Water Availability: a factor of sustainability and adaptation of agriculture to climate change

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Abstract

Climate change is expected to negatively affect agriculture. The effects of climate change on agricultural production are widely studied and adaptation strategies have already been proposed and even applied and assessed in many cases. A key component on agriculture vulnerability to climate change is water availability. The aim of the present study is to enlist and review representative proposed water management schemes and adaptation strategies related to agricultural water proposed in literature. Changes in technologies used, infrastructure, irrigation and crop patterns have been considered as adaptation procedures in order to prevent or reduce climate change impacts to agriculture. The choice of the most preferable measures should not be limited to their performance against water shortage but also on the assessment of their economic and social impacts. The suitability of each adaptation method is also depended on the scale of intervation; farm, river basin or national level.

Keywords: irrigation, water management, climate change, adaptation, water availability

1. Introduction

Climate change (CC) is expected to have varying effects on water resources depending on the region. Projected increase in the frequency and the intense of flooding and droughts and the related impacts such as reduction in irrigation water availability or damages in water infrastructures are likely to threaten agricultural production and food security. Water availability is expected to be more vulnerable mainly in areas that are already facing water stress, such as the Mediterranean countries (Turral et al., 2011). The present analysis focuses on reviewing representative adaptation measures and strategies, related to agricultural water shortage, proposed to secure agricultural production.

2. Water management and adaptation options

CC adaptation measures and policies can be classified based on different characteristics such as the scale of intervention (farm/river basin/national level), the required time to reach the expected results (short/medium/long term) and the associated cost. In the present analysis, the key adaptation measures that can be implemented to preserve irrigation water availability under the pressure of CC have been classified in three categories (Figure 1): a) crop related (agronomic) measures, b) infrastructure and technology based solutions, and c) non-intervention/management solutions (policy measures).

Representative adaptation measures related to crops are: changes in crop varieties to less water intensive and of greater resilience cultivations, irrigation rescheduling, changes in cropping calendar (Turral et al., 2011, Van Heerden and Stevens, 2010). The results of this type of measures can be characterized as short term and of low cost. These interventions are implemented at farm scale. However, in order to be widely adopted, they should be promoted by relevant authorities (through farmers information, recommendations and training, financial support, etc.).

Investments on more efficient irrigation systems and infrastructure are widely proposed as measures to deal with irrigation water shortage in a changing environment (Kahil et al., 2015, Fader et al., 2016). Smart irrigation management systems and precision irrigation can significantly improve crop yield and reduce water use supporting farmers in increasing yield and water productivity. Maintenance of the existing irrigation system to avoid and control leakages can improve the current water availability and increase water security in periods of drought (Malek and Verburg, 2017). Infrastructure such as reservoirs, technologies for water reuse and desalination, although having high investment cost, can enhance water availability and increase resilience. These large-scale adaptive measures require planning at river basin and/or national level to obtain efficient results.

The aforementioned measures (i.e. the agronomic adaptation options and the investments on infrastructure and technology) should be supported by an appropriate policy (FAO, 2013). Policy measures such as monitoring, early warning or farmer training can contribute to more effective implementation of the proposed adaptation measures. Georgiou and Karpouzos (2017) emphasize the effectiveness of adopting optimization techniques on irrigation water management for ensuring water availability in a changing environment.

Improved water charging can also lead to more efficient water use and therefore compensate for changes in water availability imposed by CC (Iglesias and Garrote, 2015). Successful and sustainable adaptation can also be achieved through an effective land use planning that determines suitable land uses in areas vulnerable to climate change (FAO, 2013). Policy measures are usually planned and implemented at national scale.

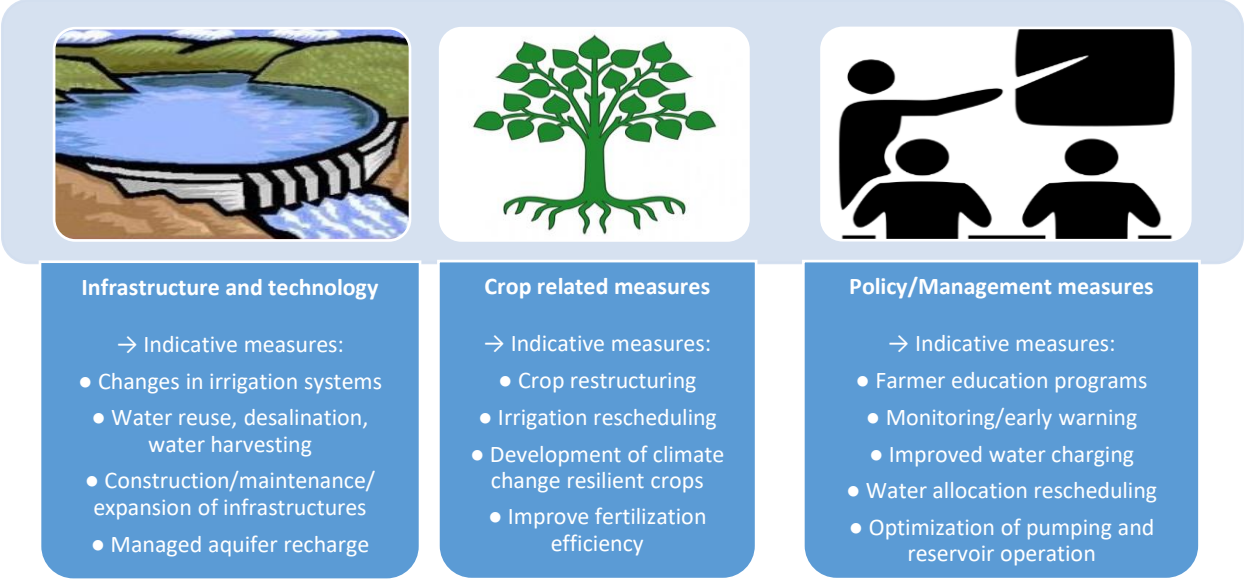

Figure 1. Indicative measures for adapting to climate change impacts on irrigation water availability

3. Conclusions

CC impacts on water availability is expected to put pressure on agricultural production and therefore raise related socio-economic impacts. In the present study an effort to hierarchy the available adaptation options and enlist representative measures for each category has been made. A preliminary characterization on the cost and the scale of intervention and planning is also performed. Nevertheless, it is noted that water vulnerability to CC is expected to enhance the competitiveness of the various sectors such as the domestic or the industrial for water demand (Iglesias and Garrote, 2015). Therefore it is essential to set priorities in water demand and adopt strategies that will ensure that water needs of higher priority will be covered.

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