Centre for Development and Environment
Institute of Geography
University of Berne

Hallerstrasse 12
3012 Berne / Switzerland

Phone +41 31 631 88 22
Fax +41 31 631 85 44
E-mail bst@giub.unibe.ch
Internet www.cde.unibe.ch

Introduction of Affordable Micro Irrigation Systems in Eritrea Feasibility Phase

Mission Brigitta Stillhardt, Pablo Loosli, Sudarshan Suryawanshi,
Bissrat Ghebru, Samuel Asghedom, Abraham Mehari Haile, Bereket Mebrahtu Araya
25. September – 16. October 2001

Centre for Development and Environment
Institute of Geography
University of Berne

Hallerstrasse 12
3012 Berne / Switzerland

Phone +41 31 631 88 22
Fax +41 31 631 85 44
E-mail bst@giub.unibe.ch
Internet www.cde.unibe.ch

Introduction of Affordable Micro Irrigation Systems in Eritrea Feasibility Phase

Mission Brigitta Stillhardt, Pablo Loosli, Sudarshan Suryawanshi,
Bissrat Ghebru, Samuel Asghedom, Abraham Mehari Haile, Bereket Mebrahtu Araya
25. September – 16. October 2001

1. Mission Background

The great interest we met during and after our first mission (pre-feasibility mission) in April 2001 (on farmers' side as well as on institutional side) asked for a fast continuation of the project. Therefore a feasibility mission was implemented in September and October 2001. This second mission served as a first step for the feasibility phase and includes besides the field mission and administrative tasks also the preparation of a users' manual. During the mission in October the feasibility of the implemented irrigation systems was assessed together with our local key partners and about two hundred sets were distributed. The other main focus was to initiate and enforce an Eritrean network of organisations, trading companies, importers, local partners, scientists, etc. This network should support people and institutions interested or involved in implementation of drip irrigation by providing a platform for knowledge exchange and discussion.

2. Terms of Reference of feasibility phase

- Monitoring of pre-feasibility phase, including a briefing by CAAS, visit of selected test sites, administrative closing of phase 1
- Definition of further collaboration between the University of Asmara (CAAS) and the University of Bern (CDE): What are the interests and possibilities (capacity, time requirement, responsibilities, interests, constancy, costs, etc) of CAAS? Financial and administrative topics, budget, etc.
- Meeting and information exchange with existing partners (maintenance of existing network). Evaluation of further national partners to build up a solid and manageable local network. Contact to institutions like AEAS, ACORD, TOKER, DARHRD, WRD, School of Agriculture in Hagaz, School of Agriculture in Hamel Malo etc and individuals like Sium, Redaetzgy etc.
- Initiation of feasibility phase via local nodes (key partners), including instruction of local distributors / backstoppers, field visits, implementation of test kits, definition of information needs, definition of set prices for participating farmers, quality control, format of reporting, elaboration of an instruction manual for farmers, implementation of impact monitoring components

- Contact to and discussion with potential Eritrean importers, distributors and traders. Assessments concerning the potential of the Eritrean market for small scale drip irrigation systems, discussions of adapted economic solutions for Eritrea (import or local production) etc.
- Identification of the actual market situation for agricultural products (level of prices, demand, price fluctuations through the year, etc) for agricultural products suitable for production under irrigation (according the list worked out by CAAS)

3. Implementation of feasibility test

a) Selection of test sites and type and number of sets to be tested

The selection followed the findings and experiences of the pre-feasibility phase (for detailed description see pre-feasibility report and final report CAAS).

For the feasibility phase 240 sets from IDE India were imported: 100 bucket kits, 100 vegetable drum kits, 20 horticulture drum kits and 20 micro sprinkler kits. Based on the experience of the pre-feasibility study an additional piece of cloth to filter the water was included to all sets.

The decision to test mainly bucket kits and vegetable drum kits was based on the following conditions:
- The bucket kit is very small and fits into house gardens. Responsibility remains therefore mainly with women. It is also the most convenient set in areas with very high land use pressure and small landholding sizes.
- The vegetable drum kit is designed similarly as the bucket kit but covers a larger area. It is optimal for vegetable production on farmers fields and the demand for this set was high during our first mission in May.
- Sprinkler kits require a higher pressure (1 bar = 10 m) than the other kits. Most farmers are not equipped with a tap providing such a pressure. In large areas of Eritrea the frequent wind is also limiting the efficiency of sprinkler irrigation. Compared to the other systems the water consumption per area is also higher.
- Horticulture kits are designed for fruit trees. Farmers in the highland suffer from an insecure land holding system (*dessa*) with re-distributions every 7 – 10 years. Therefore the investment is too high compared to the risk to lose a new plantation (high initial investments but late income).

Type, number and location of distributed sets:

Type of set	Hagaz Farmers	Hagaz School	Hamel Malo Farmers	Hamel Malo School	Barentu	Asmara, dic. Individuals	Afdeyu	May Habar	Adi Keye	Mendefera	Hal hale	Spare parts	Remaining stock
Bucket kits	4	13	0	9	2	12	10	10	15	10	4	5	6
Vegetable kits	0	4	0	2	1	3	10	10	15	15	4	5	31
Horticulture kits	0	1	5	7	0	3	0	3	0	0	0	1	0
Sprinkler kits	7	2	2	2	0	4	0	0	0	0	0	1	2

This list is not yet correct in the details, final version will follow according to information from CAAS

b) Additional criteria influencing farmers perception of drip irrigation – collected during the feasibility-mission:

- the distance between farmers fields with installed drip irrigation kits and the next water place is of central importance
- the availability of labour force influence the willingness to test the new technology

- the more problems with clogging occur the more difficult it is to convince farmers. It is not yet clear what triggered the clogging: salty water, dirty water or soil particles from outside.
- In general farm size in the lowlands is larger than in the highlands. Therefore in many places the size of "our" sets is too small. On the other hand land holding in the lowlands is more secure for farmers. This increases the willingness and ability to invest in horticulture and therefore increases the demand on this kind of sets.
- In some places the daily amount of water was hold constant but plants grew higher during the vegetation period. Water-stress for the plants was the consequence. This point shows the importance to start in the very beginning with explanations when introducing the sets the first time.
- An interesting observation was reported in Hal Hale where the total biomass of the tomato plants under drip irrigation was higher, the leafs bigger but the fruits itself smaller than under surface irrigation.

4. Technical aspects concerning the irrigation sets

a) General remarks:

- It is difficult to introduce a new product in a new market when the outfit changes within half a year. Especially because the new parts and sets do not fit to the old ones. It is a different product and some farmers told us that they have to re-start evaluating it!
- The size of the bucket (bucket kit) is too small. It has to be refilled more than once to fulfil the daily water demand of plants – benefit could be increased when the size of the bucket would fit for about a one-day requirement of irrigation water.
- Buckets and drums (barrels)s are too expensive in Eritrea (compared to the irrigation sets / actually a drum (barrel) is more expensive than the price for a horticulture or vegetable kit).
- Some packed kits were not complete, e.g. a main pipe was missed in a sprinkler kit and the number of T-joints was not always sufficient.
- Idea to follow: Soft water tank for sprinkler kits. Pressure can then be increased with additional load (stones).
- In some places it was mentioned that it is difficult to refill the drum (one meter above ground plus the height of the drum (barrel) = too high for comfortable filling!)

b) Drip irrigation sets:

Advantages of new sets:

- Quality of taps is better
- Easy to connect T-joints to the laterals the first time and as long as the temperature is high, but almost not removable (specially when cold, holes leak after re-installation and T-joints break).
- Easy to clean clogged drippers (easy removing of drippers from and re-installation to T-joints).
- Filter is now separate. Advance, because easier to clean.
- The added towel is very helpful, even when I guess that part of the farmer will use it for a different purpose.

Disadvantage of new sets:

- Not compatible to the "old" sets
- Filter is difficult to clean (bucket kit)
- Filter clogs easily -> too small (Bucket kit)
- T-joints too weak (break easily)
- Quality of pre-perforation of laterals (to connect T-joints) is not sufficient
- No spare T-joints (should have at least two in each set)

c) Micro-sprinkler:

No advantage compared to the old set

Disadvantages of new sets:
- Not compatible to the "old" sets
- More fragile than the "old" set
- Required pressure is almost the same
- Difficult to connect the sprinklers to the laterals
- Handling of sprinkler head more difficult
- De-installation of sprinkler head is difficult
- Very small parts, can easily get lost

5. Pricing

It was clear after the pre-feasibility test that sets should not be given for free – even during a feasibility phase. We follow a marketing approach and all goods have a price. We don't want to create inequity among farmers communities by giving part of the farmers sets for free – and others have to buy it with market prices half a year or a year later. On the other hand the higher risk for innovative farmers must be taken into account when fixing prices. Besides this it is obvious that a good with a certain price is treated more carefully than something given for free. This was in general the basic agreement when we started discussing how to charge farmers for the sets. The discussion-team consisted of team members of the following institutions: CAAS, IDE India, CDE. Dawit Woldu (a private Eritrean businessman in plastic tools) was invited to participate in the discussion as specialist for local economic questions.
"Soft loan" was one of the possibilities promoted through part of the participants. But this would ask for a more sophisticated infrastructure because it needs a carefully bookkeeping from a specialist as well as local representatives for "banking". Therefore this possibility was rejected after a while – even when it is clear that it limits the access of very poor farmers to the set. But again, following a market approach means also that a project can not base itself on the poorest. The goal must be to offer a product of good quality to a reasonable price. It is it is to be hoped that organisations working with personal loans (e.g. ACORD) involve themselves into the project later on, providing poor farmers access to the new technology.
Finally the discussion team agreed on a subsidised price calculated as follows:

	Bucket Kit	Drum Kit (vegetable and horticulture)	Sprinkler Kit
Price (in $) at manufacturers door	5	16	21
Plus service charge in India, 10% of net price	0.5	1.6	2.1
Plus shipment costs (in the actual case with air fright) 60% of net price	3	9.6	12.6
Plus custom clearing in Eritrea, including transport costs etc., 10% of net price	0.5	1.6	2.1
Total costs per set (in $)	9	28.6	37.6
Full costs per set in Nakfa (exchange rate = 1 : 13.5 in October 2001)	121.5	386.1	507.6
Subsidised price per set in Nakfa (higher initial risk = +/- half price)	**60**	**200**	**250**

In addition to the price for the sets farmers have to include into their calculation that they also need a bucket (about 55 Nakfa) or a drum (barrel, about 250 Nakfa) to run the set. In the total costs also additional fencing material must be included (irrigated areas are very attractive to domestic animals, either because they provide good fodder or a nice shower – or both).

Two possibilities of payment were offered to farmers willing to test the sets:

a) Farmers pay the subsidised price now. The set remains then without any restrictions as their property. Follow up and support is provided during the feasibility phase.

b) Farmers sign a contract allowing them to test the set for half a year. Later they have either to give the complete set back (including all extras provided through the study team) or to pay the set then to the same conditions (subsidised price).

6. Follow up of the field mission

a) First provisional and incomplete findings of the feasibility-mission:

It was of great help, that the Ministry of Agriculture, specially Semere Amlesom fully supported the project. The team could profit in different ways from this support:
Access to and support from the network of offices of the Ministry of Agriculture
Access to and support from the network of farmers associations
Scientific and practical knowledge of different professionals working in the Ministry

During the mission a private company was found, highly interested to start business with the IDE irrigation sets. The company owner Dawit Woldu will travel in the end of 2001 to India for more detailed information about the conditions to buy and import an extruder. He partly accompanied the team for the presentation of the sets.

On the world food day (16. October 2001) in Hal Hale an excellent presentation of Dr. Bissrat Ghebru helped to disseminate the project idea to a broader community of potentially interested institutions and individuals. Topic of her presentation was "the role of women in increasing food security". In the evening of the same day a round table discussion was emitted through ERI-TV, again with the topic of food security and again including Dr. Bissrat Ghebru. This two events were a big fortune for the project and the positive response was enormous. Based on this response the idea was created to offer in the end of the feasibility phase a one day workshop in Eritrea for interested institutions, including a short introduction in the marketing approach, a presentation of the sets and the most important findings of the test.

The English manual added to the pre-packed sets in India were adapted to the Eritrean situation and translated to Tigrinya and Arabic through the team of CAAS in Asmara. It was available in a draft form and tested during the field visits. Overall echo of the farmers was good. Stationary and computer-use is very expensive in Eritrea and the technical quality of the products is not at all sufficient. Most probably it would be less expensive to produce and print the manuals in Switzerland!

Together with the involved teachers of the schools of Hamel Malo and Hagaz and the researchers of the research station in Hal Hale a catalogue of questions was worked out for the follow up of the sets implemented during the feasibility phase. It is composed of three parts:

1) Questions about irrigation like daily water requirement, wetting pattern of soil under the drippers, frequency of clogging, leaking of the system, uniformity of water distribution.

2) Questions about crop data like total yield, total biomass, height of plants, number of fruits per plant, plant density, weeding frequency.

3) Economic questions like total labour requirement, additional material needed, repair costs, maintenance costs, additional labour input for crop related activities, additional income.

Collaboration between the study team of CAAS and the responsible people of this places will be rather intensive. The engaged teachers / researchers will get a per diem for their additional labour input.

Follow up of the sets distributed to farmers during the feasibility mission will take place once or twice during the feasibility phase and will only include more general questions about technical experience with the set, observations concerning the crop/crop yield and general observations. A more detailed follow up with almost 150 individual farmers would blow up the budget too much (the time budget as well as the economic budget). It could be also part of a masters work mentioned below to follow up some farmers more detailed later on.

b) Time frame of the follow up:

Total duration of the Feasibility phase will be one year, divided in a field phase until spring 2002 and a phase of evaluation and analysis of the collected results. It is expected that end of September 2002 the results of the feasibility phase are available.

Depending on the time of seeding the field phase of the test will last about half a year and will allow most of the involved institutions and individuals to test the set during two crop growing cycles. In part of the highland the cold season is starting now and farmers will start installing the sets in January or even later, because it is now too cold for some corps (e.g. tomatoes; for leafy vegetables temperatures are sufficient, but the value added is not as attractive as for tomatoes or onions).

Time table of planned activities:

Activity	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
1st follow up at farm-level											
2nd follow up at farm-level											
Additional visits to schools and research stations											
Final data collection											
Data compilation and analysis											
Report writing Eritrea											
Discussion and final report of feasibility phase (CAAS – CDE)											

It is assumed that in the mid-term range the implementation of irrigation will lead not only to positive effects but may also create some problems like soil leaching due to increased land use intensity, increased risk of salinity, higher total demand on water during the dry season, possibly increased conflicts between grazing land and crop land, changing competition on local markets etc. To follow up the mid-term effects (not only the negative) we propose to "invite" two students to work on this topic for their masters thesis (one Eritrean candidate and one Swiss candidate).

---

7. Annex:

Time schedule of the mission
Final report CAAS of pre feasibility test
Terms of reference Mission members CDE
Terms of reference team CAAS
Material analysis of dripping pipes for micro-irrigation systems (draft)

Annex: Time schedule Mission Brigitta Stillhardt and Pablo Loosli, 25. September – 16. October 2001

Introduction of small scale drip irrigation systems in Eritrea – feasibility phase

Day	Time	Activity	Persons met	Remarks
26. September	03.50 – 20.00	Travelling		P. Loosli travelled one week earlier and prepared the mission by organising the custom clearing and the transport of the drip irrigation sets to the store at the university.
27. September	09.00 – 11.00	Meeting Rainer	Rainer Baudendistel	Information transfer and courtesy visit.
	11.00 – 12.00	Meeting Dean CAAS		Courtesy visit and information meeting
	13.00 – 19.00	Meeting University	Samuel Asghedom Abraham Mehari Pablo Loosli Sudarshan Suryawanshy Bissrat Ghebru	Briefing CAAS. Samuel and Abraham are leaving the country soon both for a PhD Preparation of the schedule of the following days. Financial closing of phase 1
28. September			Samuel Asghedom Abraham Mehari Pablo Loosli Sudarshan Suryawanshy Bissrat Ghebru	Preparation Test Phase Visit rose farm in the afternoon (drip irrigation system is installed on a larger scale). Flower production for the European market
29. – 30. September		Privat. Travel to Massawa via Filfil		Very nice rainforests around Filfil! One of the most beautiful places in Eritrea.
1. October	08.00 – 15.00	Field day in Hal Hale	ICARDA irrigation specialist	
	15.30 – 17.00	Meeting Dawit	Dawit Woldu, polyplastids	He is very interested to start a business in drip irrigation. He is a business man, educated in Germany, working on plastic tanks and Styrofoam.

Day	Time	Activity	Persons met	Remarks
	17.00 – 18.00	Meeting Semere Amlesom		Briefing,, information and discussion of actual programme
2. October	07.00	Discussion about pricing of sets with whole team Field day Hagaz	Samuel Asghedom Abraham Mehari Pablo Loosli Sudarshan Suryawanshy Bissrat Ghebru, Dawith Woldu Head Farmers Association	Amilcare was not in Hagaz, head farmers association in the field. Mainly waiting! Preparation of a meeting the next day with farmers of Hagaz. These are not small-scale farmers. The smallest area cultivated by a single farmer is about 3 ha.
3. October	09.00 – 13.00	Presentation of the kits to the farmers in Hagaz	Between 20 and 30 participants, among them 2 ladies	Keen interest of farmers in Sprinkler sets. 7 Sprinkler and 4 bucket kits given to farmers
	14. 00 – 17.00	Meeting Agricultural School in Hagaz	Brother Amilcare Teachers of the school Ladies who tested the kits	Join in the test with own experiments. Details will be defined later between CAAS and Hagaz school. Size of bucket, spare parts
	17.00 – 18.30	Field visit to a farm – site selection for implementing sets		Discussion and advice which set is most convenient for her. Start with a bucket kit
4. October	Morning	Preparation field day in Hamel Malo		Surprised about the big success the presentation had in Hagaz also discussion on economic topics (we have no selling licence!). Some letters are to write and Dawit will take the kits under his responsibility (only legal way).
	Noon	Short visit in Afdeyu for preparation of field day		Meeting and presentation of drip irrigation kits in Afdeyu Tuesday 9. October at 2 pm
	Afternoon	Here we are!	Meeting Tseggai	Briefing Tseggay about all mission purposes Office work in Hotel
5. October	Morning			Preparation of meeting in the afternoon

Day	Time	Activity	Persons met	Remarks
	Afternoon	Meeting Dawit	Dawit Woldu, Polyplastics	Discussion about implementation of affordable micro drip irrigation systems on a market basis. Preparation of a contract, between CDE, CAAS and Polyplastics Eritrea.
06. October	Morning	Meeting CAAS	Bissrat Ghebru, Samuel Asghedom, Abraham Mehari	Project discussion, where are we, where do we want to go…
	Afternoon	Afdeyu	Semere Asmelash	Information and discussion about Workshop
07. October				Free Sunday
08. October	08.00	Prolongation visa	Tseggay Gherezghiher	Paper stuff, immigration office
	09.00	First info WS	Semere Amlesom	Briefing about WS, Goals and time schedule
	10.30	Courtesy visit WRD	Woodi Arbate	Information about what is going on
	12.00		Viswanatham Sriram Kassivajulla, WRD	Information about drip irrigation project
	14.00	Meeting CAAS	Bissrat Ghebru, Samuel Asghedom, Abraham Mehari, Bereket Tsehaye, Sudarshan Suryawanshi, Pablo Loosli	Discussion and planning of further activities. Preparation of questionnaire for schools Discussion about manual (and payment of manual)
	18.00	Meeting Sepp	Josef Muller, SKH	Briefing on all activities of Brigitta Stillhardt in Eritrea
09. October	Morning	Meeting University	Bissrat Ghebru	Discussion on continuation of Test phase (TOR's CAAS) Duration of test phase Payment of involved people Discussion on Budget for follow up
		Immigration office		Visa extension
	Afternoon	Presentation in Afdeyu	Semere Asmelash	Farmers very sceptical because Set was not implemented through Semere (Tap broken)

Day	Time	Activity	Persons met	Remarks
	Whole day	Adi Keye, meeting with farmers association	Team Pablo, Samuel	Organising presentation of kits in May Habar and Adi Keye. Difficulties with responsibility of local office of MoA (To which Zoba belongs this places…)
	Evening	Diner	Woodi Arbate	Dinner and introduction to Eritrean view of war through W.A.
10. October		May Habar	Team Pablo / Sudarshan / Bereket	Difficulties to find out to what administrative unit May Habar belongs! (Ghinda). Demonstration with about 15 Farmers.
		Hal Hale, Mendefera	Team Brigitta, Abraham, Samuel	Hal Hale: responsible person for drip irrigation test was absent Mendefera: No presentation without permission of MoA.! Afternoon (with permission): Visit of Drko and preparation for demonstration there
11. October		Adi Keye	Team Pablo / Sudarshan / Bereket	Demonstration of bucket kit in the morning, of the vegetable kit in the afternoon. According to Pablo 11'000 farmers are registered in the local farmers association of Adi Keye (high potential area)!
		Afdeyu, Keren, Hamel Malo, Hagaz	Team Brigitta, Abraham, Samuel	Barrels and Buckets for Afdeyu (barrel when first time filled with water). Meeting schools (Fafa in Hamel Malo and Theodros Mekonnen and teachers of Hagaz,) for discussion of research follow up of drip irrigation
12. October		Barentu	Team Brigitta, Abraham, Samuel	Clinic Barentu: not yet ready for customizing sets for irrigation!
13./14. October				Travel Tesseney – Omhajer – Areza – Asmara
15. October	9.00 – 12.00	Meeting MoA	Semere Amlesom	Preparation Workshop, where, what, who etc
	Afternoon			Preparation of Invitation, workshop

Day	Time	Activity	Persons met	Remarks
	Evening	Diner with Zeggai		
16. October				World food day in Hal Hale. Oral presentation of drip irrigation through Bissrat. Field presentation of drip irrigation
	Afternoon		Joseph Müller Dr Giulielmo, Geoscience	Pre-discussion of study Adi Behnuna Acord: project presentation (telephone, leader not available) Preparation field day in Adi Behnuna