Ecological Economics 132 (2017) 196–204

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Methodological and Ideological Options

The Economic Impacts of Droughts: A Framework for Analysis

Jaume Freire-González [a,*], Christopher Decker [b], Jim W. Hall [a]

[a] Environmental Change Institute, University of Oxford, Oxford University Centre for the Environment, South Parks Road, Oxford OX1 3QY, UK
[b] Centre for Socio-Legal Studies, University of Oxford, Manor Road Building, Oxford OX1 3UQ, UK

ARTICLE INFO

Article history:
Received 3 August 2016
Received in revised form 3 November 2016
Accepted 4 November 2016
Available online 10 November 2016

Keywords:
Drought
Economic impacts
Policy
Hydraulic capital
Water economics

ABSTRACT

Droughts are a specific type of natural hazard. Economic assessments of drought impacts require a framework capable of accounting for its unique and particular characteristics. Traditional conceptual frameworks used to assess the impacts of natural hazards do not adequately capture all of the factors that contribute to the economic impacts of droughts, such as: the importance of the level, and composition, of hydraulic capital; the dispersion of economic impacts across different economic activities and agents; the temporality of drought events; and the critical importance of policy-making in shaping the short and long-term economic impacts of droughts. Nor do traditional frameworks take account of the complex interaction between factors within the domain of decision-making and underlying climate conditions. We propose a new conceptual framework based around two sources of economic impact: 'green water' and 'blue water', and argue that because each source of drought impacts the economy in different ways, they must be differentiated in any assessment of economic impact.

1. Introduction

In economic terms drought is a special type of natural hazard. Droughts display specific spatial and temporal characteristics, and are heavily impacted by policy choices over the short and long term. The unique and particular characteristics of droughts mean that the standard analytical frameworks used to estimate the economic impacts of other types of natural hazards –such as floods, earthquakes and hurricanes– are not automatically fit for purpose when applied to droughts.

Many regions of the world are currently experiencing some of the worst drought conditions for a number of generations. In 2014, Brazil experienced its worst drought in 80 years, while California has recently endured its worst drought for over a century. Over the past decade, prolonged and severe droughts have also been experienced in Africa, Southern Europe and Australasia. Projections suggest that droughts will be more frequent and severe in many parts of the world as a result of population growth, rising incomes and changes in climatic conditions (IPCC, 2014). In responding to drought policy-makers, regulators, water companies and other stakeholders need a deeper understanding of the trade-offs involved with different management options, having regard to costs and the potential impacts on economic systems. This, in turn, increases the importance of developing an appropriate framework for understanding the impacts of drought and the costs associated with different policy measures. By highlighting the trade-offs and choices involved the framework described in this paper is intended to assist policy-makers, regulators, water companies, water users and other stakeholders in managing and responding to drought over the short and long-terms.

Traditional methodologies for measuring the (macroeconomic) impacts of drought assess the economic effects of droughts across a range of different regions from an empirical perspective (surveys of studies can be found at Ding et al., 2010; Logar and van den Bergh, 2013 and in Meyer et al., 2013). An important focus of most of this work has been on assessing the impact of drought on agriculture activities (e.g. Islam, 2003; Horridge et al., 2005; Wittwer and Griffith, 2010; Ferrari et al., 2014; Howitt et al., 2014). While this focus is appropriate for highly agricultural economic regions, it is of less relevance when assessing the potential impact of drought in economic regions that are less reliant on agriculture or which have a more complex and diversified industrial structure. In these settings, there is a need for a more general analytical framework that can assess impacts for all economic sectors and activities. This research sets out such a general conceptual framework for assessing the economic impacts of droughts, emphasising how policy decisions, responses and planning interact. An important element of the framework is that it recognises that drought is a complex phenomenon with several and wide economic implications.

We have organised our description of the framework into 7 sections. Section 2 describes the standard empirical approaches to assess the costs or impacts of natural hazards. It also provides an overview of selected empirical studies on the costs of droughts. Section 3 identifies some of the distinguishing features and characteristics of droughts from an economic perspective. Section 4 describes the two main sources of economic cost or impact of droughts and how they impact on economies. Section 5 analyses the role of hydraulic capital on the economics of droughts. Section 6 focuses on how short-term drought or water

* Corresponding author.
E-mail address: jaumefreire@hotmail.com (J. Freire-González).

http://dx.doi.org/10.1016/j.ecolecon.2016.11.005
0921-8009/

management policies can affect the economic impacts, while Section 7 sets out our main conclusions.

2. Characterization of Economics of Droughts

This section characterizes the main aspects to consider in drought economics focusing on costs, impacts and empirical evidence. It highlights the complexity of drought and discusses how droughts differ from other natural hazards in economic terms.

2.1. Cost Categories Used to Assess Natural Hazards

The main cost categories used to assess and estimate the impact of different shocks associated with natural hazards include (Smith and Ward, 1998; Penning-Rowsell et al., 2003; Meyer et al., 2013):

- Direct costs: including damages to assets such as buildings, contents and infrastructure; production interruption because of destroyed machinery; shortages of productive inputs or reduction of labour or its productivity.
- Indirect costs and associated economy wide impacts: indirect costs are induced production losses of suppliers and customers of economic agents directly affected by a hazard (Przyluski and Hallegatte, 2011).
- Intangible costs: damages to goods and services which are not measurable (or at least not easily measurable) in monetary terms because they are not traded on a market. Damages to environmental goods or services, physical and mental health, pollution, environmental loads and other externalities are included within this category.
- Risk mitigation costs: these can be directly incurred costs (such as those involved in the set-up of infrastructure and operation and maintenance costs) and indirect costs which are induced costs in other sectors.

The estimation of intangible costs can often be complicated by the fact that it involves the monetization of non-market goods and services, as well a need to make a decision on discount rates (Padilla, 2002). Similarly, the estimation of risk mitigation costs is often controversial because the estimation of such costs can require the development of an appropriate counterfactual. That is, the risk mitigation cost needs to be assessed having regard to the expected probability of an event of a particular magnitude, length and frequency being incurred, and then compared to the potential costs associated with taking preventative measures to avoid such an event arising in the first instance. Beyond these cost categories, the redistribution effects of natural hazards also need to be considered if a complete assessment of the economic impacts of natural hazards is to be undertaken.

2.2. Costs of Droughts

Droughts imply several types of economic impact and associated cost. Fig. 1 shows the different pathways to economic impacts of a drought. The pathways are interrelated given that economies are complex systems with all sorts of feedback effects.

Fig. 1 differentiates between two types of impacts. The first type of impact is related to how a lack of water affects different economic agents such as industry, households, government and the environment. The second type of impact refers to the secondary effects of a drought from fires, desertification, migrations, etc. Each of these secondary effects needs a specific framework of economic analysis beyond the effects of the lack of water on the economic systems. Most existing empirical studies on drought focus only on one type of impact, and do not attempt to assess all of the impacts on different economic agents (industry, households, environment etc.) within an integrated framework.

Several methodological approaches are used to assess impacts in the existing studies on drought impacts. These approaches include:

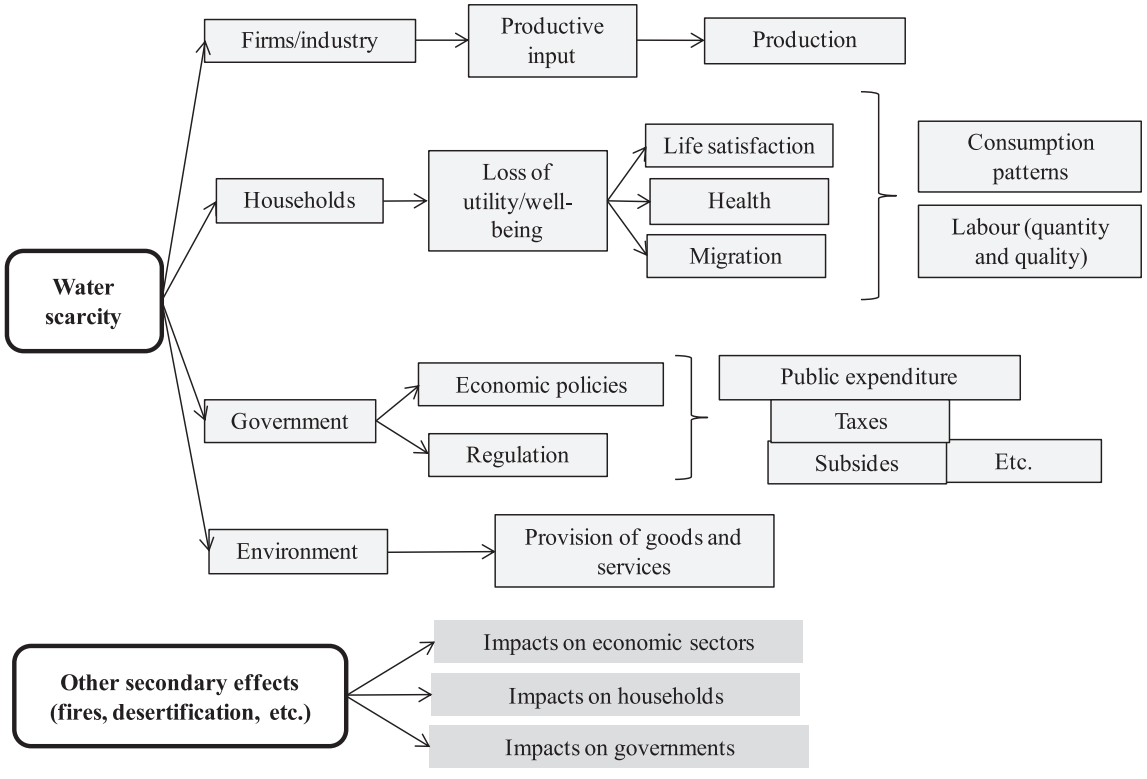

Fig. 1. Economic impacts of droughts.