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# **THE FEASIBILITY OF INDEX-BASED INSURANCE AS A RISK MANAGEMENT TOOL IN CENTRAL ASIA**

Ihtiyor Bobojonov

Leibniz-Institut für Agrarentwicklung  
in Transformationsökonomien (IAMO), Halle (Saale), Deutschland

Diana Grigoreva

Leibniz-Institut für Agrarentwicklung  
in Transformationsökonomien (IAMO), Halle (Saale), Deutschland

Aden Aw-Hassan

International Center for Agricultural Research in the Dry Areas (ICARDA), Jordan

Chandrashekar Biradar

International Center for Agricultural Research in the Dry Areas (ICARDA), Jordan

Aziz Nurbekov

Regional Program for Sustainable Agricultural Development in Central Asia and  
Caucasus (CAC-ICARDA), Uzbekistan

Kontaktautor: [grigoreva@iamo.de](mailto:grigoreva@iamo.de)



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## **Abstract**

This study investigates suitable several indexes, as well as risk coping potential of index-based insurance in Central Asia. The territory of Central Asia is very large and agro-ecology is very heterogeneous. Although there are few studies investigating the suitability of index insurance in rainfed systems of Central Asia, suitability of index insurance for irrigated systems is not yet investigated. Therefore, this study discusses the challenges of index selection for irrigated systems and compares the results with rainfed systems. For this purpose, suitability and impact of area-yield, irrigation water intake at regional level, as well as remote sensing based indexes are analyzed. The results of the study show that selection of index for the irrigated systems is more complex than rainfed systems and more caution is required in order to minimize the basis risk. Indexes, such as area yield, as well as irrigation water availability may have difficulty of capturing risk exposure in irrigated systems, since volatility of the yield may vary depending on the location of the field in the irrigation systems. Those indexes could be used as security against extreme drought only. In contrast, remote sensing data may capture small risks as they provide very close observation of vegetation growth at farm level.

## **Keywords**

Risk management, crop insurance, weather Index-based insurance, climate risk, irrigation water, NDVI, crop yield, Central Asia

## **1 Introduction**

The agricultural employment in Central Asian countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan may vary from 20% to 65%, depending on a country, e.g. World Bank (2011). Agricultural sector is very important yet vulnerable to various risks, such as production, market, natural or climate risks. Due to the climate change issues in Central Asia and high dependence on irrigation water, severe droughts are becoming the main reason of crop loss in recent years. Even though the risks sources are known, farmers face difficulties in managing climate risk due to a lack of finance and underdeveloped credit markets in Central Asia. High level of risk in agricultural production also reduces the motivation of farmers to invest into new technologies to improve productivity. Under these circumstances, the purchase of insurance policy may help to overcome those problems associated with weather risks. The potential benefit is acknowledged by policy makers in Uzbekistan and Kazakhstan and multiple peril crops insurance schemes are implemented. Agricultural insurance markets in other countries are underdeveloped. However, the multiple peril crop insurance products currently sold in the region inherit several problems common in many developing countries. In this respect, index based insurance may provide several solutions to solve high product prices and a problem of information asymmetry. Yet, there is very limited research available for Central Asia and majority of the studies consider the suitability of indexes for rainfed systems (Bokusheva, Heidelbach, & Kusajynov, 2007; Broka et al., 2012). Therefore, this study fills this gap and comparatively investigates the suitability of indexes for irrigated and rainfed systems.

## **2 Data and methodology**

The objective of the study is to analyze the feasibility of weather index-based insurance for grain production in rainfed and irrigated farming systems in the countries of Central Asia. The

farm level grain yield data are obtained for the six field locations: Akmola, Karaganda (Kazakhstan), Jizzakh, Kashkadarya, Khorezm, and RRP regions (Tajikistan). Farm level yield data are available for the years of 1980-2010. Second regional level yield (area yield) and monthly irrigation water used in these regions are obtained from statistical agencies of these countries. Normalized Difference Vegetation Index (NDVI) is obtained from MODIS satellites for the years 2000-2010. NDVI is widely utilized in many developing countries (Bobojonov, Aw-Hassan, & Sommer, 2014), but not yet in Central Asia. The field and regional level yields are detrended with linear model and fair premium is estimated with burn analysis.

### 3 Results

The estimation results reveal very high dependency of area yield and NDVI indexes with farm level yields (Table 1). Area yield index is especially suitable in case of Akmola and Karaganda regions, which belong to rainfed systems. In contrast, the correlation is lower in regards to Jizzah and Kashkadarya regions. They also belong to mainly rainfed systems but supplementary irrigation is also used sometimes.

**Table 1: Correlation of farm level yield data and different indexes**

Station/oblast	Area yield	Water, January	Water, April	Water, August	NDVI
Shortandy/Akmola	0.7798				0.6667
Gallalar/Jizzakh	0.2789	0.0035	0.1102	0.4290	0.7173
Karaganda/Karaganda	0.5268				0.4261
Kamashi/Kashkadarya	0.2120	0.0877	0.3213	0.5290	0.8911
Khorezm/Khorezm	0.5107	0.3123	0.2916	0.2515	
Tuhumparvar/RRP	0.5213		0.2155	0.2261	0.3278

Source: Own estimations, based on Governmental Statistics Services of Central Asia

Similarly, correlation between NDVI and farm level yield is very high in case of Akmola, Jizzakh and Kashkadarya regions. Considering monthly irrigation used at regional level, irrigation water availability in January, April, and August months showed correlations with farm level yields. High correlation result endorses the plantation of winter wheat in Khorezm region, which is based on full irrigation. However, correlation levels seem to be lower compared to area yield and NDVI indexes.

All three parameters prove their contribution to the climate risk minimization and possible application in crop insurance. Further decision on the choice of index depends on the insurer experience and the availability of necessary data in the exact oblast/region. Furthermore, type of farming system and management practices also need to be considered in index selection process.

### 4 Conclusion

The analysis of this study reveals that area yield, irrigation water availability, and NDVI indexes can be used as potential indexes for Central Asia. Weather index-based insurance policy acquisition by farmers may help to overcome negative weather conditions in Central Asia. The analyses show that area yield can be considered as a suitable index for large-size rainfed farms. NDVI insurance is, in general, found suitable for many farming systems. Irrigation water availability indexes can mainly be used to capture severe droughts and systemic risks. Thus, the results of this study provide new insights for further challenges that require more caution with respect to the index selection process.

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