

Access to forage in the mid and highlands of Wolayta and Kambatta

Ethiopia

An illustrated note on livestock and forage, experiences led by Inter Aide, observed adoption and first effects of the activities, considerations, issues at stake and perspectives.



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Introduction

The South of Ethiopia is a very densely populated area, characterized by its green and fertile mountains. 90% of families still greatly depend on subsistence farming. In some *Kebeles* (rural communities), population density can exceed 700 inhabitants per km². Farms tend to become smaller. Long considered as one of the breadbaskets of Ethiopia, the area has had to face a growing pressure in the past three decades, with serious chronic food insecurity situations. Hence the frequent problem of “green famines”¹.

The general objective of Inter Aide’s work in the field of support to family farming is to **improve in a sustainable manner vulnerable families’ food security in the areas of Kambatta and Wolayta**. The aim is to help families from Kambatta and Wolayta to preserve, recover and enhance their incomes and improve agricultural production. To meet this objective, Inter Aide focuses on four subjects:

1. Conserving soils and preserving their fertility;
2. Improving forage availability;
3. Improving access to and conservation of quality seeds;
4. Enhancing soil productivity and diversification of agricultural production.

This document deals with the second subject, which is about **improving forage availability**. Since 2005, Inter Aide has led a number of innovative experiences in this field. These experiences have opened up interesting possibilities, but they also raise a number of questions.

The present document first sets out the various difficulties faced by farmers from Wolayta and Kambatta concerning access to forage. We then show how activities combining soil conservation and forage production have helped to improve and diversify access to forage, especially with the combined production of *Pennisetum Riparium* and pigeon peas (*Cajanus Cajan*). We have dedicated one chapter to the observable effects and first assessments of the economic impact that can be attributed to these activities, all the while conscious that the assessment of this impact will have to be taken further. We conclude with a few avenues for reflection that we believe interesting to explore in order to improve the balance of livestock needs with forage production.

¹ For further information on Ethiopia’s agrarian system you may refer to the following study carried out in the district of Doyo Gena: CHEVEAU A., HOORNAERT C. and COCHET H., 2012. Development Perspectives for an Ethiopian Agrarian System Sinking into Crisis. 45 pages. (<http://interaide.org/pratiques/node/400>)

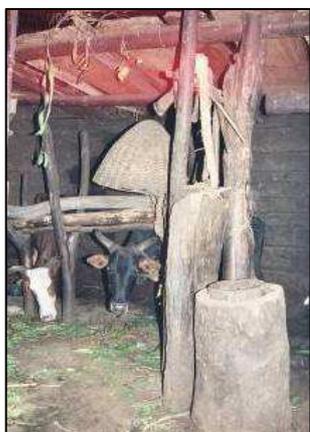
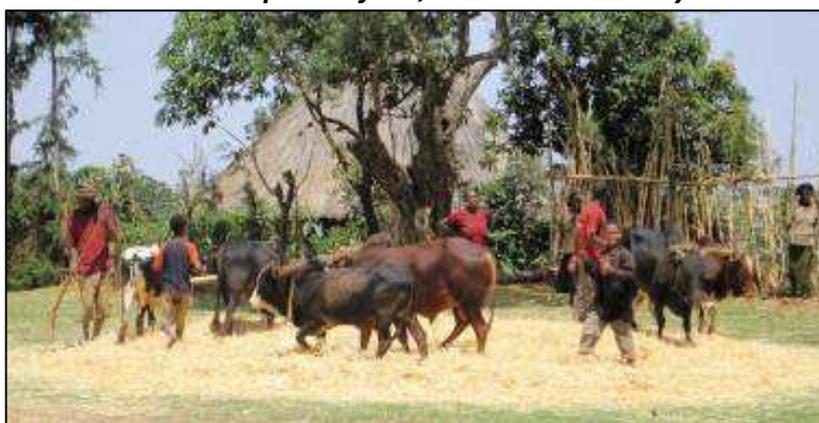
Forage availability: a crucial issue for farmers

Importance of livestock in agrarian systems of Southern Ethiopia

In the rural areas of Wolayta and Kambatta, families live on mixed cropping and breeding. They cultivate *enset*², cereals and tuber fields, along with small home gardens. Each family has around half a hectare of land. Livestock plays a crucial role in farmers' crop systems³. Every family raises animals –even the poorest have animals under contract from which they share the profits. Breeding is very important in family farms, mainly because:

- it enhances soil fertility: organic fertilisers (animal manure) are especially useful for *enset* production and home gardens, both of which require very rich soil
- it generates income: farmers can sell feeder animals and/or the butter made from bovine milk
- owning cattle is a key comparative advantage as oxen can be used for ploughing: this increases the total surface area a farmer can cultivate and also allows crop establishment at the best moment
- Cattle are also helpful for the threshing of cereals.

A few pictures (from left to right and top to bottom: cereal threshing, fertiliser application in a sweet potato field, stanchion stable system and ploughing)



² *Enset* (*Enset ventricosum*), often considered as a “miracle crop”, is related to Musaceae and commonly known as “false banana”. The extracted pulp is fermented before being eaten.

³ You may refer to this article written in 1988 on the need to integrate food and feed production in the area of Wolayta (FAO publication: <http://www.fao.org/wairdocs/ilri/x5519b/x5519b19.htm#prospects>)

Feed composition

As family farms are becoming smaller, the implementation of zero-grazing stock feeding has slowly replaced gleaning and collective grazing lands, with new practices to meet the needs of breeding systems. Throughout the different periods of the year and according to farmers' production capacity, cattle feed is made up of variable amounts of:

- **crop residues** from maize (harvested green or at maturity), beans, broad beans, peas, sweet and common potatoes. These residues are available throughout the rainy season. During the dry season, cattle are fed with straw from wheat harvests of the main growing season
- **weeds** frequently collected on field borders and during weeding operations
- **other grasses and fodder tree foliage** picked around the farms, in surrounding thickets or in idle lands sometimes quite far away (slopes, paths, small woods, etc.)
- **enset leaves, roots and trunks**
- **supplements**, depending on the resources available. These are powders essentially made up of barley and maize, wheat bran or "salty soil" –a type of salt block, with a high mineral content. These powders are given to cows during lactation and to oxen in ploughing periods.

During the dry season, forage resources of farms decrease substantially. Straw reserves are usually depleted before the end of this period, maize hasn't reached maturity and weeds haven't germinated yet. This is a critical period of the year for livestock –enset leaves and roots are the only feed they get during that time. These chronic feeding constraints have a direct impact on livestock population and zotechnical performance (CHEVEAU A. and HOORNAERT C., 2012 and BARTHES V. and BOQUIENS N.⁴, 2005).

Finding feed for livestock is an everyday task usually carried out by children. **Depending on the time of the year and livestock population, collecting forage can require 1 to 4 hours of work a day for each family.**

Differences depending on farmers' degree of vulnerability

Based on various analyses⁵ and studies carried out by the project in February 2011, we understand that the size and performance of livestock, along with the destination of their products and the management of their feeding vary depending on the degree of vulnerability of farm systems. In the same way, fodder production capacity is closely linked to the size of the farm (see appendix 1 for a presentation of a few farm differentiation criteria).

⁴ BARTHES V. and BOQUIEN N., 2005. Analysis Diagnosis of an Agricultural Region of Southern Ethiopia (Kambatta, Homa Kebele). Towards the Diploma of Agronomy (Master's degree) from the Institut National Agronomique Paris-Grignon, France. 75 pages.

(<http://interaide.org/pratiques/content/diagnostic-agricole-dans-la-r%C3%A9gion-de-Kambatta-au-sud-de-lethiopie-kebele-de-homa-2005-fr-en>)

⁵ CHEVEAU A. and HOORNAERT C., 2012

LE GAL E. and MOLINIER N., 2006. Agricultural and economic analysis-diagnosis of Obe-Jage (Damot Gale, Wolayta). Towards the Diploma of Agricultural Engineering (Master's degree) from the Institut National Agronomique Paris-Grignon, France, 95 pages.

(<http://interaide.org/pratiques/content/diagnostic-agricole-r%C3%A9gion-du-wolaytadamot-gale-ethiopie-2006>)

PLANEL S., 2008. *La chute d'un Eden Ethiopien. Le Wolaita, une campagne en recomposition* ("The collapse of an Ethiopian Eden. Wolayta, a rural region undergoing major change"). IRD Editions. Paris, France. 424 pages.

With forage availability decreasing due to the smaller size of farms and to the increasing number of land sharing contracts in favour of tenants (CHEVEAU C. and HOORNAERT, 2012), livestock decapitalisation appears as a necessary step for poorest families. The only lands they still cultivate without sharing contracts are enset fields and family gardens, neither of which provides adequate amounts of fodder. Enset fields are therefore submitted to an important pressure: many leaves are collected for animal feed, which weakens productivity. In these situations, agricultural incomes decrease until they can't ensure the family's survival any longer, forcing the active members of the family to work a great part of the year as day labourers outside their farm.

Conversely, families that have managed to accumulate capital don't have to work as day labourers, thanks to the good profitability of their farms. These families can use larger sown areas and supplementary forage resources (by renting native grasslands) in order to feed adequately more animals. Consequently, their enset fields have a better productivity as they are less exploited for breeding.

Forage production: potential and constraints

Researchers from the International Livestock Research Institute (ILRI) and the International Food Policy Research Institute (IFPRI) have highlighted that there is still much room for improvement through forage production. Growing fodder isn't a widespread practice in Southern Ethiopia. Many reasons can explain the very limited development of forage production up to date, among which DUNCAN A. *et al* (2011)⁶ highlight the very **low availability of forage seeds**, as the Ethiopian seed system is entirely dedicated to cereal production. In addition, **organised markets for quality forage practically don't exist**, both at a local level and on a larger scale. And as any other culture, forage production requires learning new technical know-how.

Activities relating to forage carried out by Inter Aide

Forage crops with a greater feeding value per unit area than natural meadows have been introduced, mainly through erosion control activities aimed at ensuring soil and fertility conservation.

The need to strengthen anti-erosion structures

The anti-erosion structures we have promoted slow down the process of storm water infiltration. This gradually helps terracing the fields. Anti-erosion structures are embankment-and-ditch structures, and they account for 6 to 8% of cultivated areas –which is a lot, even though on the long run, once the terraces are formed, ditches are usually filled in and structures occupy less space. Therefore, a first constraint is **the temporary loss of surface area caused by the setting up of anti-erosion structures**. This loss is compensated for through a better fertility, but this is only observable on the long run. As these structures usually don't exist, it is very difficult for poorest families to make long-term investments, because their focus is on day-to-day survival. We have also observed that many structures don't last more than one rainy season, because they aren't strong enough and can't resist to significant overland runoff. Some inadequately

⁶ DUNCAN A. and al, 2011. Forage seed supply in Ethiopia – some thoughts on current status and how it might evolve, in national forage seed workshop, EIAR Addis Ababa 12-14 may 2011. <http://www.slideshare.net/ILRI/forage-seed-supply-in-ethiopia-some-thoughts-on-current-status-and-how-it-might-evolve>

tamped structures are washed away when heavy rains occur. To be sustainable and effective, embankment-and-ditch structures need to be strengthened, planted and maintained until they are well established.

Enhancing the efficiency of anti-erosion structures

In 1998, when Inter Aide led its first programmes in the area, its agricultural project in Ofa district was aimed at promoting vetiver (*Vetiveria zizanioides*) propagation and subculture, in order to promote the establishment and solidity of structures. As vetiver is known as a deep rooting plant very useful to control erosion, this measure significantly helped strengthen the structures. But vetiver did have two drawbacks: it adapts with more difficulty above 2,000m (in the highlands) and, more importantly, it isn't very palatable for livestock and therefore offers no complementary benefit to families. Some farmers have already used it to feed their cattle but this was only a last resort during the dry season, when they couldn't find any other forage resources.

These two drawbacks pressed the team working on this agricultural project to find other varieties of grass that could strengthen the structures while helping to meet the high demand for forage, especially during the dry season. A number of different varieties were tested, including a forage species of *Pennisetum riparium*, which turned out to be very well suited to the environment of the area. Therefore, a better use was made of anti-erosion structures because they were also used for forage production: this solved the problem of the loss of surface area by bringing an immediate benefit (3 months after the seeds were planted). This measure brought such an efficient solution to the problem of feed insecurity that many farmers decided to set up anti-erosion structures just to have better access to forage.

From a technical point of view, different varieties were promoted in order to diversify the grasses (*Pennisetum riparium*, *Purpureum* and *Purpureum x Americanum*). As there is no forage seed supply chain, Inter Aide chose to promote the propagation by cutting of these herbaceous plants by training farmers in plant propagation. In the midlands, we promoted the association of *Pennisetum* and pigeon pea (*Cajanus cajan*), which has various benefits:

- the pigeon pea is a perennial shrub that can be used as forage (leaves) or firewood, and that is also very much appreciated for human consumption as it gives peas all year long
- it can resist to long dry periods
- it is a legume that makes it possible to balance rations and enrich the soil with nitrogenous matter
- it is a shade tree much appreciated by *Pennisetum*.

In the highlands (above 2,000m) the pigeon pea doesn't grow very well, which is why we promoted its association with the *Sesbania Sesban* shrub (also a legume) in high altitude areas.

In addition to these soil conservation activities, the project implemented various actions relating to forage:

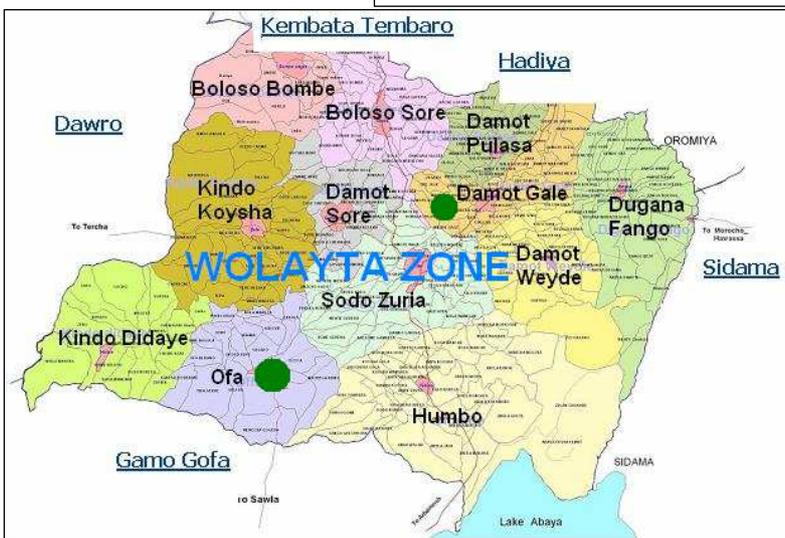
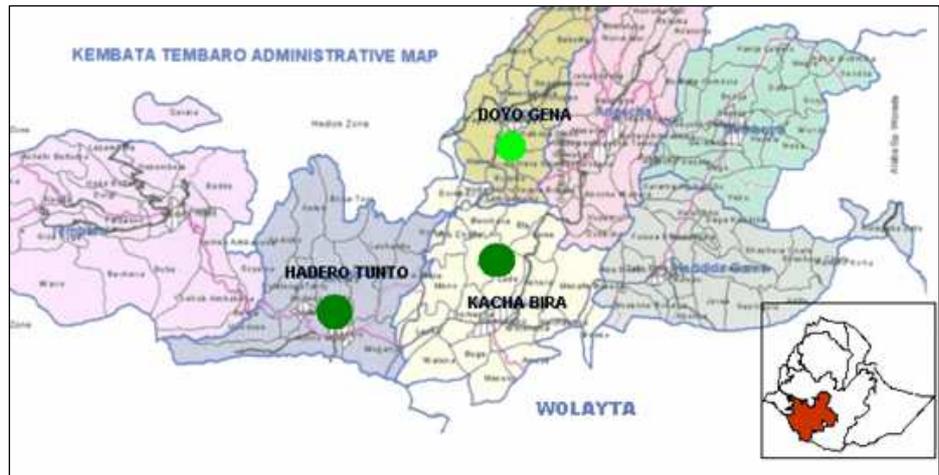
- seedlings were produced in big central nurseries run by Inter Aide, with the support of the Bureaus of Agriculture
- the setting up of small family nurseries to produce seedlings was promoted (prior to field protection activities)
- different varieties were introduced and disseminated
- technical support was provided for the production of seedlings in nurseries and their transplanting to anti-erosion structures, meadows and hedgerows

- one-day training sessions specifically dedicated to women were put in place, to train them in preparing forage for livestock (feed preparation, grass/legume mix, efficient use of structures, pricking-out techniques, etc.).



Location of Inter Aide’s actions

Actions of support to family farming are led in the Southern region of Ethiopia (the SNNPRS), in Kambatta and Wolayta. The project is now being implemented in three districts –Damot Gale, Kacha Bira and Hadero– and is gradually being extended to another district, Doyo Gena. Experiences are regularly shared with a local partner (RCBDIA), which mainly works in Ofa district. RCBDIA has developed a good expertise in the support and restoration of common lands. The maps below show the areas where the project is being implemented in Kambatta and in Wolayta.



Above: Kambatta area (700,000 inhabitants). Dark green spots show the districts (Woreda) where Inter Aide currently works (Hadero and Kacha Bira) and the light green spot shows the Doyo Gena district, where Inter Aide plans to work in the near future.

Left: Wolayta area (1.7 million inhabitants), with the Damot Gale district and Ofa district, where our partner RCBDIA works.

Level of adoption and first effects of the project

Level of adoption of forage production

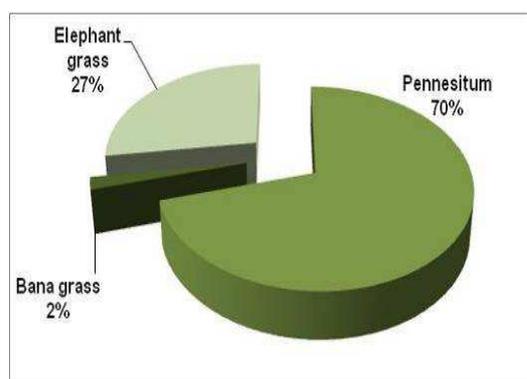
Inter Aide led a survey from September to October 2011 to assess the adoption of the production of *Pennisetum* in association with pigeon peas on anti-erosion structures. More precisely, this survey was aimed at:

- a) assessing what proportion of farmers have started growing these two types of forage (in relation to the total number of farmers in each village)
- b) measuring how much forage is being produced (in linear metres on anti-erosion structures and in open fields).

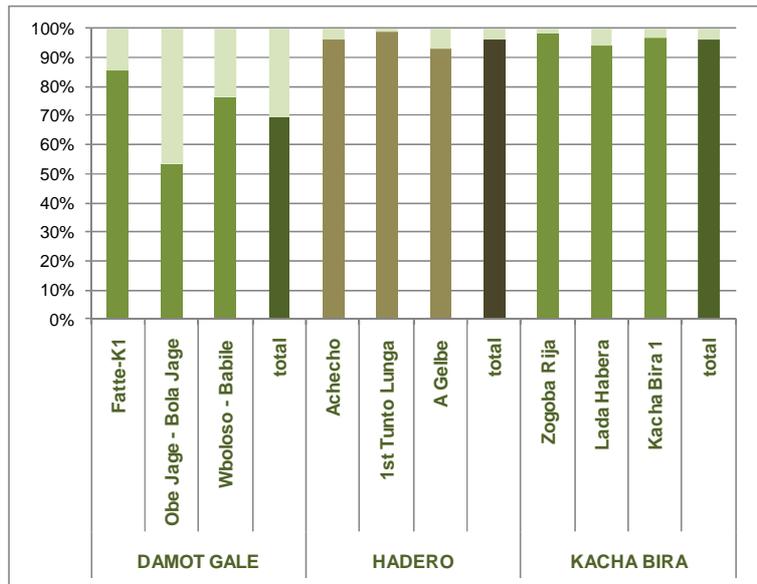
The survey was led in communities of 9 small drainage basins that were selected by the project within 3 districts (Damot Gale, Hadero and Kacha Bira). A total of 744 family farms were surveyed. This assessment was led 2 years after the activities were launched. On the basis of an initial study always carried out when programmes are launched, an analysis of the results was made taking into account families' level of poverty. Three groups were defined based on a predefined typology⁷: families with "surplus" cattle (86 families –that is 12% of all families), "intermediate" families (346 households –47%), and "poor" families (278 families –37%). Initial data wasn't available for 34 families (5%), which were divided into a separate group ("not available").

The results of the survey show that 87% of targeted families have started to grow grass for forage, while less than 5% did so before the project was launched. In two years, these farmers have planted on average 121m of linear structures for forage production –mainly on anti-erosion structures, but also in hedgerows and around their fields. What's more, 40% of farmers have dedicated part of their land to open-field forage production (66m² on average).

The chart opposite shows that most farmers grow *Pennisetum (riparium)*; then come elephant grass (*Pennisetum purpureum*) and Bana grass (*Pennisetum purpureum* x *P. americanum*). It is interesting to note that farmers from all three groups previously defined have started to grow forage (95% of families with "surplus" cattle, 88% of "intermediate" families and 88% of most vulnerable households, according to the typology established above). A logical correlation can also be observed between the surface area allotted to forage production and the size of the farm (145m for families that own the most cattle, 127m for intermediate families and 107m for very vulnerable families).



⁷ Depending on the area of land and number of animals owned.



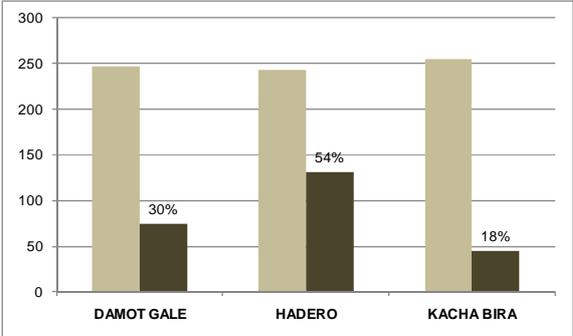
Percentage of farmers that cultivate forage (grass) in each Kebele

Two years after the project was launched, 649 farmers out of 744 (that is 87% of farmers) have started to produce forage, mainly on anti-erosion structures. The survey shows that a total of 75km of forage hedges have been planted and 19ha have been dedicated to open-field forage production.

The association of pigeon peas and grass on anti-erosion structures has worked very well in the midlands⁸. The project started by giving out a few seeds to farmers, advising them to plant peas in association with grass on the anti-erosion structures and later, after the first harvests, to give out in turn a few seeds to their neighbours.

On the whole, the adoption rate of pigeon peas little more than 2 years after the programme was launched is around 34% (29% among families with “excess” cattle, 34% among “intermediate” families and 36% among the most vulnerable families), with an average linear length of 51m. A total of 250 families have started growing pigeon peas, with a total linear length of 12km. 17 farmers have even dedicated a whole plot of land to pigeon pea crops, which adds up to a total of 2.9ha of open-field cropping. The best results have been observed in Hadero, with 54% of adoption and 45m of linear length on average. Results in Kacha Bira are weaker because of the higher altitude, which is less suitable for cultivating pigeon peas.

The chart below shows adoption rates by district:



⁸ It has been observed that pigeon peas produce well up to a maximum altitude of 2,000m.

Effects of the adoption of *Pennisetum riparium*

Following a series of semi-structured interviews carried out in Kambatta in March 2011, we have been able to draw up a first analysis of the impact of forage production and assess its adoption rates. This analysis should be viewed as the first step of an impact study which ought to be complemented in the future. These interviews were led in communities which received support in 2009 in the area of Kambatta, where *Pennisetum riparium* cropping has been adopted on a very large scale. The following data only refers to *Pennisetum riparium* cropping.

Proof of adoption:

Farmers have adopted a number of practices that show their interest in producing forage. Here are a few facts:

- **More surface area is being dedicated to forage, at farmers' own initiative:** Each family has 70 to 600m of anti-erosion structures, depending on the area of land they own, and more and more families are starting to produce forage in fields (from 20 to 800m²). These new fields can be developed in the place of natural meadows or in the place of spaces normally used for other crops (especially home gardens, where highly productive crops are usually grown). Farmers that have started to produce forage beyond anti-erosion structures say they intend to gradually increase the area of land they dedicate to forage production.



Plots where *Pennisetum riparium* is being produced. Left: a plot of land formerly dedicated to grain production in Gelbe 2, Hadero district (anti-erosion structures created 2 years earlier). Right: a former natural meadow in Barabicho 1, Kacha Bira district. Pictures taken in March 2011, during the dry season.

- **There is demand for forage on markets:** Grass was already sold on markets before the project was implemented, but now there actually is a real demand for forage. Farmers who produce more forage than they need can sell it without any difficulty, either directly (standing crops) or on nearby markets. Similarly, farmers who have big areas of land sell vegetative material for propagation.
- **Farmers have adapted their practices:** Inter Aide introduced *Pennisetum riparium* thinking it would be a perennial production once anti-erosion structures were set up. However, a farmer who started growing it since the project was launched convinced us that it is necessary to replace old crops in order to have good yields in the long run (replace crops that have become too woody and less productive). This farmer and other

farmers we met later regularly renew their forage plots by digging out old crops and planting new cuttings. We have noticed that some farmers who cultivate *Pennisetum riparium* on plots of land are even starting to use mineral and organic fertilisers for their crops. So we can see that **at their own initiative, farmers have adapted technical practices that involve an investment of time and/or money, which shows that they are truly interested in the project.**

- **Farmers give or sell each other seeds:** New families that have settled in the area after Inter Aide launched the project are interested in producing forage too, and are given or sold plant material to start growing their own crops.

Economic estimates:

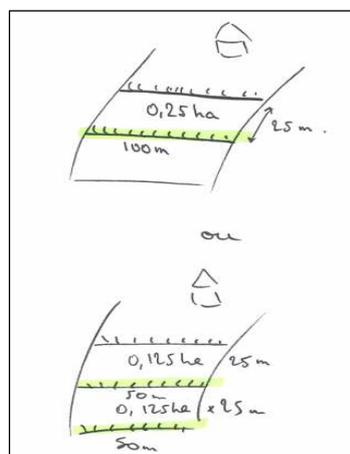
The value of *Pennisetum riparium* varies depending on:

- the season (dry season/rainy season)
- the type of sale (standing crops/on markets).

The charts below show the results of the assessments carried out by the project in 2011:

	Dry season	Rainy season	100 linear metres
Number of cuttings	1	2	
Regrowth time	6 months	3 months	
Number of bundles for 100m	11	33	
Average weight of a bundles (kg)	25		
Price of a bundle of standing crops (ETB)	12	7	
Price of a bundle sold on the market (ETB)	20	12	
Total annual production in tons (MS)			0.39
Value-price of standing crops (ETB)			600
Value-price on the market (ETB)			1,022

A *Pennisetum riparium* hedge should be cut on average three times a year: forage is harvested twice during the rainy season and once during the dry season. On the basis of the average of



121m of forage production per farmer (see above), this corresponds to an annual generated value that varies from ETB 725 to 1,230 (depending on whether the forage is sold standing or on the market). It is also to note that *Pennisetum riparium* cropping systems don't require any intermediate consumption⁹ (except in the case of fertilisation –but in that case we can assume that production exceeds the above-mentioned values). The value produced can therefore be considered as a gross value added. This sum amounts to about a third of the threshold of survival per year per rural worker (this survival threshold is estimated around ETB 2,800¹⁰). Therefore, planting forage on anti-erosion structures provides a quick “return on investment”, all the while contributing to gradually improve soil fertility (which is the purpose of anti-erosion structures).

⁹ Gross Value Added (GVA): For a given cropping system, the GVA is gross production minus intermediate consumption: GVA = GP - IC. Gross Production is the value of the final annual production. Intermediate consumption refers to the goods and services that are completely destroyed during one production cycle. These “goods” are seeds, seedlings, fertilizers, pesticides and fuel bought by the farmer; the “services” are activities that the farmer cannot carry out by himself due to a lack of necessary know-how or equipment. In <http://www.inter-reseaux.org/revue-grain-de-sel/48-mecanisation-et-motorisation/article/evaluer-la-productivite-de-l>

¹⁰ The threshold of survival refers to the minimum resources necessary to “survive” without having to rely on external food aid.

Similarly, according to the study carried out by CHEVEAU A. and HOORNAERT C. (2012), the gross value added of the most common cropping system of the highlands of Kambatta (mainly made up of potato and wheat crops) is equal to ETB 1,800 per year and per *timad* (0.25ha) on average. Knowing that anti-erosion structures take up 6 to 8% of that area of land (see above) and that cultivated plots of land have one of the configurations mentioned above¹¹, the gross value added of the initial cropping system is reduced by ETB 144/*timad*/year. But the annual production of *Pennisetum riparium* amounts up to ETB 600 to 1,022, that is a 25% increase of the gross value added of the plot only considering the selling price of standing forage (+49% considering the market price).

Further analyses will be needed to confirm whether it is interesting to develop this forage cropping from an economic point of view. However, considering the estimates given above, we can easily understand why farmers now produce forage on plots of land, and not just as isolated hedges on anti-erosion structures. **It is also to note that this analysis does not take into account a possible decrease in the production of *Pennisetum riparium* in the long run, due to soil depletion** (even if old crops are regularly dug out and replaced by fresh cuttings). **This raises the question of integrating legumes suited to high altitude areas and that propagate easily, like pigeon peas in the midlands.**

Uses of forage according to the typology:

As mentioned earlier, forage cropping seems to be suited to all types of farms. However, its uses and impacts vary depending on families’ degree of vulnerability, as shown in the following chart (see also the two examples given in appendix 2):

<i>Impact of forage production</i>		Families with “excess” cattle	“Intermediate” families	“Poor” families
Breeding performance	Increase in milk production	+++ Feed for animals	++	+
	Better fattening			
	Lower mortality rate			
	Increased strength of oxen			
Higher incomes thanks to the selling of forage			++	+++
Increase in kocho production thanks to lower pressure on enset fields		+		Creation of income and/or food security

Chart: impacts and uses of *Pennisetum riparium* production, according to individual and group interviews carried out in the Kebeles of Barabicho 1, Woreda and Kacha Bira, Kambatta area. (The two circles show what use is made of forage production for the different types of families)

¹¹ Data for this configuration (100 linear metres for 0.25ha) need to be updated (it appears that they are probably undervalued).

First conclusions, issues at stake and perspectives

The first assessments and surveys carried out reveal encouraging signs of adoption (farmers are producing forage not only on anti-erosion structures but also on their plots, they are disseminating seeds and techniques between themselves, they have adapted their cropping methods and there is a real demand for forage on markets). Forage production, which has become a new farming practice for families in Wolayta and Kambatta, has been introduced successfully and adopted very quickly. This can be explained by various factors. First, forage production solves the problem of inadequate feed supply during the dry season, which is a major constraint for small farmers. From a technical point of view, propagation by cutting of *Pennisetum* is an easy, reliable and self-sufficient method. The same goes for the propagation of pigeon peas, one of the rare species of perennial peas. Forage production activities, which aren't very time-consuming, seem to fit in farmers' work schedules, and even take up much less time than gleaning. What is more, the very structure of fields and settlements in the area (with hedges surrounding plots of land and houses) limits the risk of destructions caused by "accidental" common grazing. Another key factor is that improved access to forage seems to benefit all families, for different reasons depending on how vulnerable they are (improved zootechnical conditions of cattle, income generation through the selling of forage, impact on milk production, fattening, etc.). Some families also say that forage production indirectly improves their food security because it enables them to produce more *kocho*, as they don't have to over-exploit enset fields to feed their cattle during the dry season.

Of course, we don't have enough hindsight yet to assess with accuracy the specific impact of these activities. It is also important that we try to understand better the environment in which these activities are led, the constraints farmers have to face and the possibilities to develop further forage production activities. This is why it would be interesting to know better the informal channels that are developing in peri-urban areas and between farmers from different agro-ecological levels, for instance.

A study carried out nearly 25 years ago by the Awassa College of Agriculture (Hawassa University) and the International Livestock Centre for Africa (ILCA) stated: *"Because of the high population density, land holdings per household are small. Inadequate feed supply is the main constraint to livestock production. In order to optimise overall productivity there is a need to integrate food and feed production. Introducing forage legumes seems an acceptable approach: forage legumes will improve soil fertility, crop yields and herbage quality, and make the system more sustainable. Hedgerows of multipurpose fodder trees, productive backyard forages and undersowing or interplanting improved forages with food or plantation crops will probably be the most successful forage development strategies in this area."*

For the time being, it still appears relevant to focus on forage production and to search for, test out and suggest interesting alternatives to overcome feed shortages. Forage legumes, which are a good complement to grass varieties, are also of special interest because they contribute to enhance soil fertility and ensure the sustainability of the proposed systems. Up to now, pigeon peas are the only legume forage put forward by the project. Unfortunately, they are only suited to altitudes that don't exceed 2,000m. Different varieties could be considered (alfalfa, comfrey, varieties of mustard that seem to be available in Ethiopia, clovers, vetches, ryegrass, soya beans, etc.). But the sustainability of newly introduced varieties is and will remain restrained by limited access to seeds. This constraint is also highlighted as a major difficulty by ILRI. Access to forage seeds is therefore one of the key issues which will have to be considered if we wish to develop new activities.

Appendix 1: Differentiation criteria of farms

High vulnerability	Differentiation criteria of farmers' vulnerability	Low vulnerability
-	Cultivated lands (including lands under contract)	+
Few animals/no animals No oxen	Number of animals owned (under contract or not)	Many animals, including a couple of oxen
+	Debt load	-
Below or hardly above survival threshold	Farm income	Above opportunity cost of labour
Yes	Work outside the farm as day labourer	No
A lot of enset leaves, not much hay, no maize leaves	Feed ration of livestock	Few enset leaves, a lot of hay (with a space within the farm specially dedicated to hay storage), maize leaves, supplements bought on the market (bran)
<i>Kocho</i> ¹² produced on a regular basis with enset seedlings	Management of enset fields	Occasional production of <i>kocho</i> with older enset trees
Short fermentation of <i>kocho</i>		Long fermentation of <i>kocho</i>
<i>Kocho</i> mainly kept for on-farm consumption		<i>Kocho</i> sold outside the farm
High consumption of enset roots		Low consumption of enset roots
No handicrafts made with enset leaves		Handicrafts made with enset leaves
Small. No fertilisation	Size and fertilisation of native grasslands (in front of farmers' homes)	Big. Fertilised by the farmer
No	Improved breeds	Yes
-	Litres of milk per lactation	+
+	Calving interval	-
Purchase of new animals	Livestock renewing system	New animals obtained through on-farm breeding system
Yes (income generation)	Selling of butter and/or cheese	Not much (mainly on-farm consumption)

¹² *Kocho* is fermented enset pulp. It is the main product made from enset and forms the basis of the diet of rural populations living in Inter Aide's intervention areas.

Appendix 2: Different benefits of forage production

Walde's farm

Kacha Bira woreda, Doreba kebele, Barabicho 1 village unit

A vulnerable farm –one of the most vulnerable of the village unit

Area of land owned: 0.7 timad (=0.18ha)

Animals owned: 1 sheep

Walde, a young head of family, has built and planted 60 metres of anti-erosion structures with *Pennisetum riparium*. He has also planted *Pennisetum* around his house. As he arrived in the area after Inter Aide launched the project, he hasn't benefited from the programme. But his neighbours' experience convinced him to buy seedlings from a neighbour; he then built his own anti-erosion structures and started propagating *Pennisetum riparium*, and wishes to continue this activity.

Walde says that the main positive impact of this action is that he now picks less enset leaves to feed his sheep. Therefore, his family can produce more *kocho*: they have enough to meet their own needs and sell some on the market, while up to then they only had enough *kocho* for their own consumption. Thanks to forage production, Walde has therefore improved the yields of his enset fields and has started to sell *kocho* (for which he earned ETB 120 last year).

Walde used to own an ox that he didn't manage to fatten as much as he wanted, because he had to sell it a short while ago in order to face urgent expenses (though he did manage to obtain an ETB 600 capital gain after fattening the ox for five months, which he couldn't have done if he hadn't planted forage). He now owns only a sheep and he won't be able to buy more animals in the short term, even though he would really like to. As Walde doesn't plan to buy an animal for the 2011 rainy season, he will have excess forage: he estimates he can earn over ETB 400 throughout the year by selling part of the forage he produces (as his production exceeds the needs of one sheep). For a better capital gain, he will sell his forage directly on the market, taking care of the transport. He also plans to create a new plot for forage production and to use compost on it, in the same proportions as on his wheat crops.

Alemaye's farm

Kacha Bira district, Doreba kebele, Barabicho 1 village unit

A food-secure farm –one of the best-off farms of the village unit

Area of land owned: 5 timads (=1.25ha)

Animals owned: 2 oxen, 3 dairy cows, 3 calves, 1 sheep and 1 horse

Alemaye, a local leader, has built about 550 metres of anti-erosion structures and planted *Pennisetum Riparium* on them. Three years ago, he also started to convert natural grasslands at the bottom of a hill into artificial pastures with *Pennisetum Riparium*. More than half of this surface area (over 800m²) is now a monotypic artificial pasture, and Alemaye plans to extend it further.

Before starting to produce forage, Alemaye's children had to graze the animals for more than four hours every day on over-exploited and increasingly rare communal lands. Now, forage produced on the family's lands is entirely used to feed cattle and children don't have to graze the animals outdoors anymore. Cattle are just taken outside once a day to drink. His wife is responsible for cutting forage (2 hours a day). Small ruminants are given free access to plots of land and anti-erosion structures after the dry season harvest: they graze crop residues and the grass left over on the structures. Thanks to forage production, fresh forage is unavailable only 2 months a year now (twice less than before) and these shortages are mainly made up for with significant hay supplies. Enset leaves picked in a large enset field also help to complement hay rations during fresh forage shortages.

The main benefit of forage production is that it has led to better breeding performances:

- Dairy cows now produce twice more milk;
- The fattening of cull cows is both quicker and more efficient (in terms of their weight). Alemaye insists that there is a high demand for adequately fattened cattle, which is why a heavy, well-conformed animal has a good economic value (per kilogramme). He claims that he can even cull at the same age animals that are twice heavier and sell them three times the same price (he gives the example of the latest cull ox he sold for ETB 5,000, while he would only have sold it around ETB 2,000 if he hadn't been able to fatten it adequately) –though this might be a bit exaggerated;
- His livestock is less vulnerable to diseases;
- His draught animals are stronger.

Another benefit, though less important to Alemaye, is that he has the opportunity to sell *Pennisetum Riparium* cuttings at a local level, because there is demand from neighbours who haven't benefited from Inter Aide's actions in the area. In 2010 he sold 50 grass cuttings, for which he earned ETB 100.

Enset field hasn't been very much impacted by forage production activities, because Alemaye has always been able to maintain it correctly.