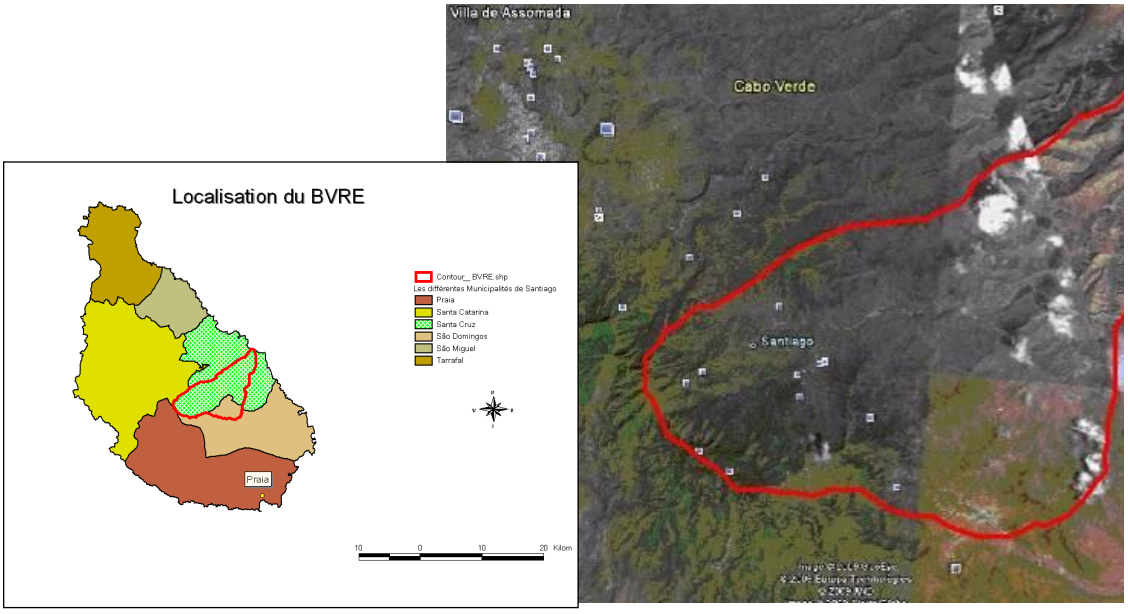
Ribeira Seca, Cape Verde

Highlights of work carried out in the DESIRE Project
Based on research at INIDA, Cape Verde

Location

Ribeira Seca is a catchment on the east side of Santiago island.

- **Coordinates:**
  Latitude: 15º07'40''N - 15º01'55''N
  Longitude: 23º32'05''W - 23º38'40''W
- **Size:** 71.50 km²
- **Altitude:** 0-1394 m (Pico d´Antónia)
- **Precipitation:** 200 mm downstream to 650 mm at the upper limit of the basin.
- **Temperature:** 16.6ºC – 28.1ºC
- **Land use:** 83% subsistence rainfed agriculture (corn and beans), 5% irrigated; 4% forest
- **Inhabitants:** 14,343 (2000 Census)
- **Main degradation processes:** on-site: water erosion, off-site: sedimentation
- **Major drivers of degradation:** population growth, deficient information, insecure land tenure, lack of institutional mechanisms



Catchment location within the Santiago I

With less than 300mm annual rainfall and about 23 000 ha of arable land with steep slopes, the natural resources of the largest agricultural island - Santiago, (off the west coast of Africa), have to be used judiciously. Investment in soil and water conservation has been essential to support food production for the more than half of the country's population. The arid hillsides are terraced wherever possible, to grow maize and different beans (and peas), supported on the maize stalks, as staple foods for the islanders. In

2000, 30% of the country's population was below the poverty line so effective water use is under constant scrutiny.

Terraces for maize, supporting peas and beans, Santiago Island, Cape Verde (January 2008) © E. van den Elsen

In Cape Verde, the low soil cover and inadequate practices on rain fed agricultural lands cause major problems related to desertification. The land surface is fragile, and severe water erosion, causing tons of land to be washed away from the fields happens every year during the rainy season. The aims of mitigation measures are to provide a certain degree of permanent soil cover to serve as shield for the impact of rain. During the DESIRE workshops for researchers and local stakeholders several technologies, all related to vegetative cover either as strips or surface cover were discussed.

Land degradation

- Technology 1: Pigeon pea (*Cajanus cajan*) barriers/strips. This consists of planting seeds of pigeon pea, a leguminous perennial shrub that has the dual purpose of protecting the soil and feeding the people. It is planted in association with maize. After the maize is harvested, the soil remains with some degree of cover. Though the objective was to plant it as strip barriers, six metres apart, most farmers planted it as general surface cover.

- Technology 2: Afforestation with fruit trees. This is the plantation of different fruit tree species in humid areas to provide both soil cover and food for farmers. Since fruit trees require several years' growth to provide effective cover, and though it was implemented in some areas, there was not sufficient progress for evaluation during the project period.

Rainfed land treated with pigeon pea

Steep slope treated with pigeon pea combined with terraces

The pigeon pea technology was selected as it appears to be the simplest, most accessible, least expensive, socio economically acceptable technique, with great impact on soil cover and land rehabilitation. Participants, farmers in particular, were unanimous in that pigeon pea is a technology that should be used throughout the country because of its numerous advantages.

For the evaluation of the pigeon pea technology, additional socio-economic criteria were proposed: employment generation, law enforcement regarding animals invading agricultural fields, urban planning, articulation among institutions and on-going projects related to desertification and food security and quality.

It was recommended that the technology should be promoted on:

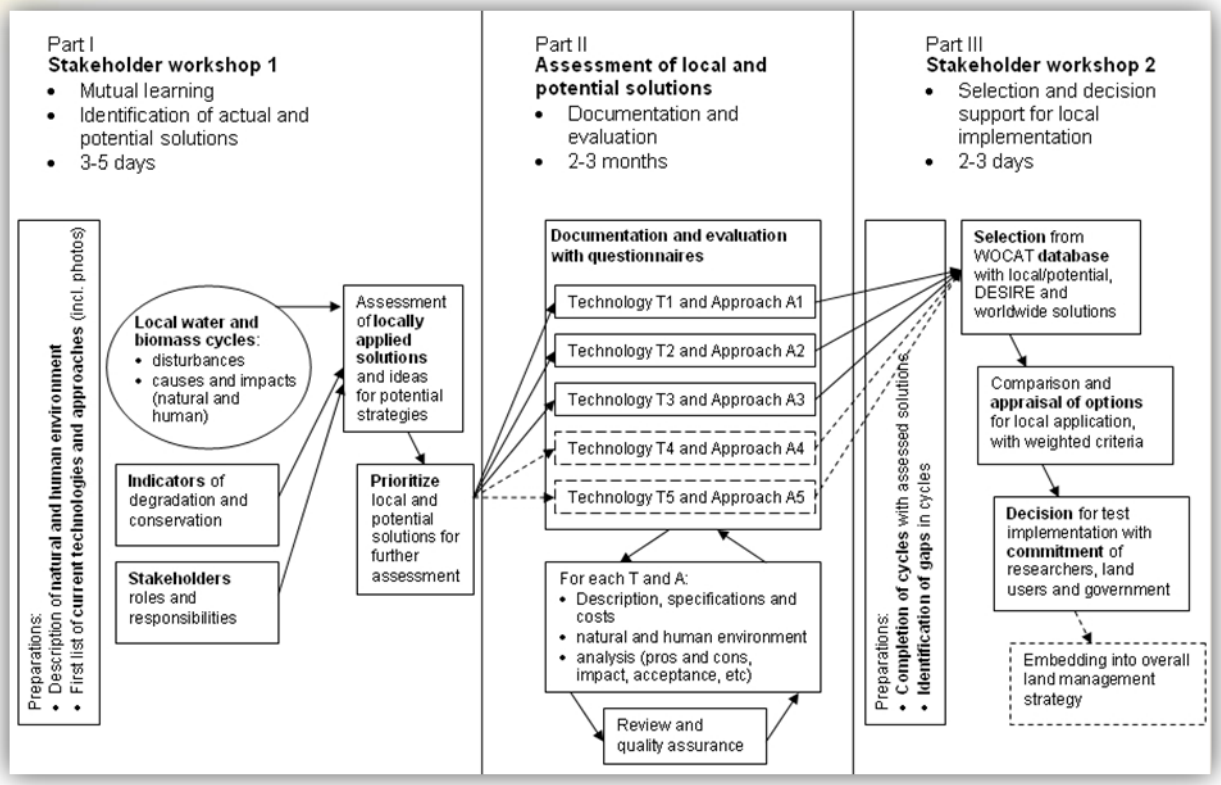
- ✓ Rainfed lands vulnerable to soil erosion and desertification,
- ✓ Watersheds that will benefit from future dams, particularly on the upstream areas
- ✓ Rainfed lands that need crop diversification

The local/regional policies that could promote wide adoption of the strategy may include: the National Plan to Combat Desertification (PAN_LCD) _UNCCD, the Municipal Action Plan to Combat Desertification, the Municipal Development Plan (PDM), and the National Action Plan for Environment (PANA)

The major obstacles to adopting these mitigation measures were:

- Inapplicability of the technology to arid climatic regions, with very low precipitation. To overcome this obstacle, lands should be treated with a more drought resistant species, such as *Aloe vera*.
- In arid regions, only irrigated lands can benefit from this technology.
- Poverty of some families forcing them to consume part of the distributed seeds as food rather than sowing. The solution to this vulnerability is complex.

Workshops for researchers and stakeholders to select sustainable land management technologies



Researchers talked with local people and policy makers, and together they decided on the best options for sustainable land use. In the DESIRE Project the three Parts to WOCAT methodology were developed as outlined above. This provides decision support for choosing technologies suited to the local environment that includes social, cultural and economic factors as well as physical science.

In every DESIRE study site researchers and stakeholders held two workshops to arrive at their selection of approaches and technologies. At the first workshop stakeholders learned about how degradation happens, and how to avoid it.

Meetings of researchers with stakeholders were used to help break the cycle of desertification. Together they discussed and tried out suggestions to find the best ways of reducing the incidence and impact of different technologies while addressing goals for sustainability.

Technologies chosen for trials

Cape Verde has been facing to severe environmental problems impact for the people living in the island. In order to control desertification (drought, storm runoff, erosion) the government has been taking actions regarding biodiversity conservation, ecosystem management and better valorisation of water resources. Slanting terraces as a form of conservation are widespread, but in the dry climate vegetation cover is low and the terraces do not always have the desired effect. The experiment aims at improving the system with vegetation barriers.

LINING TERRACES WITH PIGEON PEAS

The experiment was carried out in a sub-watershed which is located in the Ribeira Seca, Santiago island to see if vegetative barrier can be used in order to increase surface cover and reduce runoff. Pigeon pea was planted as vegetative barrier in about 330 ha land (see photo left). The advantage is that pigeon peas maintain a high cover as dense bushes and can also be used as animal fodder. The experiment included pruning of the bushes, which provides additional fodder.

To evaluate the effects of the technology the hydrologic behavior was monitored in the outlet of two sub watersheds (Longueira and Serrado). At the outlet of the Longueira subwatershed runoff flow and suspended sediment load (with sampling bottles) was measured for the period 2005-2009. For the period 2009-2011 only runoff flow was measured. In the fields, vegetation cover, organic matter and rock outcrops were estimated using 25 m transects. In addition, leaf area index and soil hydraulic conductivity were measured. Assessment of soil erosion and erosion risk for pigeon pea cultivation with and without pruning was estimated using the PESERA model. The pigeon pea were not sown in contour lines to form barriers as planned, but were planted in pits together with maize and beans to cover more soil.

RESULTS

The maximum runoff from the subcatchment did not change much (5-6 m^3/s) while the annual precipitation did vary. This is related to the variability and type of rainstorms recorded.

	2007	2008	2009
Annual Precipitation San Jorge (mm)	389.3	370.0	652.7
Number of days with rainfall (From August to October)	13	23	36
Max Instantaneous Runoff (m^3/s)	6.68	5.77	6.07
Erosion by water ($t.km^{-2}$)	211.3	540.2	115.7
Yield Fodder (tons)	51.43	72.00	60.00

The result obtained from running the erosion model (PESERA) showed that 58 km^2 of land with erosion rates greater than 10 $t.ha^{-1}.yr^{-1}$ was reduced to 42 km^2 in pigeon pea cultivation without pruning, indicating a reduction of 27,6% . With respect to biomass production the pigeon pea cultivation plays an important role not only in the fight against desertification and erosion, but also in improving the income of animal raisers. The results also showed the increase of biomass production (varying between 1410 and 1450 kg / ha) in more than 90% of the study area.

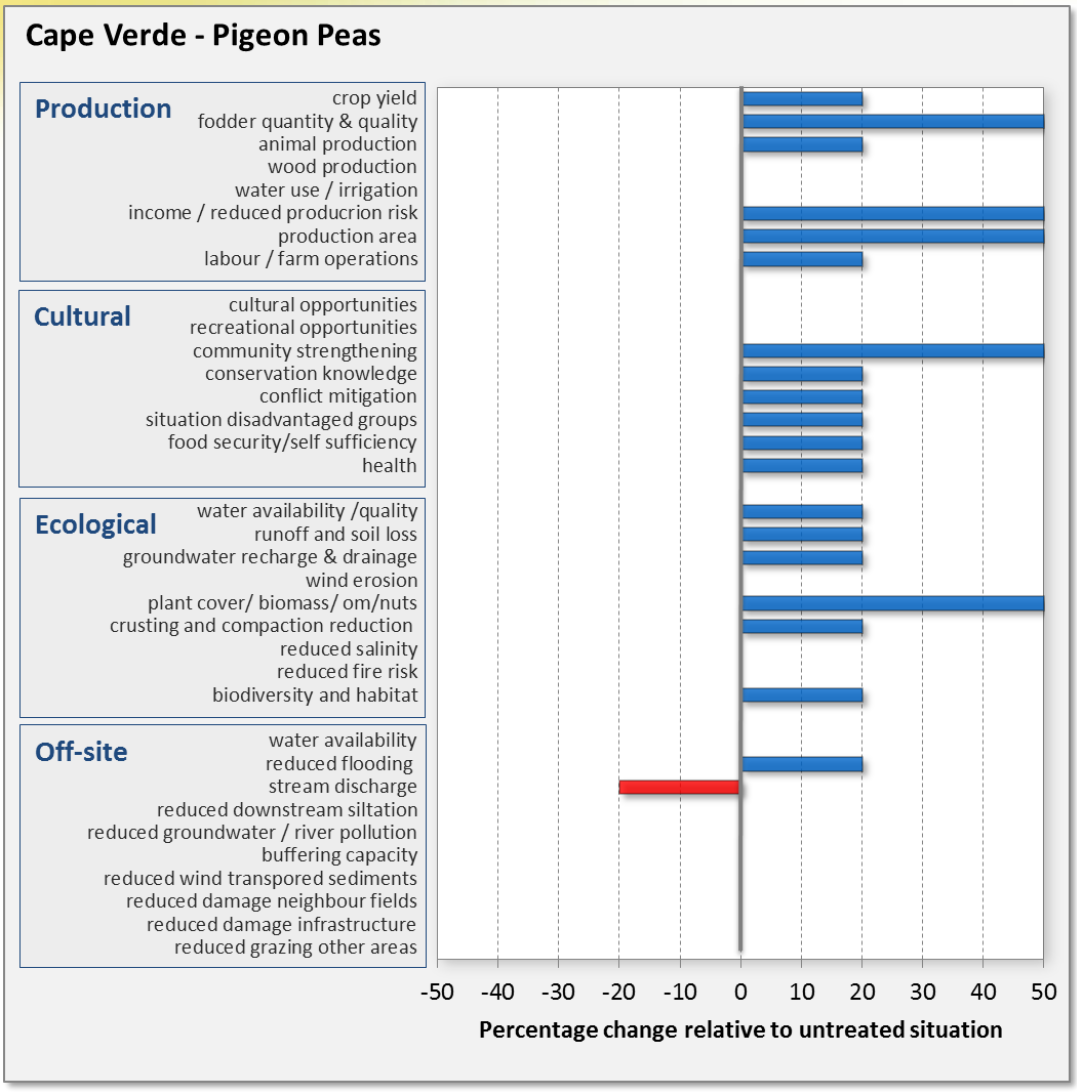
Pigeon pea with pruning		**Pigeon pea without pruning**	
Area (km^2)	Soil loss ($t.ha^{-1}.yr^{-1}$)	Area (km^2)	Soil loss ($t.ha^{-1}.yr^{-1}$)
20.4	> 20	12.7	> 20
37.6	10 – 20	29.7	10 – 20
11.7	5 – 10	25.0	5 – 10
1.5	2 – 5	3.6	2-5
0.3	0 -2	0.5	0-2

Data on runoff, erosion rate and suspended sediments are available for only 2010 and partially for 2011 (see table below). Using only one year data is not sufficient to make any firm conclusions to assess the effect of pigeon pea plantation on controlling runoff and soil losses.

Variables	2010*[1]					2011**				
	8	9	10	11	12	8	9	10	11	12
Run off max inst. ($m^3.s^{-1}$)	0	3.42	1.75	0	0	N/A	N/A	N/A	N/A	N/A
Mean Suspended sediment ($g.l^{-1}$)	0	4.0	2.80	0	0	0	7,88	0,23	0	0
Erosion ($t.km^{-2}.yr^{-1}$)	0	5.25	2.50	0	0	0	N/A	N/A	0	0
Soil cover (%)	60	80	85	85	80	83	86	90	94	94

EVALUATION

The results were evaluated from a production, socio-cultural and economic point of view. The bars (see below) express the estimated or measured percentage of change with respect to the reference situation. This change can be positive (blue) or negative (red). Note that this evaluation is based on the experiments, on the long term experience of the coordinating team in this area and on consultations with the farmers.



STAKEHOLDER OPINIONS

Stakeholders were involved since the beginning of the project. They were involved in selecting and implementing the technology. The stakeholders seem to be convinced that the cultivation of pigeon pea and afforestation with fruit trees help in combating land degradation. This was shown by the workshop organised with them.

Stakeholders evaluated the technology as very positive in terms of production and other effects that relate to a higher income. They only negative aspect is that conserving water upstream might cause water shortage downstream.

Feedback from participants

Participants found the participatory approach and methodology used in its implementation very good. This was because it gave each group of stakeholder the opportunity to be part of the project

and share responsibility for the success of the selected technology.

It was registered the reactions of some participants and here are some quotes from them:

Farmers:

- "I recommend all my friends to plant pigeon pea in their land"
- " Pigeon pea helps woman to feed their children, get extra income, enrich the soil and protect their land from being carried away"

Technicians:

- "The DESIRE methodology enforced the participatory approach used in Cape Verde to combat desertification"
- "The project changed the attitude of land users regarding the use of Natural Resources"

UNCCD focal point:

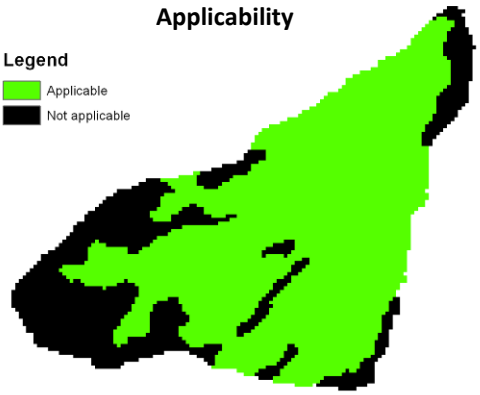
- "The objectives of the DESIRE project fit in the goals of UNCCD and the positive results should be applied to other watersheds in Cape Verde"

Technology Scenario:
Terraces with Pigeon pea (CPV01)

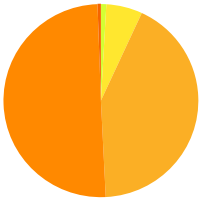
- Fixed investment costs of ECV 295,000 (€2675) are assumed.
- Transport costs of produce to market are considered; range ECV 17-2,500 per year.
- A discount rate of 13% has been applied
- A lifetime of 10 years has been set, with the first year no benefits.
- The baseline without terraces is taken as without case.

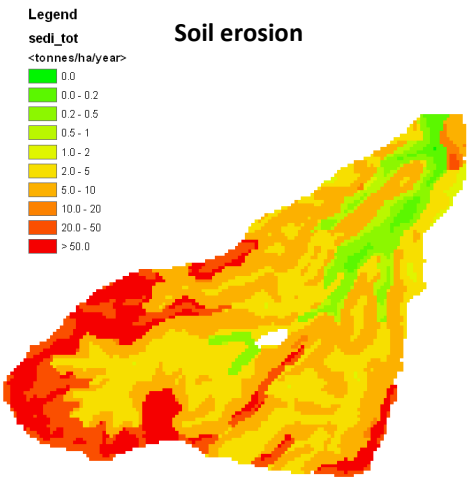
Applicability

- The technology is not applicable in very steep or flat areas



Biophysical impact: reduction of erosion





The technology 'Terraces with Pigeon Pea' requires heavy upfront investment. If implemented on unproductive (unused) land, the technology can be profitable. However, it is more likely that most land is already in use, in which case the technology has negative present value almost universally. A governmental Payment for Ecosystem Services (PES) scheme could go some way to incentivise farmers to adopt the technology. In this policy scenario we assess the effect of a subsidy of 50% of the investment cost

Conclusions

Since main results from implementation of technologies are not yet available, it is difficult to discuss or draw any relevant conclusions at this point, in particularly regarding the hydrological results which will only be measures during the 2011 rainy season. Any changes observed between 2009 and 2010 results (hydrological parameters) can hardly be attributed to the effect of the technologies since at the time of measurements the technologies were being implemented. However, we think that real impact will be evaluated in two or three years.

Farmers are optimists that both the cultivation of pigeon pea and plantation of fruit trees within the scope of DESIRE will significantly contribute to protect their soil against erosion, increase crop production and improve their livelihood conditions through more income generation. Farmers are aware of the benefits of pigeon pea crop as: a high protein content grain legume crop, green manure and firewood (woody stems).

This technology helps improve vegetation cover which helps in reducing surface runoff and soil erosion. Whether applied as terrace barrier or more mixed with the traditional Maize crop in an intercropping pattern crop yield is increased and supplemented with fodder supply from pruning of the pigeon peas.

When applied in the entire catchment it should be noted that downstream water supply might be affected. This may have consequences for a dam was built downstream with a reservoir for irrigation which may have less inflow of water.

Some Key Policy Messages

- Farmers should be the center piece in the widespread implementation of technology and be involved in decision making regarding SLM
- NGOs and extension people should sensitize and inform land users about desertification issues, prevention and mitigation strategies
- Decision makers should legislate on the use of SLM technologies like cultivation of pigeon pea on steep rainfed lands

Leading Scientist:
Isaurinda Baptista, Jacques de Pina Tavares
INIDA
P.O. Box 84
Praia, Cabo Verde
Tel.: (238) 2711127
http://www.inida.cv/
mail: ibaptista@inida.gov.cv

➜ Contact address: ALTERRA, Soil Science Centre/ Coen Ritsema, P.O. Box 47, 6700 AA Wageningen, The Netherlands
Phone: +31 317 48 65 17
Fax: +31 317 41 90 00

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Isaurinda Baptista, Jacques de Pina Tavares

See: http://www.desire-his.eu/en/ribeira-seca-cape-verde for full details of DESIRE research