TOPIC AREA:

CLIMATE CHANGE ADAPTATION: INDIGENOUS SPECIES DEVELOPMENT

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DEVELOPING A CONCEPTUAL MODEL TO EVALUATE THE POTENTIAL CHANGES IN INLAND FOOD FISH SUPPLY UNDER VARIOUS GLOBAL CLIMATE CHANGE SCENARIOS

ASIA PROJECT: BURMA
US Project PI: William W. Taylor, Michigan State University

Climate change adaptation: Indigenous Species Development/Study/16IND04MS

Collaborating Institutions and Lead Investigators

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Significance

In Burma, the limited availability of reliable data on the status of fish populations constrains the ability of fisheries managers and policy makers to determine the current status of local fish stocks and thus are often unable to effectively intervene when fisheries are in decline, until the system has virtually collapsed. This makes management efforts to anticipate the impacts of global change drivers (e.g. climate alterations) on fisheries resources exceedingly difficult. For example, Allison et al. (2009) found that the Bangladesh and Cambodia national economies were highly vulnerable to climate change impacts on fisheries, however, the authors were unable to estimate similar impacts for Burma due to the lack of needed information on fishers and fisheries. Therefore, given the importance of inland fisheries to food security in Burma, anticipating the potential impacts of global climate change agents to these critical resources will help managers, policy makers and development programs prepare for and address potential challenges to inland fisheries and local communities in Burma.

Available Data

Projections of climate change for Southeast Asia from the Intergovernmental Panel on Climate Change (IPCC) will be used to estimate how the climate is expected to change in Burma and then how these changes will potentially impact inland fisheries productivity. We will incorporate broad scale (time and space) data from two GCM models that most mirror the monsoon impact that drives SE Asia across the four IPCC scenarios. These models generally produce broad changes in temperature and precipitation patterns since the data are limited and at a broad scale (e.g. one data set for all of Burma). We will focus on up to 5 of the most commercially important inland fish in Burma (e.g. rohu, catla, common carp, snakehead, and tilapia; FAO 2003). These fish include a mix of wild and aquaculture species. Stock-recruitment relationships for these fish are available from the FAO FishStats database and FishBase.

Research Design and Activity Plan

Location

Michigan State University, East Lansing, Michigan, USA

Methods

We will use a simple linear transformed Ricker stock-recruitment model (Ricker 1954), with the inclusion of environmental variables (e.g., changes in precipitation) to model the effect of climate on the selected wild-capture fisheries:

$$log\ \frac{R_i}{S_i} = log\alpha_i - \beta_i S_i + \beta_2 env1_i S_i + \gamma_i env2_i \ldots + \epsilon_i$$

For a given year class, i, R_i is recruitment, S_i is spawning stock, α_i is the productivity parameter, β_1 is the density dependent shape parameter, β_2 is the density dependent shape parameter for a given density-dependent environmental variable (*env*1) , γ_1 is the density independent shape parameter for a given density-independent environmental variable (*env*2)and ϵ_i is normally distributed random error. Because there are limited climate data for Burma, fine-scale downscaling is not feasible at this time. These data are not site specific, so we will create a conceptual framework to illustrate general patterns that drive changes in potential fish production.

We understand that the potential to gain stock and recruitment data for Burmese fisheries specifically is unlikely. However, the fish groups we will focus on are common throughout Southeast Asia. In the instance that these data are not available for Burma for these fishes, we will use recruitment data from other areas of Southeast Asia, or for similar species (in terms of life history, habitat, and relationship to target species) for which data are available in FishBase or the FAO FishStat database. We will modify the basic stock recruitment model with projections for environmental variables that could be influenced by climate, such as changes in precipitation.

The output for this model will be eight projections (two models multiplied by four scenarios) of potential changes to wild fish production. We will develop a Ricker stock-recruitment model with environmental variables to estimate potential wild-fish production. We will also collect climate data for Burma and Southeast Asia. The Ricker model will then be used to simulate wild fish production based on environmental relationships and forced out through 50-100 years. For farmed fish, we will use a simple statistical relationship between environmental variables (measures of temperature and precipitation) and fish growth and likewise produce eight projections (sixteen projections total – eight for aquaculture and eight for wild-capture). Through these projections, we will look for initial relationships between fish production (both wild and farmed) and climate variables. These relationships can then be further developed and explored in a future model, once more climate and production data become available.

Building on this basic model, we will also create a descriptive conceptual framework, through a vulnerability lens, linking aquaculture production (as a component of Burma's GDP) to projected changes in climate variables (e.g. temperature), using the temperature model developed by Burke et al. (2015) and the vulnerability framework developed by Handisyde et al. (Figure 1; 2014). Due to lack of data on aquaculture pond area and other climate variables, this conceptual framework will provide a description of a potential culture production model. This description can then serve as a basis for future models, when data necessary to quantify the model are either accessible or collectible.

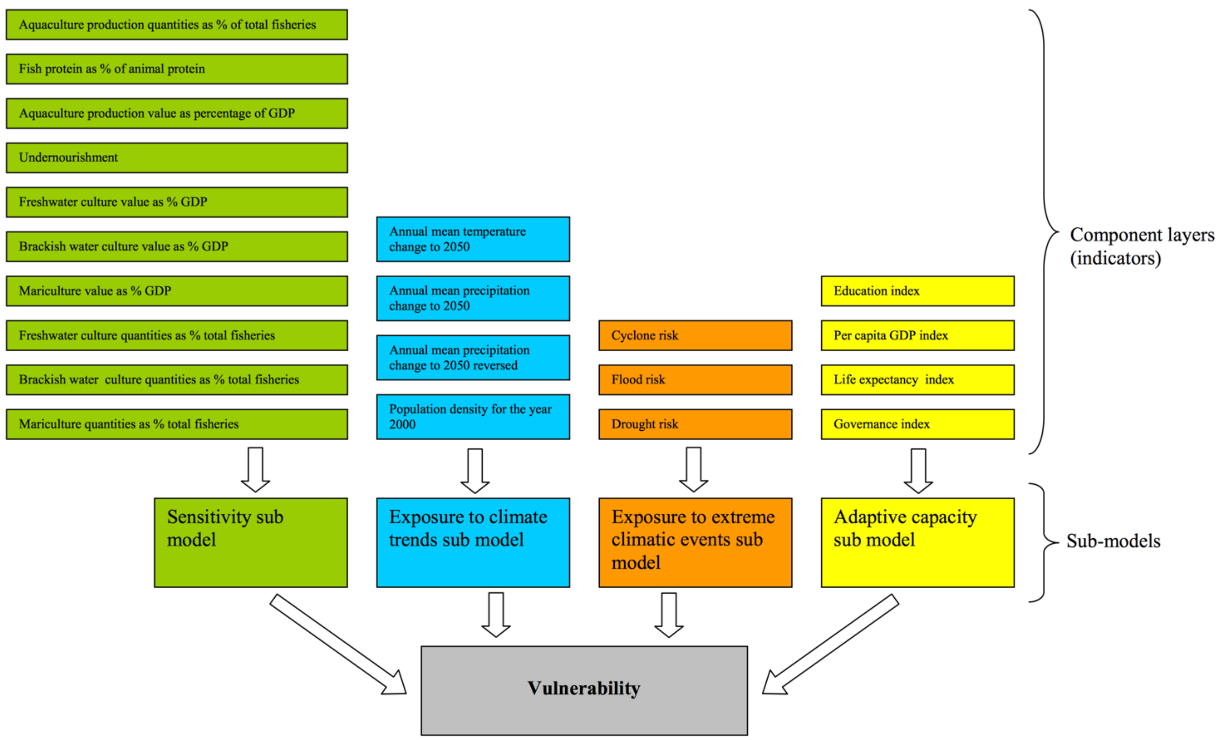

Figure 1. Vulnerability assessment framework developed by Handisyde et al. (2014). We will modify this framework to qualitatively describe factors that can affect vulnerability, then link total production to the stock-recruitment model for Burmese fisheries. The model will be both conceptual and empirical, as provided by the quantity and quality of data available.

Schedule

Project Month	Tasks/Events
1	Compile existing stock-recruitment data for common wild-caught fisheries in Burma
2	Kick-off project team meeting
3	Workshop at American Fisheries Society Annual Meeting
4	Develop simple stock-recruitment relationships for Burmese fisheries including environmental variables
5	Compile SE Asia global change scenarios
6	
7	Project impacts on global change on Burmese fisheries
8	
9	Wrap-up project team meeting
10	Complete final project report and submit by February 2018

Deliverables

A descriptive scenario model of projected global climate change impacts on regional fisheries in Burma. Although these scenarios will be developed at a regional level, due to of the limited nature of the accessible data, they should provide a broad understanding of possibility policy implications and gaps on the potential impacts of climate changes on Burma's inland fisheries resources.

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