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Policy implications of climate variability on agriculture: Water management in the Po river basin, Italy

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ABSTRACT

This paper discusses the policy implications of changing hydro-climatic conditions for water management in the Po river valley. This area is characterized by heterogeneous topographical features and intensive water use in agriculture. The first and most fundamental level of adaptation to climate change in agriculture occurs at the level of the local farmer. Farmers undertake strategies to adapt to the form of climate change that they are able to foresee, through observation of the recent trends in indicators such as average temperatures and average precipitation. However, they can do little to respond to the greater uncertainty inherent in climate change. The role of policy will be to address this residual uncertainty, investing in institutions and infrastructure. Notably, climate variability implies a water storage problem: we discuss the different roles that the private and public sector can play in managing the water stock across space and time to prevent agricultural yield fluctuations causing welfare loss.

1. Introduction

1.1. Climate change impacts and implications for water policy

With regard to water resources, climate change is expected to result in increased variability, enhanced uncertainty, and generally increased scarcity (Strzepek et al., 2011). It is expected that climate change will significantly impact water supply and demand throughout the world. This will have implications for localized planning and water resources management, even in those areas that have not traditionally faced fresh water shortage. As a result, attention is increasingly being paid to the development of adaptation strategies.

Several studies have concluded that climate change induced effects are already affecting the Alpine area in Europe and will increasingly do so in the future (e.g., Toreti et al., 2009, 2010; Beniston et al., 2003, 2011; Beniston, 2003, 2010; Lòpez-Moreno et al., 2011; European Environment Agency, 2009).

We discuss these issues in the context of the Po river basin, a mountain based watershed in the north of the Italian peninsula. This area is characterized by high water availability and intensive water use in agriculture. Our fundamental enquiry concerns the way in which optimal policy might facilitate adaptation to climate change in agriculture. We focus on policies that can help to smooth water input fluctuations.[1]

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[1] Several studies justify the focus on climatic variables as input in the agriculture production function (Deschênes and Greenstone, 2007) and as main causes of variability in agricultural yields (Mendelsohn et al., 1994; Mendelsohn and Dinar, 2003; Semenov and Porter, 1995; Mearns et al., 1996, 1997; Riha et al., 1996; Cline, 1996, 2007; Southworth et al., 2000, 2002; Ciais et al., 2005; Torriani et al., 2007; Ciscar, 2009; Lobell et al., 2011).

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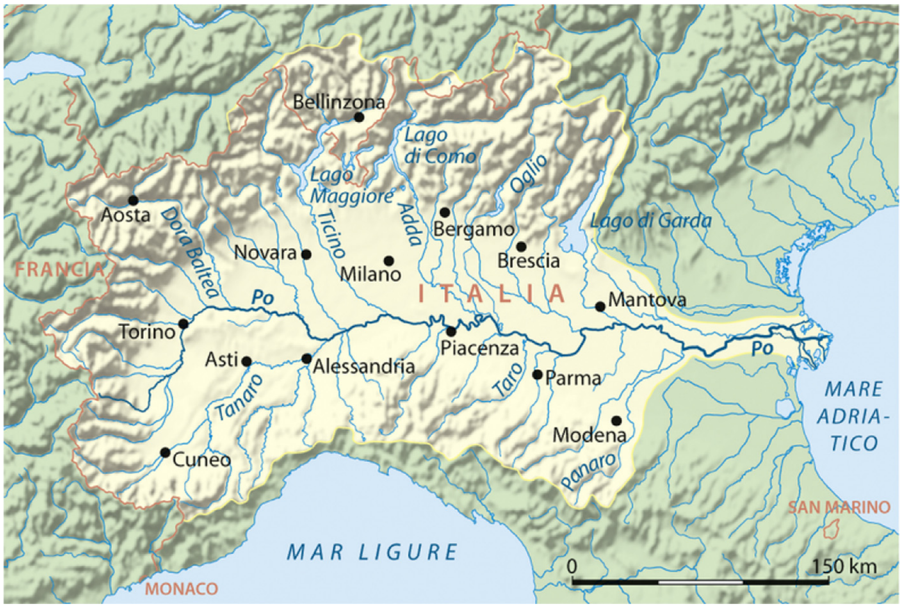

Fig. 1 – The Po river basin.

We address the different roles of farmers and the public sector in adapting to these changes. We look at water resources variability as a source of agricultural yield variability, which in turn can cause variability in welfare. The economic literature is mostly interested in coping with welfare variability, suggesting that the optimal way to deal with agricultural losses induced by climate variability may be not through crop yields, but through insurance schemes and prices. In this paper, we assume that the objective of the water manager is to deal with residual climate-induced variability in crop's yields, after the farmer implements his adaptation strategies.

Our analysis indicates that, in terms of agricultural impacts, the primary focus of water management policy should be on the facilitation of adaptation by local farmers. Farmers have both the incentives and (much of) the information to be able to adapt optimally to expected impacts. The policy maker should see its function as: (a) aiding and facilitating farmer adaptation; (b) ascertaining residual uncertainty and change unmanaged by local farmers; and (c) adoption of policy interventions that deal with the residual problem. In this study we demonstrate how such an optimal policy intervention might be devised within the context of the Po river agricultural production system.

The paper proceeds as it follows: in Section 1 we present a depiction of the changes in climate occurring within the Po river watershed, both in terms of average trends and in terms of changing variability. In Section 2 we set out how local farmers act as the first line of defense against such changes, indicating how farmers can and do adapt their production systems to the changes they anticipate. In Section 3 we identify the residual role for policy makers – in aiding farmers in the accomplishment of their task of adaptation – both by means of direct assistance to farmers and by means of altered policies and institutions. In Section 4 we assess the potential for success of particular forms of policy interventions (spatial and temporal). Section 5 concludes.

1.2. *The Po basin*

The Po river is the longest river in Italy, with a total length of over 650 km, from the foot of the Monviso mountain in the Piedmont region to the Adriatic Sea in Emilia Romagna region (Fig. 1).[2] The whole surface area of the Po basin is 74,000 km^2, dissecting seven Italian regions and about 3200 municipalities. Approximately 16 million people live in the Po basin, conducting economic activities that account for about 40% of the annual Italian GDP. About 35% of the Italian agricultural production comes from this area (Po River Watershed Authority, 2006).

From the geomorphologic viewpoint the territory is very heterogeneous, comprising mountains, hills and plains.[3] Most of the usable agricultural land (AUL) is concentrated in three regions: 37% of the whole AUL is in Lombardy region, 31.5% in Piedmont and 30% in Emilia Romagna (Po River Watershed Authority, 2006; Giupponi, 2000). Agriculture accounts for about 1.5% of the GDP produced in these regions.[4] Fig. 2 shows the topographic features of the land dedicated to agriculture in each region. Piedmont, which is situated upstream in the Po watershed, has a prevalence of mountainous areas compared to Lombardy and especially to the most downstream region Emilia Romagna. Furthermore, data at the provincial administrative level show a significant topographic heterogeneity within and between provinces.

[2] Italian regions are the first-level administrative divisions of the state. According to the Nomenclature of Units for Territorial Statistics (NUTS) they are the second administrative level in Italy (NUTS II). Each region is divided into provinces (NUTS III).

[3] The Italian National Institute of Statistics (ISTAT) classifies mountains as territories higher than 600 meters above mean sea level (MAMSL), hills as territories between 300 and 600 MAMSL and plains as territories lower than 300 MAMSL.

[4] Source: own calculations on data ISTAT, based on the 10-years average 2000–2010.

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