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The Poor Pay More – The Economic Cost of the Climate Crisis[1]

Climate Change is expected to have devastating consequences in terms of human suffering, loss of biodiversity, and economic losses although there is great uncertainty about the exact size and distribution of the losses. The aim of this brief is to map out what we know and don't know about the economic impacts and costs of climate change and how these costs will be distributed and felt in low- and middle-income countries, with case examples from Sida's partner countries.

Assessments of longer term economic impacts involve large uncertainties, and are generally incomplete as they do not capture risks of surpassing tipping points that could cause e.g. a drastic raise of sea levels across the globe. Depending on methodologies and emission scenarios chosen, losses range from a few percent of global GDP to alarming figures of 35-40% of GDP by 2100. Aggregate global numbers are important but mask large income losses and non-monetary losses for billions of those who have contributed the least to the problems. Overall, people living in poverty are projected to be disproportionally hit by climate change that will alter their ability to work, earn income, and raise themselves out of poverty – although the channels and size of the impact varies by region. Ethical considerations, including inter-generational equity matter greatly when assessing economic impacts.

INTRODUCTION

Calls to act stronger and more rapidly on climate change have intensified significantly.[2] In December 2019 the UN Secretary-General Guterres described current efforts as "utterly inadequate" and stated that "climate change has become a dramatic threat to human health and security" while noting that "climate-related natural disasters are becoming more frequent, more deadly, more destructive, with growing human and financial costs"[3].

Negative impacts in the short, medium and longer term will be most strongly felt by men, women, girls and boys living in poverty. In particular, those living in small island states or low income countries where the economy is dependent on rain fed agriculture and in places where the exposure to natural disasters is the largest will be hit hard. Rather than introducing completely new problems, climate change puts additional burden on issues associated with food security, the quality of ecosystems, natural disasters, migration, structural transformation, urbanization, and conflict. Development gains are at risk as climate change affects agricultural yields, food prices, labour productivity and health, and results in increased loss of lives and assets in natural disasters pushing people into poverty. While climate change will have profound effects on all dimensions of development, this paper will focus on the economic consequences of climate change.

Our understanding of the economic impacts of climate change is constantly evolving. This should not delay the use of the best context specific data today to inform economic policies, negotiations and development cooperation. This brief presents the current knowledge of the economic costs of the climate crisis going beyond the aggregate figures to analyse regional differences, and the variation across countries, sectors, and population groups with a focus on people living in poverty. The costs of mitigation and the transition towards a low carbon economy are outside of the scope of this brief.

1 Authors: This brief was written by Olof Drakenberg in collaboration with Thomas Sterner and Anders Ekbom, University of Gothenburg, with guidance and input from Karin Kronlid and Elina Scheja from Sida's Chief Economist Team. The authors gratefully knowledge helpful comments from Ulrika Åkesson and Jan Wärnbäck.

2 World Economic Forum, (2020), Global Risk report 2020

3 https://unfccc.int/news/antonio-guterres-calls-for-increased-ambition-and-commitment-at-cop25

CLIMATE CHANGE AFFECTS NATURAL AND SOCIO-ECONOMIC SYSTEMS

Climate change describes a change in the state of the climate, such as rainfall and temperature that persists for a longer period. As a result of human activities, increased emissions of greenhouse gases have reached levels unprecedented in at least 800 000 years. Consequently, more heat is trapped in the atmosphere causing temperatures to rise. Looking ahead it is more likely than not that average temperatures exceed 2 degrees. It is virtually certain that there will be more frequent hot and fewer cold temperature extremes over most land areas. It is very likely that heat waves will occur with a higher frequency and duration causing disruptions to production and labour patterns.

Rising temperatures contributes to changes in rainfall, rising sea levels and shrinking of glaciers. As a consequence, it causes changes in the onset of flowering and plant blooming, living conditions for pollinators and the geographical range of mosquitoes and affects the abundance of fish stocks etc. Sea levels will rise, ice will melt and it is likely that there will be more intense rains. Less is known about local rainfall patterns although water stress is expected to increase in many of Sida's partner countries with large implications for agriculture, forestry and livestock.

In addition to long-term changes, extreme weather events and natural disasters are becoming more common causing suffering and large-scale economic damage. According to the UN, climate-related disasters including extreme weather events have almost doubled from 3,656 climate-related events (1980-1999) to 6,681 climate-related disasters in the period 2000-2019[4]. Furthermore, the earth is a complex system and scientists are increasingly analyzing so-called tipping points, sudden and/or irreversible shifts with large impacts and feedback loops that reinforce ongoing warming processes. These tipping points are an important factor shaping the development, while there is uncertainty related to their size and shape.

Regional variation in the climate impact

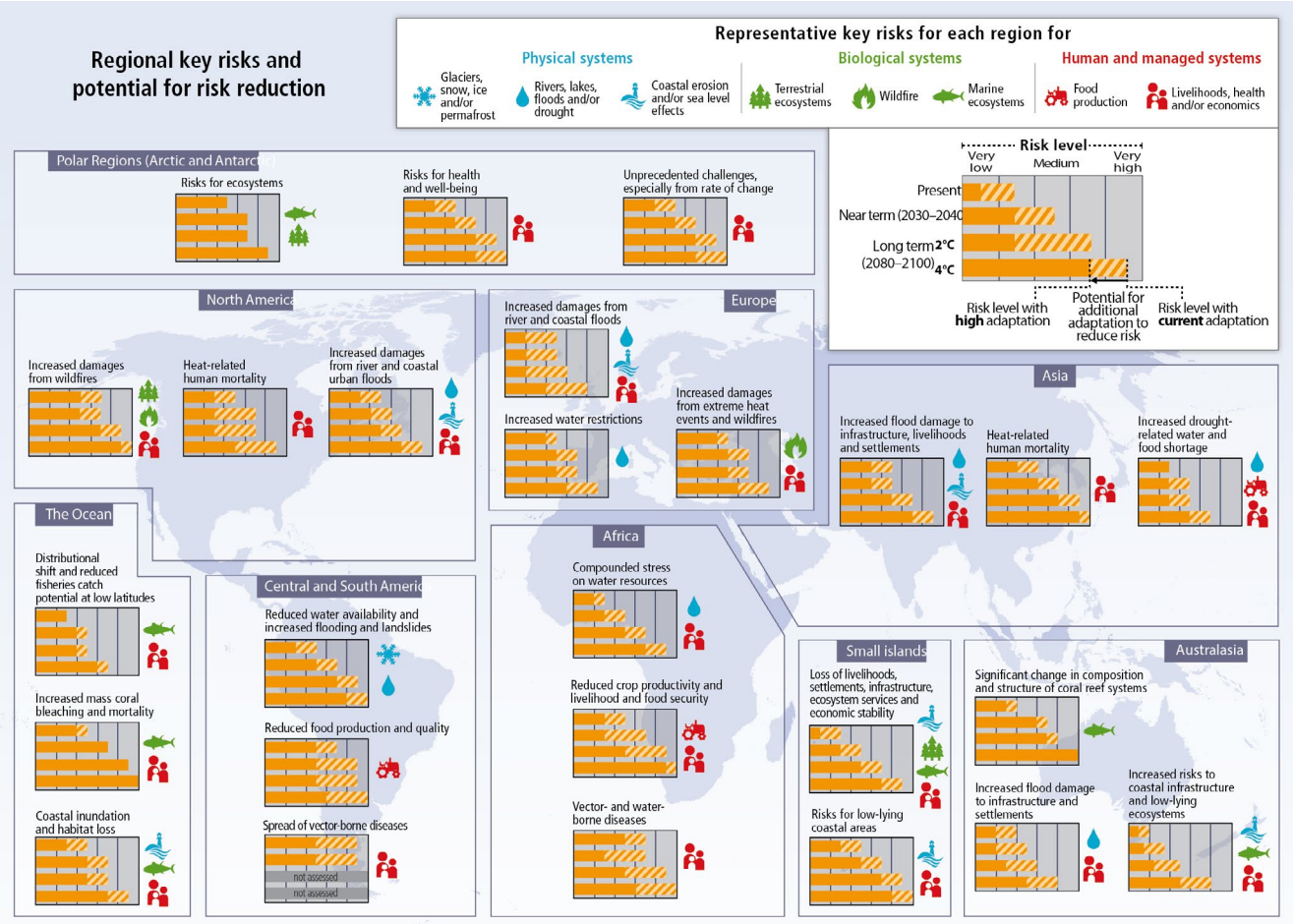
At an overall level, IPCC states that "climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and generally greater for disadvantaged people and communities in countries at all levels of development." The figure 1 gives a comprehensive view of the main climate related risk for different continents. Impacts are presented as risks resulting from the interaction of vulnerability, exposure and climate related hazards (both sudden events and gradual changes such as sea level rise). Expert judgement was used when risks were identified and ranked with criteria including large magnitude, high probability, irreversibility, persistent vulnerability and risk reduction potential. The figure also gives an indication of how additional adaptation measures can reduce impacts. In many cases, risks can roughly be reduced with a quarter if additional adaptation measures are implemented.

For **Africa** projections indicate a likely reduction of rainfall in northern Africa, and a wetter climate with more intense wet seasons in eastern Africa. At the continental level the greatest risks include water stress, reduced crop productivity and reduced food security and health problems associated with water and vector borne diseases. Although climate change is expected to increase water shortages in the Zambezi and Okawongo river basins in southern Africa, as in most places other drivers have even greater impact on future water scarcity. These socio economic drivers include population growth, urbanization, agricultural growth and land use change. Yields of major crops are very likely to be negatively affected. By 2050 yield losses across Sub-Saharan Africa are 22% and where impacts on sorghum are small (2%) compared with wheat (35%). The annual landed value of fish in West Africa is estimated to decline by more than 20% resulting in nearly 50% decline in fisheries related employment. Cholera outbreaks are expected to be more frequent in West Africa with temperature rise and increased precipitation. The highlands of East Africa will experience increased malaria epidemics in many places where temperatures currently have been too low to support malaria transmission. Many African cities and towns are highly vulnerable to climate change, for instance squatter and poor areas typically lack provisions to manage floods. Migration is a strategy to manage high levels of climate variability that is characteristic for Africa.

For **Asia**, the greatest risks include flood damages on infrastructure, livelihoods and settlements; heat related mortality; and increased drought related water and food shortage. East, South and Southeast Asia are very likely to experience more extreme rains that together with rising sea levels and cyclones

4 UNDRR and CRED (2020) "Human Cost of Disasters: An overview of the last 20 years, 2000-2019".

Figure 1: Key climate risks per region



Source: IPPC (2014) Climate Change 2014: Synthesis Report.

will result in large flood damages and disruption of basic services. Cities particularly at risk include Yangoon, Ho Chi Mihn City and Dhaka. Impacts on food production varies. In South Asia yields of sorghum and maize are expected to be reduced by 11% and 16% respectively by 2050. Sea level rise threatens coastal production areas in Bangladesh, Myanmar and Vietnam where saltwater intrusion could further reduce yields. Climate change can lead to a massive redistribution of fisheries catch potential with large declines in tropical waters and increase in high latitude waters. More frequent heat waves will increase morbidity and mortality of vulnerable groups in both urban and rural areas.

In **Europe**, the key risks are damages from river are coastal floods, water restrictions and damage from extreme heat events and wildfires. Climate projections show a marked increase in high temperature extremes, increasing rains in Northern Europe and decreasing rainfall in Southern Europe. More intense rains will result in flooding and increased infrastructure damage. Yields and forest production will increase in the Northern parts and decrease in the Southern parts while changes will be small in central Europe. Water irrigation needs will increase. Water scarcity will affect productivity, particularly in southern and south-eastern Europe where competition for water will grow. Rising temperatures and heat waves will result in forest fires, heat related mortality and morbidity and reduced labour productivity.

For **Central and South America** the greatest risks include reduced water availability, flooding and landslides; reduced food production and spread of vector borne diseases. Glaciers in the tropical Andes are melting rapidly and river runoff will be reduced during the dry months in the next 20-50 years and will affect cities like Lima and La Paz. Also Central America are expected to see reduced water availability due to reduction in precipitation and increased evaporation. Export crops like coffee and soybean could see large reductions in yield and warming and more variable rainfall is expected to reduce maize, bean and rice productivity affecting food security. Water stress and intense precipitation affect health

status, infrastructure and economic activity in many urban centers. Much urbanization involves settlement in risk prone zones prone to flooding, landslides and where basic services such as waste collection are lacking. Malaria incidence has increased in Colombia and the Bolivian Andes due to rising temperatures. Also dengue fever is affected by climate conditions. Annual economic impacts of rising incidence of dengue fever in tropical America are estimated to around USD 2 billion.

CALCULATING THE GLOBAL ECONOMIC COST OF CLIMATE CHANGE

The "cost" of large societal changes, such as climate change, cannot be measured or understood the same way as well-known costs of a new truck or the hiring of a new colleague. One reason is that societal changes involve large uncertainties. We do not know exactly how much warmer the climate will be, how much the sea level will rise or how society and the economy will respond to the new conditions. Assessing economic impacts also requires reflection on what constitutes a cost and ethical considerations, such as how we value future generations. The conventional way is to measure the cost by comparing an outcome, such as consumption, with and without climate change.

The latest IPCC assessment report (2014), stresses a large degree of uncertainty regarding impacts and state with "high confidence" the tendency of underestimating the costs. The report expresses "moderate agreement" of economic losses resulting from a 2 °C increase in mean global temperature above pre-industrial levels to 0.2% to 2% of global gross domestic product in 2100. A 2018 IPCC report cite a study suggesting that limiting warming to 1.5° (as compared with 2°) would save 1-2 % of global GDP by 2050 and 3,5% by 2100 but without expressing a level of confidence. These economic numbers stand in stark contrast to the urgent calls for strong action from natural scientists, policy makers and many economists, such as the Stern review 2006 that estimated losses to 5-20% of GDP[5].

The wide discrepancy between the estimates of the total global cost of the climate change may be explained by incomplete measurement and different assumptions. According to IPCC 2014 impact estimates are incomplete and depend on a large number of assumptions, many of which are disputable. Many estimates do not account for the possibility of large-scale singular events and irreversibility, tipping points and other important factors, especially those that are difficult to monetize, such as loss of biodiversity. Very little is known about the economic cost of warming above 3 °C relative to the current temperature level.

CAUSE FOR CAUTION: ASSUMPTIONS THAT UNDERLIE THE CALCULATIONS ON THE GLOBAL COST

The calculations on the global cost of climate change are only as good as their underlying models and data. There are a few important aspects to be borne in mind when scrutinizing the figures.

First, the uncertainties about the effects of climate change but also how the climate will change are many and very large, and thus economists agree that costs are likely to be underestimated. In a more recent study where some adjustments have been made for catastrophic events etc, the average costs were estimated to be around 10% of global GDP at 3° and 35-40% at 6°.[6]

Second, there is no consensus among economists on how we should value the lives of future generations, i.e. the costs borne today for the benefit of our grandchildren. The choice of discount rate greatly affects the results of economic analyses.

Third, for the last fifty years global GDP growth rates have been around 3-5 % per year with a slightly declining trend. Can we assume, as most models do, that future generations on all continents will be much wealthier and better equipped than us to deal with an unpredictable and warmer climate? And can we assume that the ecosystems, the technologies, human and financial resources will be sufficient for human wellbeing across the globe? As an example, climate change alone is projected to decrease ocean fish biomass with up to 25 % by the end of the century in a high warming scenario.[7]

Fourth, even if there was a broad agreement on key assumptions, global average cost says little about how costs are distributed among countries and individuals. As an example, IPCC 2018 stated with some confidence that significant reductions in GDP per capita growth are projected for much of the African continent, South East Asia, India, Brazil and Mexico.

These four reasons underline the large uncertainties involved in these complex questions, difficulties on agreeing on assumptions and the limitations of using global averages for predictions of what will happen at the individual or country level.

Global averages mask huge inequalities

Many economists projects large climate impacts on consumption levels. Figure 2 below is one such example, cited in IPCC 2018, showing large regional differences in GDP in a high temperature

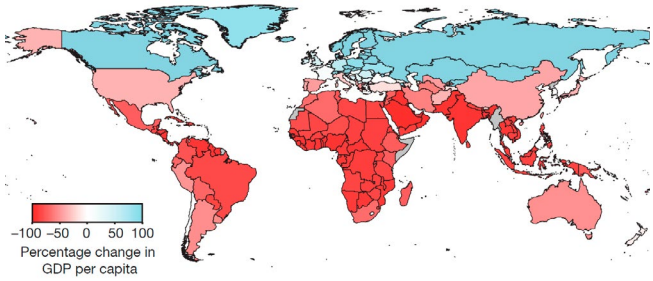
5 Stern, N. (2006) The economics of climate change – the Stern review

6 Howard & Sterner (2017) Few and not so far between: a meta-analysis of climate damage estimates

7 IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

scenario without mitigation compared with today's temperatures.

Fig 2: Percentage change in GDP per capita 2100



Source: Burke et al, 2015

Here, average income decline in the poorest 40% of countries is expected to be 75% relative to a world without climate change. Although this is not a likely scenario, it illustrates how uneven impacts are expected to be also under more moderate scenarios. Agricultural production in most of the world's northern countries will likely benefit from climate change due to a combination of factors like rainfall, extended growing seasons as temperature rises and carbon dioxide fertilization. However it is likely that the fertilization has a negative impact on global food security.[8]

Small relative benefits in rich countries can thus mask large losses in low-income countries. The same applies within countries where large losses of incomes for a group that represents a small part of the economy could have only a marginal effect on the national economy but a devastating impact on the affected group. People living in poverty are more likely to derive a large share of their incomes from non-marketed goods and ecosystem services. Small differences in the seasonality of rainfall, temperature or even wind patterns can have overwhelming impacts on people in high mountain environments, drylands and slums.[9] This illustrates the importance of looking beyond averages and making local, context specific assessments to assess the most likely impacts for different regions and groups.

Box 1: Moderate but uneven impact in Easter Europe

Climate change is projected to raise temperatures in Eastern Europe but predictions for rainfall are uncertain. More extreme weather events such as heatwaves, droughts and heavy rains are expected. This will impact on people's lives and flooding affect infrastructure (transport, water, power) which often is poorly maintained. Overall, though, the countries of Eastern Europe are not expected to face as severe challenges as many other parts of the world. Climate change can even have positive impacts on agricultural yields in the region.

A study by OSCE[10] comparing Moldova, Ukraine and Belarus found Moldova to be most exposed to and sensitive to climate changes and to have the least adaptive capacity of the three. For Moldova, projections predict higher temperatures and increased rainfall variability and reduced water availability. Within decades water availability is expected to fall below demand affecting households, industry, agriculture and energy. Negative impacts include reduced agricultural productivity, health effects from heat related diseases and higher casualties from natural disasters, disruption of transport infrastructure.

Negative climate impacts are mainly occurring in rural areas where agriculture account for a large share of employment. 98% of farmers are smallholders with limited access to finance and fewer resources to cope with climate impacts on productivity. Female headed farms are significantly smaller then male headed farms and are more rarely connected to a water supply. A World Bank study (2016) estimated the present, total cost of inaction on climate adaptation in Moldova to 600 million USD, equivalent to 6,5% of GDP. While the costs are expected to more than double by 2050 its share of GDP will diminish given projected growth rates.[11]

The economy of the poor

Climate change can impact people living in poverty through different channels. Major impacts come through water availability and supply, food security and agricultural incomes. This will result in large global shifts in where food crops will be produced and traded.

A World Bank study[12] finds that climate change will make poor people poorer and that the number of people below the poverty threshold by 2030 could increase by 120 million due to climate change. The income losses for the poorest are expected to be larger than those of the average population even without incorporating losses in ecosystem services, reduced nutritional quality, non-monetary effects or secondary impacts of disasters.

8 IPCC (2018) Special report 1.5°
9 IPCC (2014) AR5 WG II

10 IPCC (2018) Impact of 1.5° of global warming
11 Word Bank (2016) Republic of Moldova- Moldova climate adaptation investment planning technical assistance
12 Hallegatte, S. et al, (2016), Shockwaves- managing the impacts of climate change on poverty, World Bank

The most important factor is the effect of climate change on agricultural consumer prices that are expected to rise. The second is health impacts (increasing prevalence of malaria, diarrhoeal outbreaks often following floods, and stunting due to reduced food intake). Impacts such as reduced labour productivity and natural disasters are relatively less important according to this global study. Reduced agricultural yields leading to price increases will benefit farmers and agricultural workers but the overall impact is negative due to increased poverty from higher consumption prices.

The following section cover the topics listed above as important pathways to how they impact on poverty: Food security, Health and Labour productivity, Natural disasters and Migration. They are all interrelated.

Food security at risk

It is highly likely that warmer climate will have negative impacts on crop yield, crop nutrient content, livestock, fisheries, aquaculture and thus overall food security. This is expected to have major implications for poverty reduction and achieving SDG 2, to end hunger.[13] At global level each degree Celsius increase will reduce production by approximately 6% for wheat, 3% for rice and soybeans, and 7% for maize.[14] Projections on price increase due to climate change range from 3-84% by 2050 and will also depend on human factors such as incomes, dietary changes, access to land, conflict and trade patterns and governance.

Health, Heat and Labour Productivity

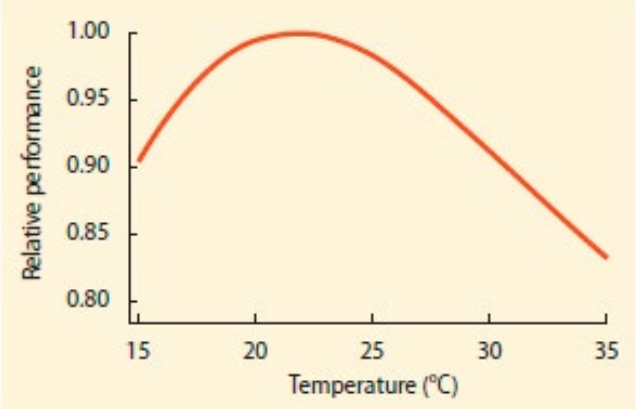
IPCC states with high to very high confidence that climate change will lead to greater risks of injuries, disease and death, owing to more intense heatwaves and fires, increased risks of undernutrition and as consequences of reduced labour productivity in vulnerable populations. The burden of malaria and other vector borne diseases are expected to increase. Heat stress will increase temperature related morbidity and mortality, and reduce labor productivity (figure 3).

Box 2: How would climate change hurt the Ethiopian economy by 2050?

Using historical data, current government plans and different climate scenarios, the World Bank compared a baseline scenario with and without climate change. The focus was on analyzing impacts on yields of major crops and livestock, flow in hydropower generation facilities, impacts of flooding on roads and effects of more frequent droughts on government expenditures. These aspects were assessed to be most important for the Ethiopian economy. Depending on the scenarios, the models found that the Ethiopian GDP would be between 2-8% lower than without climate change partly due to reduced agricultural growth. Increased costs for road maintenance will reduce or halt the speed of expansion of the road network and increase agricultural costs.

People's vulnerability to climate impacts differ substantially. As an example residents in the drought prone low lands and people dependent on single livelihoods such as farming or pastoralism were particularly vulnerable. Ethiopia is regularly affected by climate related droughts and floods and will experience warmer temperatures. This affects the health status via reduced air and water quality, heat stress and increasing incidence of malaria. Poor health reduces participation in education and economic activities with long term impacts for affected households.[15]

Figure 3: The effect of heat on productivity (task performance under different temperatures)



Source: World Bank based on Seppänen, Fisk and Lei (2006)

In most of Sida's partner countries rising temperatures are likely to have a notable and negative impact on labor productivity and consequently people's ability to earn income. Furthermore, excessive workplace heat is an occupational health hazard affecting body temperature, dehydration and causing exhaustion, heat stroke and even deaths. Workers can adapt by slowing down or by reducing work hours – and consequently also reducing their earnings. Employers can invest in air conditioning or design buildings in ways that reduce cooling needs. In high temperature countries even basic office tasks are affected although this

13 IPCC (2018) Special report 1.5
14 Asseng et al., (2015); C Zhao et al., (2017) in IPCC 1.5° 2018
15 World Bank, (2010), Economics of adaptation in to climate change - Ethiopia

may be managed with installation of climate control. The lowest income bracket jobs such as heavy labor and low skill agricultural, manufacturing and construction jobs are among those most susceptible to a warmer climate[16] For these jobs climate control is rarely an option. In agriculture where most tasks require daylight, it is difficult to adjust working hours to avoid heat. A study in India, using data from manufacturing firms found that observed warming in the last three decades could have reduced manufacturing output by about 3%. During longer heatwaves the attendance of workers typically go down thus affecting productivity and incomes.[17]

Costs of climate change are not gender neutral

Women, men, girls and boys are directly impacted by temperature increase, but in different ways. For instance, women have higher heat-related mortality, and socio-cultural factors increase their vulnerability. Current differences in income, access to resources, credit, education, and information between male and female headed agricultural households are likely to deepen as adaptation options, including access better seeds and improved farming practices, off-farm activities and migration are less accessible to women. Climate change extremes may also increase non paid hours of care work typically performed by women.

In large cities like Dar es Salaam, Nairobi, Yangoon and Addis Abeba, the local temperatures could rise with an additional 2° due to the heat island effect. It occurs when natural surfaces such as parks and fields are replaced with heat trapping concrete and asphalt in combination with local use of energy and electricity.[18] The total economic cost of climate change for cities around the world could be up to 2.6 times higher if the heat island effect is taken into account. By the end of century, cities could on average lose more than 5 % of their GDP due to climate change.[19]

Heat and other weather conditions also impact on school performance and school attendance, a factor which is at the core for academic achievement. Negative impacts are the greatest where climate control systems are absent and where the quality of road infrastructure is weakest.

Box 3: Gradual shifts in climate related losses in the Cambodian economy

The structure of the economy and its vulnerability to climate change changes over time. Cambodia is one of the more climate vulnerable countries in South East Asia. Floods account for the lion share of disaster losses that also include droughts, storms and earthquakes. 1 [20]By 2100 the temperature could rise with as much as 4.2° C and heat related deaths for people over 65 years are projected to rise to about 56 deaths per 100 000 by 2080 compared with a baseline of 4 deaths per 100 000.[21] Estimates of future losses in the Cambodian economy suggests a significant shift in where they happen. In the short term about 75% results from losses of income due to reduced natural resource productivity and reduced efficiency in primary sectors. Given that a large proportion of Cambodia's poor women and men are engaged in agriculture these losses can have large impacts. By 2050 the economy wide implications has changed completely as close to 60% of losses are the result of declining labour productivity due to higher temperatures and heat stress and one quarter is due to damage to assets. One important explanation for this shift is that the agricultural part of the economy is expected to grow much less than other sectors. GDP is expected to be about 10% lower in 2050 as a result of climate change and the annual decline in GDP growth rate will increase over time.[22]

Climate related natural disasters are costly

Exposure to climate related natural disasters differs greatly. Specific regions that are at high risk are those exposed to sea level rise and extreme events and with concentrated multidimensional poverty. These include pockets of people living in poverty in Low- and Middle-income countries such as mega-deltas in Bangladesh, Thailand, Myanmar, and Vietnam; drylands; mountain areas; watersheds in the Himalayas; ecologically fragile areas in coastal areas with severe ecosystem deterioration in eastern and southern Africa; and river deltas subject to resource extraction.[23]

16 UNDP (2016) Climate change and labour: impacts of heat in the workplace
17 Somanathan, E. et al, (2015) Discussion paper on economics
18 Estrada et al (2017) A global economic assessment of city policies to reduce climate change impacts, Nature Climate Change
19 Estrada et al (2017) A global economic assessment of city policies to reduce climate change impacts, Nature Climate Change
20 World Bank et al (2017) Disaster Risk Finance Country Diagnostic Note: Cambodia Draft
21 WHO (2015) Climate and health country profile - Cambodia 2015
22 Cambodia Ministry of Economy and Finance and National Council for Sustainable Development (2019) Addressing climate change impacts on economic growth in Cambodia
23 IPCC (2014) AR 5 WG II

Poor people lose more and have a harder time to recover from shocks

Household surveys typically show that the most poor are more likely to be exposed to shocks such as floods, extreme heat and droughts. In Nigeria, for instance, the most poor 20% of people are 50% more likely to be affected by a flood, 130% more likely to be affected by a drought, and 80% more likely to be affected by a heat wave than the average Nigerian. Case studies in Bangladesh, India, and Honduras also suggest that poor people are losing two to three times more than non-poor people when hit by a flood or storm. Climate-related shocks can keep people in poverty by making it more difficult for households to accumulate assets, regularly wiping out their stock of assets, or even creating irreversible impacts on human capital (through health or educational impacts).

Excerpt: Hallegatte & Rosenberg (2017) and WB Shockwaves

In addition to human suffering, economic costs of flooding, storm surges and extreme rains can be very high. Annual damage and adaptation costs for some low-lying developing countries and small islands have been estimated to several percentage points of GDP per year.[24] The total economic cost of natural disasters in 2019 were estimated to amount to USD 232 billion, and over two thirds of the losses were uninsured[25].

Box 4: Negative outlook for food security, plantation workers and coffee exporters in Guatemala

Climate projections for Guatemala indicate a significant decrease in the yields of staple crops such as rice, corn and beans; an increased pressure of water resources; and rising costs for extreme weather events. As an example average rice yields could decrease by 10% in 2030, 19% in 2050 and 42% in 2100 under a high warming scenario thus affecting food and nutrition security.

Guatemala is among the world's leading coffee exporters. Climate projections predict declines in coffee production by about 10% in 2050 and up to 35% by 2100. Another export earning industry, the sugar industry, generates more than 400 000 direct and indirect jobs and contributes to 15% of total exports. Rising temperatures will aggravate already difficult working conditions for seasonal workers. Scheduled breaks for drinking and eating are rare and payment systems favor long days and few breaks. In 2017 90 % of interviewed sugar cane cutters in Guatemala suffered from insolation, muscle aches, respiratory diseases and dehydration.

Also the availability of water for energy, agriculture and human consumption will be reduced. As an example, the Chixoy hydropower plant, accounting for more than 10% of the country's electricity could lose about one quarter of its capacity by 2050. Without adaptation measures, climate change is projected to reduce GDP with 3.5% at 2030 and 5% by 2100.

Source: CEPAL et al, (2018) La economia del cambio climatico en Guatemala, ILO (2019) Working on a warmer planet – the impact of heat stress on labour productivity and descent work.

24 IPCC (2014) AR 5 WG II

25 AON (2020) Weather, Climate & Catastrophe Insight—2019 Annual Report

The direct and indirect costs of damages to road infrastructure affecting access to market, education, and health clinics can be very large and long term, especially for uninsured assets and where capital markets are poorly developed. Natural disasters impact negatively on investment levels as many assets are used for consumption while coping with disasters. Furthermore, disaster risks also deter outside investors.

People already living in poverty are particularly vulnerable to disasters but also slow onset events as they have fewer safety nets and receive less support from family, friends and community[26]. Urban poor are often more exposed to climate hazards as they tend to live in floodplains and slopes, in low quality housing and without proper drainage and waste collections.[27]

Climate change impacts migration patterns and can amplify drivers of conflict

Climate change can in rare cases be the primary cause of migration. This happens when for instance citizens of small island states are forced to leave when sea level rises. In other cases climate change is one of several factors resulting in seasonal, permanent, planned or unplanned migration. Sub-Saharan Africa, South Asia and Latin America could have close to 150 million internal climate migrants in 2050 unless action is taken.[28] According to a World Bank study (Rigaud et al. 2018), the causes of migration refer to slow onset events such as decreased crop productivity, shortage of water and rising sea levels rather than sudden catastrophes. The study also suggests that efforts to reduce emissions and robust development planning could limit migration to 1/5.

A recent study by Xu et al (2020) comparing data on average temperatures and population density suggests that climate induced migration will be substantial. Without migration, the study finds that in 50 years one third of global population are projected to experience mean annual temperatures above 29 °C. These are temperatures currently found in less than 1% of the Earth's land surface, mainly in the Sahara.[29] Climate induced migration may contribute to political instability and increase social tension within and beyond national borders. As a consequence the productivity and incomes might be affected negatively in

26 Hallegatte, S. et al, (2016), Shockwaves- managing the impacts of climate change on poverty, World Bank

27 Reckien et al (2018) Equity, environmental justice and urban climate change UCCRN

28 Rigaud et al (2018) Groundswell: Preparing for internal climate migration, World Bank

29 Xu et al (2020) Future of the human climate niche, PNAS

both countries suffering from natural disasters, and neighboring countries.

Climate induced migration involves both costs and benefits. Benefits include more remittances, faster transfer of skills and reduced pressure on scarce resources such as land and water as migrants leave. Non-monetary aspects can often be forgotten when costs and benefits are assessed. A migrant may experience loss of identity, security, gender abuse etc. Gender differences may determine who migrates and who is able to return.

While it is clear that climate change influence human security, the relationship between climate change, migration and conflict are unclear. For example, IPCC suggests that droughts under most circumstances do not result in conflicts. However, for particularly vulnerable countries or groups dependent on agriculture the likelihood for sustained conflict increase significantly with drought.[30] Indirectly climate change can increase risks of conflicts by amplifying drivers of conflict such as poverty and economic shocks. Studies have found context specific evidence that climate change can have an effect on the causes and dynamics of violent conflicts in South and Southeast Asia when a) it leads to deterioration of peoples livelihoods; b) it influences tactical considerations of armed groups; c) elites uses it to exploit social vulnerabilities and resources; and d) it displaces peoples and increases levels of migration.[31]

Box 5: Who is left behind when climate induced migration increases? – The case of Bangladesh

Bangladesh is one of the most vulnerable countries to climate change, but also one of the countries with the most experiences of adapting to weather related natural disasters. About two-thirds of the country is frequently inundated and the frequency will increase with sea level rise and storm surges. Inundation causes loss of livelihoods, homes, and infrastructure but early warning systems, cyclone shelters and other measures have significantly reduced the loss of lives. A World Bank study projects agricultural GDP to be 3,1 % lower each year for the period 2005-2050 . Even though flood risks will increase, exposure to flooding is expected to be lower than today due to migration to cities. Poverty levels are particularly high in higher risk areas such as the southern region where per capita consumption levels are projected to decline.

Source: World Bank (2010) The economics of adaptation to climate change - Bangladesh

30 IPCC (2018) Global warming of 1.5°

31 Nordqvist &Krampe, 2018; Climate change and violent conflict: sparse evidence from South Asia and South East Asia, SIPRI

ADAPTATION PAYS DIVIDENDS

Individuals, communities, businesses and nations have always adapted to new conditions. The costs of climate change can be significantly reduced through adaptation. A big question is how to prioritize between adaptation options, not least given that many uncertainties remain. The obvious first step is to give priority to actions that reduce vulnerability and exposure to problems faced under current climate vulnerability.

Building Back Better post Covid-19?

The ongoing global pandemic has had serious consequences on human development over and above the direct health-related impacts: Covid-19 is expected to push some 100 million people into extreme poverty during 2020 alone[32]. While the world's economy is facing its most serious downturn in modern history, governments are investing record amounts in stimulus packages of around 10 percent of the GDP in high-income countries around 5 percent in low- and middle-income countries in order to get the economy back on track[33]. These investments vastly exceed the investments budgeted for reaching the goals in the Paris Agreement and many have argued that the money should be invested in green alternatives to kill two birds with one stone and change the pattern of economic development into a more sustainable trajectory.

But how should the green recovery look like? While coal-based industries have been hard hit by the crisis, many see an opportunity to strive for a more permanent transformation towards a carbon-free economy through steadily increasing carbon tax[34]. Others argue for investing in the "industries of the future"[35] where especially clean physical infrastructure and R&D investments in high-income countries and investment in rural development in low- and middle-income countries have been suggested as possible alternatives to promote green and inclusive economic development[36]. Furthermore, the use of 'debt for climate and nature programme'-swaps has been suggested where governments would get an opportunity to address simultaneously the crises of debt, climate and biodiversity destruction[37]. Thus far the potential of using the available investments to mitigate climate change has been underutilized, while the clock is ticking for effectful measures to avoid even larger losses in the future.

The Global Commission on Adaptation[38] analysed benefit to cost ratios for investing in early warning systems, resilient infrastructure, dryland agriculture,

32 World Bank (2020) "Poverty and Shared Prosperity: Reversals of Fortune"

33 IMF(2020) and ODI (2020).

34 IMF (2020) World Economic Outlook: Mitigating Climate Change

35 Mujankari, S. & Sterner, T. "Charting a 'Green Path' for Recovery from COVID-19", Environmental and Resource Economics (2020) 76:825–853

36 Hepburn, C., O'Callaghan, B., Stern, N., Stiglitz, J., and Zenghelis, D. (2020), 'Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?', Smith School Working Paper 20-02.

37 Steele, p. & Patel, S. (2020) "Tacking the triple crisis. Using debt swaps to adress debt, climate and nature loss post-COVID-19", IIED Issue Paper.

38 WRI & Global Center on adaptation (2019) Adapt now: a global call for leadership on climate resilience-Global Commission of climate change (co-chairs Ban Ki-moon, Kristalina Georgieva, Bill Gates)

mangroves and water resources. Investing in $ 1.8 trillion globally in these areas from 2020-2030 could generate $ 7.1 trillion in total net benefits. Adaptation contribute to avoid losses and reduces risks, it stimulates innovation and can bring social and environmental benefits. As an example mangrove forest provide protection from coastal flooding worth more than $80 billion per year while also bringing additional benefits of about $40-50 billion from fisheries, forestry and recreation. [39]

CONCLUSIONS: ACTING ON CERTAINTIES, MANAGING UNCERTAINTIES

The stakes are high. This brief has shown both a high degree of certainty that climate change will impact the course of development, as well as uncertainty regarding the size and nature of the these impacts, illustrated with case examples from Sida's partner countries.

There is great uncertainty with regards to the magnitude of the long term economic impacts of climate change. At the global level, estimated global GDP losses due to climate change range from about 2% to 40% at 2100. The IPCC has so far not been able to establish a smaller range of global GDP loss with high confidence. Differences in underlying assumptions and perspectives on intergenerational equity largely explain these differences. These differences include e.g. substitutability between different forms of capital. Can we assume that large scale losses of biodiversity, wetlands, forests or agricultural lands can be fully compensated by technological advances or accumulation of financial or human capital? If not, do economic models take this into account so decisions are well informed?

Furthermore, there is scientific uncertainty of how societies, plants, species and critical climate systems will respond to climate change. In 50 years' time, billions of people are expected to live under climate conditions currently experienced by less than 1% of the world population, mostly in Sahara. In view of this, what are the future costs of local, regional and global migration? How quickly will technologies advance and be accessible for Sida's target groups? What are the new crops, the new skills needed and the new jobs that can replace current livelihoods in a hotter and more water-scarce world? How far are we from reaching tipping points that could result in major shifts in the climate system and its associated costs?

At the same time there is broad scientific agreement that temperatures and sea levels will rise and glaciers will melt; that rainfall will be more erratic and ecosystems and biodiversity will be affected with risk of tipping points; and that economic impacts will be very uneven across and within countries. Poor women, men, girls and boys predominantly in low- and middle-income countries will suffer significant losses that risk pushing millions into poverty. Risks for adverse consequences are particularly high for disadvantaged and vulnerable populations including some indigenous peoples and local communities dependent on agricultural and coastal livelihoods.

There is also great certainty around the negative impacts of climate change on food prices and food security. On average, increase in temperature is expected to affect human health negatively; excessive heat will lower return to labor; and smaller and larger natural disasters will hamper access to markets, education and health. Assets that could be used for productive investments will be lost when rains are failing or flooding happens, especially in cases where insurance and social protection schemes are not in place.

Implications for development cooperation

Climate change is note merely a question of protecting the environment in its own right – it has direct and indirect consequences on the goal to end poverty in all its forms. The poor are disproportionally dependent on natural resources for making the ends meet, and also disproportionally effected by the negative effects of the climate crisis. World Bank estimates that the number of people falling into extreme poverty due to climate change by 2030 could be up to 130 million[40]. Understanding the mechanisms through which climate change impacts the livelihoods of people living in, and close to, poverty is therefore of paramount importance for reducing poverty and reaching the goals of development cooperation.

The current pandemic and the sizable response to it has shown both how serious consequences a global crisis can have, but also that even large interventions and policy changes are possible if there is sufficient political will to implement them. The cost of investing early in climate mitigation measures has been

39 WRI & Global Center on adaptation (2019) Adapt now: a global call for leadership on climate resilience-Global Commission of climate change

40 World Bank (2020) " Revised Estimates of the Impact of Climate Change on Extreme Poverty by 2030", Policy Research Working Paper No. 9417.

shown to be an efficient way to reduce the overall cost of the ongoing climate change. Even if there is still uncertainty around the total toll on the global economy, there is no longer uncertainty about the sizable costs to people living in poverty – costs that can be mitigated.

Therefore, the main question for Sida when calculating the economic cost of climate change is *not* what the global GDP will look like, on average, in 2100 with or without climate change. Instead, key questions for Sida on its journey towards eradicating poverty in all its forms, everywhere, include:

- What are the expected climate impacts on different groups and income segments, regions and economic sectors in a given country in the short to medium term under current climate variability?
- How are these impacts likely to affect different dimensions of poverty and the risk of falling into poverty?
- Is the best climate analysis used by economic actors at the country and local levels to inform planning, debates and political decisions?
- Do the climate models properly assess economic and other risks of climate tipping points and associated changes of ecosystem services and their impact on people living in poverty?

People, businesses and societies are adapting to climate change and governments see the benefit of taking action. For Sida's partner countries, economic development is key for building resilience to climate change, while at the same time environmental sustainability is a prerequisite for sustainable economic development. Climate change clearly demonstrates that economic development and environmental sustainability are intimately related and mutually reinforcing. Economic development that is green, sustainable and inclusive will do well to serve the interest of the groups that have been left behind.

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