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RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

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Modeling climate change impacts and adaptation measures on farm income security in Central Asia

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Background

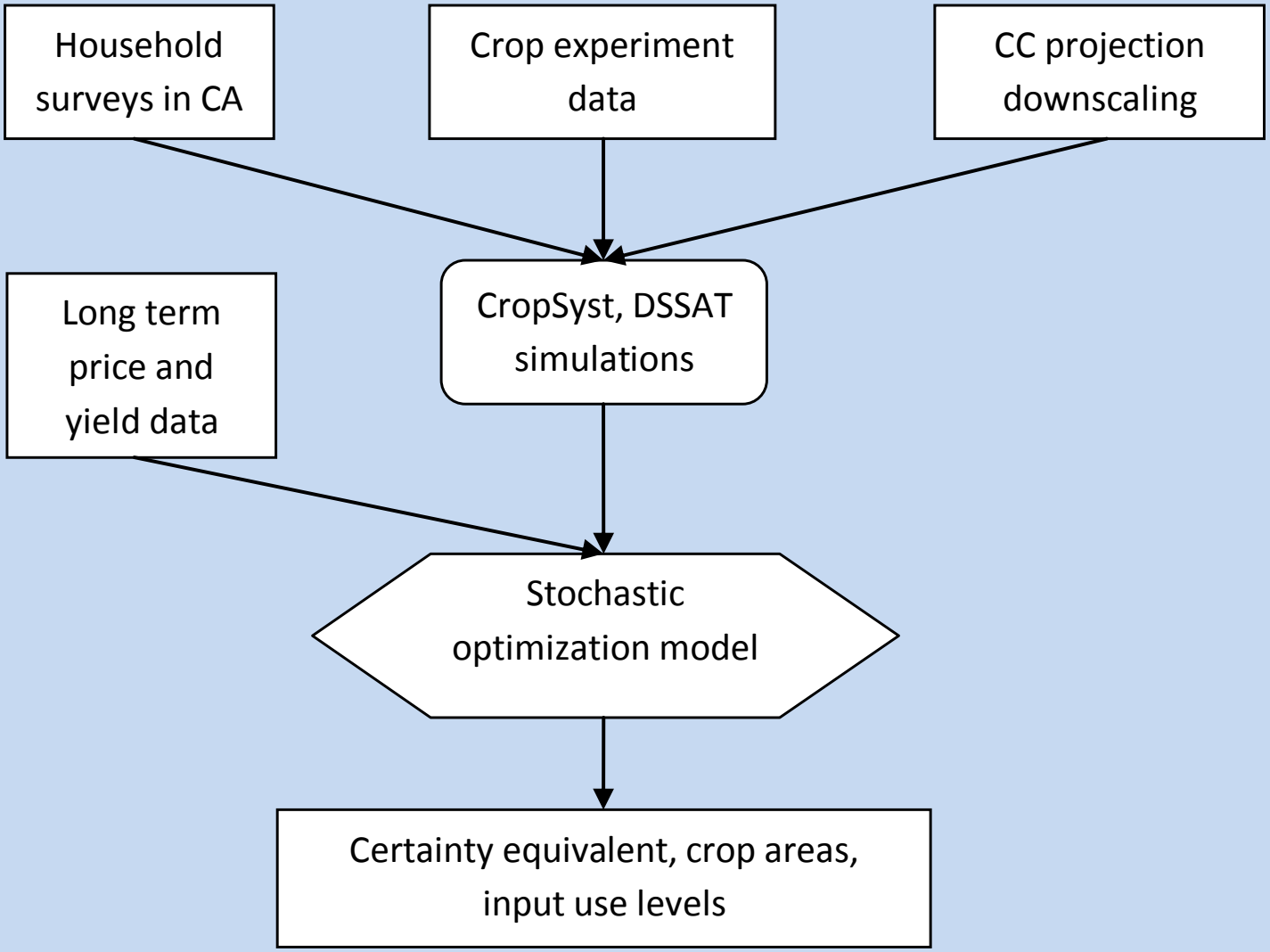
Agricultural production forms the backbone of Central Asian (CA) economies. The contribution of agriculture to GDP is lowest at 11% in Kazakhstan and highest at 38% in Kyrgyzstan. Land degradation inherited from the Soviet times is still a major problem in all CA countries where land salinization affected about 12% of the total irrigated area in Kyrgyzstan, 50-60% in Uzbekistan and even more than 90% in Turkmenistan.

Climate change is adding additional dimension to the existing problems in the region and aggravating the uncertainty in agricultural production and rural poverty.

Objective

The study objectives were to elaborate risk aspects into whole farm context instead of analyzing climate change impacts on isolated farm activities, and to provide more accurate estimates of climate change impacts at sub-national levels than those available at regional or global scales in the literature.

Methodology



Methodology

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- Integrated modeling framework, combining economic analysis with results of climate module, crop growth simulations, was applied.
- The modeling process started with climate change down-scaling to CA environments which generated changes in climate specific variables
- This followed by modeling climate change impacts on yields using crop simulation models (CropSyst and DSSAT)
- Crop simulation models were calibrated with the experimental data from representative agro-ecological zones (AEZ) using downscaled climate data.
- The model was calibrated for three main crops such as cotton, wheat and potatoes as the main agricultural activities in CA. Elaboration of yield-price covariance in the stochastic farm model enables the consideration of natural hedging effect of climate change on agricultural producers' welfare.
- Bio-economic farm model with risk component was developed to assess climate change impacts on farm income volatility in Central Asia: Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan.

Results

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- The farm revenues in many AEZs is expected to stay close to currently observed levels in the near future scenarios (2010-2040).
- Very significant changes are observed for late future scenarios (2071-2100) as presented in Figure 2. The direction of the change differ depending on agro-ecological zones and socio-economic aspects of the farming systems.
- The revenues in Uzbekistan are expected to decline in the late future (2070-2100) due to increasing temperatures and risk of increasing water deficit, especially if availability of irrigation water from transboundary rivers decline.
- Farmers in sub-humid zones of Kazakhstan are expected to benefit from increasing temperature and precipitation. Sub-humid and humid areas in Tajikistan and Kyrgyzstan will benefit while arid and semiarid regions will be negatively affected.

Results

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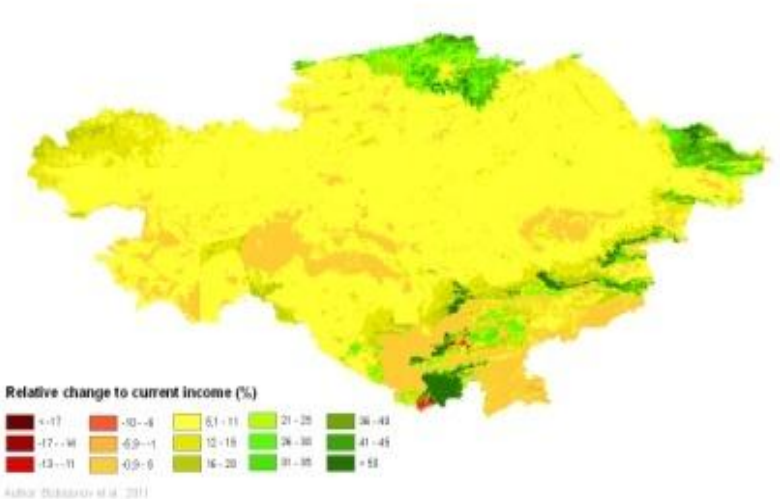
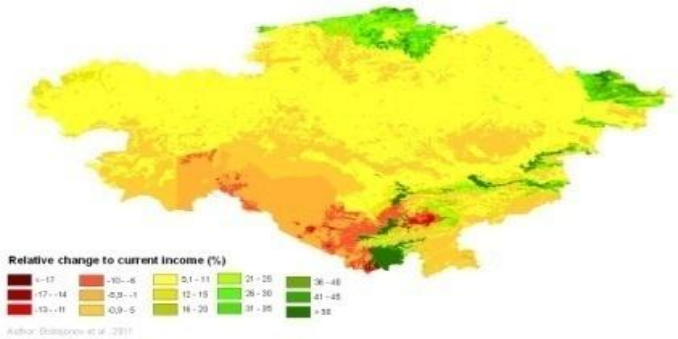
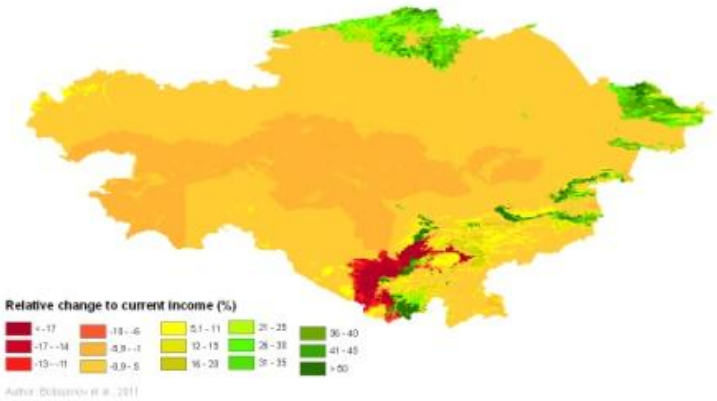
a) A1b scenario for the period 2071-2100

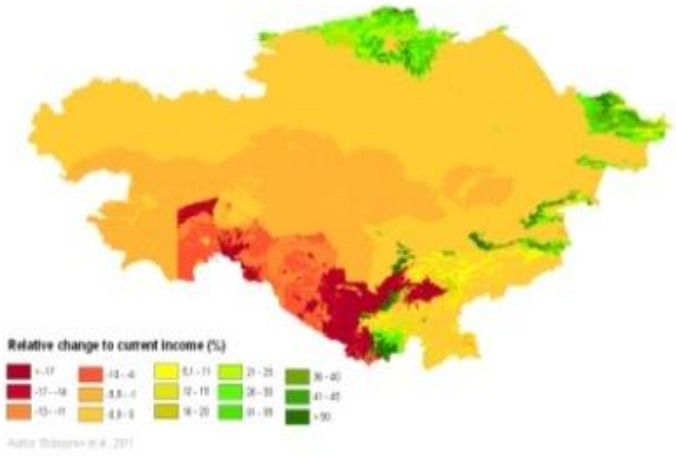


b) A2 scenario for the period 2071-2100





c) A1b scenario for the period 2071-2100, 30% reduction of irrigation water



d) A2 scenario for the period 2071-2100, 30% reduction of irrigation water

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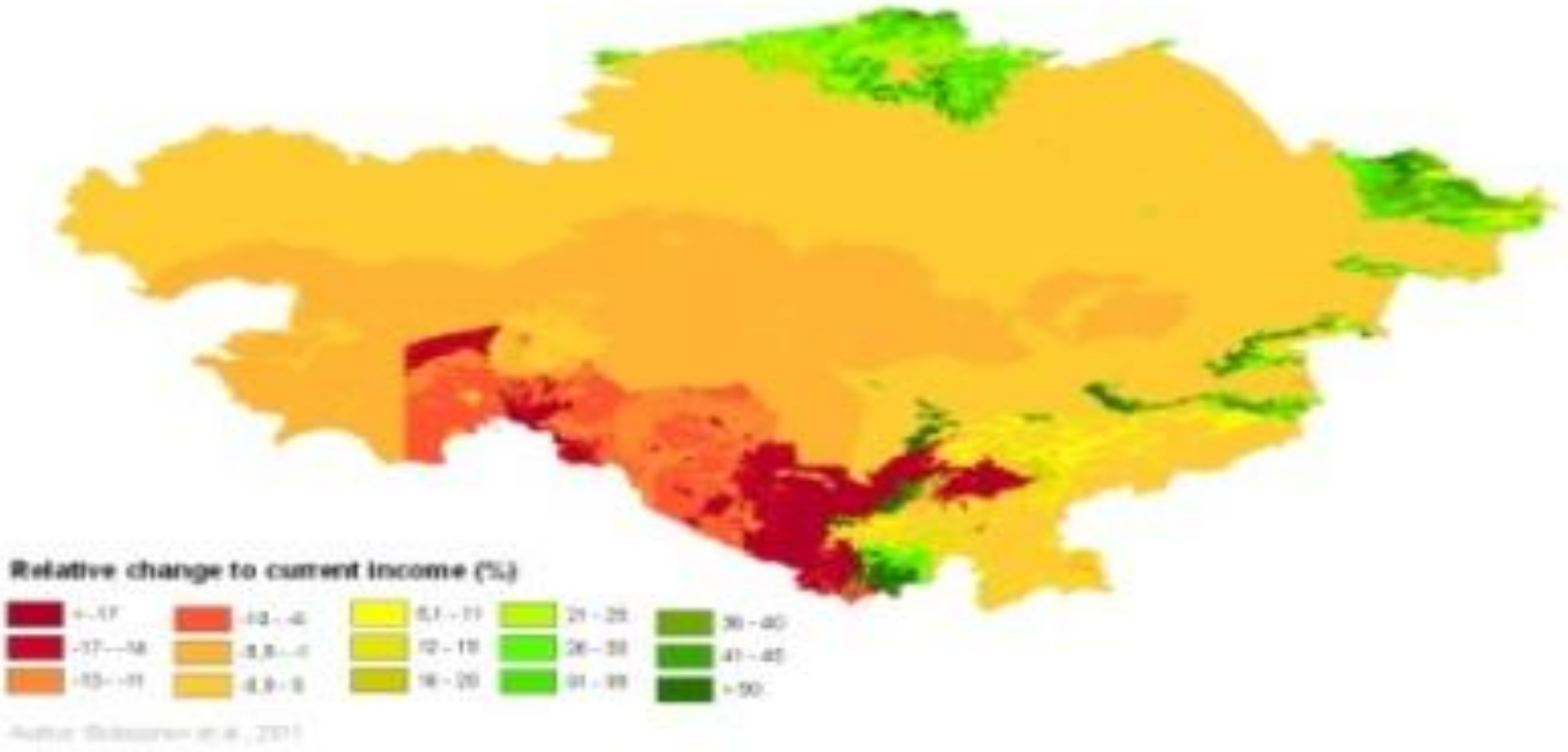

Conclusions

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- Adoption of more efficient irrigation methods could be one of the most effective adaptation measures to reduce farmers' vulnerability under climate change in arid and semiarid regions of Central Asia.

- Governments should establish policies for creating incentives for adoption of these technologies especially through improving farm advisory services and raising the awareness on climate change effects.

- The availability of the insurance programs also may play an important role to cope with increasing sequence of weather extremes.

- The analysis of changing occurrence of weather extremes in the future need to be further investigated in order to improve the results of this study.

- Trade is important aspect of climate adaptation strategy as famers will find more flexible trade policy easy to adjust their cropping patterns and take advantage of market demand

Thank you for your attention