Surface Changes – Land Loss

Land loss or land degradation refers to processes that reduce the usability of land for economic purposes, mostly agriculture, and occurs in all parts of the world. Land loss can have different causes, both anthropogenic and natural, and is in many cases a highly complex mixture of interrelated processes. It is mostly permanent and non-reversible, quite independently of its origin. Sometimes, as with land mines, the affected areas can be cleared and used again, but this is in most cases a very time-consuming and expensive task.
The page presents examples in which the soil as the basis for agriculture is lost, degraded by salinisation or made unusable by making access to the area or the consumption of the harvested products too dangerous. The examples are intended to

- give an idea of the importance of usable land for mankind;
- demonstrate the complexity of the problem in respect of the processes involved; and
- provide an insight into the huge efforts that are needed to reverse this type of process.

Map Descriptions

Map 1: Mississippi Delta, USA, 2000
Satellite/Sensor: Landsat ETM
Acquisition Date: Mosaic, 1999-2000
Band Combination: near natural colours
Map Information: -

Description: The satellite image shows the Mississippi delta (see Atlas page 162/163) and the coast of Louisiana. This area is especially vulnerable to land loss as a result of compaction, subsidence, hurricanes, tidal erosion, sea level rise, and human activities. The coastal salt marshes form a buffer zone protecting the entire coast of Louisiana from the effects of hurricanes from Mexico. Due to human impact, like that of the oil industry that dredged channels into the marshes, the sediment deposition is altered and the edges of the marshes begin to degrade. Furthermore, natural causes, such as hurricanes and storm surges, play an important role in terms of land loss. The colours of the water in the image indicate the transport of Mississippi river sediments by sea currents and thereby illustrate the processes involved – the reduction of sediment load in the Mississippi River is one of the reasons for the problems in the delta region.

Map 2a: Mississippi Delta, USA, 1976
Satellite/Sensor: Landsat MSS
Acquisition Date: 09.04.1976
Band Combination: near natural colours
Map Information: -

Description: The satellite image shows the southern part of the Mississippi Delta and its extension in 1976. A comparison with Map 1 shows differences in the extent of vegetation e.g. in the delta region near Venice, but also in the marshes north of Timbalier Bay.

Map 2b: Louisiana, land area changes between 1976 and 2001
Satellite/Sensor: based on Landsat MSS, Landsat ETM
Acquisition Date: 09.04.1976, 1999-2001
Band Combination: pseudo colours
Map Information: land loss and gain

Description: The change map derived from Landsat MSS and Landsat ETM data shows areas lost to the sea (red) and reclaimed from the sea (green). In most parts of the coastal region the areas of marshland have shrunk, with the important exception of some of the river arms of the Mississippi delta. Here the course of the river and narrow strips of surrounding land have been stabilised by special constructions, because the river is also an important route for ships.

Map 3: Huang He-Yulin, China
Satellite/Sensor: Landsat ETM
Acquisition Date: 06.08.2002
Band Combination: near natural colours
Map Information: -

Description: The Loess Plateau covers some 640,000 km² in north-west China and has one of the world's highest soil erosion rates. Loess is a fine windblown deposit which is derived from glacial deposits. It is highly prone to erosion caused by wind and water. Due to the fertile soils, which developed on the loess, the plateau was for centuries intensely used for agriculture and grazing. Large-scale deforestation has been carried out In order to increase the amount of arable land. Unsustainable farming practices, combined with huge population pressure, have led to severe environmental degradation. Large gullies now traverse the former flat plateau.
Before the construction of the Three Gorges Dam, the annual total sediment load of the Yellow River at its estuary was about 480 million tons, with about 90% coming from soil erosion on the Loess Plateau. Conservation practices, like tree planting, ridge construction between fields and around gullies, terrace and dam construction are being implemented (see also Atlas page 203, afforestation in Yulin) on a large scale in order to reduce soil erosion.

Map 4: Soil Erosion Patterns, Yulin, China
Satellite/Sensor: QuickBird
Acquisition Date: 23.10.2005
Band Combination: near natural colours
Map Information: -

Description: The detail view illustrates the problems of soil erosion. Gully systems form at the edges of the fields, and fertile soil is lost during rainfalls.

Map 5: Southwest Australia, overview
Satellite/Sensor: Landsat ETM
Acquisition Date: 23.08.1999
Band Combination: near natural colours
Map Information: -

Map 6: Salinisation Map, Southwest Australia
Satellite/Sensor: Thematic map
Acquisition Date: salinisation change 1990-1998
Band Combination: pseudo colours
Map Information: salinisation changes

Description: The south-west of Western Australia is an agricultural area dominated by a Mediterranean climate, with 24 million hectares of agricultural land, forest and remnant vegetation. The replacement of the natural vegetation by annual pastures and crops has altered the hydrological balance and led to the raising of the ground water level, which was originally more than 10 m below the root zone. Due to

the geology of the region the ground waters, which now reach the roots, are saline. Salinisation of land and inland waters is among the highest priority environmental issues of the region, as it has significant effects on the natural vegetation as well as on agricultural productivity. The salt-affected areas were estimated to cover 1.8 million ha in 1996 and to double until 2020. The salinisation map (Map 6) has been produced using satellite data for the assessment of salinised areas,

Map 7a: Chernobyl, 1986
Satellite/Sensor: Landsat TM
Acquisition Date: 29.04.1986
Band Combination: near natural colours
Map Information: -

Map 7b: Chernobyl, 1992
Satellite/Sensor: Landsat ETM
Acquisition Date: 02.10.1999
Band Combination: near natural colours
Map Information: -

Description: The two satellite images show Chernobyl and its surroundings directly after and six years after the catastrophic explosion at the nuclear power plant. Chernobyl lies in the northern Ukraine near its border with Belarus. Before the accident it was an important centre of trade and commerce. On April 26, 1986 tests of reactor number 4 of the nuclear power plant were performed without following the safety procedures. This lead to a steam explosion, subsequently to a fire and a series of additional explosions, and eventually to a nuclear meltdown. Because there was no containment building, a plume of radioactive fallout drifted over parts of the western Soviet Union, Eastern Europe, Scandinavia, UK and the eastern United States. Large areas of Ukraine, Russia and Belarus were massively contaminated (see Map 8). More than 200,000 people had to be evacuated and resettled, and the number of casualties is still a matter of discussion.
The satellite images show the power plant at the northern end of the cooling pond, the Pripyat River, and the city of Chernobyl to the south-east. In the image acquired shortly after the accident, a clear agricultural pattern can be recognised with the fields at different stages of maturity, especially to the south-west of the Pripyat River. By 1992 large areas of agricultural land were no longer used due to the relocation of the people, and the field structures have disappeared from the image. The white structures north of the river are concrete barriers.

Map 8: Endangered zones after the Chernobyl outburst
Satellite/Sensor: background Envisat MERIS
Acquisition Date: Sept. 1996
Band Combination: near natural colours
Map Information: radiation spots.

Description: The thematic map shows the radiation spots resulting from the nuclear power plant accident. The radiation density was also used as a parameter defining different zones, from closed zones, permanent control zones and periodic control zones to contaminated, still uncontrolled zones. Due to the prevailing winds more than 60% of the radioactive fallout landed in Belarus, changing wind conditions spread the fallout over large parts of Europe.

Map 9: Closed military area, Germany
Satellite/Sensor: Landsat ETM
Acquisition Date: 04.09.1999

Band Combination: near natural colours
Map Information: -

Description: The satellite image map shows the former military training area at Lieberose north of Cottbus, Germany, which was used by the Soviet Army when the area was part of East Germany. Because of the 100 t of partly unexploded ammunition left behind after the retreat of the Red Army, the area is closed and cannot be used for other purposes. Clearing of the area is done in a way similar to demining and is very time-consuming. On the other hand, it has become a refuge for numerous plant and animal species.

Map 10: Bikini Atoll
Satellite/Sensor: Landsat ETM
Acquisition Date: 14.01.2001
Band Combination: near natural colours
Map Information: -

Description: The Bikini Atoll is one of the Micronesian islands in the Pacific Ocean. It is one of the Marshall Islands and consists of 36 islands surrounding the lagoon. The United States used some of the Marshall Islands as nuclear testing sites. The aim was to study the effects of nuclear weapons on ships, equipment and material. 23 atomic bombs were tested in the lagoon of the atoll between 1946 and 1962. Preceding the nuclear tests, the indigenous population was relocated to other islands. Due to the nuclear fallout the atoll has remained contaminated.

Map 11: Mine-belt, Croatia
Satellite/Sensor: Landsat TM
Acquisition Date: Mosaic, 1990-1995
Band Combination: near natural colours
Map Information: mine information.

Description: The break-up of Yugoslavia started in 1990 and led to a military conflict between the later successor states. During the conflict large areas along the front lines were mined to prevent the respective enemies from crossing. Years after the conflict, large parts of the region are still inaccessible as they are areas where mines are suspected. Between 1998 and 2006 more than 2,600 mine victims were counted in Croatia, and nearly 100 of them died. Despite ongoing demining efforts, in 2006 the mine-infected area was larger than 1,100 km² for Croatia alone.