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Resilience of the Tef Value Chain in Ethiopia

Final Report

Prepared by: Jonas Joerin, Kebebew Assefa, Pius Krütli, Kenza Ben-abderrazik, Samuel Hauenstein, Luzian Messmer, Tewodrus Lulseged, Evans Dawoe, Zerihun Tadele, Johan Six

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Ethiopian Institute of Agricultural Research

World Food System Center

About the Initiative

The Assessing and Enhancing the Resilience of the Tef and Cocoa value chain (AETRTCvc) project is part of the flagship project "Enhancing Resilience in Food Systems" of the ETH Zurich World Food System Centre. The AERTCvc project is led in joint collaboration between the Sustainable Agroecosystems group, the TdLab and the Climate Policy group of ETH Zurich as well as the Kwame Nkrumah University of Science and Technology in Kumasi in Ghana and the Ethiopian Institute of Agricultural Research in Debre Zeit in Ethiopia. This research project is funded by a COOP World Food System Grant.

Title

Resilience of the Tef Value Chain in Ethiopia – Final report

Report prepared by

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Title picture

Tef trials in Debre Zeit, Ethiopia

Layout

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Preface

This research project was conducted in close collaboration between the Ethiopian Institute of Agricultural Research in Debre Zeit (EIAR) and ETH Zurich (Sustainable Agroecosystems [SAE], Climate Policy [CP] groups and the Transdisciplinarty Lab [TdLab]). The collaboration between ETH Zurich and the EIAR exists since 2015. Our first joint project included a pilot study to qualitatively assess the tef value chain in Ethiopia. The objective was to map-out the system and identify the key stakeholders of the tef value chain.

Based on initial findings from this pilot project and a similar pilot study on the cocoa value chain in Ghana, we applied in late 2015 for a World Food Systems Grant, funded by COOP (a major Swiss retailer), to compare the resilience of the tef value chain in Ethiopia versus the cocoa value chain in Ghana. We received approval in early 2016 and started the project in the middle of 2016 (Figure 1).

In both case studies, the objective was to use transdisciplinary research techniques in order to co-produce knowledge in close collaboration with local stakeholders who are directly involved in the value chain. After the pilot study in Ethiopia, we initiated a transdisciplinary (TD) process together with key stakeholders of the tef value chain in a first workshop in March 2017 with 14 scientists and 25 stakeholders, including private input suppliers, cooperatives, farmers, millers, traders, injera processors, consumer representatives and officers from different governmental and non-governmental agencies.

Subsequently, we conducted a resilience assessment in form of a survey among key value chain stakeholders and validated the results with the same stakeholder group during our second workshop in November 2017. During the same workshop, we co-identified ac-

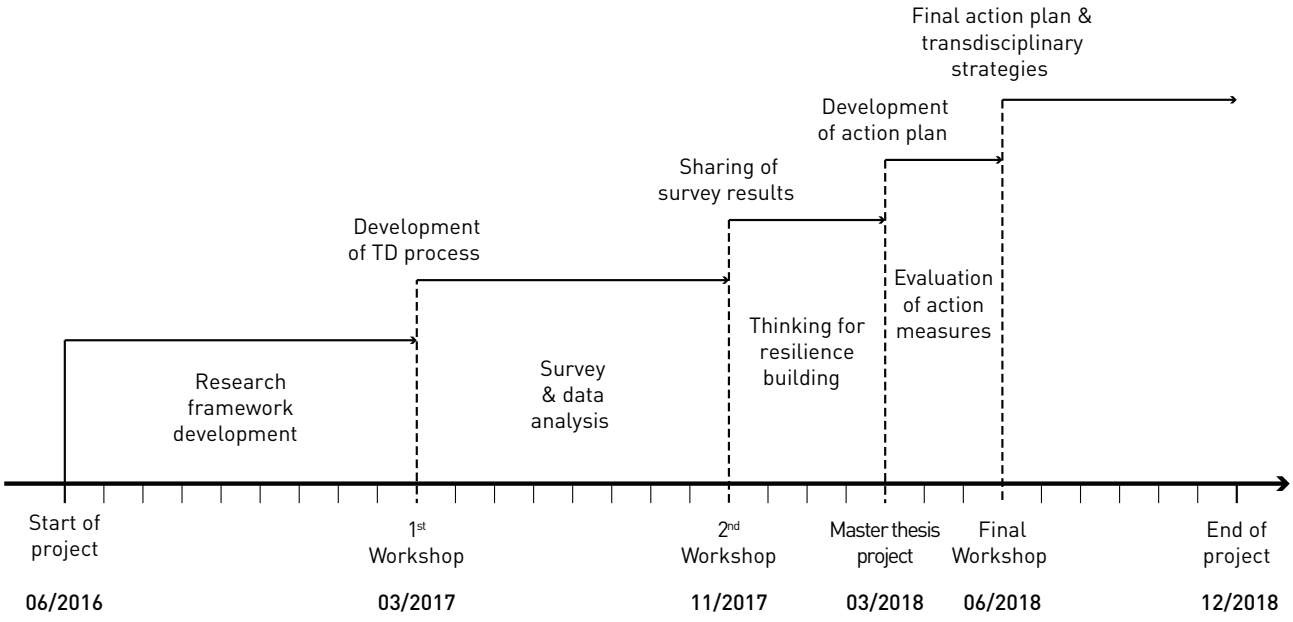

Figure 1
Project timeline

tion measures for input suppliers, farmers, millers and traders, injera processors. Additionally, representatives from consumer groups and governmental and non-governmental organisations developed action measures relevant at the policy level.

Accordingly, we developed action plans to identify pathways for building resilience in the tef value chain in Ethiopia. In a final step, some of the key action measures identified by farmers are taken up in an ongoing master thesis project to analyse their feasibility and appropriateness in building resilience among tef farmers.

This report provides a summary of this research project and targets practitioners of the tef value chain, experts and policy-makers. The results and findings of this study highlight areas where intervention is needed to enhance the resilience of the tef value chain in Ethiopia.

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Sara Yilma (Input supplier)

Executive Summary

The emergence of more frequent and intense stresses and shocks challenge the functioning of stakeholders in food value chains. Shocks related to climate change (e.g. drought) and market changes are of growing concern to stakeholders in the tef value chain in Ethiopia. While tef farmers are directly suffering from a drought shock in form of yield losses, other activities before and after the production suffer from cascading impacts. A reduced yield means for them less trading and processing opportunities. Accordingly, it requires them to be flexible to respond to such a sudden change.

To display how stakeholders in food value chains deal with shocks, we adopt the concept of resilience and combine it with a transdisciplinary research approach. This means that the research team and the stakeholders jointly identified areas of concerns and actions to be taken to assess and enhance their resilience against drought risk.

This report summarises the key steps, results and lessons learned from this research project. In a first step after establishing a transdisciplinary process with a selected number of key stakeholders of the tef value chain, we conducted a survey-based resilience assessment among all stakeholders to understand their ability to deal with drought shocks. In a second step, through a design-thinking approach, stakeholders identified relevant action measures which would enhance their resilience against drought shocks. We identified the following key issues and findings:

- Stakeholders across the tef value chain are highly challenged by an occurrence of a drought. Their resilience to avoid, absorb, recover and learn from a drought event is low to moderate. The cascading effects of a drought cause tef prices to increase which means that droughts indirectly influence the functioning of all other stakeholders across the tef value chain.

- All stakeholders have hardly incorporated the possibility of a drought shock into their business activities. Although, stakeholders do have a certain robustness to avoid a drought, they rely almost exclusively on financial resources to absorb, recover and adapt to it. In particular, tef processors rely most on a continuous stable and safe (high quality) supply of tef grains. In contrast, the income of tef farmers, traders and millers relies not only on producing or processing tef, but also on other crops (grains).

- Stakeholders proposed various action measures that directly address deficits identified in the resilience assessments. However, most of these action measures require external help, such as the government, NGOs, research institutes and international development agencies.

- The way forward is to transform the tef value chain in Ethiopia and to establish a roundtable together with all stakeholders. A roundtable would allow to identify ways how to build resilience in a system which is currently protected by an export ban to keep stable domestic prices of tef.

- From a resilience perspective, it is crucial to equip stakeholders with greater flexibility and independence. Making the system more resilient will have positive implications on the well-being of all stakeholders and will reduce the impacts of future droughts and other types of shocks.

Introduction

Tef (*Eragrostis tef*) is a key staple crop in Ethiopia and mostly used as an ingredient for making injera. A flat, moist, slightly sour and soft flatbread. Tef is an endemic crop from Ethiopia and until today, around 99% of the global production takes place in Ethiopia. The cultivation of tef is distributed across the whole country although intensified in altitudes ranging from 1000 to 2500 m above sea level. Tef is produced predominantly by smallholders, but commercial farming is increasing. In 2014, during the main agricultural season (Meher), 21% of the agricultural cropland in Ethiopia was used by smallholders for the production of tef and only 0.04% by commercial farmers (Central Statistical Agency 2014). Among the production of major cereals, tef occupied 30.6% of the agricultural cropland used for the production of cereals, followed by maize (20.3%), sorghum (17%), wheat (16.3%) and barley (10.4%). In the same year, smallholders produced 4.4 million tonnes and commercial farmers 8,800 tonnes of tef. The productivity of tef was almost equal among smallholders and commercial farmers with around 1.45 tonnes of tef per hectare.

Tef is sometimes perceived as one of Africa's 'super crop' similar to quinoa in South America due to its high nutrients content (e.g. iron), containing a lot of fibre and being gluten-free.

These features have contributed to the popularity of tef, which has become increasingly popular among people living outside of Ethiopia. However, until today, non-processed tef cannot be exported out of Ethiopia. A ban on exporting tef is in place since 2006 to control and protect domestic prices of tef. Despite this measure, tef prices in Ethiopia are rising (Figure 2), making it less and less affordable for people with low income. Rising prices of tef negatively influence the tef content of homemade injera since tef can partially be replaced by wheat, sorghum, maize and rice to make injera. Between 2011 and 2015 nominal (current) prices of injera increased by 42.7% which in real (inflation adjusted) prices refers to 23.4% price increase. While consumers had to pay significantly more for injera, farmers received only 18% more for their tef grains. This means that other stakeholders in the tef value chain increased their margins.

Figure 3 highlights that in 2015 millers were able to increase their margins at the expense of injera processors and traders compared to 2011. However, millers and traders only received less than 10% of the injera price in 2015. Major beneficiaries from the production of tef remain farmers and injera processors. Farmers received 44.6% of the price of the processed product sold to consumers. This highlights that tef, as of 2015, continues to play a significant role in providing food security in Ethiopia, despite high growth rates in price.

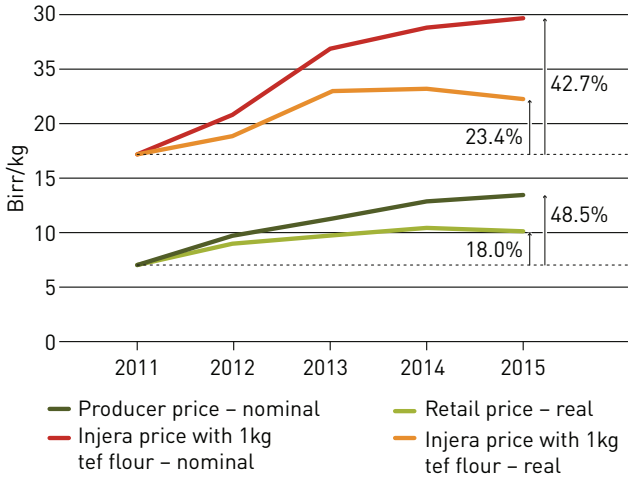

Figure 2
Producer and injera prices from 2011-2015; nominal and real prices (authors calculations with data provided by the Central Statistical Agency)

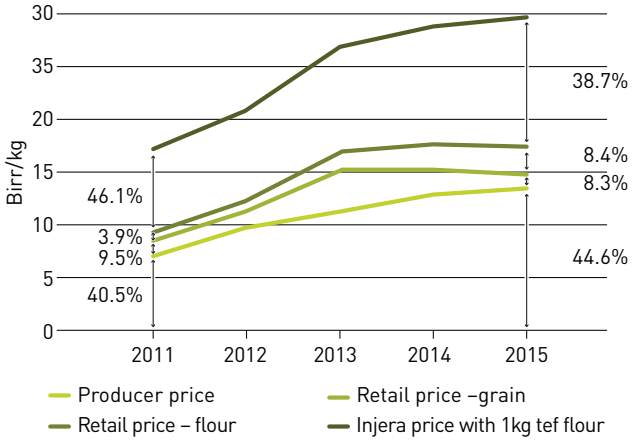

Figure 3
Nominal prices of tef for key stakeholders in the tef value chain from 2011–2015 (authors calculations with data provided by the Central Statistical Agency)

Like other crops in Ethiopia, tef is increasingly exposed to climate change. A severe drought taking place from 2015 to 2017 caused substantial yield losses in several parts of Ethiopia. However, tef is known to be more resistant to harsh weather conditions, such as extended periods of no rain, compared to other cereals. It is also capable of absorbing heavy rainfalls and waterlogging. Moreover, since tef is endemic from Ethiopia, it is largely resistant to local pest and other plant diseases. Nevertheless, the growing emergence of droughts raises the question whether the various stakeholders in the tef value chain are capable to deal with such unexpected changes or not. By capability, we mean whether stakeholders are resilient and therefore can withstand, absorb, maintain and recover from a shock.

In our study, we focused primarily on the ability of stakeholders that are part of the tef value chain in Ethiopia. The material flow analysis of the tef (Figure 4) shows that the value chain is diverse and contains a large number of stakeholders. There is, however, a dominant pathway of producing tef. This pathway starts with smallholder farmers possessing their own unimproved seeds to apply on their fields. To increase the productivity, farmers buy inputs (mostly fertilizers) from cooperatives (unions and primary) who get the inputs supplied by the Agricultural Input Supply Enterprise (AISE). After the production of tef, regional traders collect the tef grain and sell it to urban traders who then distribute it to a range of stakeholders for processing. Currently, private millers process more than half of the tef grain and then sell the tef flour to individual consumers. Only a very small proportion of tef is processed to the level of injera and then sold to consumers. Surprisingly, a link between millers and injera companies does not exist because of quality control issues. The harvesting of tef grains is still done with traditional techniques which include threshing of the husks and straw with oxens and winnowing. This results in tef grains being usually mixed with small quantities (up to 10%) of sand. For commercial injera companies, this means additional cleaning of tef grains before they get milled and then processed to injera.

Goals of the study

We aimed to combine aspects of building resilience with development by adopting a transdisciplinary research approach. This means that the knowledge of this study is co-produced together with stakeholders of the tef value chain in Ethiopia and enriched with empirical data. Thus, the goals of this study were:

- to establish a transdisciplinary process with key stakeholders of the tef value chain in Ethiopia;
- to measure the resilience of stakeholders of the tef value chain in Ethiopia;
- to identify strategies for building and enhancing the resilience of the tef value chain in Ethiopia.

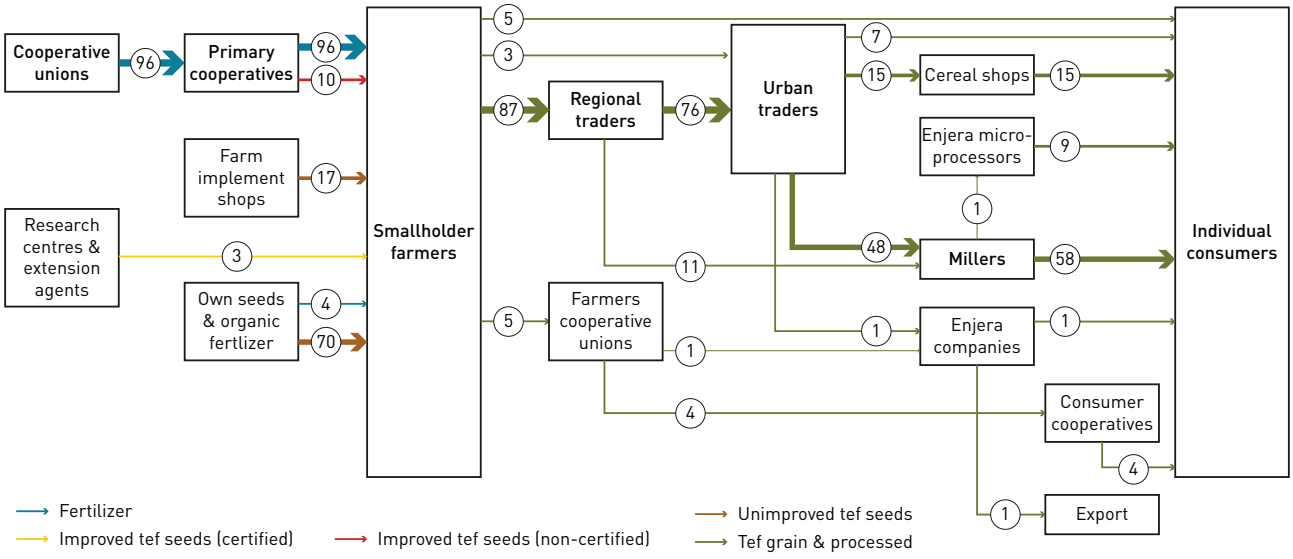

Figure 4
Material flow map of the tef value chain in Ethiopia (adapted from Hauenstein, 2015)

Methodology

The concept of resilience

To assess the ability of value chain stakeholders to deal with shocks, we used the concept of resilience. The key strength of this concept is that it tries to catch dynamically the impacts of a shock or disturbance, as shown in Figure 5. In this case, a more resilient food system is one that is capable to limit the impact of a disturbance, is able to recover from it and increases its functionality to provide food security (Tendall et al. 2015). In our case, we focus on the resilience of value chain stakeholders. Hence, we consider a resilient actor (e.g. input supplier, farmer, etc.) one who cannot only withstand a shock, but also limit (absorb) the impacts of a shock on his/her functionality and is able to recover and learn (adapt) from it. By functionality, we mean whether, for example, a farmer can recover from a drought in terms of delivering the same yield and income as before a shock. Thus, the functionality varies for each actor.

Figure 6
Discussions with stakeholders

Adopting a transdisciplinary research approach

In this study, we actively made use of the knowledge and experience of key stakeholders of the tef value chain in Ethiopia. This means that we involved key stakeholders from the beginning and invited stakeholders to shape the direction and outcomes of this study. In a first step, we discussed together with them what the challenges and opportunities are of their activity (Figure 6).

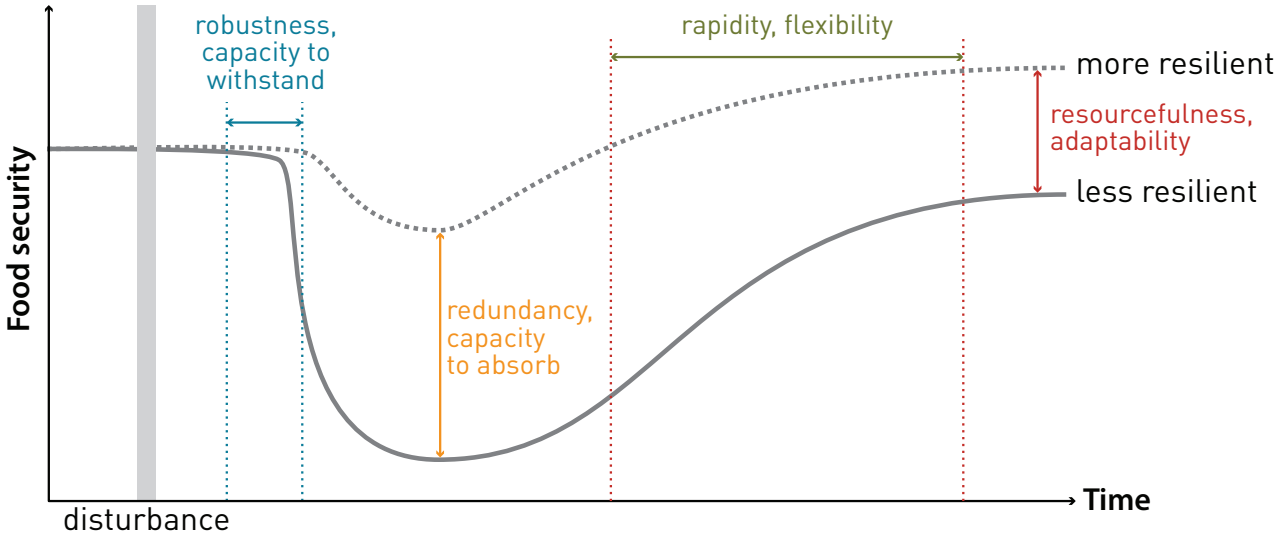

Figure 5
Food system resilience in the context of food security (Tendall et al. 2015)

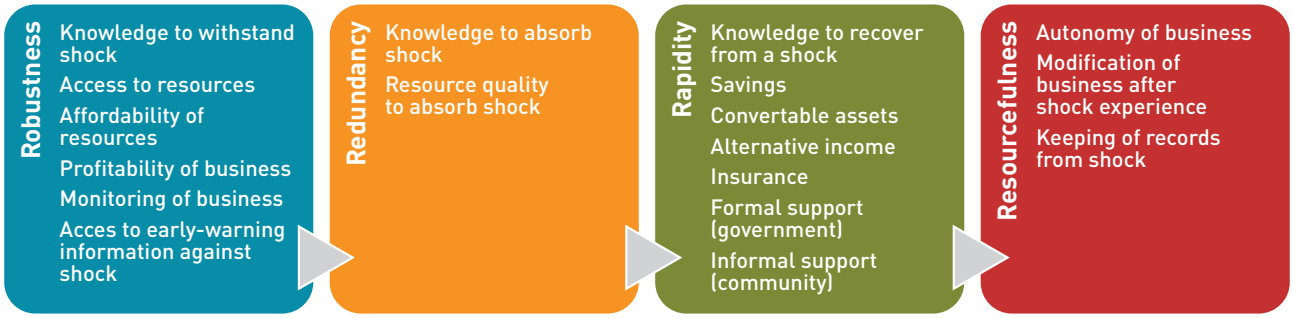

Figure 7
Conceptual framework for assessing the resilience of value chain actors

The outcome of this discussion was that drought is a key shock that affects all activities across the tef value chain. While farmers are directly affected through yield reductions, input suppliers, cooperatives, traders, millers, injera processors and consumers are indirectly affected. Input suppliers cannot sell inputs (e.g. fertilizers, tools, etc.), traders trade less tef grains, millers mill less tef grains, injera processors pay more for tef flour and consumers pay more for the tef flour and injera.

In a second step and in combination with a previous pilot study to review the current status of the tef value chain in Ethiopia, we developed and validated with our stakeholders surveys for assessing the resilience of key value chain activities. These surveys combined conceptual aspects of resilience with contextual knowledge and resulted in the identification of a set of factors for assessing each resilience element (Figure 7). For the resilience element 'Robustness', for example, we identified that knowledge to withstand the shock (e.g. drought) is needed as well as access and affordability of resources. We also considered that a stakeholder whose business does well, monitors his/her activities and has access to early-warning information is more likely to sustain the impact of a shock. Accordingly, for the resilience element 'Redundancy', knowledge and the quality of key resources to absorb a shock were identified as key factors. For 'Rapidity', knowledge combined with financial capacities as well as government and community support were seen as key factors to explain the ability of an actor to recover from a shock. For 'Resourcefulness', the autonomy over a stakeholder's business, previous efforts of stakeholders to modify the business activities and keeping records after experiencing a shock, were identified as factors that explain whether an actor would adapt and learn from a future shock.

Figure 8
Tablet-based survey

Since for many of these identified factors no baseline data exists, we decided to conduct a survey that allows the stakeholders to self-evaluate the availability of these factors. On a scale of 0 (not available) to 100 (fully available), the surveyed stakeholders had to determine to what extent their business has those factors. We then determined that a 'low' resilience level has a score between 0-33, a 'moderate' level between 34–66 and a 'high' level between 67–100.

Upon framing our resilience assessment, we conducted the survey by using tablets (Figure 8) for face-to-face interviews with all relevant stakeholders.

While the total number of existing private input suppliers, tef farmers, traders, millers and injera processors in Ethiopia is several thousands, we limited the sampling of our survey to the Adaa and Boset Woredas and Adama Special Zone. These three locations are all part of the East Shewa Zone in the Oromia Region. While Adaa has not been much affected by drought in recent years, Boset suffered from a severe drought from 2015 to 2016. The data for this resilience assessment was collected in April 2017.

After conducting the survey, we discussed together with our stakeholders the meaning of the results and validated them. In a subsequent step, we developed together action plans by using 'design thinking' techniques. After the identification of relevant measures for building resilience in the different activities of the tef value chain, we analysed the relationship between the different measures by using Vester's system analysis tool. In a final workshop, we discussed the way forward to effectively build resilience in the tef value chain. This report aims to guide stakeholders in the future process of making the tef value chain in Ethiopia more resilient against shocks, particularly drought.

Overall Resilience of the Tef Value Chain

As our stakeholders identified 'drought' to be the key shock affecting the tef value chain in Ethiopia, this resilience assessment focuses exclusively on this shock. This overall assessment (Figure 9) includes only those factors that can be compared across all the selected activities of the tef value chain in Ethiopia. For a detailed analysis of each selected stakeholder group, see the subsequent sections of this report.

Robustness

The robustness of the tef value chain in Ethiopia is characterised by stakeholders consistently monitoring their activities (scores range from 85 for millers to 99 for ccoperatives), but low to moderate profitability (scores range from 25 for input suppliers to 50 for millers) of doing business with tef. This underlines that tef at the time of the data collection (April 2017) still played the role of a food security crop which does not yield in massive gains by any stakeholder group. However, not surprisingly, millers make highest profits from processing tef because tef flour is in quite high demand by micro injera processors and urban consumers. Millers represent a bottleneck in the tef value chain (see Figures 3 and 4), as more than half of the tef grain production goes to them for processing it into flour. Knowledge about how to avoid impacts (scores range from 11 for millers to 22 for cooperatives) is low among all stakeholders.

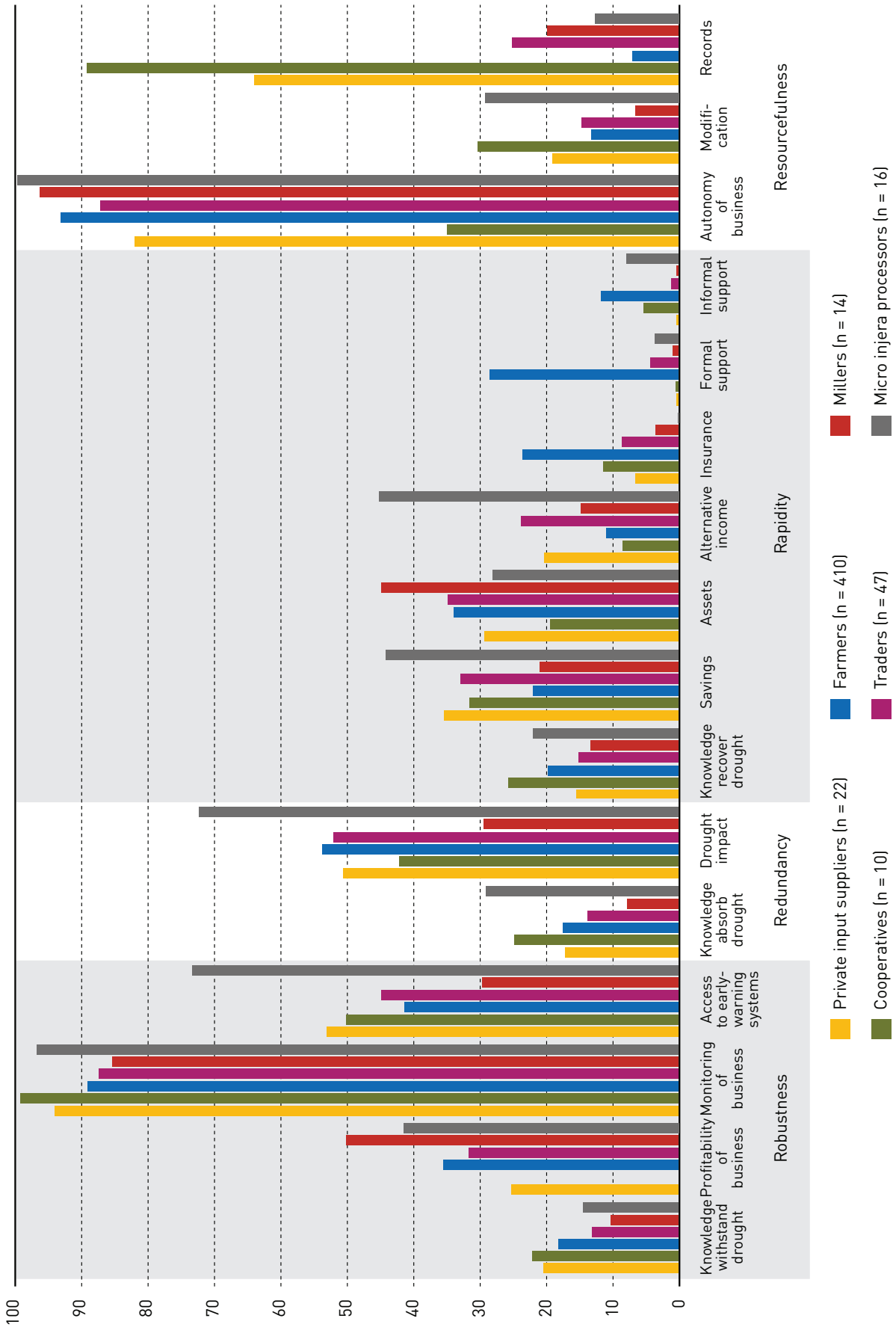

Figure 9
Overall resilience of stakeholders of the tef value chain in Ethiopia to drought; 0 (not available) to 100 (fully available)

Redundancy

The redundancy of value chain stakeholders to a shock focuses on their ability to minimise the impacts of a shock, in our case drought. The perceived impact of drought is highest among micro injera processors (score of 72) followed by farmers (score of 54), traders (score of 52), private input suppliers (score of 51), cooperatives (score of 42) and millers (score of 30). This is not surprising since micro injera processors usually only produce injera and because higher droughts cause higher tef prices, tef-based injeras become more expensive. Droughts have direct impacts to farmers and indirectly cause price changes due to reduced supply. As tef is already today a rather expensive cereal compared to wheat, maize and sorghum, droughts can seriously disrupt the functionality of stakeholders in the tef value chain. Evidence from Boset where stakeholders experienced a severe drought from 2015 to 2017 showed that tef temporarily lost its function as a food security crop. Farmer consumers in this rural area reduced their tef-based injera consumption.

Knowledge on how to reduce impacts is limited among all stakeholders (scores range from 8 for millers to 29 for micro injera processors) which puts farmers into a passive role on how to deal with drought shocks.

Rapidity

The ability of the stakeholders to recover from a drought is low to moderate among all stakeholders. Financial resources to recover from a drought can hardly be built since tef does not create much profit for any stakeholder in the tef value chain. This means that during normal times, savings and assets cannot be built to a level that would allow stakeholders to buffer potential price increases related to a drought. Likewise, the lack of financial resources limits the ability of governmental and community support to stakeholders in the tef value chain. However, farmers in Boset benefitted from governmental support during the drought from 2015 to 2017. The knowledge on how to recover from a drought is for all stakeholders low because stakeholders (scores range from 14 for millers to 26 for cooperatives) have not yet established a thinking that considers dealing with shocks. The occurrence of shocks, such as drought, and how to manage them is hardly part of their business strategy.

Resourcefulness

The resourcefulness reveals whether stakeholders are more or less likely to learn and transform their activity based on the experience of a shock, in this case drought. The results show that cooperatives (score of 89) and private input suppliers (score of 64) keep high records on how droughts impact their business. Except cooperatives (score of 35), all stakeholders have high autonomy (scores range from 82 for private input suppliers to 100 for micro injera processors) over their business activities. However, many stakeholders operate in the informal sector which reduces their recognition by stakeholders from the formal sector. This has implications on their ability to learn from droughts and modify their business management. For example, they may not receive credits or get permissions to run their businesses as they wish.

Overall resilience of the tef value chain

Overall, stakeholders in the tef value chain have limited resilience to deal with drought shocks. A resilience thinking in terms of establishing shock resistance is hardly existing among all stakeholders. For example, knowledge levels are low across the different resilience elements (robustness, redundancy and rapidity). Among all stakeholders, micro injera processors are a little more resilient than other stakeholders in the tef value chain. Interestingly, micro injera processors are most impacted by a drought because they solely rely on producing injera which sells better (higher price) with a high tef content. Thus, during a period of low supply of tef caused by a drought, tef prices rise. Higher tef prices then have direct implications on the price of tef-based injera. Therefore, a drought shock creates cascading effects across all value chain activities and indirectly has implications on the food security of consumers.

Private Input Suppliers and Cooperatives

In our case study area, we surveyed 22 private input suppliers and 10 cooperatives in the Adaa and Boset Woredas. The role of cooperatives is to provide seeds, fertilizers and pesticides. Private input suppliers play a complementary role by providing herbicides, insecticides and tools for farming. Cooperatives receive fertilizers directly from the AISE. The Ethiopian Seed Enterprise (ESE) provides improved tef seeds to primary cooperatives. Domestic and international suppliers provide through wholesalers pesticides (including herbicides and insecticides) to private input suppliers or farm implement shops. However, since tef is endemic and because pesticides are not particularly needed during a drought, cooperatives play a more important role compared to private input suppliers in the provisions of inputs to farmers during a shock.

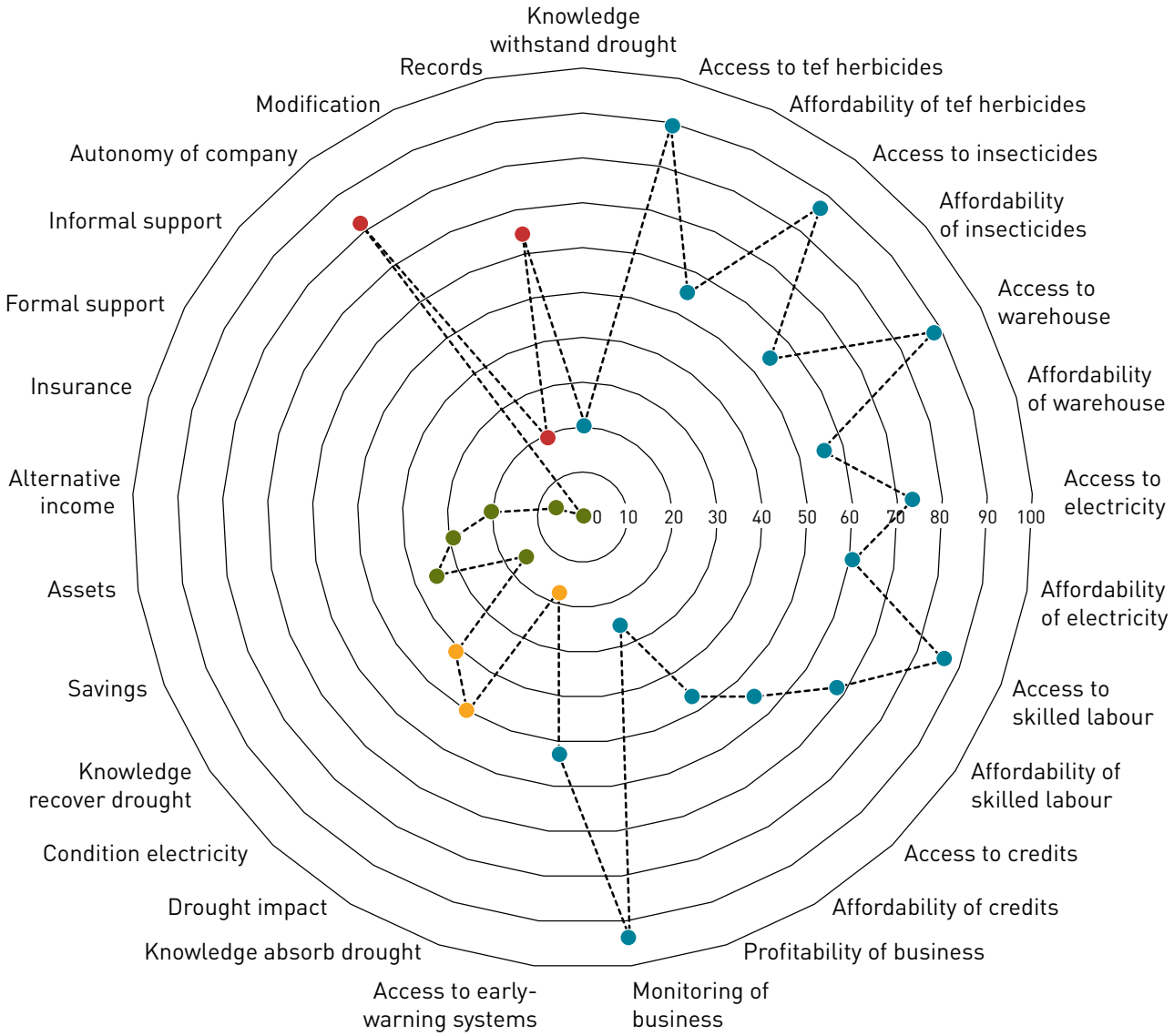

Figure 10
Resilience of private input suppliers (n=22) against drought; 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

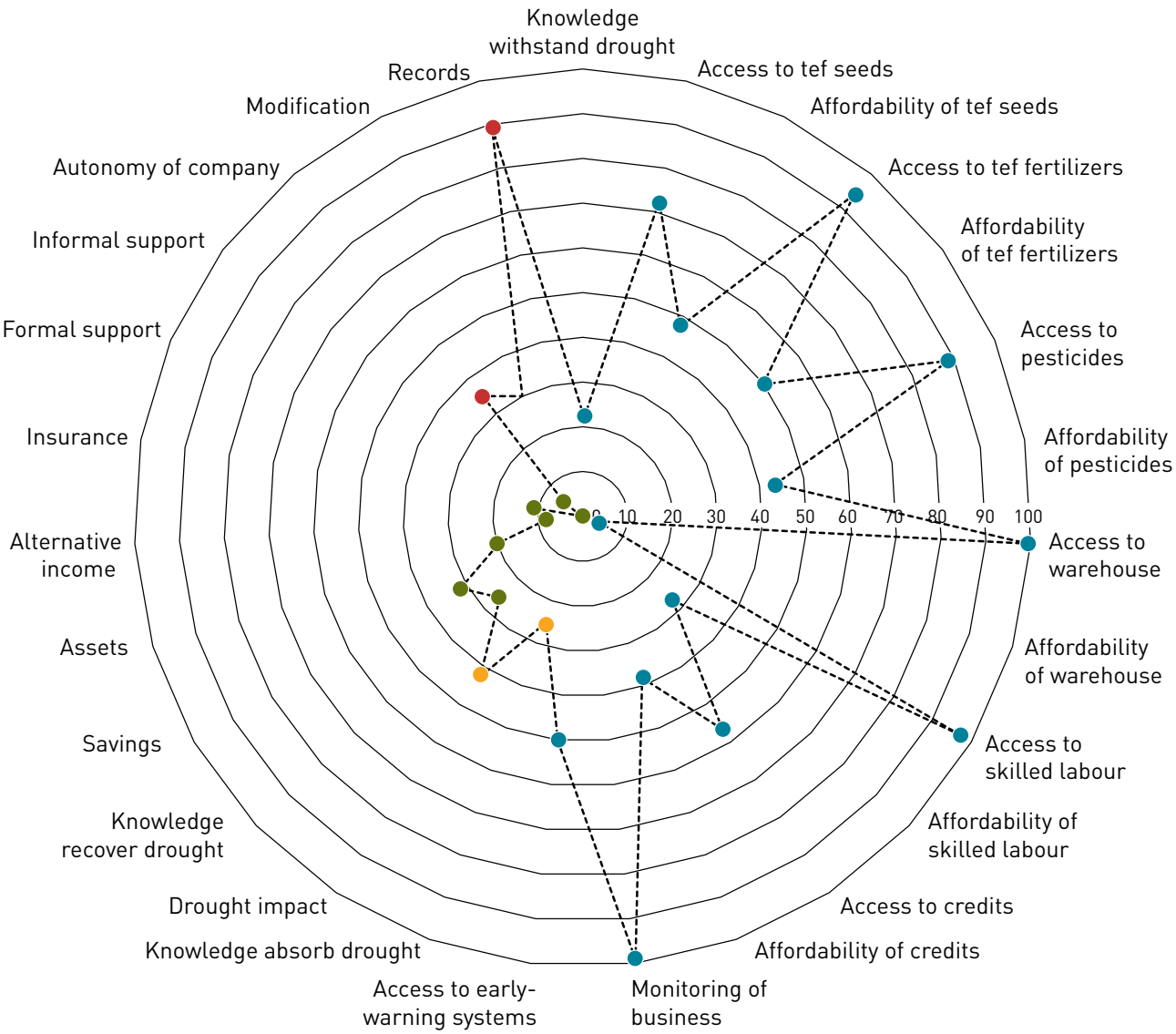

Figure 11
Resilience of cooperatives (n=10) against drought; 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

Robustness

Overall, the robustness of private input suppliers (Figure 10) and cooperatives (Figure 11) is similar in terms of high access to inputs, but only moderate ability to afford them. Private input suppliers tend to be in a better financial condition compared to cooperatives as they can better afford skilled labour (scores range from 68 for private input suppliers to 27 for cooperatives) and warehouse space (scores range from 55 for private input suppliers to 3 for cooperatives). Credits are for both input players moderately affordable (scores range from 47 for private input suppliers to 38 for cooperatives). Knowledge on how to deal with drought is low (scores range from 20 for private input suppliers to 22 for cooperatives) and hardly considered in their management practices. Both input suppliers monitor their business activities and to some extent have access to early-warning information against drought (scores range from 50 for private input suppliers to 53 for cooperatives).

Redundancy, recovery and resourcefulness

Private input suppliers and cooperatives are only indirectly affected by drought impacts in form of reduced business activities (scores range from 50 for private input suppliers to 42 for cooperatives). Accordingly, the availability of savings, assets and alternative income sources is required to sustain a period of limited business activities. For both stakeholders, financial buffering capacities are low which underlines that both of them are challenged to recover from a drought. External (governmental or community) support is unavailable for both input suppliers and cooperatives. The autonomy of cooperatives compared to private input suppliers is considerably lower (scores range from 82 for private input suppliers to 35 for cooperatives) due to the complex ownership structure. Cooperatives are usually owned by a large number of members who are part of the decision-making processes whereas private input suppliers are run by single entrepreneurs. Private input suppliers and cooperatives keep records (scores range from 64 for private input suppliers to 89 for cooperatives) from past drought events which can support their ability to deal with future drought events.

Overall resilience of private input suppliers

Overall, the resilience of private input suppliers and cooperatives to deal with drought is limited. Both input suppliers do not have alternative options to replace reduced business activities during a drought. In essence, they limit their business activities and rely on limited available financial capacities. Insurance solutions and external help are not available to compensate for losses during a drought. However, private input suppliers and cooperatives keep records which allows them to adapt business management strategies in the advent of a drought, for example, ordering less supply of inputs.

Farmers

In Adaa (Adaa Woreda) the estimated total number of farmers in April 2017 was 17,100 among a population of 131,000. In Boset (Boset Woreda), the number of farmers was 101,000 among a population of around 243,000. For our study, we sampled 207 farmers from Adaa and 203 farmers from Boset. The selection of the farmers was done through a stratified sampling. In Adaa, we selected farmers from 7 out of 22 kebeles (smallest administrative unit in Ethiopia, similar to a neighbourhood) and in Boset 9 out of 33 kebeles. The average tef farm size was in both woredas similar with 1.4 ha in Adaa and 1.3 ha in Boset. In contrast, the tef yield for the 2016 agricultural season was much higher in Adaa with 1.23t ha-1 compared to 0.29t ha-1 among farmers in Boset. The reason for these yield differences was a severe drought which affected farmers in Boset much more than farmers in Adaa, despite the short distance of only 70 km between the centres of both woredas. Boset lies in a different valley than Adaa and rain hardly reached there for a period of around three years.

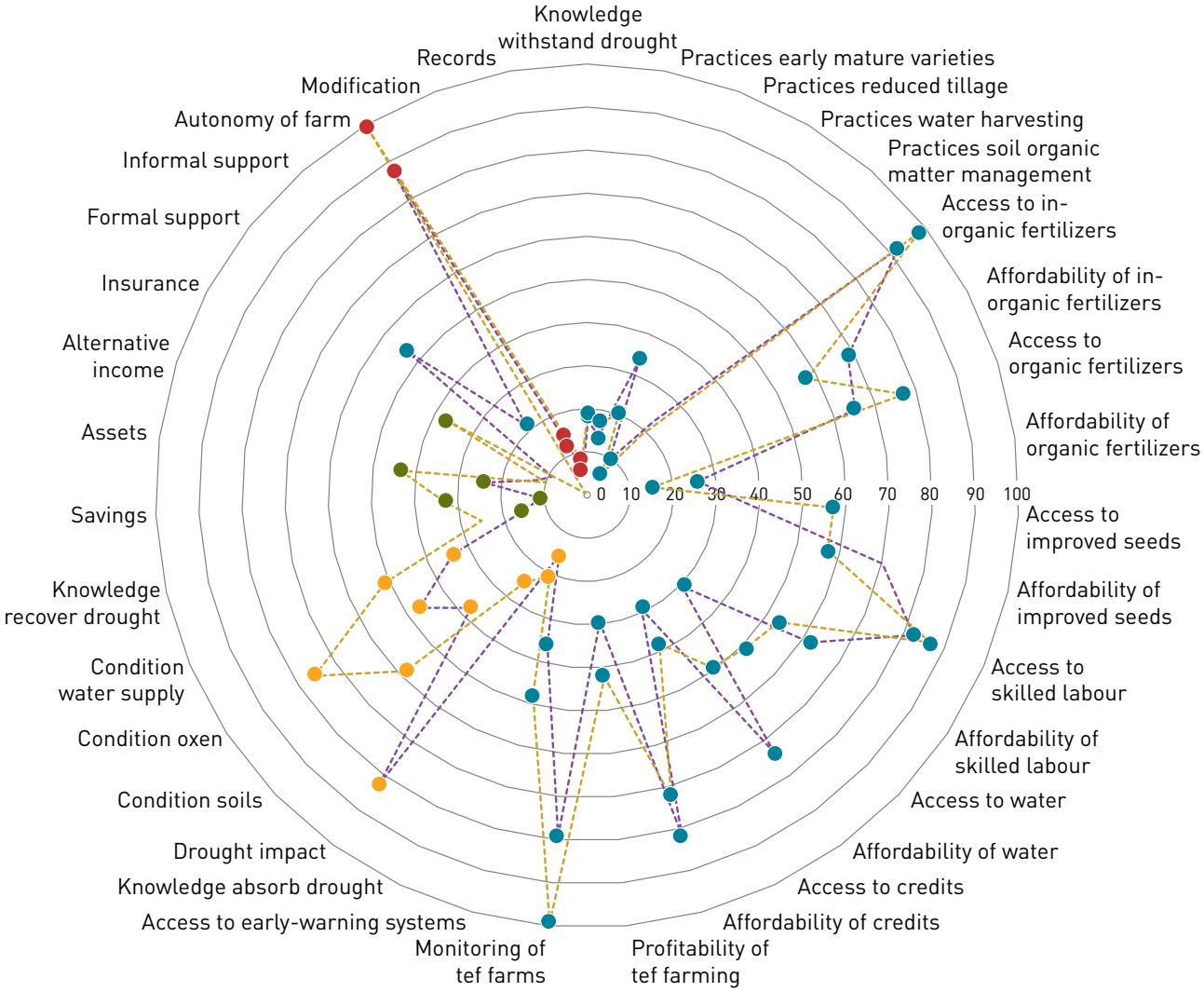

Figure 12
Resilience of farmers in Adaa (brown line, n=207) and Boset (purple line, n=203); 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

Robustness

Overall, the robustness (Figure 12) of tef farmers to avoid impacts of drought is limited. On the one hand, farmers do not much practice water harvesting (scores range from 6 for farmers from Adaa to 10 for farmers from Boset) and also find it difficult to practice the application of early mature varieties (scores range from 17 in Adaa to 14 in Boset). Moreover, their knowledge about withstanding drought is low (scores range from 19 in Adaa to 17 in Boset). On the other hand, farmers do have some financial resources to afford inputs, such as water (scores range from 49 in Adaa to 73 in Boset) and credits (scores range from 72 in Adaa to 82 in Boset). However, they cannot make use of it due to limited access/availability to those resources (access to water scores range from 51 in Adaa to 30 in Boset and access to credits range from 38 in Adaa to 29 in Boset). Similarly, farmers are interested in improved seeds, but the availability/access is only moderate (scores range from 57 in Adaa to 37 in Boset). In contrast, access/availability to inorganic and organic fertilizers is high (scores range from 98 in Adaa to 92 in Boset). Despite recent increases in producer prices, the profitability of tef farming is low to moderate (scores range from 42 in Adaa to 29 in Boset). Tef farmers do get access to early-warning information, but are limited in taking appropriate steps to avoid being affected by droughts.

Redundancy

Because Boset was affected by a severe drought between 2015 and 2017, the drought impacts were significantly higher compared to farmers in Adaa which were hardly affected by the same drought (scores range from 24 in Adaa to 82 in Boset). Farmers in Boset consider the ability of their soils (scores range from 59 in Adaa to 37 in Boset) and oxens (scores range from 76 in Adaa to 47 in Boset) to reduce the impacts of a drought lower than farmers in Adaa. Field visits to those areas confirmed that the farmers in Adaa benefit more from drought absorptive soils (vertisol). The availability of water is more limited in Boset to dampen drought impacts.

Rapidity

The ability of tef farmers from Boset to recover from drought impacts is lower than in Adaa. Those farmers who still remain in Boset and have not migrated or abandoned their tef farming activities rely on few financial assets (scores range from 44 in Adaa to 24 in Boset). However, farmers from Boset have received support from the government during the drought (scores range from 0 in Adaa to 54 in Boset). Since farmers in Adaa were not affected by this drought, governmental support was not available to them.

Resourcefulness

The resourcefulness of tef farmers is characterised by high autonomy over their farms (scores range from 99 in Adaa to 87 in Boset), but limited ability to modify their farm management practices (scores range from 15 in Adaa to 12 in Boset). The results suggest that farmers from Boset could hardly find ways to adapt to this drought autonomously without external support.

Overall resilience of tef farmers

Overall, tef farmers have difficulties to adequately prepare against and to respond to a drought. Unlike one may expect, the challenge is not that much the lack of financial resources among farmers, but much more the absence of sufficient available resources (access). For example, the availability of water and credit resources as well as improved seeds are limited in Adaa and Boset, despite farmers demanding it and in contrast to the high availability of fertilizers. Another challenge is the limited knowledge of farmers about suitable farm management practices to better cope with drought impacts, such as the application of early mature varieties and water harvesting. The lack of available resources and knowledge make farmers in Adaa, and particularly in Boset, vulnerable to the occurrence of droughts. Once a drought occurs, farmers in Boset have a lower perception about their ability to reduce the impacts compared to farmers in Adaa. Farmers in Adaa tend to have a bit more financial recovery capacities due to higher profitability from tef farming. Although, farmers in Boset could rely on minor support from the government to provide assistance during the recent drought. A high autonomy among farmers suggests that farmers are in a position to build resilience.

Traders and Millers

Traders play an important role in collecting and distributing tef grains to urban traders, millers and injera processors (small and big companies). Millers and traders are usually small-scale entrepreneurs who are run only by few people. The estimated number of traders and millers in Ethiopia is difficult to estimate because they often operate in the informal sector. The estimated numbers are around 30,000 for traders and 10,000 for millers. Traders and millers usually deal not only with tef, but also trade or mill other grains. In our study, we surveyed 47 traders and 14 millers from Adaa, Adama and Boset.

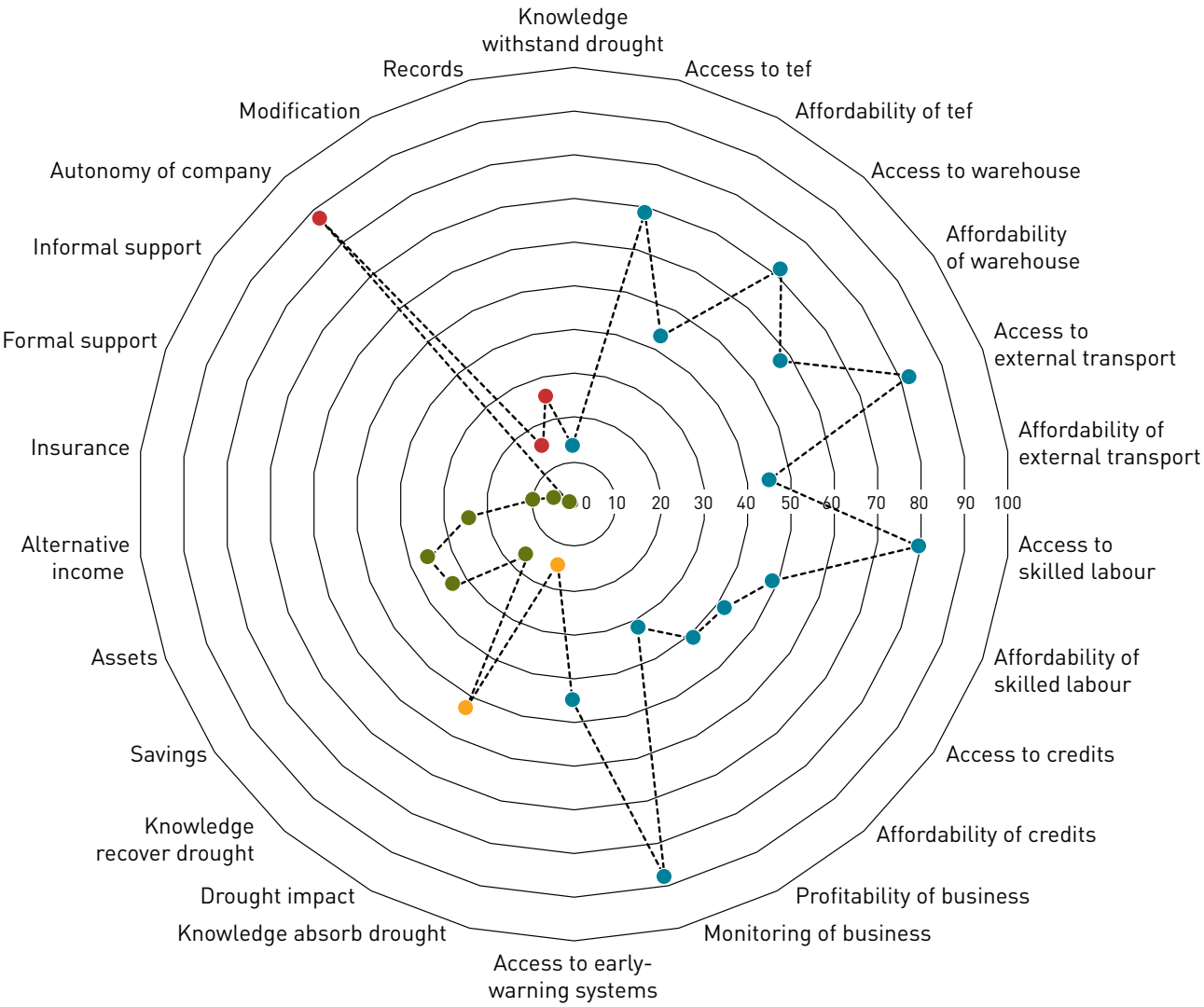

Figure 13
Resilience of traders (n=47) against drought; 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

Robustness

A drought only has indirect impacts to traders and millers. The impacts are simply less supply of tef grains. A solution to avoid being affected by a drought are the availability of storage space. As the results show, traders (Figure 13) and millers (Figure 14) have considerable access to such space (scores range from 71 for traders to 82 for millers), but find it a bit difficult to afford it (scores range from 58 for traders to 60 for millers). Likewise, traders do have access to other resources, such as external transport (score of 83) and skilled labour (score of 80), but find them expensive (scores are 45 for external transport and 49 for skilled labour). Millers evaluated the access and affordability of electricity and skilled

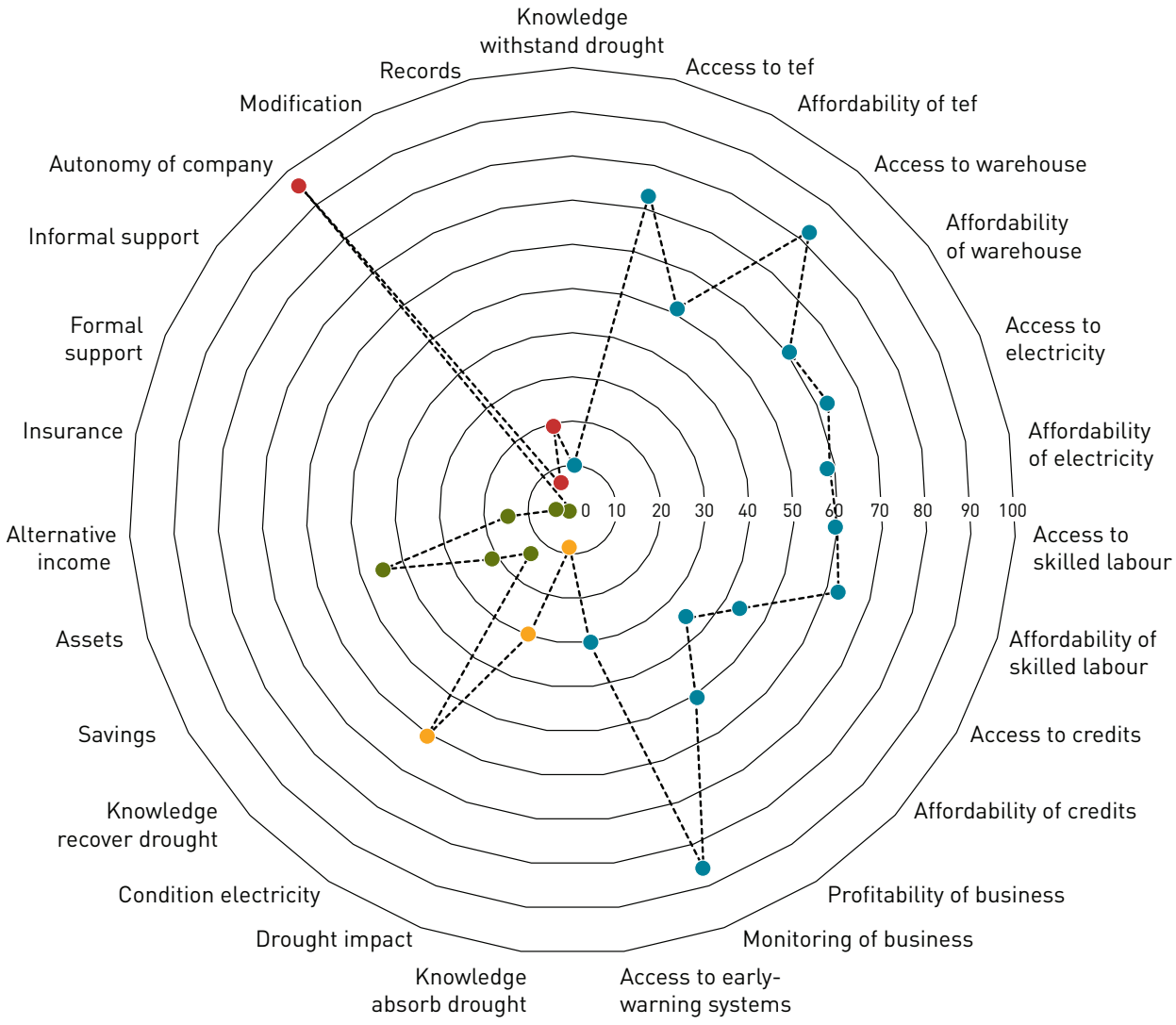

Figure 14
Resilience of millers (n=14) against drought; 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

labour equally which highlights that the financial capacity is not the only challenge, but also the availability of electricity and manpower. Similar to other stakeholders in the tef value chain, the affordability of credits is linked to its access. Credits with attractive conditions and interest rates are only moderately available for millers and traders (scores range from 42 for traders to 43 for millers). While millers can to some extent make a living from doing business with tef, traders are working in an environment with fierce competition. As shown in Figure 3, the margins that traders get from selling tef grains has decreased in the last couple of years. This has impacts on their profitability which is low for traders (score of 32) and moderate for millers (score of 50). Traders and millers monitor their activities (scores range from 88 for traders to 85 for millers) and have moderate access to early warning information about drought (scores range from 45 for traders to 30 for millers) to adjust their business practices.

Redundancy, recovery and resourcefulness

Transporters perceive the impact of drought as moderate (score of 52). Essentially, transporters are capable to shift their transport activities to carry different types of goods and commodities. Therefore, the impact of a drought can be absorbed by shifting to other businesses. The impact of a drought is only related to the lack of transport opportunities and does not affect any other parts of their transport business. The knowledge of transporters to absorb a drought (score of 8) is perceived to be irrelevant because transporters think that they cannot actively reduce the impacts of a drought.

Overall resilience of traders and millers

Overall, the resilience of traders and millers against drought is characterised by moderate robustness and limited redundancy, rapidity and resourcefulness. Both of them experience indirectly the impacts of a drought and seem to be rather reactive than pro-active. This means essentially that they do not have many resources available to maintain their business activities related to tef at the same level during a drought. However, millers and traders are small-scale entrepreneurs who can reduce their business activities quickly during a drought and then scale-up again after a shock. Thus, during the recent drought in Boset, traders and millers substituted tef by trading and milling other crops from outside of Boset. This explains why the impacts of drought are not perceived very high.

Micro Injera Processors and Consumers

In Ethiopia, only very few (10–20) big tef processors exist. Some of them (e.g. Mama Fresh) export injera and some others produce for local restaurants. However, most of the processed tef is either prepared at home or by small micro injera processors. While people in rural areas individually process tef to injera, urban consumers increasingly rely on small micro injera processors which are estimated to be more than 100,000 in Ethiopia. These processors are usually run by women in form of small-scale businesses. Many of them are informal which makes it difficult to precisely estimate how many exist in Ethiopia. In our study, we surveyed 16 micro injera processors and 279 consumers from Adama, Boset and Debre Zeit.

Robustness

The robustness of micro injera processors (Figure 15) against drought is characterised by high access to tef

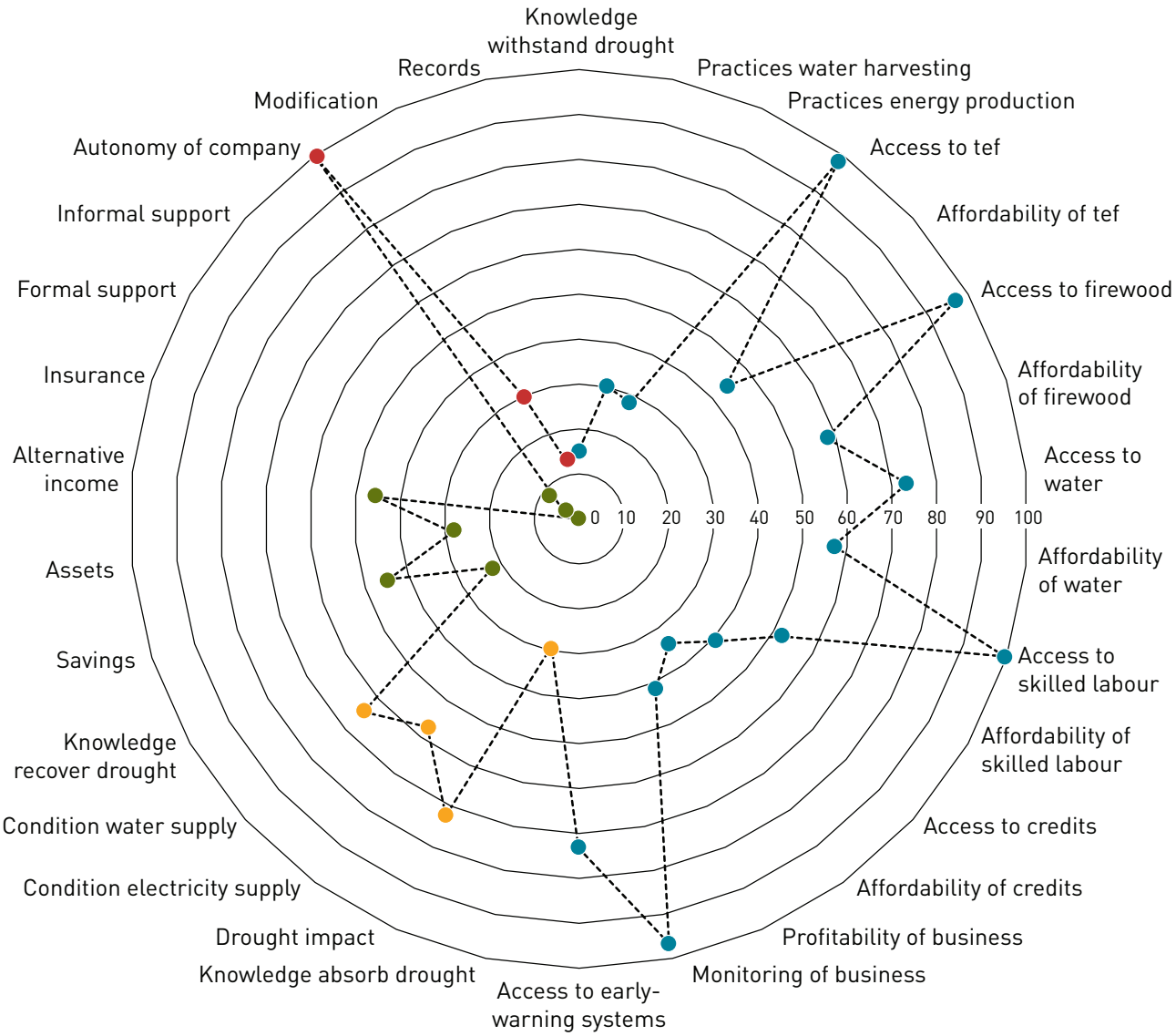

Figure 15
Resilience of micro injera processors (n=16) against drought; 0 (not available) to 100 (fully available). Blue indicators are for robustness, yellow for redundancy, green for rapidity, and red for resourcefulness

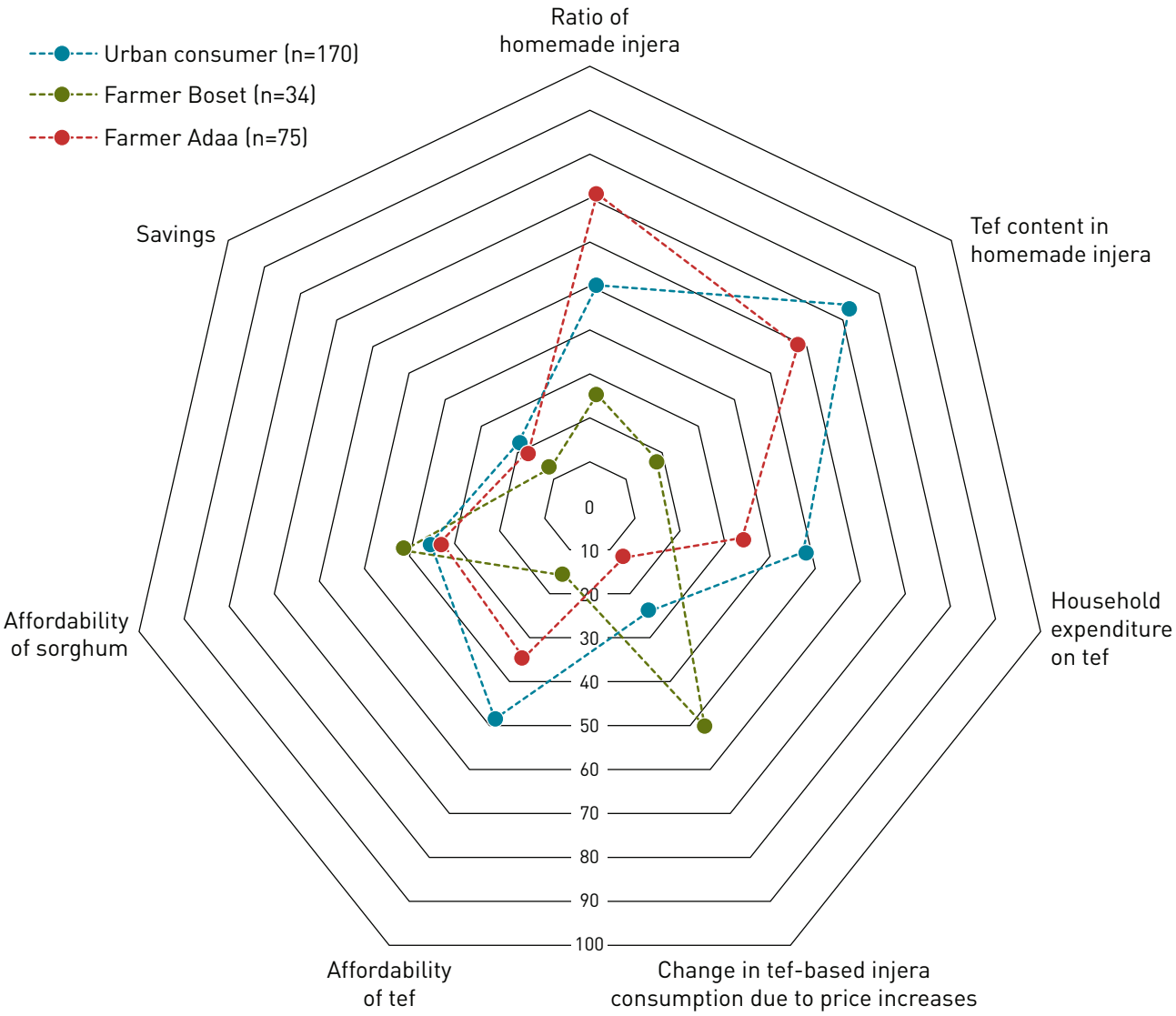

Figure 16
Resilience of farmer consumers from Boset (n=34) and Adaa (n=75) and urban consumers (n=170) (fully available)

(score of 98) and skilled labour (score of 100), but only moderate affordability to those resources (scores are 44 for tef and 41 for skilled labour). Practices to avoid drought impacts, such as water harvesting (score of 30), are hardly practiced. Since many of them are located in village or town centres, the availability of water is quite reliable. Similar to other stakeholders, micro injera processors have only moderate access to credits (score of 41) and do not have very high profitability from doing business with tef (score of 42).

Urban and tef farmer consumers from Adaa (Figure 16) are moderately able to afford tef (score of 57 for urban consumers and 41 for tef farmers in Adaa). In contrast, tef farmers from Boset can hardly afford tef (score of 19) and may rather sell than consume their own produced tef While urban consumers tend to spend a higher share of their household income on tef, they also prepare injera with a higher tef content (scores range from 77 for urban consumers, 61 for farmers from Adaa and 18 for farmers from Boset). Farmer consumers from Boset ate less injera (in average 2.4 times per day) during the period from May to September 2016 and compared to urban consumers (in average 2.6 times) and farmer consumers from Adaa (in average 2.9 times). Furthermore, the tef content of injera was significantly lower for homemade injera for farmers from Boset (score of 18) compared to urban consumers 77) and farmers from Adaa (score of 61).

Redundancy, rapidity and resourcefulness

Micro injera processors as well as farmer consumers from Boset respond sharply to tef price changes related to drought. Droughts cause price increases of tef which translate into more expensive injera. This effect is particularly visible for farmer consumers from Boset. However, since tef is substitutable, micro injera processors and consumers may adjust the tef content and replace it with sorghum or wheat or rice depending on which one is cheaper at a given time. As savings are limited, micro injera processors and consumers may quickly switch to using other crops as ingredients for their injera.

Overall resilience of micro injera processors and consumers

Overall, the resilience against drought of micro injera processors and consumers is very much linked to price changes of tef. Higher prices of tef cause immediate impacts on the level of tef content used for making injera. During a drought, the supply reduces and prices increase. The fact that prices of tef and injera are rising (Figure 2), raises concerns that tef is increasingly becoming a cash crop. This reduces the ability of consumers with low income to afford tef. Moreover, smallholders continue to produce tef, but not consume it, as shown among farmers from Boset. Micro injera processors respond to drought by reducing the tef content of their injera and replace it with cheaper grains. This implies that tef may not fulfil its function as a food security crop during a drought.

Building Resilience in the Tef Value Chain

In this study, one of our goals was to translate results from a resilience assessment into the development of action plans that build and enhance the resilience of the stakeholders of the tef value chain in Ethiopia. We find it imperative that in a first step stakeholders' strengths and weaknesses in dealing with drought risk are assessed and then, in a second step, get recognised in the process of developing adequate and feasible action plans.

'Design thinking' technique

In order to include and properly reflect the complexity of different activities of the cocoa value chain (system), we used available Design Thinking techniques (e.g. Brown [2008]; Brown [2009]; Buchanan [1992]). The objective of our design thinking model (Figure 17) was to allow stakeholders to come-up with action measures through an iterative, creative and step-wise thinking process:

1. Stakeholders analysed and validated the survey results (resilience assessment) → identified *insights* about what kind of challenges and problems (e.g. resources are mostly accessible, but not affordable) they face in their particular activity.

2. Stakeholders discussed and attached *basic needs* (e.g. more money to afford resources) to address these *insights* → prioritised a set of *underlying goals*.

3. Stakeholders isolated the specific underlying goals (e.g. sustainable business management) → identified *specific problems* (e.g. lack of knowledge, etc.) that would need to be resolved for achieving a specific underlying goal (Figure 18).

4. Stakeholders attached concrete measures (e.g. more extension officers for farmer) to each problem.

5. Stakeholders evaluated (Figure 19) all the measures based on a list of 13 evaluation criteria.

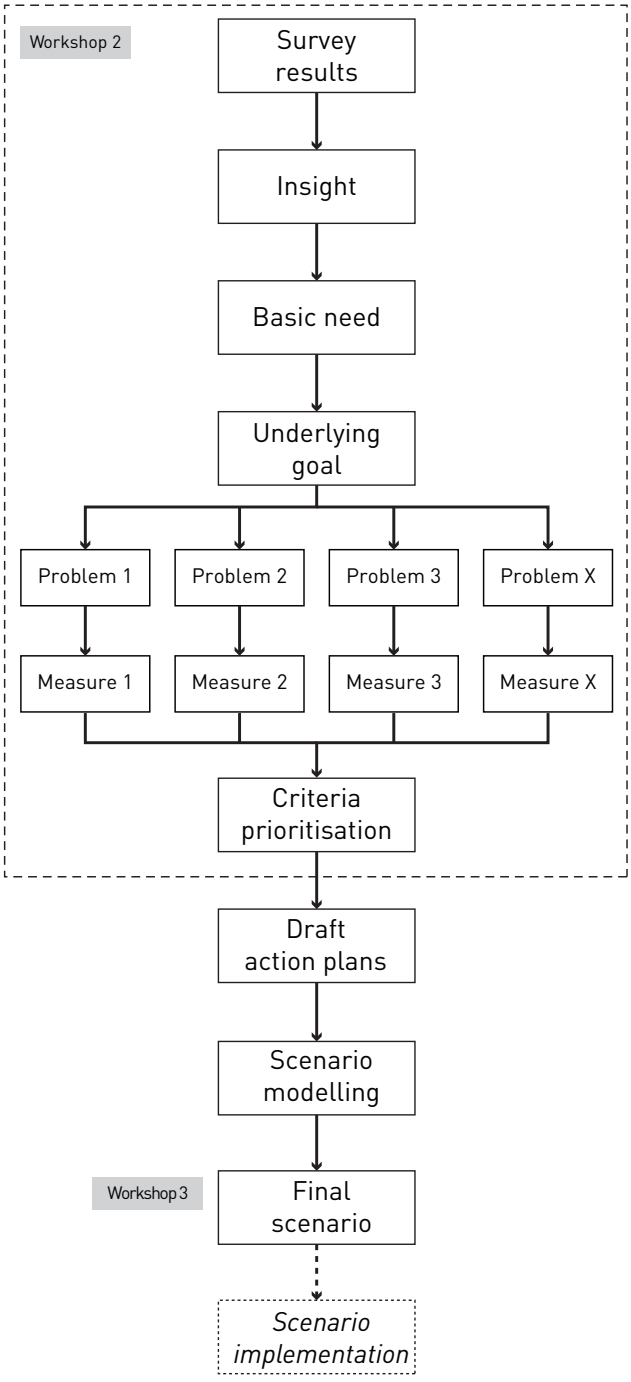

Figure 17
Using Design Thinking to generate action plans

Figure 18
Farmer developing action measures during second workshop

Figure 19
Traders evaluating action plan during second workshop

6. Stakeholders split all the measures into three categories with equal number of actions. The three categories prioritised the measures into *urgent*, *important* and *nice to have* in terms of implementation.

SystemQ analysis – scenario modelling

In a final step, we analysed the proposed action measures by using Vester's (2012) impact matrix (using the software *SystemQ*) to identify the influence of the proposed measures to each other. Concretely, we compared each action measure to another measure to identify whether they directly influence each other (indirect influences were not considered). For example, if measure A has high influence on measure B, measure A is an *active* measure in the system of all measures. If measure B is highly influenced by measure A and perhaps also by measures C and D, it becomes a *passive* measure. By comparing 1-by-1 each measure to another measure, we identified the key action measures among the draft action plans. The outcome of this impact matrix analysis is that action measures get allocated into different boxes that show whether a particular action measure is *active* or *passive* in influencing other measures. If it has high active and passive values at the same time it becomes an ambivalent measure, and its behaviour in the system of all measures is difficult to predict.

If it has little influence on other measure and does not get influenced strongly, it is a *buffer* measure which means it has stabilizing function in the overall system of the measures.

Final scenario

The outcome of this impact matrix analysis of action measures is to directly support the formulation of scenarios on how to build resilience in the tef value chain. Knowing about what stakeholders think is feasible and appropriate for their activity, makes the implementation of action measures more realistic and appropriate.

Action Plan: Tef Production

Based on the above-described design thinking approach, our tef farmers identified action measures that they perceive would enhance their resilience against drought risk. In total, they identified 11 action measures (Figure 20).

Urgent action measures for implementation

Among the action measures that need to be *urgently* implemented and which are active in influencing other measures is only the *research on agro-ecology and soils*. Our tef farmers perceive that research institutes should provide improved seeds that even better allow tef plants to sustain droughts. The EIAR and other research institutes in Ethiopia and abroad are intensifying the research on such improved seeds and also try to find ways to increase the productivity of tef plants to increase the yield per hectare. *Governmental subsidies* are also seen as important to support farmers in the construction of *irrigation technologies*. The farmers seek to be less dependent on rain-fed agriculture (Figure 21).

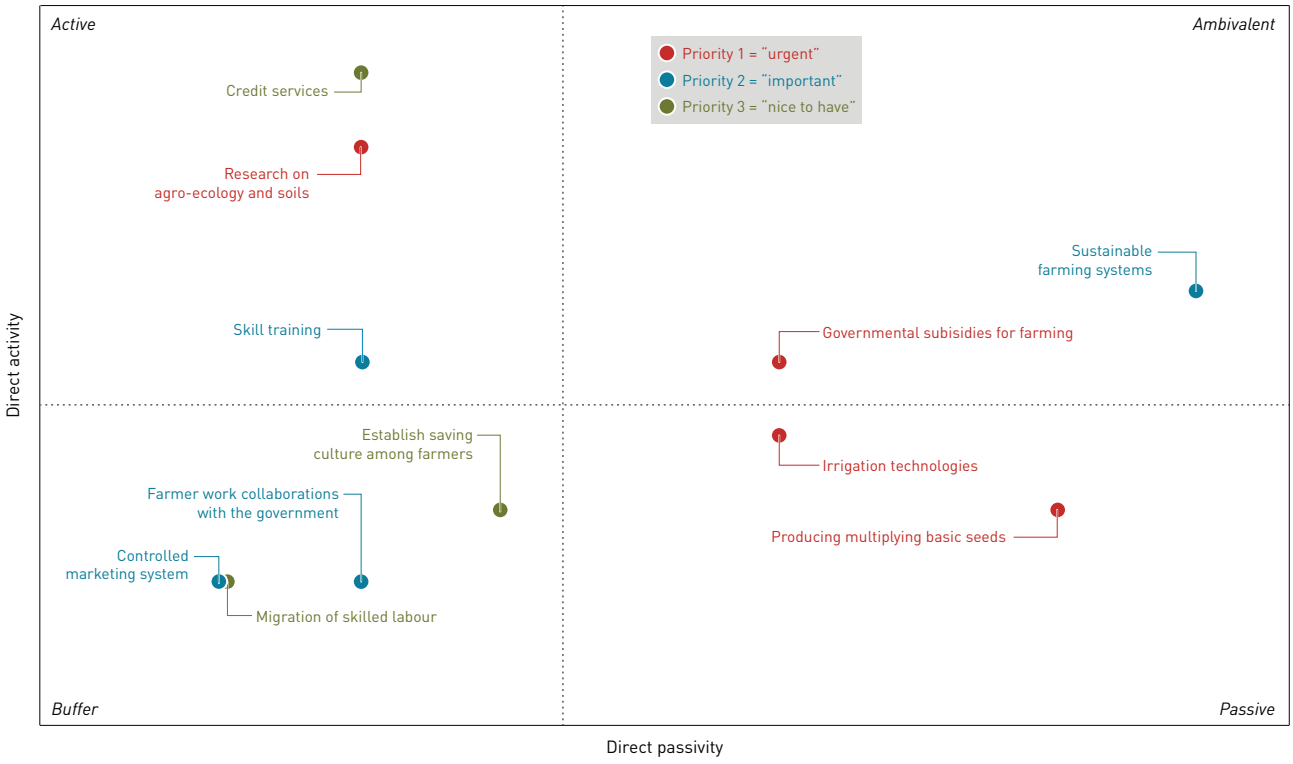

Figure 20
Action plan for tef production analysed with *SystemQ* software. Dotted lines indicate mean activity and passivity of all measures. They separate the four boxes *active*, *passive*, *ambivalent*, and *buffer*

Figure 21
Drought affected Boset, April 2017

Important action measures for implementation

Among the action measures that are *important* and active in influencing other measures is only *skill training*. Farmers feel that their knowledge on sustainable farm management practices and techniques to avoid and cope with droughts is limited. Greater support from extension services are sought to provide knowledge to farmers about the application of sustainable farm management practices. Other measures that are seen as important, but which do not influence other measures are *controlled marketing system* and *farmer work collaborations with the government*. These measures aim to involve the government more in the provision of services to farmers and essentially ensure basic support is provided to farmers.

Nice to have action measures for implementation

There is only one action measure that is *nice to have* and which is also active: *credit services*. This action measure would directly support the financing of irrigation technologies and purchasing of improved seeds to better cope with drought risk. This measure would also allow farmers to invest into the mechanisation of their farms.

Action measures in the *buffer* box

Among the 11 action measures, four measures were mentioned that are neither *active* nor *passive*. For example, it is *important* to have *controlled marketing systems* and *farmer work collaborations with the government*. The other two measures are *nice to have* and aim to *establish saving culture among farmers* and *reduce the migration of skilled labour*. All those measures are important to consider in the process of building resilience in the tef production.

Linkage of action measures to resilience assessment and outlook

Among the identified *active* and *urgent* measures are those that are also identified in the resilience assessment to be weak or lacking. Particularly, farmers lack capacities to conduct water harvesting and apply improved seeds, such as early mature varieties. Improved availability of credit services and better trained farmers could support the process of improving the application of sustainable farm management practices. As a conclusion, the resilience assessment and proposed action measures correspond nicely. However, many measures require the involvement and support of the Ethiopian government and its subsidiary branches. Considering the limited availability of financial resources, the implementation of several proposed measures is likely to be difficult in the short-term.

Action Plan: Tef Processing Activities

In our study, we aggregated the traders and millers into a single group to define action measures that would enhance their resilience. In total, traders and millers identified 7 action measures (Figure 22) and micro injera processors (Figure 23) 16 action measures that would enhance their resilience against drought risk. However, the proposed measures will only indirectly build resilience against drought risk. In essence, the measures aim to improve the robustness of traders, millers and micro injera processors to deal with price changes and also to become more competitive and productive.

Urgent action measures for implementation

Among the action measures that need to be *urgently* implemented and which are *active* in influencing other measures are for micro injera processors *research in processing* and *promotion of injera products*. Mircro injera processors are challenged by limited automated processing. This results in injera quality that is not always stable. Likewise, traders, millers and micro injera processors are challenged by unclean tef that contains sand. More research to develop automated technologies for processing of tef grains would help to enhance the quality of injera. Higher quality of injera would then translate into better opportunities to promoted standardised tef products.

Important action measures for implementation

Among the action measures that are *important* and active in influencing other measures are for traders and millers *sustainable business management practices* and for micro injera processors *development of saving culture*. Both stakeholder groups believe that it is important to improve their business management to ensure that price changes can be better absorbed and investments better planned.

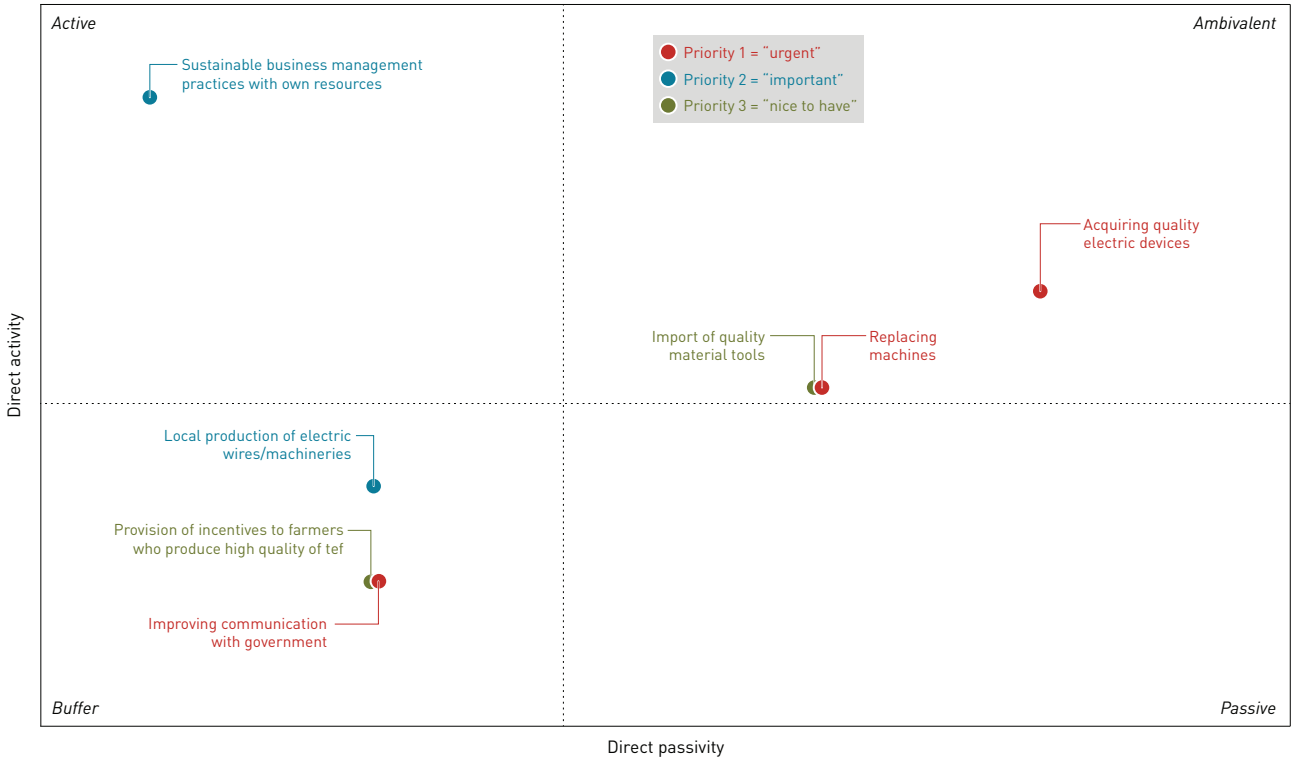

Figure 22
Action plan for traders and millers analysed with *SystemQ* software. Dotted lines indicate mean activity and passivity of all measures. They separate the four boxes *active*, *passive*, *ambivalent*, and *buffer*

Action measures in the *buffer* box

Among all the identified action measures, two measures are *urgent*, but neither very *active* nor *passive*. These measures are for traders and millers *improving communication with government* and for micro injera processors *strengthening of family business models*. A better communication with the government would include to formalise these small-scale entrepreneurships.

Linkage of action measures to resilience assessment and outlook

The stakeholders in the tef processing activities primarily aim to modernise their business practices. Greater efficiency of milling machines and injera production equipment would help to increase the quality and amount of their products. Low product quality is seen as a major barrier for expanding business activities. For example, tef often comes along with a sand content of 5-10%. Thus, having modern processing equipment would allow to achieve higher quality standards. Higher quality standards would subsequently translate into a profitability of their business and indirectly result in higher resilience against drought. This is how tef processors perceive the pathway for building resilience in their activities.

To achieve a higher profitability, partnerships with stakeholders from academia and government are perceived to be most promising to tef processors to acquire the relevant knowledge and financial resources to modernise their business. However, to acquire external funding remains a problem for these stakeholders due to a lack of available credit sources and because they are often part of the informal sector.

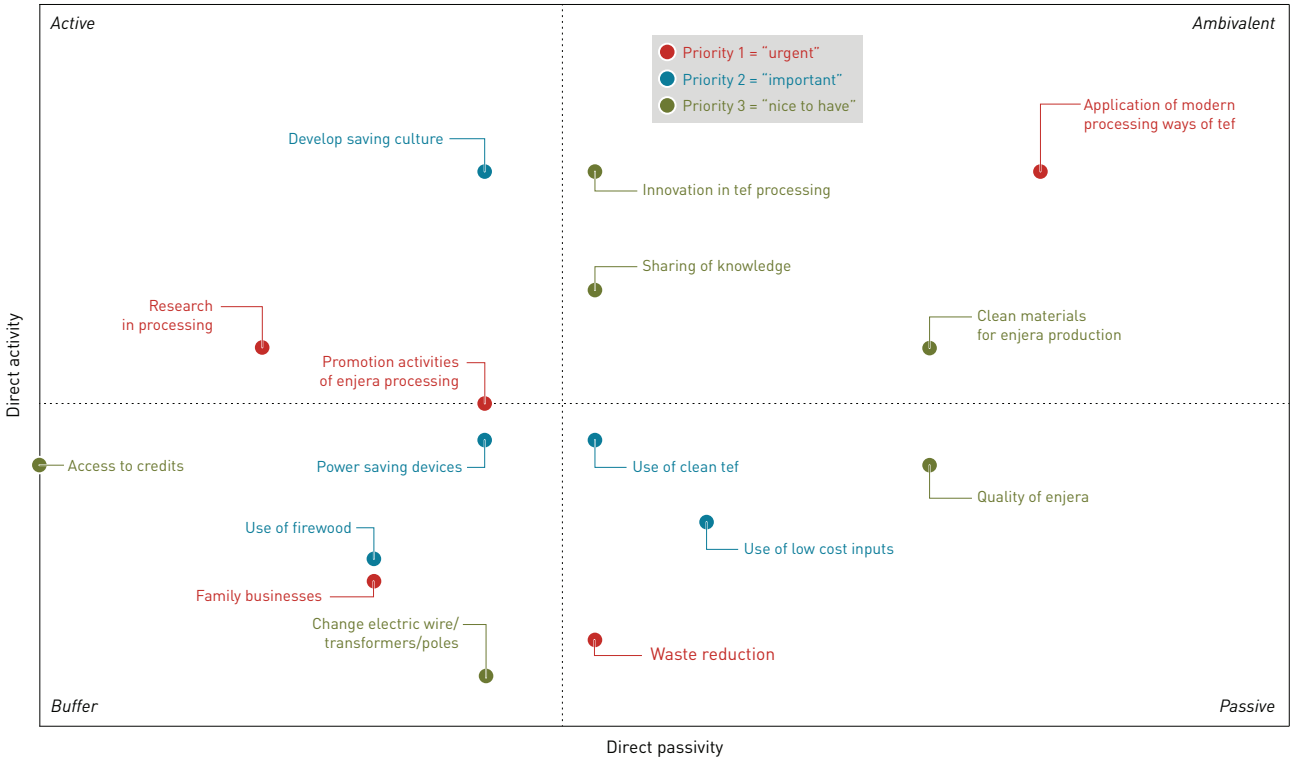

Figure 23
Action plan for micro injera processors analysed with SystemQ. Dotted lines indicate mean activity and passivity of all measures. They separate the four boxes *active*, *passive*, *ambivalent*, and *buffer*

Action Plan: Tef Policy Group

Among our stakeholders, we also have representatives from governmental institutions and consumer representatives. Those stakeholders formed a 'policy group' to identify relevant measures that would be beneficial across activities of the tef value chain to increase the resilience against drought. In total, they identified 18 action measures (Figure 24).

Urgent action measures for implementation

Among the action measures that need to be *urgently* implemented and which are active in influencing other measures is only *stress resistant high yielding varieties*. The policy group perceives that tef productivity gains are urgent during drought periods. As shown among drought affected farmers in Boset, they only collected 0.29t ha^{-1} compared to farmers in Adaa with 1.23t ha^{-1} who were not affected by a drought in 2016. These differences are due to the different level of drought exposure, soil type and farm management. Ensuring a drought-stress tolerant production would be beneficial to a range of challenges, such as food security and reduce the pressure to emigrate from drought prone areas. Other important action measures to build resilience against drought, but which are neither *active* nor *passive* include: *financial resources*, *irrigation technologies for agriculture* and *mechanisation of agriculture*. All these measures would also be beneficial to the production of tef during a drought. An *urgent*, but *passive* measure are the provision of *facilities for storage*. Improved availability of storage facilities for keeping tef grains would help during a drought to compensate yield losses.

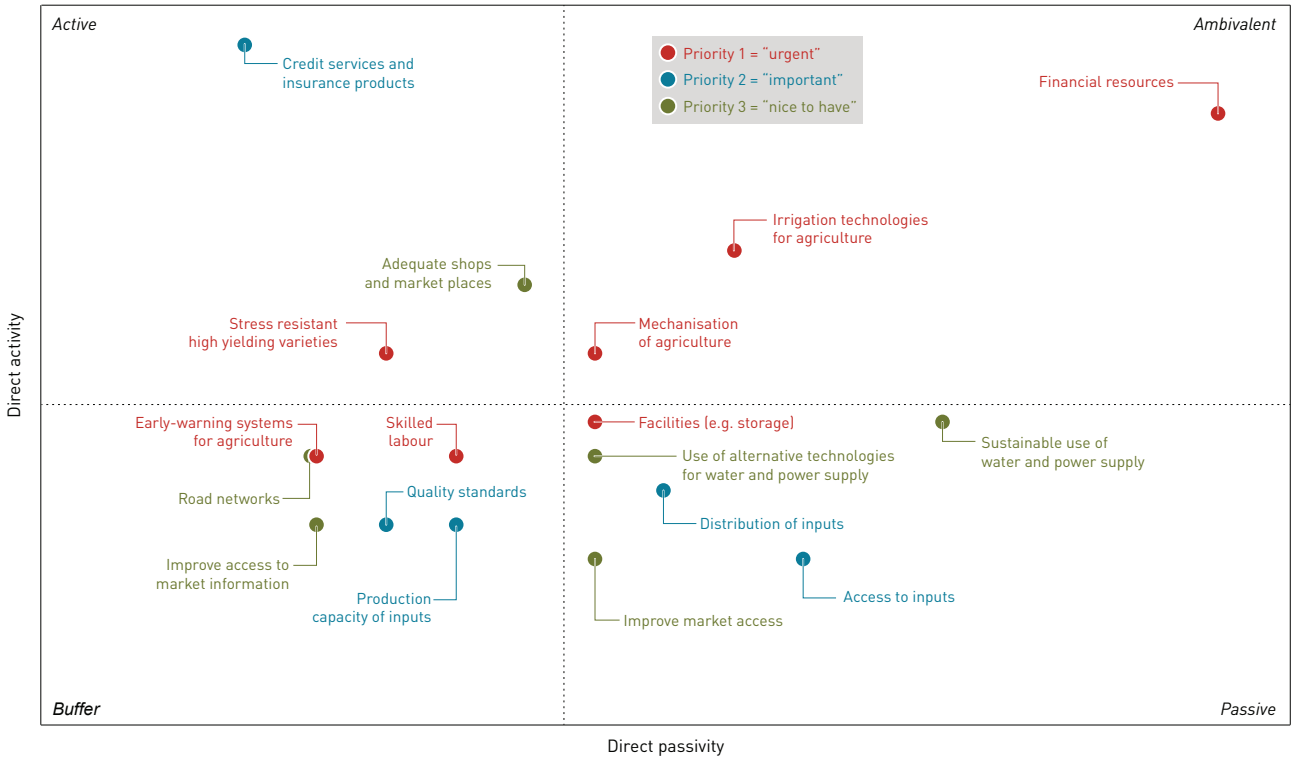

Figure 24
Action plan policy group analysed with SystemQ. Dotted lines indicate mean activity and passivity of all measures. They separate the four boxes *active*, *passive*, *ambivalent*, and *buffer*

Important action measures for implementation

Among the action measures that are *important* and active in influencing other measures is only *credit services and insurance products*. This measure would support all activities across the tef value chain. The availability of credit and insurance services is limited in Ethiopia. In many cases, credit or insurance products simply do not exist. Non-existence of such products makes it difficult for all stakeholders in tef value chain to invest into their business activities. In particular, tef processors would require an improved provision of affordable financial resources. This would allow to address the urgent need of modernising the tef processing activities. Improved and higher quality of processed tef products would subsequently improve their market access and competitiveness. A more adequate availability of financial resources would also help stakeholders to invest into alternative and sustainable resources to ensure water and energy supply during a drought.

Nice to have action measures for implementation

There is only one action measures that is *nice to have* and which is also active: *adequate shops and market places*. This action measure would directly support the distribution of tef products. As of today, tef products are mostly available in local markets and small shops. A retail system of shops does so far not yet exist in Ethiopia. Such shops would allow proper storage of tef products at places where air temperature and humidity are constant. This action measure is not directly related to reducing drought risk, but is seen as a *nice to have* measure to increase the financial robustness of stakeholders in the tef value chain.

Action measures in the *buffer* box

Among the 18 identified action measures, six measures are neither *active* nor *passive*. Despite their need, they stand-alone and will hardly influence other measures either positively or negatively. For example, it is *urgent* to improve *early-warning systems for agriculture* and more *skilled labour* is required, but both measures will not directly influence other measures. Nevertheless, they are important in the process of building resilience in the tef value chain. Better informed stakeholders about drought risk will be able to better cope with its impacts during a shock.

Linkage of action measures to resilience assessment and outlook

The stakeholders in the policy group proposed action measures that are in line with deficits identified in the resilience assessments. A lack of available drought tolerant tef varieties and limited availability of credit and insurance products are expected to be the action measures that are most influential in transforming the tef value chain. However, both of these measures require external assistance and can hardly be provided by the stakeholders themselves. Likewise, the implementation of many other action measures requires (international and governmental) assistance. Given that external assistance is provided, the implementation of those active action measures would enable more sustainable business practices and improved availability of tef products. Subsequently, it is expected that all stakeholders across the tef value chain would be better able to deal with drought risk.

Strategies for Action Plan Implementation

In a final workshop in June 2018, we discussed together with our stakeholders (Figure 25) strategies for implementing the action plans. The following aspects should be considered in the process of implementing the proposed action measures:

- **Key action measures:** Among all the action measures, the final discussion resulted in giving priority to making the tef production more resilient to drought through irrigation technologies and stress resistant high yielding varieties, acquiring new technologies for the processing (milling and injera production) of tef and enhancing the knowledge of all stakeholders about drought risk.

- **Responsibilities of implementation:** The implementation of these key action measures requires a holistic approach to allow stakeholders to participate in the development and implementation of those measures. The stakeholders perceive that different partners are needed for the implementation of the identified action measures. A top-down and government-led approach may not be viable and instead, the role of the government is to facilitate the interaction between stakeholders from the private sector. A lack of interaction (talks, exchanges, etc.) between stakeholders was found to be a challenge in the tef value chain.

- **Resources:** The lack of available finance, technologies and knowledge are seen as major barriers which have implications on the implementation of action measures. A key implication is that stakeholders require external funding, partners and governmental support to finance and develop/implement potential action measures. However, the stakeholders like to keep the ownership of developing and implementing the proposed action measures. Public-private partnerships may offer pathways to overcome challenges related to resource deficits and ownership.

Figure 25
Stakeholders discussing implementation strategies for building resilience in tef value chain

Key Lessons Learned

In this transdisciplinary study, we co-learned together with our stakeholders (Figure 26) the following key lessons:

- **Drought resilience:** Overall, stakeholders across the tef value chain in Ethiopia have higher robustness against drought compared to redundancy, rapidity and resourcefulness. This means that stakeholders primarily focus on avoiding a drought and have so far limited abilities to reduce impacts, recover and learn from drought events.

- **Factors determining the resilience of stakeholders:** Knowledge and financial assets are crucial factors to determine the resilience of stakeholders in the tef value chain in Ethiopia. For example, the access to inputs is often available, but stakeholders find it difficult to afford them. An exception is the access to credits. All stakeholders have difficulties to get suitable offers for loans and other forms of financial support.

- **Modernisation of activities:** Across all activities in the tef value chain, there is a need to modernise business practices to increase the resilience against drought. A lack of modern farming and tef processing equipment hinders stakeholders to generate higher productivity.

- **Interactions among stakeholders in the tef value chain**: Stakeholders from a particular activity in the tef value chain do not yet interact much with stakeholders from other activities. However, they show great interest to learn and enhance their resilience together with different stakeholders.

- **External dependency in building resilience:** Stakeholders know well their weaknesses and proposed action measures that could tackle them. However, they see little potential to increase their resilience on their own. Instead, stakeholders expect that they will receive external assistance from the government, NGOs and international development agencies for building resilience in their activities.

Figure 26
Stakeholders involved in transdisciplinary process in March 2017

Way Forward

Based on our study, we propose the following way forward:

- **Roundtable and national tef strategy:** To enhance the resilience of stakeholders in the tef value chain, it is crucial to bring stakeholders from all activities together to discuss potential pathways for transforming the tef value chain in Ethiopia. The stakeholders could organise themselves with the help of local institutes like the EIAR. However, also the Ministry of Agriculture could take a lead and involve other institutional partners and stakeholders from different activities of the tef value chain. As the government plays a strong role in the provision of inputs and export of tef, future pathways could be substantially enforced if the government actively steps forward in offering a future vision for stakeholders in the tef value chain. Such a roundtable should be supported by a 'neutral' player to balance potential power asymmetries and to avoid deadlocks. Science may play a role here in structuring the process, providing appropriate communication techniques, and feed in science-based options to support a fruitful process.

- **Tef export ban:** Based on our study, we do not yet propose to fully abolish the existing export ban on tef, as domestic prices of tef keep increasing due to the popularity of tef-based products across Ethiopia. A removal of the ban without flanking measures would result in greater quantities of tef being exported. As tef still plays a crucial role for the provision of food security among millions of smallholders during non-shock times, the transformation of farming activities needs to be done in proper consultation with all stakeholders of the tef value chain.

- **Partnerships:** Stakeholders in our study have well received their involvement throughout the project period. Building project collaborations with local stakeholders requires a full recognition of all involved project partners. Project decisions need to be taken jointly and through consensus. In light of international interests to become active in Ethiopia, potential partnerships need to pay particular attention to the needs of local stakeholders.

- **Further research:** We propose to look in detail at potential barriers for stakeholders to build resilience against drought in the tef value chain. Furthermore, the tef value chain also offers an interesting case to investigate how a food security crop gradually transforms into a cash crop.

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