WATER MANAGEMENT POLICIES FOR FOOD SECURITY (WATER_MAN)

Reference spoke: 1 (and 7)
Reference partner: UNIMI (and UNIMIB)
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WPs involved: WP 1.1. Promoting sustainability in food production; WP7.4 - Policies for healthy and sustainable diets
TASK involved: T 1.1.1, T7.4.1, T7.4.4
Duration: 26 Months

State of the art:

Water shortages and floods are increasingly common in developing and emerging economies. Climate change also makes water stress and flooding episodes more frequent and severe, both in water-abundant regions such as Latin America and in regions particularly exposed to climate change such as Italy.

While there is an extensive literature on the socio-economic consequences of climate fluctuations (Dell et al., 2014), the impact of climate adaptation policies and technologies has received much less attention in empirical micro-economics.

In this research project, we investigate the impact of water management policies and technologies on food outcomes. We focus on both: (1) large-scale water (and flood) management projects such as irrigation and hydroelectric dams; and 2) small-scale interventions aimed at helping households cope with irregular rainfall. In the empirical analysis, we focus on Brazil, as it provides both an interesting laboratory to evaluate specific policy interventions and extensive access to data. The findings of our research are expected to have more general implications beyond the Brazilian context, however.

Dams. Dams, which are often financed by international financial institutions such as the World Bank, are often socially and politically contentious projects. Yet, the empirical literature has not systematically examined the consequences of dam construction. The only exception is Duflo and Pande (2007), who find evidence of higher agricultural production and lower poverty in districts downstream from dams but increased volatility in farm output and higher poverty rates in the districts where dams are built.

In Brazil, dam construction is known to harm the livelihoods of the rural poor (Da Rocha, 2016). Dam construction has also been associated anecdotally with social unrest (Peixoto et al., 2022). In particular, land invasions are a common phenomenon in which poor farmers and landless agrarian workers invade large landholdings and occupy them until either expelled by private militias and the police, or granted official titles (Hidalgo et al., 2010).

Yet, the effect of dam construction on food security and rural conflict is poorly understood. Using Indian data, Sarsons (2015) finds that the effects of adverse rainfall shocks on religious riots is stronger in areas downstream of irrigation dams, even though agricultural production in these regions is much less sensitive to rainfall shocks (Duflo and Pande, 2007). Yet, Sarsons' (2015) analysis overlooks the potential violence induced by dams in the regions immediately surrounding the water reservoir, where agricultural land is often submerged or degraded by increased soil salinity.

Cisterns. Previous studies have also evaluated the impact of the Brazilian Water Cisterns (WC) programme (active since 2003), which builds rainwater tanks next to houses in the *sertão* region of North-East Brazil, a poor and mostly agricultural area that is facing an increasing incidence of droughts. The UN has hailed this programme as a pioneering initiative in the fight against droughts and water stress. Partly for this reason, this programme has been replicated elsewhere in the world (e.g. in the Sahel region of Africa).

Focusing on pregnant women exposed to the effects of cistern construction, Da Mata et al. (2023) find the WC programme has a beneficial impact on birth outcomes. The programme was found to be most effective among households who live further away from existing water sources such as ponds and reservoirs. Absent the availability of a cistern, households typically rely on women (including pregnant women) to collect water. Water-collection involves up to two hours of heavy physical work per day and is likely to adversely affect pregnancy and infant health. Further, Bobonis et al. (2022) report that cistern construction improves various dimensions of household well-being, including a measure of child food security. It also makes households less dependent on incumbent politicians for contingent benefits in case of adverse income or weather shocks.

This activity:

In this research project, we intend to examine the impact of two water management interventions (dams and cistern construction) on food production and consumption outcomes in Brazil.

Dams. Hidalgo et al. (2010) present evidence that adverse economic shocks induced by rainfall fluctuations cause the rural poor to invade and occupy land. We hypothesize that dam construction may be an additional (exogenous) driver of land invasions in Brazil. In particular, there is reason to believe that dam construction may increase landlessness and exacerbate food security concerns amongst the rural poor, inducing redistributive conflict involving land.

We plan to test this mechanism using geo-located data on irrigation and hydroelectric dams, the *PAM* dataset, and data on land invasions. The latter is provided by Brazil's *Comissão Pastoral da Terra* (*CPT*), which records the number of distinct land invasions and the number of families involved in each invasion in each Brazilian municipality starting in 1988. To identify the causal effects of dam construction, we intend to implement a

staggered diff-in-diff design that compares treated municipalities (those with a dam) to untreated and not-yet-treated municipalities (those without a dam in year *t*).

Water Cisterns. We hypothesize that, in the context of the Brazilian semi-arid, household-level water tanks may function as a time- and labour-saving technology akin to household appliances such as washing machines and freezers (Coen-Pirani et al., 2010). As such, they may functions as 'engines of female liberation'. Treated households might reallocate unpaid female labour (up two man-hours per day) from water collection to food production and preparation. The prevailing gender-based division of labour in this region prescribes that women should be responsible for food production and preparation. Treated households may thus not only increase the labour input on the family farm, but also improve the quality of food production. Thus, the reallocation of female labour from water collection to food production may positively affect food security and household well-being, explaining some of the existing research findings.

For the analysis, we intend to use data from the administrative registry of the WC programme, household-level socio-economic data from *Cadástro Único,* municipality-level climate data from Saldanha et al. (2024), and statistics on municipal agricultural production (*Produção Agrícola Municipal,* or *PAM*) from Brazil's national census bureau (IBGE).

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Operational plan:

PHASE 1 **(March-November 2024)**. Data collection, check and data management.

PHASE 2 **(December 2024-December 2025).** Data analysis (qualitative and quantitative) and preparation of the draft research papers. Presentation of results at international conferences.

PHASE 3 **(January 2026-May 2026)**. The research work will be concluded by submitting the manuscripts to top-field journals (e.g., *Journal of Development Economics, American Journal of Agricultural Economics*).

Expected results:

The research attempts to investigate the impact of water management policies and technologies, in particular in the context of Brazil, but with broader implications. It will focus on the relationship between water management policies and technologies, both at the micro-level (household) and macro-level (territorial). In the first case, we expect a positive impact of the policy, especially for the women's labour market. In the latter case, we expect a negative impact of the presence of dams on communities residing nearby.

Project deliverables:

D1.1.1.2. Report on network governance strategies aimed at facilitating access to food

D7.4.1 The last decades have seen a surge in policies promoting healthy and sustainable diets. T74.1 will: (1) review existing ex-post evaluations of public policies at the international level; (2) generate new evidence, using robust methods, evaluating international, European, and Italian national, regional policies.

D7.4.4 Production of a set of policy-oriented guidelines and set of recommendations based on: (a) current national and international evidence-based; (b) findings and inputs from all tasks and activities, especially WP7.2, WP7.3 and Task 7.3.3; (c) proposals to modify existing legislation; (d) feedback from stakeholders and policymakers