Agricultural and non-agricultural productive use of grid electricity in rural Ethiopia

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Successful rural electrification requires both consumptive and productive loads. What are the current patterns and prospects of productive use of grid electricity in rural Ethiopia? We gathered related evidence in two case-study areas, with an explicit analysis of small-scale irrigation.

Key messages and recommendations

- For enterprises in rural Ethiopia, acquiring an electricity grid connection remains a problem of the availability of infrastructure, not of a lack of interest or of affordability. The range of enterprises and scope of new productive electricity uses in electrified communities, nevertheless, remains limited. Electricity access helps to ease entrepreneurial barriers, but integrated rural development strategies are required that improve market access more generally.
- Few farmers adopt electricity for irrigation, not only because of switching costs from diesel to grid-electricity motorised pumps, but primarily because of the unavailability of grid electricity at their fields. Decentralised solutions such as solar-powered pumps may be considered based on the relative cost-efficiency of grid expansion vis-à-vis off-grid options for irrigation.

The potentials of productive energy use

The agricultural sector is the backbone of large parts of the rural African economy, generating income for a high share of the population. The current National Electrification Plan (NEP) of the Government of Ethiopia has ambitious targets to expand the productive use of electricity in agriculture and the country enjoys favourable conditions through low electricity prices and expanding supply capacities. Electricity can enhance the engagement in productive activities by increasing productivity, by reducing unit costs, or by adding value, both through the creation of new activities or the replacement of traditional forms of energy used for existing activities. The use of electricity for irrigation, for example, can increase the profitability of irrigation by reducing the cost of fetching water, and it can induce more farmers to engage in irrigation in the first place, thereby potentially increasing farmers' harvest and revenue.

To inform the NEP, researchers from the University of Massachusetts Amherst, the RWI – Leibniz Institute for Economic Research and the Policy Studies Institute (PSI) conducted a study on electricity demand forecasting in agriculture with a focus on irrigation. As part of this research, primary quantitative and qualitative data was collected in two regions of rural Ethiopia with particular potential for irrigation as identified in previous studies, namely an area east of Lake Tana in the Amhara region and central parts of the Oromia region, each covering around 3.000 km^2. Data collection took place in early 2021 among a range of local actors, including households, enterprises, communities, and regional representatives. Communities refer to kebeles in the Ethiopian context, in our sample having on average around 1200 households.

Limited non-agricultural productive use

Despite the notable size of communities, both electrified and non-electrified communities have only a limited range of enterprises. Common non-agricultural enterprises include small shops, bars, restaurants, passenger and freight transportations, and barbers. Wood-works and welders/garages as other more energy-demanding enterprises are relatively rare in both categories of communities.

Enterprises in our Ethiopian context tend to connect to the grid if it is available: 97% of enterprises have a direct connection to the grid in communities with higher grid coverage. This share is merely 50% in communities with fewer than 25% of households connected to the state-owned utility, indicating a lower electricity grid coverage. Unconnected enterprises often rely on off-grid solar-powered electricity sources or on connections via neighbours in electrified communities. In non-electrified communities, the share of off-grid electricity access among enterprises is around 80%. Nevertheless, the grid connections go along with a broader set of appliances used. The most often found appliances among non-agricultural enterprises are lights, fridges and entertainment devices. Some manufacturing enterprises use electric tools, such as cutters, grinder and compressors. The non-connected see most opportunities from new appliance acquisitions in selling cold beverages. Generally, existing and prospective enterprises are mostly from the

trade category, less from the service category, and only very few in the manufacturing category.

Milling as the main agricultural productive use of energy

Transformation of agricultural products is the key agricultural productive use of electricity. Milling, grinding and pressing play an important role at enterprise and household level. These forms of transformation are similarly practised in non-electrified as in electrified communities thanks to off-grid diesel mills and households relying on manual processing, each with higher per-unit monetary or time costs. Mills are generally the main more energy-demanding machine run with electricity, with 84 percent using grid electricity in electrified communities, and sampled non-connected grain millers show a high willingness to replace diesel generators by grid electricity.

Irrigation lacks use of grid electricity

Water availability differs considerably across our two case-study areas, which contributes to strong regional differences in the prevalence of irrigation (Figure 1). Water scarcity currently seems to be the larger obstacle to irrigation in comparison to the lack of electricity. Even if 22 percent of farming households have access to the electricity grid, it was found that on-grid electric energy is not used for water pumping in the study areas (Figure 1). The main reason for this absence of grid-electricity motorised pumps is that the electrification of communities is mostly concentrated in residential areas and does not reach where agricultural fields are located. Despite high per unit fuel cost, the high portability of diesel motorised water pumps makes them the technology of choice among farmers in our sample regions and beyond, together with gravity-based irrigation using river diversions.

Policy Recommendations

Existing research supports the overall picture emerging from this study of mixed evidence on the opportunities of productive use from grid electrification in rural areas, especially in the agricultural sector. Electricity access is an important barrier to rural development to be addressed by policy, but governments need to consider two important constraints:

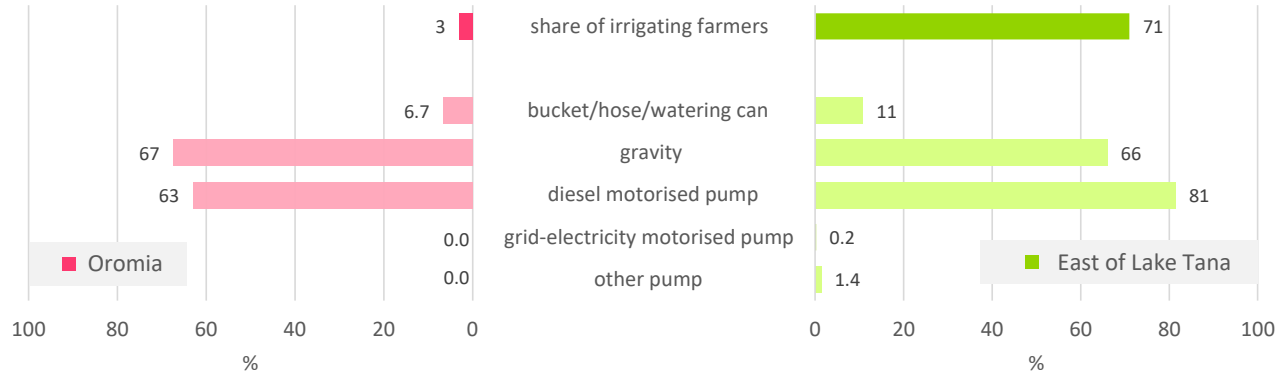
- Rural grid coverage would need to be expanded considerably in order to increase the use of electric energy for irrigation, which is often seen as one important additional agricultural productive use. Decentralised solutions such as solar-powered pumps may prove to be a more cost-effective and flexible solution in some settings given the relative cost-efficiency of grid expansion vis-à-vis off-grid options for irrigation. The daily and seasonal electric load shapes of irrigation must also be considered.
- Rural development typically faces a myriad of barriers that call for more integrated rural development strategies, which also address the lack of access to input and output markets, the improvement of farming practices and households lack access to financial services to invest into expensive inputs.

Reference

A more detailed account of the present findings is provided in:

Bensch, G., Steinmetz, C. and H. Teklewold (2022), Productive use of grid electricity in rural Ethiopia. Current status and prospects in two case-study areas. *Applied Research Programme on Energy and Economic Growth (EEG). Available at* Productive use of grid electricity in rural Ethiopia | EEG (energyeconomicgrowth.org).

Figure 1: Irrigation prevalence and methods to obtain water in the two case-study areas



Note: Shares on the methods to obtain water add up to over 100 percent because some farmers rely on multiple methods

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