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*Contributory paper*

# **Desertification and Coping Strategies**

## **1. Anthropogeneous factors of desertification**

The Atacama Desert in western South America and the Namib Desert in south western Africa are among the few deserts of which we can say with some certainty that their existence has not been caused by human factors. In the case of the Atacama Desert, the Humboldt Current brings up cold water from the Antarctic region, very similar to the situation of the Namib Desert, where the Benguela Current off the south west African coast also carries cold water from the south.

But with regard to many other deserts on this planet, there is proof that they originate from the destruction of a once rich nature, and that those destructions of complex ecosystems have been caused by man. Although it can be said that the results of destructive action are always relative and depend on various other, especially climatic, factors, there is usually a destabilisation of a formerly stable system, going along with irreversible losses of species. After such destruction, the system will again reach a state that is relatively stable; however, it will then be impoverished and it will have much less complexity than in former times.

Examples of human influences that have led to a radical change, not only of the ecosystem, but also of the climate, can be found around the Mediterranean Sea, as well as in south eastern, southern, south western, western and other parts of Europe. We know from historical records that already in ancient cultures, especially in the Roman Empire, logging took place to an extreme extent. Timber was used for ships, which usually did not last very long and soon ended up at the bottom of the sea. But wood was also cut for fuel and for the production of charcoal, which was then used for smelting furnaces. Both flora and fauna were destroyed with a remarkable lack of consideration. Unfortunately, things have not really changed since then; only that they have shifted towards the tropics, where the destruction of the rain forests now take place in a large scale.

As far as Europe, and not Africa, was concerned by those deforestations of the past, the outcome was not desert in the common sense, but landscapes that have been stripped of their assets. Not only have many of the forests gone,<sup>1</sup> but also soil has been washed away, with karst formations dominating vast regions. Once the soil is gone, reforestation becomes very difficult, and even agricultural use is very limited. This is the case in large areas, e.g. of Greece and Iberia. It was not only the Romans, but also other cultural groups, such as the Normans, who had this greed of wood, for building ships and for martial purposes. The results can be found in parts of the British Isles and in Northern Europe. We can assume that Scotland has once been covered with dense forests. Also, overgrazing and other careless agricultural use led to a pauperisation of species and to erosion. Due to the Gulf Stream, Europe is in a relatively lucky position of constantly receiving some warm and humid input from the west. However, the cutting down of the rain forest of the Amazon basin can be expected to have a negative effect on the Gulf Stream.

For Northern Africa, historical records indicate that there was logging and arson at Phoenician time. Now, the Sahara is expanding southwards, gaining 200 square kilometres of ground annually. In the Hoggar and Tassili mountains, ancient rock paintings bear witness of a once rich ecosystem, a lush green habitat with animals that nowadays can be found in tropical Africa.

Even Australia, the desert continent, had a green past. Certain species, like some *Livistonia* palms, now living in different canyons far apart, where they have the moisture that they need, prove that once, there was a continuous forest layer covering the land. Computer simulations that try to reconstruct the historical processes modellise quite plausible how humans, having entered Australia from the Indian subcontinent, have cleared it successfully from its forests by means of fire. As a result, there is open land now, in which only species can survive that are able to withstand the hostile arid conditions. Eucalyptus, formerly presumably rather a rare group of plants, then spread all over the land. Some of the species now common to Australia are even specialised in fire germination: Its seedpods only deliver the seeds after having been exposed to fire.

In the deserts that are located in what is now the southwest of the USA, the collective behaviour of pre-Columbian humans parallels to what had happened in ancient southern Europe. The process of desertification also took place within a short time. Like in other cases, it was triggered by logging, serving the needs for the production of certain goods. The pre-Columbian Indians produced a lot of pottery and used up the trees. In the now deserted ruins, archaeologists have found rat droppings, which they analysed, and it turned out that they contained the seeds of trees, the fruits of which apparently were on the rats' diet. However, those trees need a humid climate, and it was thus proved that until a certain moment in the course of that civilisation, those trees existed in that area. Depletion then led to their eradication.

The climate change that occurs after the extinction of the flora has to do with certain mechanisms that are necessary for rain to come about. The mere humidity of the air, the mere existence of clouds is not enough. The water molecules in the air need a point to crystallise on. Any particles can serve this purpose, but in an intact ecosystem, certain bacteria, which are carried up with the winds, enable the water molecules to dock on and form ice crystals that then sink down to warmer layers, where they smelt, so that they become water drops – it rains. But the precondition for those bacteria to

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<sup>1</sup> In Spain and Portugal, there was cork-oak as a successive monoculture. But these trees have become victims of EU policy: Since there is compensation for fallow land, cork-oaks have been cut down.

exist are plants. Once the plants are gone, it won't rain. Without rain, plants cannot grow. A vicious circle.

Deforestation with subsequent erosion, as described above for ancient Europe, is unfortunately something that happens globally. There are areas in Brazil, where rain forest had been cut down, and only ten years later, there was bare rock.<sup>2</sup> Such an environment does not provide good living conditions, neither for humans, nor for plants, or even for certain bacteria.

Monocultures, as they are being presently established to produce soya or bio fuels - alcohol from sugar cane, plant oil from palms -, exterminate huge areas of forest, including their inhabitants. Plant and animal species are being extinct. Indigenous peoples face degradation, being displaced and forced into globalised clothing, in order to live a marginalised life outside their territories that used to be intact forests. However, those soils are not suited for these monocultures, they are soon exploited and, when given up, prone to massive erosion, finally leading to desertification. Of course we have to change towards renewable energy, but we have to ensure that this is done in a sustainable way. We should make sure not to touch any more ecosystems. But in order to preserve ecosystems, it is necessary to preserve the indigenous cultures living in them. The connection between culture, environment and climate has also been pointed by the United Nations Environment Programme.<sup>3</sup> This should be taken very seriously. If, by law, it is made sure that everyone who enters such an indigenous territory, has to leave outside objects, which represent the industrial culture and which might destabilise the indigenous culture concerned, because those cultures still know how to manage the habitat in a sustainable, environmentally friendly way. The global culture does not know this any more, and it is very unwise to delete that knowledge. But it can only be preserved if those cultures stay alive. Therefore, the protection of those remaining cultures means the protection of those remaining intact ecosystems, which means the protection from further desertification.

On the other hand, with regard to cultures with cattle, sheep and goats, it cannot be overlooked that overgrazing furthers aridity, and is also a factor leading to desertification. Nomadic and pastoralist cultures need enough space to move within. As long as their herds remain within the traditional size, and as sufficient room is granted, the plants can recover. However, burning the grass, as it is often done in Africa to give way for new growth, should not be practised, because the effect of having some fresh green is not worth the detrimental effects.

## **2. Catching the moisture – an example of combating desertification**

In both deserts mentioned initially, the Atacama and the Namib Desert, there are also certain mechanisms that hinder the rain, though natural ones. Both deserts touch the ocean, and there is the almost paradox situation of a dry desert right next to lots of water. But the currents off both coasts do not carry enough thermal energy. Although fog is very common there, this is not enough to go up high, to condensate and then sink within a temperature bias.

Therefore, these stretches along the sea belong to the areas of the world, where the supply of drinking water is very problematic due to aridity. However, although it does not rain, there is atmospheric humidity, namely the fog, sea mist, or nightly dew. In recent

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<sup>2</sup> Each second, 2.420 tons of soil are washed into the seas of the world (Paczian, 2007, p. 9).

<sup>3</sup> UNEP news release, Nairobi, 8. Feb. 2001. Cf. also Groh (1994, 1995).

years, there have been several projects of trapping this moisture with large nets.<sup>4</sup> The results have been very promising. If there is moisture that evaporates from the sea, villages and even small towns can be supplied with drinking water.

But those nets require constant manpower in terms of maintenance. Also, those nets are made of artificial material, and they do not really fit into the natural environment. They are, by far, not as effective as plants that are specialised for catching humidity from the air.

The probably most effective plant to serve this purpose is *Pinus canariensis*, a tree native to the Canary Islands. It is well known for its capability of collecting air moisture, and has already been used for many centuries for this purpose. This tree would allow a much more effective and environmentally friendly way of supplying arid regions with drinking water than what can be reached with fog-catching nets. Moreover, it would also help to establish or re-establish vegetation in a natural way. Agriculture would profit from it, too, because vegetables could be produced, watered with the help of *P. canariensis*.

In those places, where the net-projects are currently running, it is the right time now to plant *P. canariensis* seedlings underneath the nets, as long as there is constant watering to allow them to grow. They would then soon replace the nets. The surface of the trees is much larger than the surface of the nets, thus enabling much more moisture to condensate. Within a few years, a population of *P. canariensis* would be established that collects many times more water than the nets. With regard to ecological aspects, the introduction of *P. canariensis* into the environments concerned do not cause a problem, since in those desert areas, there are no native trees that could be superseded, and the *P. canariensis* trees are easy to control. They are a natural alternative to the unnatural plastic nets, and can even help to enhance any local flora.

The functions of trees within different ecosystems with regard to collecting fog water have been studied intensively during the past years, both in general,<sup>5</sup> and especially with regard to *P. canariensis*.<sup>6</sup> The tree grows in a wide range of climatic conditions, it can survive drought, heat, and some frost, and it can live in areas from sea level up to more than 2.000 m above sea level. When a population of trees has been established, it additionally produces timber and fuel-wood.

Areas, in which *Pinus canariensis* could be used for obtaining drinking water, include: *Chile, the Dominican Republic, Ecuador, Eritrea, Guatemala, Haiti, Israel, Namibia, Nepal, Peru, The Sultanate of Oman, Venezuela and Yemen.*

Generally, these are areas where there is air moisture, but the climatic conditions do not allow for enough condensation of the humidity in the air, which is necessary for rainfall.

The research institution S.A.C.S. (Structural Analysis of Cultural Systems), based at the Technical University of Berlin, has recently suggested to the UN Human Rights Council that projects of implementing *Pinus canariensis* be carried out, targeted at serving the access to drinking water in such areas.<sup>7</sup>

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<sup>4</sup> Cf. <FogQuest.org>.

<sup>5</sup> Burkard et al. (2002), Hughes & Brimblecombe (1994), Jauregui (1991), Neal et al. (1993)

<sup>6</sup> Aboal et al. (2000), Grill et al. (2004), Morales et al. (1999), Page (1974), Luis et al. (2004), Tausz (1998)

<sup>7</sup> In reply to Decision 2/104 on Human Rights and Access to Water, particularly with regard to items d), e), f), and g). Correspondence of 13. 4. 2007. There has already been a preparatory meeting with the scientists of the Universidad de la Laguna (ULL), Tenerife, who are specialised in *P. canariensis*

### 3. Tackling irrational obstacles

A number of trees are well apt and even seem to be ideal for the reforestation of treeless areas. Whereas *P. canariensis* can unfold its capabilities in regions that are dry, but yet have air moisture, other places have different conditions. *Betula alba* is a very good pioneer plant. *Betula* seeds are shaped like little airplanes; they can be carried by the wind. After the last Ice Age, *Betula* ssp. were probably the first trees (followed by *Pinus* ssp.) to establish themselves in the open lands of the Northern Hemisphere from which the glaciers had withdrawn. Since the tree needs frost and humidity, it could be especially useful in mountainous areas that have frost due to the altitude and in other wet and cold regions without trees. However, one has to look for the specific reasons why the trees have vanished from a certain area. In Africa, trees are often cut carelessly for fuel. Even if only a small amount is needed, a whole tree might be cut down, one branch is taken, and the rest is left behind for deterioration. Under such conditions, *Phytolacca dioica* can be a good solution. It looks like a tree, it even has a large and impressive trunk, but it does not produce wood. Inside, it is structured like a herb, without the yearly lignin rings that are typical for trees. Whoever cuts such a tree in search of fuel, or even just a branch of it, will learn instantly that this tree does not yield any wood. From then on, he or she will leave alone any tree of that kind.

However, we have to look carefully which tree we introduce into which area. Whenever there is a local tree that can fulfil the necessary tasks, it should not be pushed away by any imported species. Eucalyptus, for example, that has been planted in Mediterranean coastal areas since a long time, causes problems for local plants by absorbing the nutrients from the ground and dropping its leaves, which contain essential oils and prevent other plant species from growing. Yet, the situation is different from the one that we have in deserts, or in areas prone to desertification. Along the Mediterranean coast, there are still a large number of local trees, whereas in arid or semi-arid areas, the lack of trees is the problem. And generally, trees can be controlled easily, they are not really small, and they are stationary, unable to hide, like rabbits do.

A dogmatic refusal to introduce plants into a new environment can be very negative for the region concerned, taking the various possible scenarios into account. Planting trees when there are no other trees is a good option, if the alternative would be to do nothing at all. Also, to plant some trees that are less threatened to be cut down is a good option, because there is the chance of continuous forestation, with other plants, including local trees, also having the chance to survive in the shelter of those persistent trees.

Apparently, the aspects of natural and artificial spreading are relative distinctions that need revision. When seeds are carried by birds and dropped somewhere, this is considered natural. But actually, humans are natural beings, so what about them carrying seeds? Another aspect is that many species have been extinct during the Ice Ages, when giant glaciers, like bulldozers, scraped all life off the ground, and when they withdrew, they left more or less sterile land behind. In Europe, the Alps were barriers for the vegetation and the animals to return from south to north, other than in America, where the mountain ranges run along the latitudes. Would it, therefore, be legitimate to say that since some species (like *Sequoia* ssp. or *Ginkgo* ssp.) that existed in Europe before the Ice Age(s), should not be reintegrated because the Ice Ages were something

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research. At the ULL, there are enough seedlings available to start such a project. Also, preparatory correspondence has been made with research scientists in several other countries, as well as with project partners in Namibia and Peru. The Technical University of Berlin is in touch with scientists in most of the countries concerned, so that the number of project locations could easily be expanded.

“natural”? As far as astrophysical phenomena can be blamed, the mechanisms that caused the Ice Ages occurred independently of the ecosystems concerned. Therefore, the rationale of having to accept the loss of species due to the Ice Ages has to be questioned.

Generally, a high density of species characterises well-functioning ecosystems. A system is the more stable, the more subsystems exist. High density of species means complexity of life. Low density of species means desert.

#### **4. Striving for balance**

Finally let us have a look at the fascination of deserts. Such a fascination is generally felt by people who do not live in the desert, and who experience deserts only on TV, by watching pictures, or during a holiday trip, like other consumable experiences. From outside the desert, from the safe havens of the First World, the desert can even be mystified and in such a way be portrayed in literature, film, music and other media. It is easily overlooked that indigenous cultures living in the desert, have adapted to it only under the pressure of the circumstances, often having ended up in the desert as the last refuge when being threatened by other ethnic groups. As I once heard one Tuareg say, “Everyone of us knows what thirst is”.

Deserts are not very desirable for our planet. There are, as mentioned, a few deserts that have come to exist without human action. The Namib Desert, for example, results from the restructuring of geological formations under the influence of the maritime streaming that shifts material to settle it along the coast. Those natural deserts have conditions to which certain species have adapted. Looking at it the other way round, we can say that we need those deserts, since they are necessary for those species.

But the other deserts, whose growth can be seen in connection with human action, should be regarded in the global context of man-made changes. Especially, they should be seen in the context of the carbon dioxide balance. Deserts mean a lack of biomass that otherwise would bind CO<sub>2</sub>. Looking at a globe, we can see the deserts like large bald spots on a head. If they would be reforested, we would have some very large CO<sub>2</sub> sinks.

Therefore, the acceptance of deserts should be reduced to a minimum. Deserts are dangerous. Not only for individuals to be lost in them, but also for our atmosphere. Taking a globe of 1 m in diameter, how thick would be the atmosphere in the same scale? 5 cm? 10 cm? – No, it would only be 1 mm! Just a thin film, covering the planet. We need this film. And we urgently need oxygen input into it.

Reforestation is one of the predominant and most pressing tasks with regard to this planet. Instead of hesitating and delaying, we should use every opportunity to forward it.

*Arnold Groh*

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