***Policy Note: Climate Change in Mozambique and Vietnam[[1]](#footnote-1)***

As the impacts of climate change become imminent, countries are concerned about the potential implications for economic growth and development. Fully quantifying the extent and magnitude of the impacts is difficult, however, due to the inherent multi-disciplinary, multi-sector and economy-wide nature of the issues. This report explores these issues, using similar integrated modeling frameworks for Vietnam and Mozambique. These frameworks translate a set of climate projections into biophysical and economic impacts through 2050. Quantifying these potential impacts provides policy makers the context needed to develop adaptation strategies, incorporate changes into mid-range and long-term development plans, and secure funding necessary for implementing change.

**Case Studies: Vietnam and Mozambique**

Vietnam and Mozambique have similar recent economic histories. Both experienced high growth rates since the late 1990s with a broadly similar growth composition. Three quarters of Vietnam’s population lives in rural areas, where most derive some farm income. Similarly 70% of Mozambique’s population is rural and virtually all are engaged in agriculture in some way. In Vietnam about 90% of the poor live in rural areas, while in Mozambique approximately 75% do. Both countries have been successful in reducing poverty over recent decades.

Vietnam and Mozambique face different sets of climate change challenges. With a significant population residing in low elevation coastal zones, particularly in the Mekong River Delta, Vietnam is highly vulnerable to rising sea levels and cyclone surges. In addition to social instability, rising sea levels threaten to destroy agricultural land and road infrastructure. Additionally, changes in Vietnam’s climate are likely to adversely impact agricultural productivity.

In Mozambique, climate change is likely to increase the already-high climate variability and extreme weather events, significantly threatening agriculture and social stability. Droughts are the most frequent disaster, occurring every 3–4 years, and are a major constraint to development. Further, because Mozambique lies at the end of numerous transnational river basins, flooding is a perennial risk to both farmers and infrastructure, especially when coupled with cyclonic storm surges.

**Climate Projections**

Although climate change is widely acknowledged, considerable uncertainty remains over its projected course. When modeling climate change’s impacts, it is important to consider multiple projections because they can vary widely across scenarios. Capturing this variation, the Vietnam study analyzes 56 climate projections for the period 2007 to 2050. Studies of Mozambique utilizes 4 climate projections for the period 2003 to 2050, which represent the total possible variation in precipitation outcomes at the global and country levels.

Vietnam’s climate conditions are projected to become more arid, although the median change is not dramatic. The median expected temperature increase is somewhat less than 1.5 degrees Celsius, with regional temperature increases ranging from slightly less than 1 degree Celsius to slightly more than 2 degrees Celsius by 2050. Precipitation projections are more uncertain, with a negative median across all 56 scenarios. Wetter conditions are only somewhat less likely than dryer conditions at both the national level and across all regions.

Climate change is expected to result in Mozambique’s climate becoming hotter and more variable. In both wet- and dry scenarios, all sub-national regions are projected to experience a 1 to 2 degree Celsius increase in temperature by 2050. Greater variation in average precipitation changes exists in all four scenarios, reflecting both the selection of climate change projections based on precipitation and a lack of consensus amongst climate models over local precipitation projections.

**Model**

Using an economy-wide multi-sector approach, atmospheric projections for baseline and climate change scenarios are translated into economic impacts via four specialized sector models (Figure 1). Specifying a baseline scenario that reflects development trends, policies and priorities in the absence of climate change is necessary in order to estimate the economic cost of climate change. Climate change information flows through the integrated river basin and water resource models down to the agriculture, energy and infrastructure models. Results, together with a fourth impact channel that determines land losses from sea-level rise, are passed to a dynamic computable general equilibrium (DCGE) model to estimate economy-wide impacts of climate change.

The DCGE model simulates the functioning of an economy, including labor, capital and commodity markets, and illustrates how changes in economic conditions are mediated through prices and markets. DCGE models provide a “simulation laboratory” for quantifying how various impact channels influence economic structure and sectoral performance.

In the DCGE model climate change affects economic growth and welfare via the four principal mechanisms. First, productivity changes in rain-fed agriculture are taken from detailed crop models and the DCGE then determines how resources should be allocated across crops, given their profitability relative to other activities. Second, the DCGE model directly incorporates fluctuations in hydropower production based on a river flow model Third, a detailed regional road network estimates the length of regional road networks which the DCGE model then uses to determine the productivity of transport services. A shorter road network lowers transport productivity and increases the cost of moving goods between producers and consumers. Finally, the DCGE model incorporates the effects of sea level rise by reducing the total amount of cultivable land in each region by land inundation estimates.

The long time frame over which climate change unfolds implies that dynamic processes are important. A central aspect of DCGE models is that they capture annual changes in the rate of physical and human capital accumulation and technological change. Generally, even small differences in capital accumulation and technological progress can cause large differences in economic outcomes over long time periods.

**Results**

Overall, climate change worsens the economic growth prospects of Vietnam out to 2050. Compared to baseline projections, climate change is estimated to impact the level of GDP between 0.25 and -2.5 percent, with the majority of outcomes between -0.5 and -1.5 percent. This translates into a small change in the worst-case scenario GDP growth rate of between 0.01 and 0.08 percentage points. Because Vietnam's GDP is expected to exceed US$500 billion by 2050, the losses caused by climate change are large in absolute terms. The majority of scenarios examined predict losses between US$6 billion and US$15 billion (discounted at a 5% rate and in real 2007 dollars).

Sea level rise is expected to have the largest implication, especially in the highest sea level scenarios and when combined with cyclone strikes. The Mekong River Delta is particularly vulnerable, with significant areas submerged in 2050. Projected climate change, however, is not expected to generate large declines in hydropower or agricultural production. Increases in extreme events that threaten infrastructure, such as inland flooding, are also not observed in most climate scenarios. While other factors are likely to be more important determinants of growth rates, substantial losses do occur that intelligent adaptation policies could reduce considerably.

Each of the four climate change scenarios considered reduces the national welfare of Mozambique. Results indicate that climate change could reduce average annual absorption (GDP less net exports) growth rates by as much as 0.38 percentage points during 2003 to 2050. Because the impact of annual absorption growth rates is cumulative, even small reductions in the growth rate could translate to significant economic damages. In particular, reduced growth due to climate change is estimated to result in a 4 to 15 percent loss in absorption compared to the baseline scenario or between US$ 2.3 billion and US$ 7.4 billion (discounted and in real 2003 dollars).

While agriculture is adversely affected by climate change, it is major flooding and the damage it causes to transport infrastructure that dominates overall welfare losses in Mozambique. However the cause of economic losses varies across climate change scenarios. One-third of damages in the worst-case scenario occur during the final decade of the time period, and are mainly due to flooding and its effect on infrastructure. Overall, damages in Mozambique are more related to river basin conditions within Southern Africa than they are to climate patterns within Mozambique itself. Local precipitation projections were important only in the scenario with dry local conditions; flood frequency declined leaving agriculture as the primary source of economic damages.

**Conclusions**

Climate change is expected to reduce economic welfare in both Vietnam and Mozambique thus adaptation policies are merited. The best strategy may be reinforcing existing development objectives. More rapid development will create a more flexible and resilient society. A more educated populace, supported by flexible and competent public and private institutions, will be better able to both plan for and react to climate challenges.

In addition to continued development efforts, specific policies emerge, including:

* *Invest in agricultural research and extension*. If climate change redirects resources away from agriculture causing its underlying rate of technical advancement to decline, then large welfare losses are almost inevitable. In Vietnam, effective research would focus on developing of heat resistant crop varieties and improving water use. In Mozambique, effective research would vary depending on the crop and region.
* *Change design standards for infrastructure such as roads to handle a warmer and more variable climate*. Sealed rural roads cost more to construct but are more reliable than unpaved roads. If properly constructed, they cost less over time due to reduced maintenance requirements.
* *Invest in information systems to monitor and manage climate change impacts*. Vietnam would benefit from improved geographic information systems, emphasizing elevation data for low lying provinces, monitoring river flow, and closely tracking global sea level rise projections. Mozambique would benefit from cooperative river basin management, including regional coordination.

Vietnam’s most serious policy choices concern sea level rise combined with cyclone strike. Two proactive and not mutually exclusive options emerge. First, governments could adapt planning policies to channel economic activity to safer ground. Land use policies are particularly powerful, as future capital investments over coming decades are likely to exceed already installed capital, which in turn will depreciate well in advance of the main onset of climate change.

Although governments could invest in protective infrastructure, such options should be carefully scrutinized, as they may actually *increase* exposure to extreme events by reducing risk. For example, building dikes may reduce the probability that cyclones and storm surges damage capital, but they encourage investment behind the dike. If the dike is breeched, damages will be greater. Available evidence indicates that a gradual channeling of activity to safer ground is more likely to be economically efficient and is certainly less risky.

**Figure 1** Integrated modeling framework

*Runoff*

Climate Projections

River basin models

Crop models

Hydropower models

Infrastructure model

Economy-wide model (DCGE)

Water resource models

*Temperature and precipitation*

*Floods*

*Crop yields*

*Energy supply*

*Road network length*

*Streamflow*

*Irrigation water demand*

Sea levels and cyclones

1. This policy note summarises original research undertaken as part of the project *Economic Governance and Development in Vietnam and Mozambique* and involving researchers from Vietnam, Mozambique and affiliated with the University of Copenhagen. Financial support for the project from Danida is gratefully acknowledged. Further details, including original research produced by the project, are available from <http://www.econ.ku.dk/derg/activities/ffu/>. [↑](#footnote-ref-1)