Ethiopian Economics Association

Issue No. 01, March 2017

EEA Research Brief

Improving Food Security By Reducing The Maize Yield Gap In Ethiopia

1. Maize in Ethiopia

The prospect and context for agricultural growth in low income countries (LICs) have changed considerably over the last decade. An important question is how agricultural development, an important contributor to economic growth, employment and food security, can be best promoted. More specifically, insight is needed into how agricultural productivity can be raised at the level of households, farms, crops and farming communities. Still significant yield gaps, i.e. the difference between potential yield and yield which farmers actually obtain, are observed in the agricultural sector of low income countries (LICs), which suggest possibilities for improving performance.

Maize is of key importance for food security and income in Ethiopia, in particular in rural areas. With 17% it accounts for the highest national calorie intake followed by sorghum and wheat.[i] The share of maize in total cereal consumption has doubled since the 1960s, effectively replacing teff, the traditional food staple in Ethiopia. Maize currently occupies about 2 million ha, equal to 14% of total land area, the second largest share, after teff. At present more than 9 million smallholders, more than for any other crop in the country, grow maize. Around 88% of their production is used for food consumption.

Over the last two decades, the maize sector has experienced unprecedented transformation.[ii] Maize yields have doubled from around 1.6 t/ha in 1990 to more than 3 t/ha in recent years, the highest level in Sub-Saharan Africa after South Africa. Important causes for the increased productivity include increased availability and use of modern inputs (e.g. modern varieties and fertilizer), better extension services and increasing demand. Figure 1 on the next page shows the evolution of the maize yield per hectare for Ethiopia in comparison with other regions. Despite the rapid yield growth, considerable opportunities still exist for further yield increase. Yield levels in Ethiopia are still much lower than those achieved in other regions, such as Asia and South America.

2. Urgency of productivity growth

A key question with respect to food security, not only today, but also in the future is to which extent domestic production will be able to satisfy the expected growth in demand. Recent results from the Global Yield Gap Analysis (GYGA) project allow to make a projection of Ethiopia's self-sufficiency rate with respect to cereals (i.e. maize, wheat, sorghum, millet and rice) of which maize contributes 34% in terms of area. Currently Ethiopia's cereal self-sufficiency ratio is 0.95. Only if the currently observed cereal yield increase is maintained to 2050, Ethiopia will still be self-sufficient, even though at that stage the population will have probably more than doubled, and also consumption per capita levels have adjusted to a higher prosperity level. If yield levels stay at the present level, Ethiopia will only be able to produce 40% of its cereal needs, which is a great risk to food security.

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Economic Knowledge for Optimal Decision!

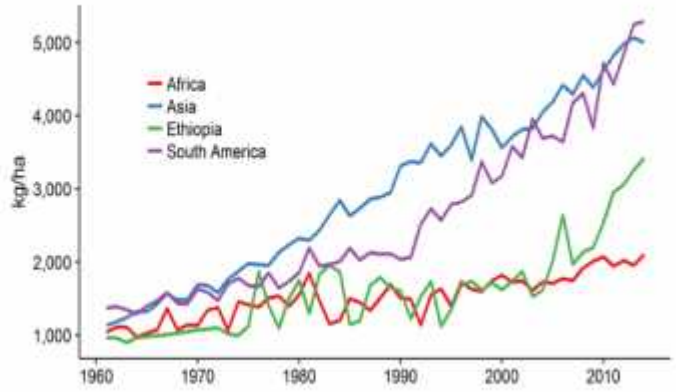

Figure 1: Maize yield for Ethiopia and selected regions. Source: FAOSTAT.

Sustaining self-sufficiency requires that maize yields continue to grow between 2010 and 2050 at the same rate as over the past two decades, which implies that Ethiopia has to maintain the yield growth of around 85 kg/ha per annum. Achieving this will require a tremendous effort from both the private and public sectors, including the policy realm, crop research stations and extension services.

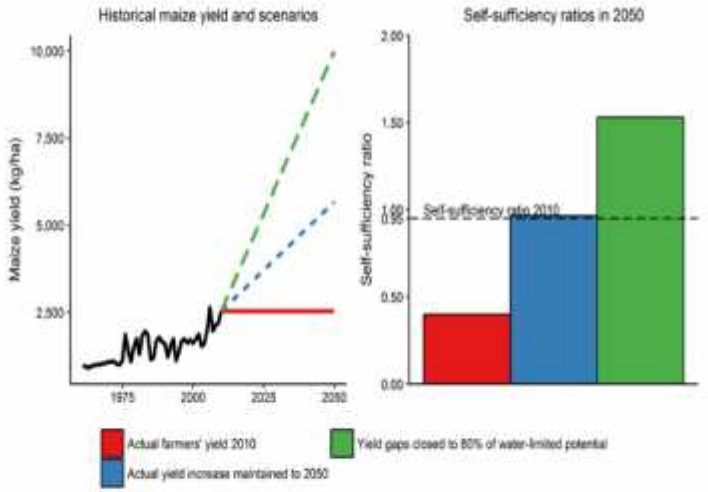

Figure 2: Maize yield scenarios and cereal self-sufficiency ratios in 2015. Source: Van Ittersum, M. et al. (2016), Can sub-Saharan Africa feed itself?, Proceedings of the National Academy of Sciences of the United States of America (52), 14964–14969. https://doi.org/10.1073/pnas.1610359113.

3. Maize yield gaps in Ethiopia

The Global Yield Gap Atlas shows estimates of potential yield and yield gaps for nine major food crops in a large number of countries, including maize in Ethiopia (Figure 2).[ii] Yield potential is the biophysical maximum yield of a crop (e.g. without limitations from nutrients, pests and diseases) and is calculated using crop simulation models evaluated with crop growth experiments. For rain fed crops the water-limited yield potential is calculated, taking into account constraints to water supply. Figure 3 presents a map of the yield gap in Ethiopia using estimations for water-limited potential yield and information on actual yield from national statistics and local experts. Potential maize yield ranges from over 18 t/ha in western Ethiopia to below 9 t/ha in eastern Ethiopia. According to the GYGA-project estimations, actual farmers' yield were only 15 to 35% of these potentials over the period 2005-2011. Hence, there is large scope to increase maize yield in the future.

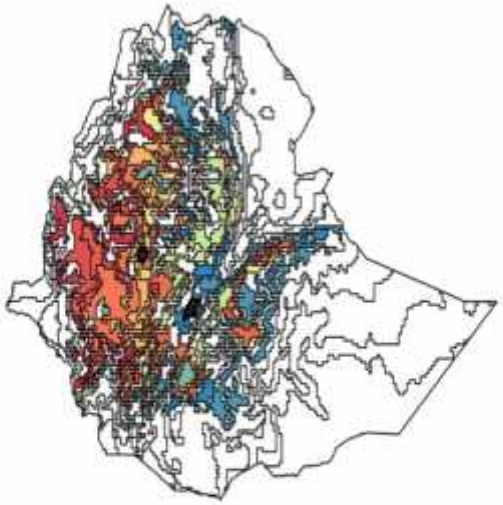

Figure 3: Maize yield gaps in Ethiopia by region. Source: Global Yield Gap Atlas (GYGA), www.yieldgap.org. Bold lines indicate the location of case-study regions (see box).

4. Expected research results and relevance for stakeholders

The required increase in today's and future cereal supply will need to come from two sources: either an increase in crop land or an increase in yields. As land is constrained and expansion of agricultural area is at stake with biodiversity conservation and climate change mitigation, an important contribution should come from crop yield increases. This will require the reduction of the yield gap (the difference between water limited potential crop yield and currently realized crop yields). As such understanding the yield gap (its measurement, explanatory factors) and how this is impacted by well-targeted agricultural policies and agronomic research and extension efforts is crucial.

Key research questions and focus points of the IMAGINE project that need to be addressed to achieve the required future crop yield growth are:

- The identification of the main bio-physical, management and socio-economic factors that explain the observed yield gap in cereals production across Ethiopia;
- The provision of decision makers, farmers and other stakeholders with action and policy recommendations on how to reduce or close the yield gap taking into account the complex environment in which farmers operate.

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Vision:
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Mission:
" To represent the professional interests of our members, advance the discipline of economics and contribute to the development of the Ethiopian Economy"

Physical Address:

Ethiopian Economics Association

Yeka Sub - City, Kebele 19

On the Road from Megenagna to CMC

Adjacent to St. Michael Church

Addis Ababa ,

Ethiopia

Telephone and Fax

Tel: 251-(0)11-6453200

Fax:251-(0)11-6453020

Postal Address

Ethiopian Economics Association

P.O.Box 34282

Addis Ababa

Ethiopia

Email and Website

Email: eea@ethionet.et

Website: www.eeaecon.org

IMAGINE project

The 'Integrated Assessment of the determinants of Maize yield gap: towards Innovation and Enabling policies' (IMAGINE) project uses a framework that integrates agronomic and economic approaches to assess maize yield gaps and analyse agricultural performance at the plot and farm level.

In the project the maize yield gap is estimated and analysed at two different levels. Nationally representative farm level surveys are analysed with econometric estimation techniques to assess the impact of environmental (e.g. rainfall, soil and temperature) and farmer-controlled factors (e.g. fertilizer, seeds and capital use) on maize yield. This is deepened by means of an in-depth investigation of farm and plot level production data that is gathered via surveys in selected districts in Ethiopia. For Ethiopia case studies are done in Adami Tulu JidoKombolcha (J.L.) and Bako Tibe districts. Adami Tulu J.K. is in the Central Rift Valley region, and is a lowland area with a warm and temperature climate. Bako Tibe is in the Western Oromia region, and has a flat topography with some hilly mountains and has a warm and humid climate. The yield gap is estimated at 3.8 t/h for Adami Tulu J.K. and at 12.5 t/h for Bako Tibe. The high value in Bako Tibe is mainly caused by the high level of water-limited potential yield, not the low level of actual yield. Based on this, the project will identify promising technological improvements and policy interventions, that will be assessed in on-farm experiments and policy and stakeholder workshops.

IMAGINE is implemented in Ethiopia by Wageningen University & Research, CIMMYT and the Ethiopian Economics Association. Please contact prof. Martin van Ittersum (martin.vanittersum@wur.nl) for more information. IMAGINE is funded by the DFID-ESRC Growth Research Programme under research grant ES/L0 12294/1.

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