

CONCLUSION

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By any measure, teff is an important crop in Ethiopia. It is estimated that one-fifth of all land under cultivation in the country, approximately 2.7 million hectares, is used to grow teff. However, while teff has been grown and consumed in Ethiopia for centuries, relatively little is known about the economics of teff production and the postfarm teff value chain that supplies this staple to millions. This is set to change with more time and effort being devoted to building the value chains surrounding its production, marketing, and consumption in various ways. People in government, agriculture, health, research, and other areas are becoming more aware that by increasing teff productivity through research, application, and training, this drive could turn around the lives of many poor people in rural communities.

Ethiopia's economy is transforming, people's incomes are increasing, and as consumers purchase more preferred foods, they consume more teff. But such demands come at a price. There is pressure on the government and other stakeholders to change agricultural and food policies and their implementation, as well as pressure on the smallholding traditional farmers to modify their practices to adapt to a changing consumption pattern, with new farming techniques that increase yield and minimize waste. Teff is emerging to become a crop that is more productive and renowned for its gluten-free and rich nutrient constitution. This "orphan crop" is receiving more attention after decades of relative neglect, and this first book on the teff economy represents the beginning of greater insight into the economic fundamentals of the value chain of this tiny grain. The important consequence and possibility of teff for Ethiopia's economy, and further afield, deserve broader recognition.

Although unique, teff has been subject to many misconceptions. Even from the early years in primary school education, Ethiopian children were raised with the notion that teff was of low nutritional value and that it was the food of the well-to-do or the rich. Moreover, it was considered a low-yield crop with little potential for technological manipulation. Fortunately, growing scientific understanding and empirical evidence have eroded these misconceptions.

Nevertheless, the price of teff is still prohibitive for most lower-income households although it offers, as a cash crop, an important source of income for agricultural households.

Past food security policies in Ethiopia seem to have been influenced by certain characteristics of teff. First, the environmental impact of teff-based farming systems, especially in terms of low productivity, were considered not suitable for ensuring food security for a fast-growing population. The land preparation techniques therefore require significant improvement to attain sustainable teff production. Second, given the low yields, the calorie output per hectare is limited compared with other crops, and this constitutes a considerable constraint with the increasing scarcity of land in the mid-altitude ecozones of the highlands where teff is well adapted to the conditions. Therefore, expansion of teff at the expense of other higher-yield crops like maize, wheat, sorghum, and enset that consequently generate more calories will pose significant challenges in terms of meeting food security and food self-sufficiency nationally, especially for poor families who cannot afford to farm or purchase this crop. A key policy challenge is finding ways to promote production and consumption of teff, while maintaining the mixed farming systems that combine these other crops as well as legumes and livestock.

Teff's productive potential has intensified significantly, albeit from a low base, over recent years with a combination of better seeds and improved farming practices. Farmers' yields still remain relatively low though. In parallel, the rising domestic and potential international demand can only be met via considerable growth in teff production. The dilemma continues as to how much exposure to international trade this "hidden food source" can carry in light of the impact this could have on domestic teff prices and Ethiopian consumers. Nevertheless, the time is ripe for the emergence of teff from what was once thought "a threat to food security that should be abandoned" to a crop that deserves more recognition locally and globally. It is hoped that this book contributes toward that recognition.

A Transforming Teff Economy

Based on emerging patterns in teff production, marketing, and consumption as described throughout this book, the overall shift within the teff sector is driven by changes in technology, urbanization, and behavior, among others. The teff value chain is on the move; and through identifying the working practices, processes, and drivers from upstream through downstream in the value chain, key revelations about teff are brought to attention. The following

highlights the key findings and discussions within the three domains referred to in the introduction—production, marketing, and consumption. The concluding part of this chapter covers the policy implications with due consideration of the challenges faced in developing the teff economy in Ethiopia.

Production

Teff is Ethiopia's most important cereal crop in both area and value. Teff production in 2013/2014 was valued at approximately US\$2.5 billion, significantly higher than any other single crop in the country. The value of its commercial surplus was as high as US\$750 million, equal to the value of commercial surplus of all other cereals in the country combined. Teff provides comparable calorific value to other cereals as well as considerable nutrient content and is gluten-free. It plays a complex and significant role in the diets of the Ethiopian consumer. Consumption of teff and its different qualities—white, mixed, and red—are linked to the budgetary constraints of consumers. The budget share of teff grows with income since it is a more preferred cereal. This growth is augmented by two price-related facts. First, teff prices are high compared with other cereals. Second, the highly preferred and expensive white teff varieties are consumed more by richer consumers than red varieties (Chapter 3). Both lead to growing expenditure on teff consumption as household income rises.

It was not until the mid-20th century that modern science was introduced to programs to improve teff cultivars, distribute improved teff seed, and accelerate the contribution of genetic gain to teff yield growth across the country's smallholder farming systems (Chapter 4). Teff breeding has, until now, focused on conventional cross-breeding and selection techniques. With more sophisticated techniques available, a faster selection process is possible to deliver a larger portfolio of improved teff varieties to farmers (Chapters 3 and 13). While the Quncho variety has been successful, there remains room to further breeding programs that address, for example, consumers' preferences as well as disease and pest resistance (Chapters 3, 13, and 14).

In this regard, it is not easy to design an architecture that integrates formal and informal seed systems and bridges gaps between state, private, and civil society actors in the provision of seed (Chapter 4). Nevertheless, creating better ways to measure seed demand and supply could provide the critical information to designing seed systems that are responsive to farmers' needs and the capability of seed producers. A market-based design in which seed demand assessments are conducted by those who have greater incentives to engage in delivering seed quality and quantity would, if coupled with other strategic

public interventions, improve supply to smallholders (Chapter 4). Building on policy initiatives already in place, any structural reform needs to raise practical and flexible collaboration between essential actors to expand seed enterprises.

Bridging the gap between formal and informal systems as described above presents parallels with traditional and modern practices in farming. There is often a big gap between the supply of new technologies and their efficient adoption, since innovations spread slowly and require different management skills (Moser and Barrett 2003; Duflo, Kremer, and Robinson 2008; Collier and Dercon 2011). The design and implementation of a promotional campaign for adopting improved technologies (described in Chapter 5) shows the challenges in the adoption of row planting to increase teff yields. Like most improved land management technologies (for example, Moser and Barrett 2003), labor requirement showed an increase from traditional broadcasting to organized row planting. In addition, other changes such as the time and effort for learning new methods by farmers, and the engagement from extension workers, are illustrated. Using cost-benefit analyses, teff yield gain was shown to outweigh the extra labor cost, if yields increased by more than 8 percent, making the investment worthwhile. Moreover, the use of a mechanical row planter demonstrated high returns and could also stimulate higher adoption rates (Chapter 5).

Many factors influencing teff productivity are analyzed in this book. In Chapter 6 the spatial patterns that emerge from examining the road infrastructure, the connectivity between the regions, and access to markets suggest that areas of greater teff production and fertilizer application are closer to major roads and cities. This pattern is much broader than the production corridors between Addis Ababa and two other cities—Bahir Dar and Adama—that existed almost 20 years ago. However, continued investment in road infrastructure to expand road links to rural areas and improve communications, and the resultant improvements in market access, are likely to be associated with improved production patterns and input use (Demeke et al. 1998; Dorosh et al. 2010; Minten, Koru, and Stifel 2013). Relatedly, productivity is shown to improve with both scale of operation and level of specialization (Chapter 7). Teff-producing households are more productive with better levels of education and with greater access to financial institutions, production information, and extension services. Access to and participation in markets, along with low risks of crop failure, help farmers specialize to become more efficient and productive. However, specialization depends on many factors and may not be appropriate for all households because of the risks associated with cultivating fewer crops (Chapter 7).

Some believe that smallholders respond little to changes in economic incentives. Using dynamic models, the association of price with the amount of land farmers cultivate with teff (teff acreage demand) was examined in [Chapter 8](#). The results show that teff acreage demand rises both in the short run and long run in response to increases in teff price. Moreover, increases in the opportunity cost to farmers, as a result of a potentially greater revenue attained from other crops, led to a fall in teff acreage allocation. Overall, teff was found to be sensitive to market changes even over a short period and teff supply is price elastic. Indeed, a comparison of these estimated elasticities with those obtained by a previous study using the same approach but with data from a different period illustrates the importance of government policies to agricultural supply response (Taffesse 2003) ([Chapter 8](#)).

A number of further insights regarding productivity growth come from analysis covering the major teff production zones ([Chapter 9](#)). First, the levels of input use exhibit high rates of return to investments in the development of better seed varieties such as Quncho. Second, that farmers with access to extension services achieve higher productivity suggests that the investments made by the government to expand the agricultural extension system have paid off (Davis et al. 2010). Third, remoteness is associated with decreased productivity due to lower output prices and possibly restricted access to modern inputs at reasonable prices. Reducing the costs of remoteness by building roads and increasing distribution outlets therefore has a positive association with teff productivity (Minten et al. 2013b). Finally, teff is a labor-intensive crop producing higher yields when farmers spend more time plowing and weeding.

A large fraction of Ethiopia's economic growth comes from the agricultural sector. Having explored teff productivity from different angles, the question remains as to what impact an expansion of teff and cereal production might have on Ethiopia's economy. In [Chapter 10](#) the effects of changes in production of teff, wheat, and maize in particular on the Ethiopian economy are analyzed using Computable General Equilibrium (CGE) modeling. This chapter considers the impacts of the government's Cereal Initiative, which promotes growth in the production of these three cereals. The analysis generates insights on the merits of such investments.

The results show that increasing teff production generates greater benefits for urban consumers, particularly for urban poor households. This impact is lower with growth in the output of the other two cereals. Demand factors explain some of the consumption patterns observed—teff is viewed as a superior commodity and its consumption is associated with a better quality of life.

Nevertheless, maize provides more production on less land, which has strategic significance regarding the productivity decision. Furthermore, the market value of production is an important criterion guiding farmers' decisions on which crops to cultivate (Chapters 8 and 10). Given the agroecological diversity of Ethiopia, though, a mix of cereals makes sense for agroeconomic reasons alone (Chapters 7 and 10).

The cereal subsector has already made and continues to offer a large contribution to potential economic transformation through agronomic productivity. Should the value chain become more complex with more of the processing of teff occurring outside the household, it is likely that teff consumption may be reclassified as a source of manufacturing growth rather than agricultural growth, as it is currently classified based on the prevailing definitions in the national accounts. This would then result in a shift in the economic structure with respect to the compilation of the national accounts. Through increased productivity and the extension of these value chains beyond the agricultural sector, gradually more positive spillovers into other sectors of the economy and stronger links will become established (Chapter 10).

Marketing

Teff value chains are found to be relatively unsophisticated, short, and in contrast with common perception, fairly well organized (Chapter 11). At the farm level there are no interlinked transactions with buyers of the produce (which is often seen in other countries, especially in more developed value chains), the role of credit is minor, and most of the transactions are cash transactions. Farmers obtain a relatively high share of the final retail price (on average 80 percent), and the importance of distress sales is low. During 2001–2011, changes in the market structure of teff seem to have been linked with economic growth, urbanization, improved roads (and consequently decreased transport costs and possibly competition in better and bigger fleets), greater access to information and communications technology (mobile phones are universally used by brokers and traders, striking deals and bypassing wholesale markets entirely), and better agricultural technology adoption. These changes in teff markets have given rise to predicted outcomes of considerable market improvements. For example, increasing urbanization, increased supply, and income growth have led to more quantities traded and greater economies of scale and thus to lower margins overall. In addition, access to better price information has contributed to a more efficient marketing system and consequently lower overall margins (Chapter 12).

While better road conditions, declining transportation costs, and smaller marketing margins generally result in a more efficient agricultural economy, change inevitably results in both winners and losers along the value chain. Nonetheless, the net gain for the economy as a whole is likely to be substantial, yet there is still significant room for improvement. The transformation of the teff production and marketing systems is shown to be still at an early stage of agricultural development (for example, Reardon and Timmer 2007) (Chapter 13). At the production level the number of farmers who use improved varieties is still low, the quantities of chemical fertilizers that are being used are still below the recommended levels, and mechanization, which is happening quickly in other emerging economies, is still mostly absent (Chapter 6). In addition, very little vertical integration is observed as well as minimal coordination mechanisms between teff production and marketing. Midstream and downstream of the value chain, little evidence of upscaling of trade is seen nor of modern retail or of branding. Typically, these can be observed as agricultural market development gets under way (Reardon et al. 2012).

However, despite this seemingly negative picture, modern inputs are increasingly adopted in teff production. Quality and convenience demands are on the rise among teff consumers, and the teff marketing system is becoming more efficient. All these changes have resulted from exposure to the increasing availability of improved varieties and chemical fertilizer, a better extension system in rural areas, and conversely the increasing downstream demand for commercial teff, which is driven by growing incomes, urbanization, and high income elasticities for teff. The changes upstream have especially transpired in those areas that are reasonably well connected to the city, illustrating the importance of market access and demand for rural and agricultural transformation (Chapter 13).

Consumption

Comprising a third of the country's total food budget, teff plays a significant role in the average urban Ethiopian household's diet. Teff is consumed largely by the well-off households and its purchase increases with income. Households headed by individuals with better labor market status also seem to consume relatively more teff than those with poor labor market status, such as casual workers (Chapter 14). Over the period of study covered in Chapter 14, the consumption of teff barely changed, yet the price increased by nearly threefold. This indicates that some households continue to rely on teff

as a main source of carbohydrate in their diet, irrespective of the price increase (see [Chapter 10](#)). However, given the fact that around 28 percent of urban households fall below the absolute poverty line (Alem 2014), there is some concern that the high prices of teff are excluding the poor, who seem to resort to cheaper cereals in their food baskets ([Chapter 14](#)).

Teff appears in different colors (super white, white, mixed, and red), and these are used as indicators of quality and hence market value by producers, traders, and consumers (Minten et al. 2013a) ([Chapters 3 and 14](#)). In addition, there is variation in nutrient composition across teff varieties, which warrants further research ([Chapter 15](#)). Teff flour is considered to be nutritionally rich and healthy with similar amount of protein and fiber as whole wheat flour, yet it provides more nutritional substances such as iron and is gluten-free (Baye 2014). Despite having a very good nutrient profile, teff's consumption is limited to Ethiopia and Eritrea. Knowledge about teff seems a well-kept secret. Limited awareness of its rich nutritional profile, along with the challenges faced in making teff-based food products for domestic and international consumers, has restrained its advantage as a global food source for human consumption. However, studies on the excellent nutritional composition of teff and its potential to create teff-based food products have grown ([Chapter 15](#)).

The role of teff consumption on the management and prevention of diabetes, and the human absorption (bioavailability) of iron in teff and how it can contribute to the prevention of iron deficiency, has generated great international interest. Moreover, there are the possible health benefits in managing celiac disease linked to gluten. Obviously, all these areas pertaining to health benefits require further investigation. Nevertheless, all point to the potential of teff to be a future global functional food for health promotion and disease prevention ([Chapter 15](#)).

Implications

This book describes and documents major changes that are occurring throughout the teff value chain. However, transformation of teff production and marketing systems in Ethiopia are yet to reach the level to which the country aspires. Despite the progress, a number of constraints still apply and need to be addressed by policy and other interventions to facilitate further transformation. [Table 16.1](#) describes the principal challenges faced by producing and marketing teff in Ethiopia, along with those factors or actions that could help mitigate these challenges.

TABLE 16.1 Challenges for policy changes and proposed actions

Challenge	Response
Improving productivity and resilience	Invest in basic research and researchers
	Invest in a breeding program that addresses multiple traits
	Consider climate change in technology development
Selecting and scaling-up new technologies	Consider gender impacts
	Improve monitoring and evaluation of uptake of improved technologies
	Conduct rigorous and regular evaluation of outcomes
Establishing fit-for-purpose distribution systems	Experiment with alternative input delivery mechanisms involving different arrangements, actors, and payment modalities
	Improve market efficiencies by stimulating involvement of cooperatives
Managing labor demand and postharvest operations	Provide sturdy, multipurpose, cheap mechanized planters and harvesters
	Invest in storage technology
Extending markets	Devote time for study and exploration of output options and to mitigate marketing challenges
	Promote appropriate deepening of credit, insurance, and labor markets

Source: Authors.

Challenge 1. Improving Productivity and Resilience

Over time, there have been relatively few investments in Ethiopia toward improving teff productivity, and expenditures for R&D in this area have not been at appropriate levels (Flaherty, Kelemework, and Kelemu 2010). Given the size of the sector in the country, the beneficial attributes of teff, the increasing urban demand for the crop, and the relatively low yields, as well as the growing challenges of climate change, it seems that increased investments toward the development of appropriate technologies that can assure a resilient teff sector would be beneficial for Ethiopia.

As shown in [Chapter 9](#), the returns gained from successful developments in improved seeds have been very high, and there is still significant room for growth given the low investments of the past. Further strengthening of agricultural research and extension can lead to higher generation and adoption rates of improved, high-performing, and resilient seeds, and thus it is likely to deliver large payoffs. To stimulate adoption, better supply and marketing conditions are required. On the supply side, although the public sector plays an important role, channeling more resources into the development of improved seeds at local research centers would reap higher returns (Alston et al. 2000). So would a more active role from the private sector. Moreover, a more vibrant

seed sector with better marketing, distribution, and information provision on improved seeds is critical.

Climate change is expected to have a significant impact on Ethiopian agriculture in the decades ahead. It is estimated that the shifting rainfall patterns and increasing temperatures will lead to large crop yield decreases (Robinson, Strzepek, and Cervigni 2013). Moreover, the incidences of unexpected weather shocks are projected to increase. Incorporating climate change and developing more teff seeds adapted to weather stress and shocks will therefore become increasingly important to assure resilience of the sector.

Challenge 2. Selecting and Scaling-up New Technologies

Once promising improved technologies have been developed and tested in research settings, there is need for careful on-farm trials that are subject to rigorous impact evaluations before the scale-up process. Often important lessons can be learned from such impact evaluations that allow fine-tuning of technologies, extension packages, and messages, which in turn lead to more successful scaling-up of improved and adapted technologies. It is also important to ensure that appropriate monitoring and evaluation schemes are in place at the national level. This would assure that appropriate lessons are learned on adoption and disadoption of new technologies, and which policy instruments (for example, access to credit, extension, distribution, and incentives) can be better tailored to improve uptake of superior technologies.

Challenge 3. Establishing Fit-for-purpose Distribution Systems

Intensification of teff production will need to receive even more attention in the future since land constraints have increasingly become binding (Headey, Dereje Regassa, and Taffesse 2014). There will be a need for more widespread adoption of modern inputs and improved technologies. Two modern inputs—chemical fertilizer and improved seeds—widely used in teff production and delivered through extensive national distribution systems are important. Chemical fertilizer use stays central to the government effort to increase agricultural productivity overall. It has therefore initiated a unique soil-mapping exercise in the country to adjust fertilizer packages to specific soil conditions. This is a promising development that might address soil deficiencies in the country more appropriately. However, prices of chemical fertilizers are

sometimes out of reach for poor farmers or simply not available at all to them. Moreover, the distribution system of improved teff seeds could be improved. As illustrated throughout this book, the accessibility of good distribution systems, whether for seed or for fertilizer, is crucial to encouraging the adoption of these inputs. Therefore, alternative and more inclusive distribution systems of these modern inputs should be considered.

Challenge 4. Managing Labor Demand and Postharvest Operations

The increasing transformation of Ethiopia's economy is leading to higher real wages in rural areas (Bachewe et al. 2015). These higher rural wages will provide the impetus and incentives for innovative labor-reducing technologies (Ruttan and Hayami 1984). This trend can already be seen by the increasing adoption of herbicides, a substitute for weeding labor, in commercial teff areas, but it will also drive the demand for more mechanization, especially for those activities where there is a peak demand for labor, such as during planting and harvesting periods. Mechanization in teff production and postharvest activities is currently low. Making sure that sturdy multipurpose mechanized planters and harvesters, and spare parts, at affordable prices will be available to alleviate that constraint is an important further challenge for sustained higher teff productivity.

Investments will be required to fund new off-farm technologies, such as storage and processing, which might help to satisfy the rapidly increasing urban demand. It seems that current storage is mostly carried out at the farm level, but the rather often rudimentary storage in these settings might need to be upgraded to reduce storage losses and smooth out teff supply over the year. The milling sector might also see a drive toward upgrading and modernization, as seen in other countries driven by the requirements of more demanding consumers (Reardon et al. 2014).

Challenge 5. Extending Markets

As the Ethiopian population is becoming richer and more urbanized, this will lead to changing demands for foods, different consumption baskets, and a transformed agricultural sector overall (Worku Hassen et al. 2016). The teff sector is a case in point, although it has to be recognized that there will be a significant part of the population that remains relatively poor and that will likely not be involved in shaping future teff markets, given the high income

elasticity of teff. It seems there will be an increasing willingness-to-pay for quality and convenience teff food products by these relatively better-off consumers, likely leading to two major changes in future market demand. First, it is expected that demand for teff flour and injera will grow fast, given the increasing opportunity costs, especially for women who will increasingly demand convenient and ready-to-use products. We are therefore likely to see a movement away from the purchase of unprocessed teff grains. Second, adulteration has been reported to be a major issue in urban teff markets. Hence, branded teff products with ensured quality characteristics might likely take off in a market where quality matters, and where consumers are willing to pay for such characteristics. Further stimulation to expand a private modern retail sector—that is currently hardly involved in teff trade—might possibly lead to better coordination toward quality assurance for teff consumers.

Further exploring the appropriate role of farmer unions and cooperatives in output marketing would be useful. It is assumed that cooperatives can play an important role in improving the access of smallholders to markets (Bernard et al. 2010; Francesconi and Heerink 2010). However, while these cooperatives have been successful in the marketing of some crops, their importance in cereal—and teff—markets is less pronounced, given that coordination of output sales by cooperatives is more complicated in such situations.¹ International experience has shown that the role of cooperatives is especially successful in cases of export crops or perishable products (such as dairy), where good coordination between small farmers is a precondition for successful development of value chains (for example, Cunningham 2009). For these reasons the role of cooperatives and farming organizations has seemingly been less important until now in the case of teff.

Moreover, the increasing focus on gluten-free food products in international markets will lead to a surge in demand in the near future within these markets (Research and Markets 2014). Given the unique gluten-free property of teff, positioning Ethiopia in a situation where it can take full advantage of these emerging opportunities would be beneficial for Ethiopia's teff export performance. However, it will need to build up supply chains that can reliably and sustainably deliver quality products in sufficient quantities. Developing an export sector such as this for teff might therefore demand considerable time and effort, especially given the limited expertise and experience in this

1 Based on a large-scale survey of farmers and cooperatives in 2005/2006, Bernard et al. (2010) show that only a limited number of farmers participate in cooperatives, even when cooperatives were established in their villages. Especially the smallest farmers tended to not use cooperatives. Similar results are cited in this book about teff (see [Chapter 11](#)).

area and considering that cereal export bans have been in place for a number of years, which have restricted exposure to market opportunities.

The dilemma, however, is how small-scale Ethiopian teff farmers may benefit from such export opportunities and the effect that such rapid growth in the export sector may have on domestic consumption (especially for the poor from the high prices of teff). It seems that there could be comparative advantages for potential new entrants and/or companies to rapidly increase production and tap into the expanding export market. Rapid growth in supplying the export market can seemingly be facilitated under situations where tradeoffs with domestic consumption are limited, and agronomic and climatic conditions would be permissive to increase yields. With this in mind, the government is therefore currently looking at stimulating large-scale commercial farming in less land-constrained settings of Ethiopia, with a focus on these export markets.

These efforts should be complemented by those that aim to strengthen credit, insurance, and labor markets. The demand for improved credit and insurance services is likely to rise, not only reflecting the needs of an increasingly more complex teff value chain but also in response to the challenges of climate change. Experimentation with different modalities of provision, such as index insurance and innovative input credit schemes, should continue and be scaled up as appropriate. Similarly, labor markets have to develop further to more efficiently address the expansion of wage labor and the reallocation that will occur due to greater prevalence of modern techniques of production and concomitant growth in agricultural labor productivity. In this regard, further exploring traditional seasonal agricultural labor flows can provide useful insights.

This book has systematically established the considerable benefits and the even greater potential of teff in Ethiopia. In parallel, it has highlighted that the realization of this potential requires further public sector leadership and investment as well as noticeable expansion in private sector participation, in part promoted by a more active public policy and public-private partnership. These efforts, this book also underscores, need to be undergirded by rigorous evidence on and deepening understanding about the challenges and their solutions.

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