If we take care of the Earth,
the Earth will take care of us.

Teff: The Story of Ethiopia's Biodiversity

Forum for Environment (FfE)

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Abenet Girma

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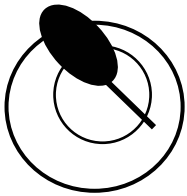

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Acronyms

ABS	Access to genetic resources and benefit sharing
CBD	Convention on Biological Diversity
EARO	Ethiopian Agricultural Research Organization
FiRST	Financial Resource Support for Teff
HPFI	Health and Performance Food International bv.
IBC	Institute of Biodiversity Conservation
ISD	Institute of Sustainable Development
MAT	Mutually Agreed Terms
MoU	Memorandum of Understanding
PIC	Prior Informed Consent
SCBD	Secretariat of the Convention on Biological Diversity

Foreword

The planet's species, habitats and the goods and services they provide form the basis of our wealth, health and well being. Despite repeated global commitments to protect this heritage, the variety of life on earth continues to decline at an unprecedented rate.

Following the signing of Convention on Biological Diversity with the aim of sustainably utilizing genetic resources and putting in place appropriate conservation measures, the International Day of Biodiversity has been and continues to be celebrated throughout the world on 22nd May.

Biodiversity loss is moving ecological systems ever closer to a tipping point beyond which they will no longer be able to fulfill their vital functions. The deadline has arrived; yet the deterioration of our natural resources continues apace. To refocus attention on this challenge, the United Nations General Assembly declared 2010 as the International Year of Biodiversity.

Similarly, World Environment Day (WED) first celebrated in 1973 is celebrated every year in over 100 countries hosted by different cities with a different theme and is commemorated with an international exposition in the week of 5th June. WED was declared by the United Nations General Assembly in 1972 to mark the opening of the Stockholm Conference on the Human Environment. It was the first platform where the political, social and economic problems of the global environment were discussed at an intergovernmental forum with a view to actually taking corrective actions. WED is a day that stimulates awareness of the environment and enhances political attention and public action to promote environmental issues to become active agents of sustainable and equitable development.

As part of the commemoration of WED 2010, Forum for Environment (FfE) and Institute of Biodiversity Conservation (IBC) joined hands to co-organize a half day panel discussion on the main theme "Teff: the story of Ethiopia's biodiversity".

Following the opening sessions by the Director of FfE and Director of Genetic Resources Transfer and Regulation Directorate, IBC, respectively presentations and discussions were made on the diversity of genus Eragrostis, nutritional value of teff, the technology of transplanting teff and its feasibility, production issues of teff, newer approach to increasing the productivity of teff and the like. Additionally, the challenges faced on implementation of the agreement on access to and benefit sharing on teff between Ethiopia and a Dutch company were identified.

The panel discussion has brought importance issues to table with regards to benefits arising from the use of genetic resources which necessitate due attention. We hope that valuable lessons will be learnt for future endeavors.

Key note address

Gemedo Dalle, Director, Genetic Resources Transfer and Regulation Directorate, IBC

The total amount of ecosystem services is estimated to be 72 trillion USD per year out of which wetlands provide 3 trillion USD per year. The story of biodiversity is the story of opportunities and challenges. Protected areas cover only 30% of the planet while 1/3 of the world's ecosystem is converted to other uses. The loss of species has increased 1,000 times as compared to the past as reported by UNEP. So, restoration is a key action. The United Nations (UN) has also declared 2010 as International Year of Biodiversity.

Before ten years the 2010 target was to significantly reduce the current rate of biodiversity loss and to achieve the Millennium Development Goals (MDG). The global strategy of plant conservation has set 10 targets such as halting of the decline of resources, *in-situ* conservation of 60% of the world's threatened species, utilization of 30% of plant-based products derived from sources that are sustainably managed and others. The question is "Did we achieve the above targets?"

Climate change is indeed a problem and biodiversity conservation is part of the solution.

The following are recommendations that require consideration:

- Ecosystem protection with carbon storing capacity is important;
- Awareness raising is critical;
- Giving due attention to hotspots is essential;
- Conservation must be a common agenda for all nations to ensure the health of future generations;
- Since people need nature to survive, we should conserve biodiversity for our well being.

Therefore, biodiversity is our life. Let us conserve it!

Variability of Panicle Characters of Teff (*Eragrostis tef* (Zucc.) Trotter) from South, North, East, West and Central Highlands of Ethiopia

Alganesh Tesema[1]

Abstract

A total of 10,800 panicles belonging to 720 landrace populations, 15 plants each were used in the study. The materials were collected from 11 different regions. The study was aimed at investigating the variability and frequencies across regions based on phenotypical markers. Five traits: seed color, glum color, panicle form, panicle color and glum hairiness were observed. Analysis of the overall materials indicated the existence of 114 different panicle forms. Out of 114 variants, 94 variants were found to be rare (≤ 1% frequency) while 20 variants were common (> 5% frequency). All Ethiopian regions have their own specialties of genetic resource concentration. Broken white color was observed only in about 26.3% while red color was found in 33.3%. Extreme white color (Magna) was observed with highest frequency (40.1%). The intermediate panicle form was observed with the highest frequency (63%). The highest variability was found from Tigray, Shewa, Keffa, Wello and South Ethiopia (40, 33, 25, 6 and 4). Surprisingly, teff from Gojam, an area native to teff, exhibited low variability. The results necessitate an exhaustive study in all localities of Gojam as well as expedition and collection measures.

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Introduction

Ethiopia has diverse agro ecological zones. This diversity has endowed the country with diversified fauna and flora. This situation favors the country to be the center of origin and diversity for many economically important crops such as *Eragrostis tef, Guizotia abyssinica, Enset ventricosum, Coffea arabica, Catha edulis, Rhamnus prinoides, Hagenia abyssinica, Coleus edulis, Coccinia abyssinica, Brassica carinata, Triticum durum* and *Hordeum vulgare* (Vavilove, 1951).

Teff is believed to have been first domesticated by pre-Semitic inhabitants in Ethiopia between 4,000 B.C and 1,000 B.C. Teff belongs to family Poaceae and genus Eragrostis. *Eragrostis tef* is diploid (2n = 20). From the point of evidence from Genetics the most probable wild ancestor is *Eragrostis pilosa* which is tetraploid (2n = 40) (Endeshaw Bekele and Lester, 1981). Teff is an annual grass which is widely cultivated through out Ethiopia as a staple cereal crop (Plate 1). According to Ethiopian flora, teff occurs up to 2,500 m a.s.l. However, the Institute of Biodiversity Conservation expedition and collection database indicates that teff is collected from the altitudinal range of 800 m a.s.l. up to 3,200 m a.s.l. It is adapted to a wide range of environment from water stressed to water logged soil conditions. It grows well under difficult conditions, which are poorly suited to other cereal crops. Teff is considered as typically native to northern Ethiopia. However, five accessions of collection were found from lowlands of northeastern and southeastern part of Ethiopia. Tadesse Eba (1975) found variable and large number of cultivars based on grain color, panicle type and color. Mengesha Haile Melak *et al*. (1965) reported large variability in most of the characters of his assessment of 124 panicle sample collections.

Teff is highly economical food grain in Ethiopia where it is used for making a thin type of flat pan cake ('injera'). It is also possible to make 'injera' from other cereal crops but it becomes dry after few hours. The high quality 'injera' with complex nutrients at possible size is made only from teff. Teff accounts for about a quarter of the total cereal production in Ethiopia (Eleni Zaude, 2001).

Plate 1 Matured teff at Debre Zeit Agricultural Research Center (Photo: Tareke Berhe, 2009)

The grain has high nutritional values: a very high protein, carbohydrate, fat, vitamin A and C, fiber, Thiamin, Riboflavin, Niacin, Calcium, Chloride, Chromium, Copper, Iron, Magnesium,

Manganese, Phosphorus, Potassium, Sodium, Zinc (Teff and gluten intolerance, 2008) and the eight Essential Amino Acids (isoleucine, leucine, methionine, lysine, phenylalanine, threonine, tryptophan and valine). The protein digestibility is high because the main protein fractions are the most digestible types. The main protein fractions (albumin) are rich in lysine. Teff grains are reported to contain 9-11% protein. However, samples tested in IBC laboratory have shown even higher protein level (15%). Teff is essentially free of gluten. Teff occupies 2.1 million ha of the total 32% of area. It contributes to 24% of the gross grain production. Teff has more value than the major grains. This is probably because it is always eaten in the whole grain form; the germ and bran are consumed with the endosperm.

Teff is the only cultivated of all 300 *Eragrostis* spp. Its agro ecological adaptability has resulted in its cultivation as an important crop in 10 of 18 agro ecological zones of the country. It is able to grow under a wide range of agro climatic, edaphic conditions and a variety of soil from light sandy to heavy clay of variable fertilities. It is used as replacement for failures of early sown crops due to drought. Teff has relatively minimal post-harvest losses.

At the Institute of Biodiversity Conservation gene bank there are about 4,820 accessions of domesticated landraces and 5 accessions of wild relatives of teff (Fig.1) collected from different agro ecological zones of twelve former administrative regions. These are conserved at below zero 10^{o}C (Fig. 2 and 3).

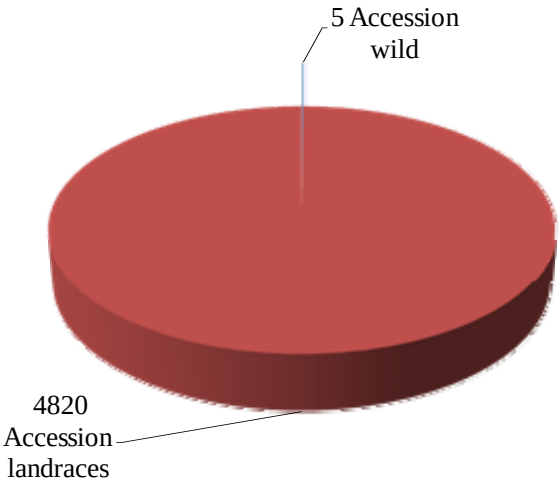

Fig. 1 Collection status at gene bank

According to previous documents, large numbers of cultivars have been found (Tadesse Eba, 1975; Seyfu Ketema, 1993). Tadesse Eba (1975) has made a comprehensive study to establish core collection of 35 cultivars on 1,000 individuals based on phenotypic character. Kebebew Assefa (2003) investigated a total of 3,600 individuals representing 36 landrace population of teff based on morphological markers to measure the phenotypic diversity. The present study was aimed at investigating the variability and frequency across regions based on phenotypical markers.

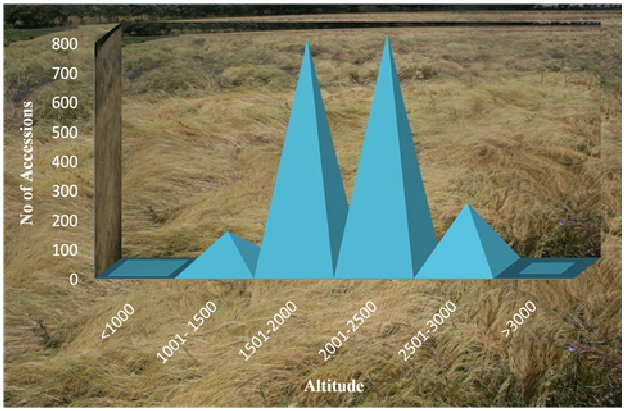

Fig. 2 Collection of teff based on varying altitudes

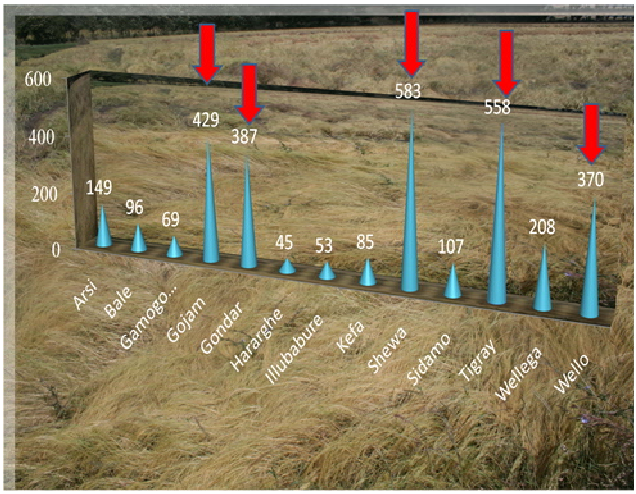

Fig. 3 Collection of teff from former administrative regions

Materials and methods

Genetic material

A total of 10,800 single panicles belonging to 720 landrace populations, 15 plants each were used in the study. The materials were collected from 11 different regions as indicated in Fig. 4. Since accessions were maintained as field samples, they may represent the diversity in the original populations. Teff is a self pollinated plant with only 0.2 – 1% out crossing (Seyfu Ketema, 1997). Thus, the possibility of gene flow is limited.

Field work

The materials were planted at Debre Zeit Research Station, located at 8°45 N, 38°59 E, 1920 m a.s.l. in one of the major teff growing areas in the country. Fifteen plants were randomly harvested from each plot and evaluated for five qualitative traits namely, seed color, panicle color, panicle form, glum color and glum hairiness.

Data analysis

Data collected were analyzed by power core software. The analysis was repeated for each region and character in order to detect the significance of the variation among populations in the region. Original data were then analyzed to evidence the most frequent classes of characters in regions and populations in the same region.

Results and discussion

Five traits, seed color, glum color, panicle form, panicle color and glum hairiness were observed in each of the 10,800 panicles belonging to 720 landrace populations from eleven

different regions of Ethiopia. Analysis on the overall material indicated the existence of 114 different panicle forms. Similarly, high variable and large number of cultivars have been described based on grain color, panicle type and color (Tadesse Eba, 1975). Frequency below 1% was considered as rare. Out of 114 variants 94 variants were found to be rare with ≤ 1% frequency, while 20 variants were common with > 5% frequency (Fig. 5). Within 720 populations to have 114 variant with unique genetic characters is promising. However, the biological survival of the rare variants is in question. The existence and fate of the rare variants is determined by natural and artificial selection.

The distribution of single characters, however, did not follow a similar pattern. Broken white color was present only in about 26.3% while red color was found in 33.3%. The extreme white color (Magna) was observed with highest frequency of 40.1%, the possible reason being the preference of the consumer and market attractiveness. The intermediate panicle form was observed in the highest frequency (63%) while the extreme compact showed lowest frequency (0.7%). In line with Tiruneh Kefyalew *et al*. (2000), Tadesse Eba (1993) and Kebebew Assefa (2003), the study indicated significant variability across population within regions (Fig. 4). The highest variability was found from Tigray, Shewa, Keffa, Wello and South Ethiopia (40, 33, 25, 6 and 4). On the other hand, the lowest variability was observed in Hararghe (Fig. 4). The variability frequency in Bale and Arsi were equivalent. Surprisingly, teff from Gojam, an area native to teff, exhibited low variability. The results necessitate an exhaustive study in all localities of Gojam as well as expedition and collection measures.

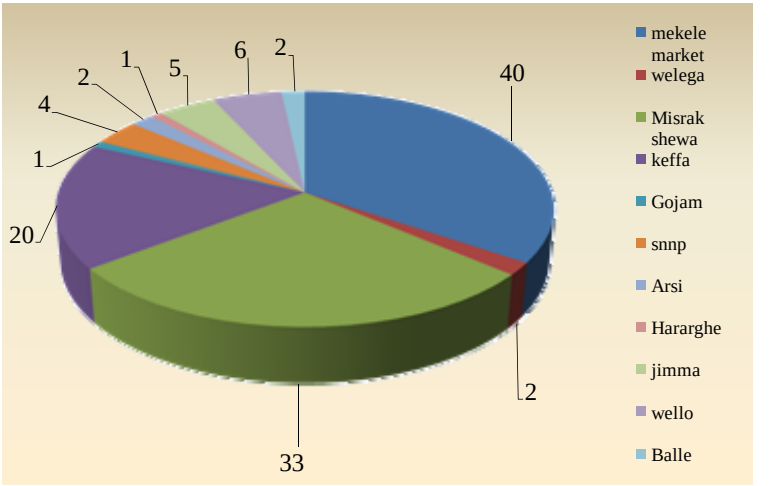

Fig. 4 One hundred fourteen teff variants of 10,800 genotypes found across regions

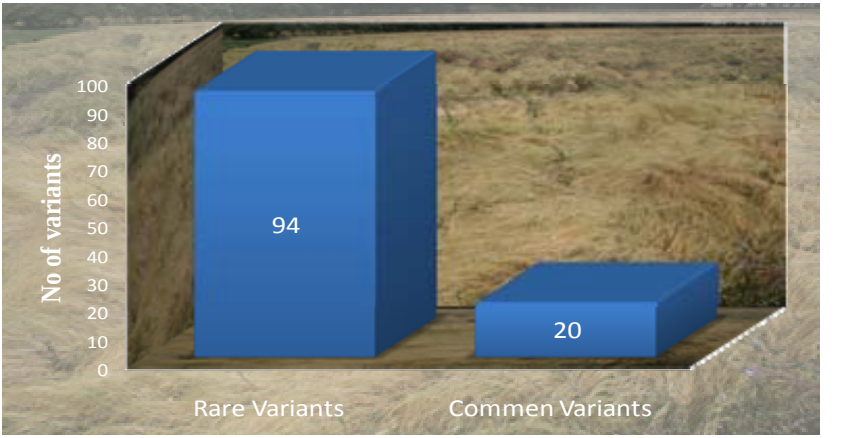

Fig. 5 The level of frequency of teff variants

The distribution of world genetic resources is not evenly distributed. It is concentrated in specific small areas. However, the Ethiopian genetic resource distribution is a different story. All Ethiopian regions have their own specialties of genetic resource concentration. In fact, the present study indicated the number of variants commonly shared in all teff growing regions. However, unique variants (4,3 3 and 2) were found in different regions of Ethiopia (Wello, Shewa, Keffa and Bale regions). The indicated set of variants were found only in specific regions. The first four set of unique variants were found only in Wello. Three set of unique variants were found only in Shewa; the other three unique variants were found only in Keffa and two unique set of variants were found only in Bale (Fig. 6). The distribution of those specific unique variants is region limited. This suggests that some Ethiopian regions have the potential to offer set of variants with unique genetic characters. Therefore, the comprehensive study is critically important from different angles and thus should be supplemented by systematic *in situ* and *ex situ* conservation for sustainable use.

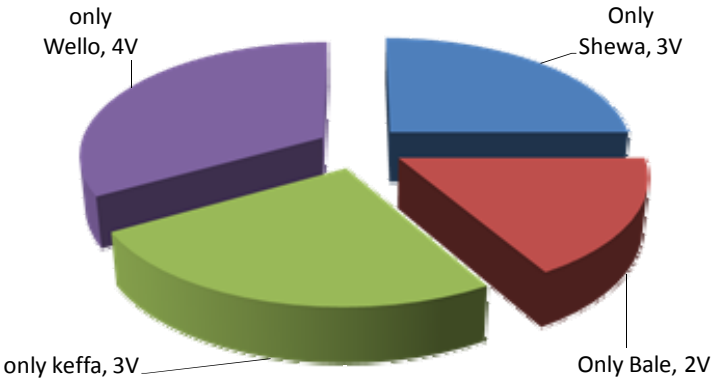

Fig. 6 Region limited variants of teff

The study indicated that the highest fat content was 4% and the lowest 2%. The highest fiber content was 4% and the lowest 2%. The highest carbohydrate content was 74% and the lowest 68% and the highest moisture content was 13% and the lowest 10% (Fig. 7).

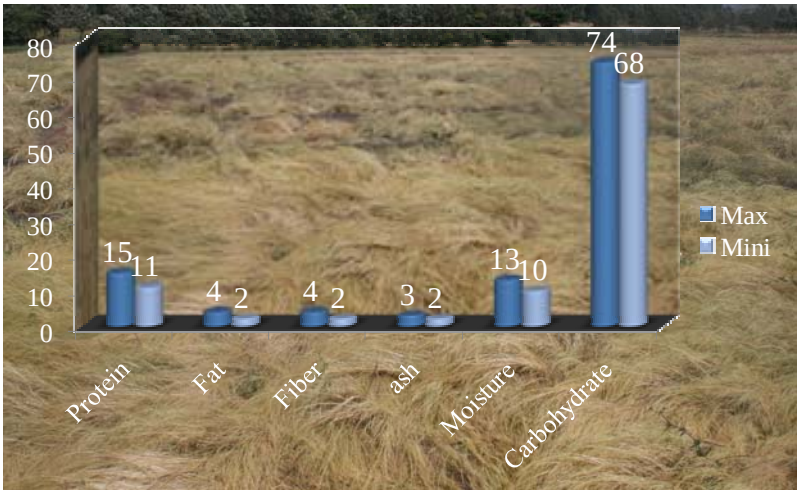

Fig. 7 Nutritional analysis of teff

What have we done?

- Breeders' varieties are successfully in use.

What remains to be done?

- Conservation of genetically variable and diversified landrace varieties from all localities and all pockets of agro ecological zones.
- The existing conservation is not based on molecular techniques.

- Comprehensive identification and characterization of landraces.

Recommendations

- Farmers are a source of valuable information and knowledge. Therefore, this vital indigenous knowledge regarding critically valuable resources should be documented, protected and disseminated.
- The case for conserving genetic resources should be established on the basis of economic as well as scientific grounds.
- Without a diverse genetic reservoir to draw from further improvement may not be possible. Therefore, conservation of our genetic reservoir is imperative.
- It would be better to encourage farmers to continue to manage a landrace gene pool in evolutionary real time, rather than to freeze this material in *ex situ* collection.
- A complete inventory of the valuable plant species has to be taken.

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Access and Benefit Sharing Agreement on Teff (*Eragrostis tef*) and its Implementation Challenges

Gemedo Dalle[1]

Abstract

Ethiopia is committed to the implementation of the third objective of the Convention on Biological Diversity (CBD): the fair and equitable sharing of benefits arising out of the utilization of genetic resources. This commitment has been demonstrated by putting in place legal provisions and identification of a competent national authority mandated to give access to genetic resources and associated traditional knowledge. There are clear procedures in the country to facilitate access to genetic resources and to ensure the fair and equitable sharing of benefits arising out of the utilization of genetic resources. In the framework of CBD, the Institute of Biodiversity Conservation has given access to teff (*Eragrostis tef*) genetic material to a Dutch Company called Health and Performance Food International bv. (HPFI). Teff is a cereal of Ethiopian origin that does not contain gluten, a specific protein which cannot be digested by people suffering from the celiac disease. With a business objective of introducing Ethiopian traditional cereal to the western market, the company accessed teff varieties from Debre Zeit Agricultural Research Center of the Ethiopian Institute of Agricultural Research and other external sources including botanic gardens. In other words, access to the teff genetic material was never difficult. The company negotiated and signed the agreement

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under pressure. Although the legal process for accessing teff genetic material was concluded successfully, the benefit sharing component has never been implemented. None of the benefits identified in the signed agreement were shared with Ethiopia. Limited capacity and lack of effective enforcement and follow up mechanisms for the Access and Benefit Sharing agreement were identified to be critical gaps. It is concluded that there is a great need to coordinate efforts to ensure Ethiopia's right to benefit from its genetic resources.

Introduction

Teff (*Eragrotis tef* (Zucc.) Trotter) is an endemic species to Ethiopia in the Poaceae family. It is one of the most important cereal crops in Ethiopia. The grain is used to make 'injera', a flat, spongy and slightly sour pan cake. 'Injera' is the most commonly eaten food in almost all households in the country. Although teff is grown for its grain, the straw is used as forage for livestock as well as to reinforce mud or plasters in the construction of houses both in rural and urban areas.

The Convention on Biological Diversity (CBD) has three objectives: (1) the conservation of biological diversity; (2) the sustainable use of its components; and (3) the fair and equitable sharing of benefits arising out of the utilization of genetic resources (known as "access to genetic resources and benefit sharing or "ABS"). Parties to the CBD have formalized ABS through certain articles of the Convention and through the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of Benefits arising out of their utilization.

Specific requirements under the Bonn Guidelines address:

- Prior Informed Consent for access to genetic resources;

- Mutually Agreed Terms for access and the use of genetic resources; and
- Benefit sharing from the utilization of genetic resources.

Prior Informed Consent (PIC) is obtained by the user from the government and other providers, as the case may be, after fully disclosing all the required information that permits access to their genetic resources and associated traditional knowledge, under Mutually Agreed Terms. PIC is obtained in writing from the competent government authority and from the relevant stakeholders, including local communities and indigenous people who are the owners, managers or custodians of genetic resources or traditional knowledge associated with genetic resources. It is linked to a commitment to negotiate fair and equitable benefits for each stage of access and use. The general perception and agreement is that genetic resources are used only for the purposes expressly outlined at the time of PIC negotiation, and a new PIC is given for any use that differs in type or scope from that originally outlined.

Mutually Agreed Terms (MAT) are conditions and provisions of access and benefit sharing, among others, negotiated between the user and the provider and involving other relevant stakeholders. MAT is negotiated in a manner that builds confidence and a relationship of trust between owners, managers or custodians of genetic resources who are the providers and the users of genetic resources. The MAT establishes the basis for a long-term, transparent and respectful relationship and communication between the provider and user. MAT are negotiated in good faith by both users and providers, respecting the terms and understanding of PIC, allowing benefits to flow to the owners, managers or custodians of the genetic resource, and facilitating access. It has been noted that

MAT takes into account the differences in capacities and needs of the providers, including governments, and indigenous and local communities, holders of *ex situ* collections, and the intended user organizations, to allow fair processes of negotiation and equitable outcomes in the benefits to be shared.

Benefit sharing is participation in the economic, environmental, scientific, social or cultural benefits resulting or arising from access to genetic resources and associated traditional knowledge under Mutually Agreed Terms. A fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge is provided in order to support compliance with the three objectives of the CBD. Benefits are provided according to the specific stages of use set out in the PIC agreement (discovery, research, development and commercialization) and are re-negotiated when the type of use is expected to change beyond the agreed PIC. Benefits are shared fairly and equitably with all those who have been identified as having contributed to the resource management, scientific or commercial process. Benefits are intended to create or strengthen capacity of the providers or other stakeholders, especially through technology transfer and training, which is important for the conservation and sustainable use of genetic resources. Benefit sharing arrangements are implemented in good faith, respecting the terms and understanding of PIC agreed for use of the genetic resources collected, and the terms and conditions negotiated in the Mutually Agreed Terms. Benefit sharing provisions should be negotiated and implemented in a manner that contributes to the conservation of biological diversity.

Teff is an intriguing grain, ancient, minute in size, and packed with nutrition (Railey, 2010). Review of different studies show that teff grains and flour do not contain gluten and are rich in minerals, especially iron (van Delden *et al*., 2010). It was

because of these characteristics and qualities that teff became a highly desirable food crop in western markets particularly for celiac disease patients.

Because teff is gluten-free, its food products were identified as an option for the gluten-intolerant consumers in Europe and other developed countries. Besides, teff has various other attributes of interest to the food industry and therefore, there has been demand for its grain or flour in western markets.

Health and Performance Food International (HPFI) was one of the companies that have studied the potential markets for teff products. The central focus for HPFI was to develop teff products for western markets in forms such as bread, beer, etc (SCBD, 2008).

The main objective of this paper is to describe the background history and implementation challenges of the Access and Benefit Sharing agreement signed between the Institute of Biodiversity Conservation and the company.

Historical background on accessing teff genetic resources from Ethiopia

The Ethiopian Agricultural Research Organization-Larenstein University-Soil and Crop Improvement Contract

The Memorandum of Understanding (MoU) was signed between the Ethiopian Agricultural Research Organization (EARO) from Ethiopia and the Larenstein University and Soil and Crop Improvement from the Netherlands. The objectives of this MoU were:

a. To strengthen the position of Ethiopia as a leading teff producer in commercializing the international market for teff-based gluten-free products encompassing a wide

variety of products suitable for consumers with and without intolerance to gluten.

b. To support Ethiopia to further develop local and international markets for teff-based products.
c. To assist and strengthen teff research and production in relation to the project in Ethiopia.

Varieties sold to Larenstein University

Debre Zeit Agricultural Research Center of EARO had sold 1,440 kg of 12 varieties of teff to the Larenstein University for research and development (Plate 1). The research center has communicated this to the Institute of Biodiversity Conservation.

Plate 1 Teff planted at Debre Zeit Agricultural Research Center (Photo: Tareke Berhe, 2009)

This MoU was signed on different dates (26 March 2003 to 29 July 2003) and had no official stamp of Larenstein University and the Soil and Crop Improvement Company. The MoU focuses on three major issues: (1) Registration and utilization of teff varieties, (2) Research on teff and (3) Establishment of teff Fund. It was noted that this MoU has some procedural irregularity and substantive insufficiency.

To begin with, the names of signatories from each party were not mentioned in the MoU. The other important point was that EARO was not nationally mandated to give access permit to foreigners or to send genetic materials to foreign countries. The act of EARO was in violation of Proclamation No. 120/90 Articles 6(2), 12 and 13.

In August 2003, a professional magazine in the Netherlands called Vakblad reported the following:

- Teff flour makes gluten-free products that are tasty. They made reference to Mr. Hans Turkensteen, Financial Director of the Soil and Crop Improvement, who claimed that teff products were delicious.
- The magazine pointed out that the first ever flour made from teff was to be introduced to the market in Europe.
- Products made from teff flour (biscuits, bread and cakes) are totally gluten-free.
- These products are as tasty as other similar products produced by a normal bakery.
- Koopmans Meel was the company that will process the teff seeds for gluten-free flour for subsequent introduction to the market.
- The first Dutch harvest of teff will take place in the Netherlands in August 2003.

- The first gluten-free product from this harvest was planned to be distributed to supermarkets in the Netherlands, France, Belgium and Germany.
- The company behind this business of growing and processing teff was identified to be Soil and Crop Improvement BV (www.soilandcrop.com).
- Mr. Hans Turkensteen informed the magazine that his company has discovered an opening in the market for the teff products.
- Varieties of teff grain and their uses have been patented and Soil and Crop Improvement is the holder of those patents. The company patented the production and processing of teff in the European Union.
- Soil and Crop Improvement together with Koopmans Meel BV initiated field experiment of teff in the Netherlands.
- In 2001, 250 varieties of teff were sown on 17 hectares and in 2003 teff was harvested from 620 hectares.
- Culturing and field experiment has continued in the Netherlands. Besides, there were experimental fields in France, United States and Germany.

In 2004 the Consulate General of the Federal Democratic Republic of Ethiopia – The Hague wrote an official letter (dated 16/02/2004 Ref. No. INV/v2/137/04) to notify the activities being undertaken by the Soil and Crop Improvement Company in the Netherlands. In this letter, the General Consulate reminded concerned Ethiopian authorities to give due attention to the activities started as well as those planned by the Soil and Crop Improvement Company. The Consulate General also pointed out that Mr. Hans Turkensteen was a Chief Financial Officer who was indicated as Director of the company on the signed MoU. It was suggested that all concerned Ethiopian

governmental organizations need to take urgent and appropriate action on time.

Agreement on access to and benefit sharing from teff

The Access and Benefit Sharing agreement on Teff genetic material was signed on 05 April 2005 for a duration of 10 years between:

- The Institute of Biodiversity Conservation, Ethiopia (Provider)
- The Ethiopian Agricultural Research Organization, Ethiopia and
- Health and Performance Food International bv. (HPFI) (User)

This agreement was signed in the presence of the Ambassador of the Netherlands to Ethiopia and Director General of the Environmental Protection Authority, Ethiopia.

Scope of the access

Some of the provisions listed in the scope of this agreement include:
The Institute of Biodiversity Conservation (IBC) has given the company access to and use of 20 teff varieties specified and annexed in the agreement.

- The company can use teff genetic material for developing non-traditional teff-based food and beverage products.
- The company cannot use teff for any other purposes (such as chemical or pharmaceutical) under this agreement unless explicit written consent is given by IBC.

- IBC shall not grant access to teff genetic resources for any other party for the purpose of producing the teff products identified by the company.
- The company is not permitted to access traditional knowledge of Ethiopian communities on the conservation, cultivation and use of teff. It was explicitly pointed out that the company shall not claim any rights over nor make commercial benefits out of such traditional knowledge unless written agreement to that effect is given by IBC to the company.

In the preamble and scope of this agreement, it was made clear that teff is a crop species of Ethiopian origin and the company acknowledges this fact irrespective of the source of teff it has acquired or will acquire.

The other important point in the agreement was that the company shall not transfer teff seed samples or any component of the genetic resources of teff to third parties without first having explicit written consent from the Institute of Biodiversity Conservation.

Benefit sharing on teff

The company agreed to share the benefits that arise from the utilization of teff genetic resources as identified below:

- To pay 1% of the average gross net income of the years 2007-2009.
- Annual royalty of 30% of the net profit from sale of basic and certified seeds of teff varieties specified in the agreement.
- To contribute 5% of its net profit to the Financial Resource Support for Teff (FiRST) that aimed at improving the living conditions of local farming communities and developing teff business in Ethiopia.

This contribution was agreed to be not less than €20,000 per year.

- To share research results, knowledge or technologies with IBC and EARO, except when those are identified to be undisclosed information.
- To involve Ethiopian scientists in teff research.
- To establish profitable teff businesses in Ethiopia (teff farming, cleaning, milling enterprises, bakeries, etc) so that access to teff genetic resources can be linked to improvement of local economy and poverty eradication.

In summary, the modes of benefit sharing recognized in the agreement were both monetary and non-monetary benefit. Monetary benefits were royalty fee, lump sum payment, license fee and contribution to FiRST. The non-monetary benefits included employment opportunity, participation of nationals in research, preferential access to products and technologies, training to national institutions and local communities and provision of equipment, infrastructure and technological support. With the implementation of these benefits, it was expected that this agreement will contribute to poverty alleviation in Ethiopia. Particularly, the establishment of profitable teff businesses in Ethiopia (teff farming, cleaning and milling enterprises, bakeries, etc.) were hoped to contribute to a better income for teff producing communities and reduce unemployment in the country.

Implementation challenges

Some of the key issues of concerns identified and communicated to respective bodies by the Institute of Biodiversity Conservation include:

1. Annual Payments: Article 8 (8.1,8.2,8.3) of the agreement deals with monetary benefits that largely

depends on the progress of the company and could not be controlled and claimed by IBC due to the existing information gaps. The only deposit the company made so far is €4,000 paid in March 2007 which IBC could not correlate to any of the agreed financial benefit stated in Article 8 of the agreement. Besides, Article 14 of the agreement states that "Each year, the Company shall pay a sufficient sum of money in advance from which the requests by the provider for payment will be subtracted". However, this agreed money, too has never been paid.

2. Financial Resource Support for Teff (FiRST): Article 8.4 of the agreement states that the company shall contribute annually 5% of its profit, which shall not be less than €20,000 to FiRST, that shall be administered jointly (by IBC and the company). Besides, Article 8.5 of the agreement further states that the details of administration of FiRST shall be specified by a subsidiary agreement of the parties (IBC and HPFI). However, the company did not even come together to discuss the details of establishment and administration of FiRST. On the other hand, the company has taken unilateral action and established FiRST in the Netherlands and further entered into an agreement on a project with some German institutions using the fund from FiRST. This was a destructive measure as far as the mutual relationship between IBC and the company was concerned and also was not in line - with the spirit of Article 8.5 of the agreement.
3. Reporting: According to Article 16 of the agreement, the company is required to give the provider annual research and financial reports. However, IBC has not received any formal comprehensive report in this regard

except some e-mail communications. The only formal report sent to IBC was progress report of year 2006 written in Dutch. When IBC requested for an English version of the report, the company responded by saying no agreement was made to provide reports in English.

4. Intellectual property right: Based on the provision of Article 5.2 of the agreement IBC was not clear whether the company has developed new varieties that shall be registered as co-ownership with the previous EARO (now Ethiopian Institute of Agricultural Research). However, from the e-mail communications with the company, it was noted that teff has been registered in the name of FiRST which was not in accordance with the very nature and purpose of FiRST.

In 2007, the Institute of Biodiversity has noted that there was a communication gap between the company and the Institute and therefore invited Mr. Hans Turkensteen to evaluate the progress of the implementation of the agreement done so far and also requested the company to facilitate conditions for a smooth implementation. In this letter it was mentioned that the unilateral establishment of FiRST in the Netherlands and its administration, registration of varieties, and reporting were the major concerns. No official response was given from the company. In 2008, the Institute expressed its concern over annual payment, FiRST, reporting and intellectual property rights and again requested the two witnesses to mediate. This request for mediation was in accordance with Article 13 of the agreement. However, no significant progress was made on the mediation effort and therefore, another letter was again sent and official letter to the two witnesses reminding them of the previous letter and once again requesting for their mediation. In this letter the Institute pointed out that there was a need to clarify and rectify the gaps created between the Health and

Performance Food International and the Institute. Unfortunately, there has been no progress so far and the whole issue became complex. It was difficult and also very expensive to hire lawyers to follow up the issue at the international level.

On the other hand, it is known that the company has claimed patent right in relation to teff genetic resource conservation and utilization. This was not on the basis of the agreement in view of sub-Articles 4.5 and 4.6 which states that "the Company is not permitted to access the traditional knowledge of Ethiopian communities and shall not claim any rights over, nor make commercial benefit out of it".

Discussion

There is a growing tendency by some foreign organisations and companies that undermine implementation of national ABS regimes that regulate proper access to biological/genetic resources and/or their associated indigenous knowledge without PIC/MAT or any agreeable Memorandum of Understanding. Such organisations and companies get access by directly using their economic might, while in some cases biopiracy is done under some bilateral agreements or projects meant to address socio-economic empowerment in rural areas.

It is clear that the fair and equitable sharing of benefits arising from the utilization of genetic resources is one of the three pillars of the Convention on Biological Diversity (CBD). That is, benefit sharing is extremely important for the successful implementation of CBD.

In this agreement, the Institute of Biodiversity Conservation provides access to teff to the Health and Performance Food International for the purpose of developing non-traditional teff-based food and beverage products. As was clearly outlined in the agreement document, the company was not allowed to

access Ethiopian traditional knowledge on the conservation, cultivation or use of teff.

Although the agreement contains quite extensive benefit sharing provisions including monetary and non-monetary benefits, none of the expected benefits were shared with Ethiopia. Unofficial sources indicated that the company has gone bankrupt. There is a provision in Article 12 of the agreement that refers to termination of the agreement on such grounds. Article 12(1) states that if the company is in the process of bankruptcy, the Provider can immediately terminate the agreement. It has to be noted that this provision gives right to IBC (Ethiopia), not to the company. Furthermore, to apply the provisions under the remaining sub articles [12(2) – 12(5)], the specified conditions were not met and that might be the reason why the company had taken the bankruptcy case as an option for illegally terminating the agreement.

In general, the teff ABS agreement was not implemented in the spirit of mutual benefit. There is a high need for Ethiopia to strengthen coordination among its different Institutions for the successful implementation of the Access and Benefit Sharing Proclamation. It has to be noted that once genetic resources leave a territory, that is it, especially as those providing the resources are the weakest members and users are the strongest.

Did the company misuse the Memorandum of Understanding?

In March 2004, the Wageningen University Science magazine reported that a Canadian non-profit organization has charged the Soil and Crop Improvement Company with biopiracy. Using the Memorandum of Understanding it signed with EARO, the company applied for property protection of the products in order

to gain sufficient return on its research investments into improvements and potential uses of teff. Mr. Hans Turkensteen, Financial Director of Soil and Crop Improvement, explained in this report that the unilateral measure his company took for the patent application was right because negotiations with the Ethiopian authorities were taking much longer. However, this reason can not be accepted or justified as there is no provision in the MoU that gives the company the mandate of unilaterally applying for the patent. In the same report, it was mentioned that the Dutch focal point on Access and Benefit Sharing for the Convention on Biological Diversity had asked the company to proceed carefully with the sharing of advantages of potential patents with Ethiopia which the company did not want to accept and implement.

Was the teff ABS negotiation in good faith?

The company did not come to the negotiation table in good faith regarding teff ABS as was the case from the Ethiopian side. Some of the reasons for this conclusion include:

- The Coalition Against Biopiracy (NGO) has awarded the same company the Captain Hook Awards 2004 for Biopiracy in the category of "Most Outrageous (http://www.captainhookawards.org/winners/ 2004_pirates). This award was given to the company at the 7th Conference of Parties to the CBD in Kuala Lampur, Malaysia. The Soil and Crop Improvement (The Netherlands) was given this award for seeking to negotiate joint ownership of Ethiopian teff varieties with the Ethiopian government, and for falsely claiming that Soil and Crop has acquired intellectual property for growing the teff crop as well as for the production of all products containing teff or teff flour. Coming to the ABS agreement was under such pressure.

- The company mentioned (several times) the ban of teff export as a major infringement of the agreement reason that was not mentioned in the agreed document and therefore, is not part of the agreement.

On the contrary, the Ethiopian negotiators were focusing on long term partnership in good faith. According to the Secretariat of Convention on Biological Diversity (SCBD, 2008) report, there was a deliberate focus on developing a long term partnership, and rejection of the upfront payments and similar concepts. The reports quoted one of the Ethiopian negotiators saying "It is not the sweets they give you at the beginning but the meal you want to share".

Gene banks and botanic gardens: pathways for biopiracy?

According to the SCBD (2008), the Health and Performance Food International (HPFI) Company obtained teff varieties from gene banks around the world and subsequently selected ten varieties suited for cultivation in western Europe. Abeba Tadesse (2009) also pointed out that the Royal Botanical Gardens at Kew, England, accessed teff and then distributed it to other botanic gardens in Australia, Africa and Asia.

This can be a wake up call for developing countries including Ethiopia to consider how to deal with issues related to the role of botanical gardens in the world. Furthermore, botanical gardens need to positively contribute to the three objectives of the Convention on Biological Diversity as a package.

In other words, these botanical gardens need to practically demonstrate to the world that they are not pathways to biopiracy.

Critical problems

Based on the progress made so far, the following can be identified as critical problems for implementing the ABS agreement.

1. Limited human and infrastructure capacity
2. Lack of coordination and information exchange among the relevant stakeholders
3. Absence of international regime on ABS

The other point that the Ethiopian side did not take into consideration was that the company had two different names from the very beginning. The original communication was with the name Soil and Crop Improvement but when it came to signing of the agreement the same company used a different name: Health and Performance Food International bv. (HPFI).

The company got teff varieties through purchase from the then EARO (now Ethiopian Institute of Agricultural Research, Debre Zeit Research Center) before even signing the ABS agreement. This may lead to many other questions but clear provisions need to be in place and all relevant stakeholders need to be informed.

In conclusion, Ethiopia should build on the lesson learnt from this agreement for any future action including ABS agreements. It was noted that the company came to the negotiation with the Institute of Biodiversity Conservation not because it was convinced or believed in the importance of benefit sharing but it was under pressure.

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Increasing the Productivity of Teff: New Approaches with Dramatic Results

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Background

- Tef is the most important cereal of Ethiopia.
  - Annually, it occupies over 2.8 million hectares = 25-30% of the total area covered by cereals (CSA 2007/2008)
  - Daily food staple for about 50 million inhabitants (60% of the total population of 80 million).
  - Excellent nutritional value
  - High resilience in resisting stresses
  - Excellent food security crop.
- Imbalance between supply and demand resulting in a price of around Birr 1000/quintal.

- Only 16 improved varieties of tef
- Increase in yield has not exceeded 25%.
- National average yield has stabilized between 800-1,000 kg/ha for the last 3 decades.
- Total production increases have been mostly from the cultivation of more and more areas.
- Drastic measures be taken to improve tef productivity by exploring new and innovative approaches

New Approaches

- E. tef x E. curvula inter-specific crosses
- Spraying with a plant growth hormone
- Spraying with foliar fertilizers (yield boosters): NPK + micronutrients
- Gynogenesis – obtaining homozygous plants from doubled haploids (2
- Spaced transplanting – planted tef seedlings at 20 cm x 20cm
- Application of granular complete fertilizers (NPK + micronutrients = Zn, S, Mg, etc,)

Results

- No increase in productivity from the first 3 technologies.
  - No seeds obtained from E.tef x E.curvula crosses
  - Growth hormone shortened the plants but also panicles. Hence, no increase in productivity.
  - No yield advantage from plants sprayed with foliar fertilizers.
- Promising results were obtained from gynogenesis.
- Best results came from spacing - giving individual plants wide space to show their potential, and the use of complete fertilizers.

EXPERIMENT 1

Variety	Sowing Method	Fertilizer	Yield kg/ha
Cross 37	Broadcast	None	1014
	Broadcast	Yes	483
	20cm x 20cm	None	3390
	20cm x 20 cm	Yes	5109
Cross 387	Broadcast	None	1181
	Broadcast	Yes	1036
	20 x 20	None	4142
	20 x20	Yes	4385

EXPERIMENT 2

Variety	Treatment	Yield kg/ha
DZ-01-974	DAP + Urea	6700.13
	DAP + NP + Zn	8143.02
	DAP + NP + Cu	7923.97
	DAP + NP + Zn + Cu	8590.65
	SUKUBE SUKUBE + Urea	8785.89
	Check- no fertilizer	938.11

Tillering in tef

Tef transplanted in rows

Fig 1. Yield kg/ha for variety Dz-01-974 at 20 cm x 15 cm spacing & different fertilizer types

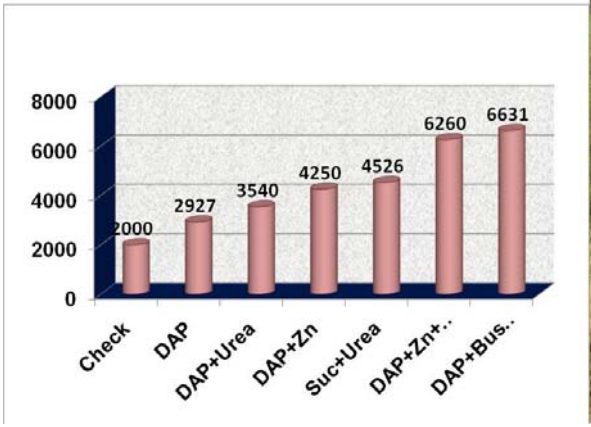
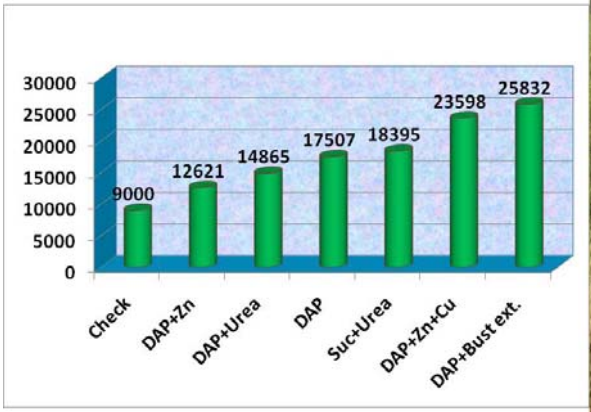


Fig 2. Straw yield (kg/ha) for variety Dz-01-974 at 20 cm x 15 cm spacing & different fertilizer treatment



Thankyou

Discussion

1. Institute of Sustainable Development (ISD) is advocating organic (ecological) farming especially in areas of moisture stress. What do you recommend for farmers since the central Ethiopian farmers have years of experience of using high input for agriculture and there is a growing population? The farmers also need high production. Do you think transplanting teff will be successful and provide high yield for farmers? Can we produce large amount of compost for large-scale production?

    - The aim of ISD's teff transplanting is to improve production. Improved seeds go with artificial input like pesticides, fertilizers and other chemicals which contribute to environmental pollution and climate change. So, what ISD recommends is that, if some uncountable harm comes to your farm you can use chemicals, but it is not always required to use chemicals in the farm. Night soil (human waste) should be used for agriculture again like previous times; agriculture has to be organic and environment friendly.

    - There are a lot of things that can be used as compost. It is possible to produce enough amount of compost even for large-scale production. The main attitudinal issue for utilization of compost and to minimize chemical fertilizers is on the middle level experts but not on higher level experts and farmers.

2. What is being done for large-scale teff transplant farming?

    - Teff transplanting can be grown in commercial farms like forage production. First, row planting has to be practiced rather than broadcasting, not

transplanting. So, it helps in weeding, cultivation, water utilization and improves production.

3. Morphological characters are highly influenced by environment. Why didn't you use molecular characters to study variability on teff?

    - There are many (around 30) characters to be used in characterization of teff which are controlled by single gene or not influenced by environment. This makes it also possible to use morphological characters for the characterization of teff, which are highly heritable and not much affected by environment.

    - There are so many challenges for Ethiopian breeders to improve teff. Teff gene mapping is vitally needed. IBC should have the capacity for gene mapping. Teff is a very important crop for Ethiopian farmers. No other crop gives food satisfaction to Ethiopian farmers

4. Have you assessed or checked what has been done so far and the follow up since 2005 on the agreement of teff with the Dutch company? Have you tried to contact the Netherlands Embassy to Ethiopia?

    Did the Dutch company agree before the ABS was in place or not? If the company is not governed by CBD, IBC should have the right to stop the access. Is it still accessing or already using the material once taken?

    - What IBC was doing regarding the agreement with the Dutch Company was clarified as there was no problem on the agreement. Lawyers and other professionals were involved and it was acceptable. The problem was on application of the agreement. In the agreement it says dispute shall be resolved

by mediation of both parties. If not, it should be submitted to an arbitrary body. As a result, a letter was written to the Netherlands Embassy and Director of Environmental Protection Authority (EPA) to be witnesses. The current situation is that all documents have been given to Ministry of Foreign Affairs and Intellectual Property Rights (IPR) office.

- A representative from the Netherlands Embassy explained that she knows the issue very well. The government of the Netherlands is happy to work on ABS with relation to the Dutch company. She also explained the company has not performed well because of low production. Other problems related to the company include the consideration of teff as alien species as it has no natural enemies. So, there was a question raised by nature and conservation groups. She explained that personally she was not familiar with neither the company nor the individual but it was evident that the individual seemed difficult to work with and the company is in bankruptcy and no more in business. On the contrary to this explanation, some participants explained that a lot of different teff products are available in supermarkets in the Netherlands and some of them are patented. Also different teff varieties have been released. Dr. Gemedo stated that the representative of the embassy could be right but the reason for this platform is not to blame one another but to reach to a mutual understanding on how to go forward. The reason that IBC was passive was out of respect for the embassy and the company and assuming that things will proceed in the right track. However, the company is stating that it is out of business while it

has patented 26 varieties of teff and it didn't terminate the agreement immediately.

Participants of the panel discussion

5. After we have passed along our right it is not wise to state about lack of capacity; stakeholders should have been consulted during the draft.

6. There are several genetic resources that leave Ethiopia. What should be done for such genetic resources? What should be done and who should do what in the future?

    - We have so many such cases like teff and we have to go through possible diplomatic channels and to secure countries sovereignty over genetic resources.

    - The international scenario related to biodiversity is not good; the play ground is not fair and smooth. On the other hand, there are people in the North which are helping our endeavors. So, if we work hard and bring it to the international forum, we will get support from the North and will get solution for the issue. Other participants also suggested that consumers are the best tool to bring companies to the right track by refusing to buy their products. The important thing is to be ready for change including IBC. The participants urged IBC to take the lead on such issues as well as the issue of Genetically

Modified Organisms (GMO) as reported in Afar as BT cotton.

- IBC should go along with internationally agreed agreements, such as the CBD even though there are different organizations which are not abiding by international agreements and which attempt to access genetic resources through farmers.
- It was also indicated that foreign companies that are working outside their country should be obligated to obey the laws and regulations that they have agreed to.

Panelists responding to questions. From left to right: Dr Gemedo Dalle (IBC), Ato Negusu Aklilu (FfE), Dr. Sue Edwards (ISD) and Dr Alganesh Tessema (IBC)

FfE has been registered and licensed by the Charities and Societies Agency as an Ethiopian Residents Charity. It serves as a platform for environmental communication and advocacy among people concerned with the Ethiopian environment. In order to carry out its mandate, FfE organizes public meetings and debates on issues of environmental and climate change concern; publishes a magazine (Akirma) and information dossiers; prepares speaking engagements; conducts researches; facilitates access to advisory services; creates and joins networks; establishes and strengthens local groups in various parts of the country; undertakes lobbying and campaigning; and acts as a liaison for funding projects that focus on protecting or improving the environment. Furthermore, FfE currently hosts the Ethiopian Civil society Network on Climate Change (ECSNCC) that consists of 58 member organizations working on climate change issues. Since its establishment FfE has been actively engaged in drawing the attention of citizens to the severity of environmental challenges in the country and promoting solutions to the challenges.

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