# Valuing meteorological services in resource-constrained settings: Application to smallholder farmers in the Peruvian Altiplano

(Knowledge Transfer)

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**Abstract**

Changing climate and weather patterns have resulted in reduced agricultural productivity in some parts of the world and put pressure on global food security. Availability and improved quality of meteorological information is seen as a potentially propitious means of adaptation to changing climate conditions. Forecasts of extreme weather events are especially valuable in resource-poor settings where climate-related vulnerability is high, such as for smallholder farmers in the developing world. In this paper we provide estimates of frost warnings valuation in the context of small-scale quinoa production in the Peruvian Altiplano. We first present a detailed contextual assessment of quinoa production in the study region based on agrometeorological and socio-economic data that was obtained through a representative farm household survey conducted in December 2016. Building on this assessment, we propose a stochastic life-cycle model, replicating the lifetime cycle of a quinoa-producing household, in order to derive a theoretical valuation of frost warnings. Calibrating the model to our data we provide estimates of frost-warning valuation which are in the range of $30-50 per household and year, depending on the forecast accuracy and agents' risk aversion. In a last step, using the observational data from the farm household survey, we show that access to existing meteorological services is empirically associated with avoided losses in agricultural production that amount to $18 per average household and per year. Our findings point to high climate vulnerabilities of smallholders in the Peruvian Altiplano and potentially large welfare gains from incorporating improved meteorological services into their decision-making process.

**Keywords** climate services; climate change; adaptation; quinoa farming

**Aims of the Third Mission activity**

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| **Cooperation partners outside the university sector** | MeteoSwiss, Zürich, Switzerland; SENAMHI Peru |
| **Cooperation partners from the scientific/research field** | Filippo Lechthaler, Prof. Dr., Bern University of Applied Sciences |
| **Faculty** | Department of Economics |
| **Timeframe** | 01/12/2016 - ongoing |
| **Funding** | Swiss Agency for Development and Cooperation; WMO |
| **Research basis** | fully |
| **Social/economic relevance** | Social relevance: 1) Raising awareness of farmers regarding the use of climate information for their production and decision-making processes. 2) Improvement of livelihoods in poor settings. 3) Capacity building in local environments. Economic relevance: 1) Justification for investment in necessary infrastructure (e.g. meteo stations). 2) Enhancement of food security. |
| **Integration into academic teaching/the curriculum** | One chapter in my course 'Resource and Environmental Economics' is devoted to climate services. |
| **Impact** | 1) Substantial economic benefits from existing weather forecasts, namely up to $18 per household per year. Considerably higher potential benefits of improved forecasts, up to $80 per household per year.<br>2) Raised awareness of farmers about the benefits of climate information.<br>3) Raised trust in the local provider of the meteorological information.<br>4) Improved presentation and dissemination of forecasts. |

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| **Transfer aspect of the activity** | Farmers were provided with an enhanced weather forecast. Personnel of SENAMHI and students from the La Molina university were trained in Peru as well as during workshops in Switzerland. |
| **Future orientation & sustainability** | The impact of the project is relatively long term as it established the basis for provision of enhanced weather forecasts for quinoa farmers on the Peruvian Altiplano. Moreover, it explicitly showed that better climate information is capable of improving the decision-making process of farmers, which resulted in avoided crop losses. The farmers understood the relevance of climate information and increased the uptake of forecasts in their everyday production process. These are all long-term effects which will hopefully continue to improve the well-being of households in poor regions. |
| **Achievement of objectives** | We conducted an empirical investigation using relative harvest index as dependent variable and various controls, including the use of climate information. |
| **Measures to sustain this activity over the long term/expand it** | I would like to develop a follow up project on the use of climate information. |
| **Visibility** | webpages, publications, radio program in Peru, youtube |
| **Links/Publications** | • https://public.wmo.int/en/projects/climandes<br>• https://www.meteoswiss.admin.ch/home/research-and-cooperation/international-cooperation/international-projects/climandes.html<br>• https://www.senamhi.gob.pe/climandes/<br>• https://anglejournal.com/article/2018-02-how-climate-services-can-help-the-worlds-poor-and-beyond-an-economic-perspective-on-enhancing-climate-sensitive-decisio/<br>• https://www.sciencedirect.com/science/article/pii/S2405880720300479 |