutions to these challenges. Instead, it aims to provide a new perspective on the problem – one that recognises that fundamental issues of national prosperity and regional security are ultimately at stake, and can offer a new platform for action.

Initial policy recommendations are therefore laid out below to serve as building blocks for nationally-focused discussions that will take place between different stakeholders in each of the five countries considered in this report:

RECOMMENDATION 1:
SECURITY HOT-SPOT MAPPING AND MONITORING

To identify areas where water, energy, food or health security are most vulnerable in Amazonia – both individually and in combination – and to quantify with greater confidence the social and financial costs of likely impacts within and beyond the forest. This would entail the following collaborative work across the region:

- **Defining a set of social, environmental and economic indicators** to enable better monitoring, information sharing and communication of water, energy, food and health security across Amazonia.
- **Assessing the vulnerability of different populations and different sectors** both within and outside the forest to quantify likely impacts of changes in Amazonia.
- **Annual Security Hotspot mapping** using security indicators and security threat scenarios to identify geographic 'hotspots' of vulnerability for water, energy, food and health.

- **An early warning system** building on the hotspot mapping tool to focus on the impact of extreme climate events, land-use change, and pollution outbreaks on the securities. One such system is that established by MARN in El Salvador.

RECOMMENDATION 2:
ESTABLISH NATIONAL 'NEXUS GROUPS' TO HELP INFORM DECISION-MAKING ACROSS SECTORS.

The new security agenda outlined in this report overlaps with many different areas of policymaking and private sector activity, such as regional and national development plans, and national adaptation plans. Its approach would bring critical new information to bear on decision-making in these areas, especially where future vulnerabilities may have a material impact.

Currently, cooperation between ministries and sectors is limited, standardised information is not readily available, and the view some hold of Amazonia as a resource base distant from the economic and political centres of power persists. While these barriers are difficult to overcome, there is a clear need for strong leadership and improved coordination to harness the benefits of a more integrated and systematic approach to regional security risks.

This report therefore recommends that 'nexus groups' be established, consisting of senior experts from different ministries and sectors with a high-level mandate to share information, define priorities, identify policy gaps, and highlight opportunities and barriers to achieving water, energy, food and health security for Amazonia and beyond. These could be modelled on the 'Presidential Task Forces' adopted within many countries (Indonesia's UKP4 – Presidential Delivery Unit is one successful example) to address cross-sectorial public policy challenges.

To be effective, these nexus groups will need strong technical capabilities to help strike the difficult balance between economic development and safeguarding vital ecosystems, and be politically empowered to facilitate cross-sector collaboration in planning and decision-making. Compromises are inevitable to ensure that security risks are dealt with before they become a critical social, economic and political issue.

References and End Notes

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Figures

Figure 1: Amazonia underpins regional water

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Figure 3: Amazonia's export economy

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Figure 4: Extreme drought in Amazonia

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Figure 5: Climate change hotspots in Amazonia

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Figure 6: The Amazonia Security Agenda

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