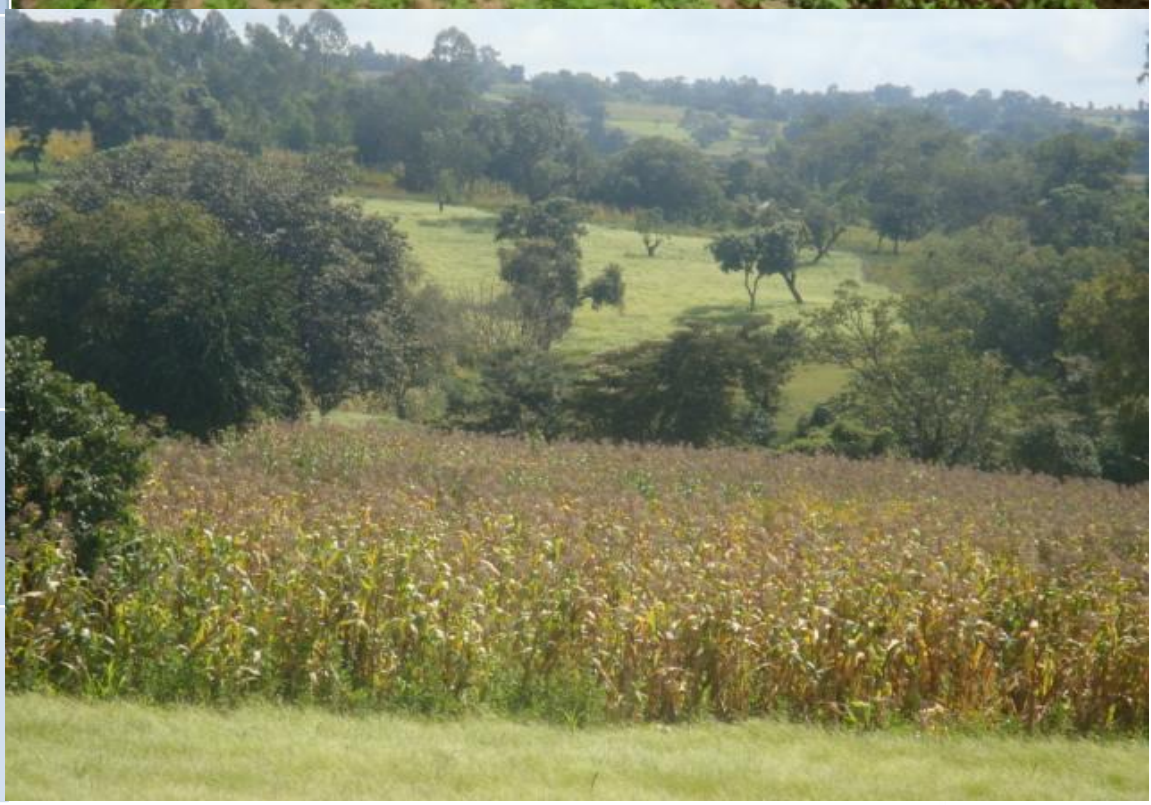
Good Agricultural Adaptation Practices in Ethiopia



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UNIQUE Forestry and Land Use and Kulima Integrated Development Solutions
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Contents

1. Introduction

Ethiopia is one of the most vulnerable countries to climate change in East Africa. The future climate change projections suggest that temperature will rise and rainfall variability will increase with high unpredictability. Agriculture is extremely vulnerable to these changes, with concerns that the yields of the main cereal crops will be adversely affected.

Six African countries (Ethiopia, South Africa, Togo, Burkina Faso, Zambia and Cameroon) were selected for an assessment of observed agricultural adaptations. This report summarizes findings from the Ethiopia research[1]. The findings from Ethiopia have, in turn, been used as an input to a continent-wide report that details the six overall good practices (decided upon using an evaluation framework).

2. Assessing good adaptation practices for three selected crops

After making an exhaustive review of the existing adaptation options in the agriculture sector in the six countries, it was agreed to focus on few commonly-shared commodities. The thrust was on good practices, which taking into account available technologies, scalability, policy support, affordability, benefits to women, main barriers and limitations. Accordingly, three commodities (maize, wheat and haricot bean) were selected for the study for Ethiopia. The criteria and rationale for the selection of the commodities was that the first two are major staple crops and the third is an important export crop. All three were also assessed in at least one other country to enable comparison.

Maize is a significant contributor to the economic and social development of the country. The crop is grown by about 8 million smallholders in the country, and also plays a key role in Ethiopia's food security. It is the least cost source of cereal calories, providing one and half times and two times the calories per dollar compared to wheat and teff, respectively. Assessment studies show that an effective maize sector could propel food production to quickly reduce the national food deficit and keep pace with the growing population (IFPRI, 2010). Maize is a warm climate growing crop largely produced in the mid altitude sub-humid agro-climatic zone. As such, its major growing zones are the central and southern lowlands (including the Rift Valley escarpments) in the altitude range of 1500 to 2200 meters above sea level. Maize is particularly important in the south and southwest of Ethiopia, with the Oromiya Region producing the largest quantity. **The case study area is BakoTibe**. This area is selected for the study because it is one of the major maize belts, in the western part of Oromia region. In addition, **Bako** is the national center for maize research in the country. The experts working on maize research are accessible from such centers.

[1]For the full report and more information on the project, see www.kulima.com/agriculturaladaptation or email mekuriaa69@gmail.com

Wheat is the third most dominant cereal crop[2], cultivated by about 4.2 million smallholders in the country. Recent efforts by the Ministry of Agriculture to increase production and productivity have shown significant results in boosting wheat production both in yield and quality to supply local industries, thus reducing the need for costly imports. Realizing the potential in the country, the government is targeting a further increase in wheat production to enable Ethiopia to become a net exporter in the coming years. Wheat is a cool weather crop grown in the tepid to cool moist mid-highland agro-climatic zone, predominantly occupying the Ethiopian highlands in the optimum altitude range of 1800 to 2200 meters above sea level. **The case study area is Iteya district**. The area is selected for the study since it is found in the major wheat production belt of the country in the Arsi-Bale highlands, where the **Kulumsa** agricultural research center is found. Kulumsa is the national center for wheat research. Farmers in the entire region predominantly produce wheat for consumption and, to some degree, for industrial use. The largest farmers association on grain marketing (mainly wheat and other crops) is found in Iteya district. There have also been some reports suggesting climate change is already affecting wheat production in the area.

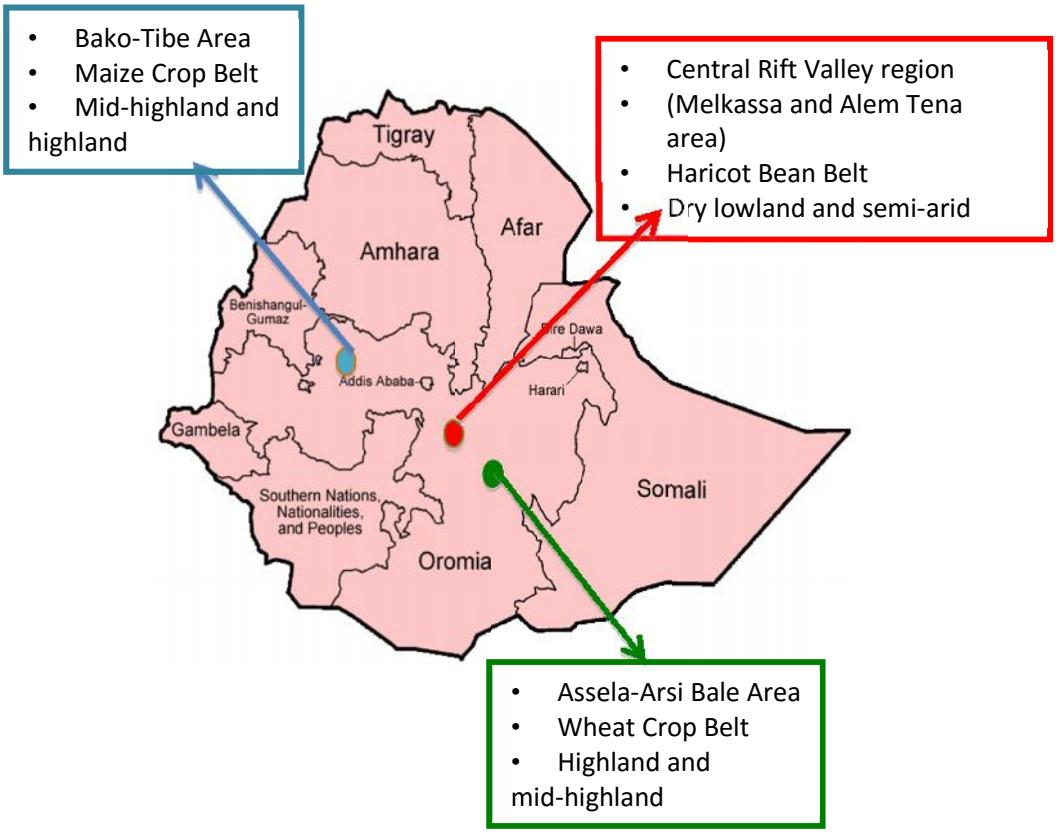

Figure 1: Location map of the study areas

[2]Including teff in the study was not an option given it is uniquely grown in Ethiopia and thus could not be compared with the experiences in the five other countries.

Haricot bean, or common bean, is a warm weather crop and it is one of the major pulses produced in Ethiopia. Pulses account about 13% of total crop production and are the principal source of dietary protein. Pulses, mainly haricot bean, have recently become significant export crops, diversifying sources of foreign income from the agricultural sector. It is the largest agricultural export crop after sesame and coffee. To support the domestic and export markets, the Ethiopian Institute of Agricultural Research (EIAR) has developed a range of high yielding, multi-disease resistant bean varieties, including red beans (Red Melka, Red Wolaita, and Naser) and white beans (Awash 1, Awash Melka, and Mexican 142). Common bean is widely grown in Ethiopia in areas between 1400-2000 meter altitude ranges. The main production areas include eastern Ethiopia, the south and the south west, the west and the Rift Valley. The Rift valley area accounts for more than half of the country's bean production, mainly of the white bean type that is grown for export (Ronner and Giller, 2012). The case study area is **Melkassa district**. It is selected for the case study because it represents one of the main common bean producing areas in the Rift valley in the hot to warm humid lowland agro-climatic zone-which is also experiencing changes in climate. Melkassa agricultural research center in the district is the national center for Haricot bean research.

3. Methods of Assessment

The study was conducted by employing different qualitative research methods. Data and information on adaptation practices were collected from both primary and secondary sources. Primary data were collected using interviews, focus group discussions and participatory field observations. The interviews were conducted with individual farmers (model farmers), researchers at the respective research centers, climate change experts, and decision makers at the Ministry of Agriculture and agricultural research institutes. Secondary data and information were collected from literature (published and unpublished materials) and reports from the respective research centers.

Each of the observed adaptation practices has pros and cons in terms of simplicity, availability, affordability, available policy and research support, and other benefits to women and environmental co-benefits. Therefore, all the observed adaptations were evaluated using set of criteria to determine the good practices from all the identified examples (Table 1).

Table 1: Evaluation criteria for adaptation good practices

Category of criteria	Probing and screening criteria
Adaptation Practice	• Proof of concept (proof of track record at a local level) • Sustainability (lack of negative externalities, and appropriate longevity) • Build on existing practices/structures (cultural compatibility, inclusivity, demand-led, adoption rates, applicable to different scales) • Accessibility (cost efficiency ratio, availability, ease of use) • Improved outputs (production and quality)

Enabling environment	• Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services) • Government support (extension services, policy environment, national strategies) • Positive impact on women
Additional "bonus" criterion	• Co-benefits (mitigation, biodiversity, multiple production objectives)

A simplified qualitative scoring matrix method was used to evaluate all the practices, based on the inputs from the farmers, researchers, experts and decision makers. This was done for all the identified adaptation practices for each crop type in order to determine the best examples.

4. Findings

4.1 Defining good adaptation practices

The result of the evaluation shows that, in Ethiopia, *crop rotation*, *repeated tillage* and *shifting to other, more climate-appropriate crops* are best traditional adaptation practices while *improved varieties* and *row planting* are best adaptation technologies provided from extension and research for all the three crops (Table 2). Conservation agriculture and agro-forestry are good adaptation practices only for maize. Seed renewal and mechanization are good adaptation practices for haricot bean and wheat farmers. Intercropping is a good adaptation practice only for haricot bean and maize. Relay cropping is a good adaptation practice only for maize and wheat. Dry sowing/early sowing and seed renewal are good adaptation practices only for haricot bean.

Table 2: Total scores for observed adaptation practices for the three selected crops (those scoring 70 out of a possible 140 are considered good practices)

Adaptation Best Practice	Haricot bean (small scale)	Wheat (Small scale)	Maize (Small scale)
Agro-forestry	-	-	100
Composting	-	4	4
Conservation Agriculture		4	98
Crop rotation	88	95	99
Dry sowing/early sowing	70	4	
Improved varieties	104	104	105

Intercropping	80	4	83
Mechanization		82	
Relay cropping		81	81
Repeated tillage	85	93	87
Row planting	103	109	108
Seed renewal	85		
Shifting to other crops	93	97	97

4.2 Elaboration of the good adaptation practices

(Note: only those that have been evaluated to have a score of over 70 are elaborated here)

4.2.1 All three crop types-traditional adaptation practices

Crop rotation:

- Crop rotation is a regular traditional practice by all farmers for all crops. It helps to resist disease that is caused by climate change. Farmers rotate cereals with legumes. The rotation cycle is often one to two years (one cycle of legumes and two cycles of cereals). The practice is generations old.
- The benefit is soil fertility improvement, yield increase and disease protection. The practice does not incur any cost.

Repeated tillage:

- This is advised by the extension services and it is highly promoted by government. Repeated tillage is believed to improve water and air movement, increase root growth, facilitate germination, and reduce the risk of crop failure during early cessation of rains.
- If the land is tilled well, it will increase moisture availability. Farmers also claimed that repeated tillage increased yield. The practice benefits women by increasing food availability.

Shifting to other Crops:

- When the normal rainfall distribution is disrupted for the regular crops, farmers simply change or shift to other crops which fit to the rainfall period. When the rainfall is late for haricot bean, farmers shift to other, more climate-appropriate, crops such as teff. This has become a common practice for most of the crops and in most of the areas.
- Farmers have found it essential to be prepared with other crop seeds to plant if necessary due to the late rain. Maize in most areas is replaced with teff. Haricot bean is also replaced with teff.

4.2.2 All three crop types-adaptation technology practices

Improved Varieties:

- Improved varieties are the main technology farmers are using to adapt to the changing climate for all the three crops. Especially for wheat growers, improved varieties are the best adaptation technology to resist disease and yield decline due to climate change. Not all farmers can afford to buy the improved varieties. Supply through the market is also insufficient.
- Those farmers who could not afford to buy seeds of the recently released improved varieties still use the old varieties, which is low in yield but resistant to rust attack. The respective research centers release high yielding, early maturing and disease resistant varieties. Increased yield from improved varieties benefits women in increasing food and income for the household, and thus reducing their burden of responsibility.

Row Planting:

- Row planting is a technology popularly promoted by the extension system for all crops to efficiently use moisture during droughts and irregular distribution of rainfall. Farmers are aware of the benefits of row planting in moisture conservation, controlling weeds and improving yield. However, due to labor and time shortage during late onset of rains, they prefer to use broadcast sowing than row planting.
- Farmers claimed that row planting has almost doubled the yield but increased the labor demand for sowing/planting. The problem is that there is a shortage of row planters and so seeding is done manually. However, this is, to a certain extent, offset because, once planted in rows, weeding becomes easier. Since women are typically responsible for weeding, this practice has benefited them by reducing labor.

4.2.3 Good adaptation practices for maize and wheat

Relay Cropping:

- The practice contributes effective utilization of moisture during periods of irregular distribution of rainfall due to climate change.
- In some areas close to the highlands, a number of farmers use relay cropping. For instance, when early maturing wheat or barley is harvested, the residual moisture can be used for producing flax seed. This option is only possible when there is good distribution of rain in the season.
- The practice is common in the highlands only. Where there is irrigation, relay cropping is also used.

4.2.4 Good adaptation practices for haricot bean and maize

Intercropping:

- For haricot bean and maize, intercropping maximizes effective utilization of space and residual moisture. When rainfall is late for haricot bean in early June, intercropping is preferred to utilize the residual moisture in the maize fields.

- Intercropping is often done during normal rainfall years when maize is planted at the end of April, and haricot bean will be intercropped within the maize plants later- in early June. Nowadays, since the rainfall does not start in April as it used to, intercropping is not often practiced in haricot bean growing areas but it is used in maize growing areas. The maize crop is often skipped in some seasons because of the variability of rainfall. The practice benefits women in availing enough food for the household and thus reducing their burden of responsibility.

4.2.5 Good adaptation practices for maize

Conservation Agriculture:

- Practiced to conserve moisture in times of drought exacerbated by climate change, and to maximize nutrient return to the soil.
- In the maize growing areas almost all farmers use conservation agriculture (CA). However, the practice is limited to reduced tillage and residue management. On average, only about 25% of the mulch or crop residue is left in the maize fields. The rest of the residue is used as forage or fuel. The reduced tillage is applied only with the herbicide called Round Up.
- The herbicide is used to kill weeds two weeks before planting the maize. Then the field will be ripped with an ox-plough and planting is done by hand. CA increases yield and improves soil fertility. It reduces cost of tillage but increases cost of input (herbicides). The practice benefits women by reducing the labor needed for weeding.

Agro-forestry:

- In maize growing areas of the mid-highlands, trees are deliberately integrated with crops. The trees are naturally grown and farmers selectively keep them to remain in crop fields (which is a traditional practice). *Cordia africana* is the most common tree in farms. Othermultipurpose species such as *Milletia ferruginea, Albizia gumiffera, Croton macrostachyus and Ficus vasta* are very common in cultivated fields.
- This is practiced by all farmers in the maize growing area. Agro-forestry practices are aimed at reducing moisture loss due to droughts caused by climate change, increasing household income, providing alternative food supply, fuel wood and construction materials, to increase soil fertility, to increase ground water recharge and to reduce further degradation.

4.2.6 Good adaptation practices for wheat

Mechanization:

- In wheat growing areas, when the onset of rainfall is late and the land preparation time is not enough for repeated tillage, farmers resort to renting a tractor at higher cost and do the tillage at once. The machine can go deeper and can crash the hard soil surface easily. This will soften the soil and will improve the workability. According to the farmers, repeated tillage improves the soil in responding to fertilizer.

- The effect of turning over the soil means that water infiltration also improves, increasing the retention of moisture for the crops. The popularity of tractors for ploughing is mediated by the cost of the equipment, meaning it may not be affordable to many of the poor farmers. When there is access to tractors it can benefit women in reducing the labor burden; but often women are less likely to be able to afford tractor use relative to male farmers.

4.2.7 Good adaptation practices for haricot bean

Seed Renewal:

- Practiced for haricot bean to improve seed vigor and resist disease caused by climate change.
- For haricot bean, farmers use what they call “renewing the seed” every year by planting the seed in irrigated or flooded areas with residual moisture. Farmers claim that renewing seeds increases the vigor and improves the disease resistance ability.
- None of the farmers can explain how this process benefits the seeds, but they have observed that it does. If seeds from the previous season that have not been renewed are directly sown in the subsequent season, the yield will be low and the plants will be highly affected by rust.

Dry sowing/early sowing:

- Farmers normally sow the seeds dry (in advance of the first rain, but in anticipation of its arrival). Farmers believe that this will compensate the time lost because of the late onset and the dry sowing facilitates early germination. Most farmers apply this and found it effective to take advantage of the first instance of rain.
- Sometimes early/dry sowing results in complete crop failure since, if the rain is not forthcoming, the seeds may dry and lose viability. Farmers with small plots of land do not apply dry sowing. Dry sowing is often done when the land is repeatedly tilled and made ready for planting. There is no special benefit to women.