PD ISO/TR 14055-2:2022

BSI Standards Publication

Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification

Part 2: Regional case studies

Documents
Document Sharing Hub

Full document details: PD ISO/TR 14055-2:2022

National foreword

This Published Document is the UK implementation of ISO/TR 14055-2:2022.

The UK participation in its preparation was entrusted to Technical Committee SES/1/5, Environmental Management - Life cycle tools and techniques.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 15335 4

ICS 13.020.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2022.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD ISO/TR 14055-2:2022

TECHNICAL REPORT

ISO/TR 14055-2

First edition
2022-03

Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification —

Part 2: Regional case studies

Management environnemental — Lignes directrices pour l'établissement de bonnes pratiques pour combattre la dégradation et la désertification des terres —

Partie 2: Études de cas régionales

Reference number
ISO/TR 14055-2:2022(E)

Documents
Document Sharing Hub

© ISO 2022

Full document details: PD ISO/TR 14055-2:2022

COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TR 14055-2:2022

Contents

Page

Foreword ... **vi**
Introduction ... **vii**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Abbreviated terms ... **1**
5 Presentation of case study examples ... **3**
6 Case study A — Community education and sustainable livelihoods for land degradation management in the sub-montane La Rioja province, Argentina ... **6**
6.1 General ... 6
6.2 Context ... 7
6.2.1 Location ... 7
6.2.2 Physical features ... 7
6.2.3 Socio-economic features ... 8
6.2.4 Interested parties ... 9
6.3 Land degradation problems faced ... 9
6.3.1 Types of land degradation observed ... 9
6.3.2 Drivers of land degradation ... 11
6.3.3 Risk of future land degradation — Resilience ... 11
6.4 Objectives ... 12
6.5 Interventions ... 12
6.6 Results ... 16
6.7 Lessons learnt and benefits ... 16
6.8 Conclusion ... 17
7 Case study B — Use of GIS and RS to support spatial planning for drought resistance in continental marginal lands in India ... **17**
7.1 General ... 17
7.2 Context ... 18
7.2.1 Location ... 18
7.2.2 Physical features ... 18
7.2.3 Socio-economic features ... 19
7.2.4 Interested parties ... 19
7.3 Land degradation problems faced ... 19
7.4 Objectives ... 20
7.5 Interventions ... 20
7.6 Results ... 22
7.7 Lessons learnt and benefits ... 22
7.8 Conclusion ... 23
8 Case study C — Sand dune stabilization in continental desert region of western Rajasthan, India ... **23**
8.1 General ... 23
8.2 Context ... 23
8.2.1 Location ... 23
8.2.2 Physical features ... 24
8.2.3 Socio-economic features ... 25
8.2.4 Interested parties ... 25
8.3 Land degradation problems faced ... 26
8.4 Objectives ... 26
8.5 Interventions ... 26
8.6 Results ... 26
8.7 Lessons learnt and benefits ... 27

Documents
Document Sharing Hub

© ISO 2022 – All rights reserved

Full document details: PD ISO/TR 14055-2:2022

8.8 Conclusion ... 28

9 Case study D — Water supply for irrigation and household use in cold deserts, northwest Himalayas, India ... 28
9.1 General ... 28
9.2 Context ... 29
9.2.1 Location ... 29
9.2.2 Physical features ... 29
9.2.3 Socio-economic features ... 30
9.2.4 Interested parties ... 31
9.3 Land degradation problems faced ... 31
9.4 Objectives ... 31
9.5 Interventions ... 31
9.6 Results ... 32
9.6.1 Augmentation of water supply to water spring ... 32
9.6.2 Creation of snow reservoir ... 32
9.6.3 Creation of artificial snow glacier or ice stupa ... 32
9.6.4 Snow fences ... 33
9.6.5 Use of solar energy for pumping water from aquifers ... 33
9.7 Lessons learnt and benefits ... 33
9.8 Conclusion ... 33

10 Case study E — Food security and value chain analysis for critical coexistence landscapes: The case of Pandamatenga Farms, Botswana ... 34
10.1 General ... 34
10.2 Context ... 35
10.2.1 Location ... 35
10.2.2 Physical features ... 35
10.2.3 Socio-economic features ... 36
10.2.4 Interested parties ... 36
10.3 Land degradation problems faced ... 38
10.3.1 Types of land degradation observed ... 38
10.3.2 Drivers of land degradation ... 39
10.3.3 Risk of future land degradation — Resilience ... 39
10.4 Objectives ... 40
10.5 Interventions ... 40
10.5.1 Approaches ... 40
10.5.2 Challenges and constraints ... 41
10.5.3 Agricultural value chain finance analysis ... 42
10.5.4 Infrastructure and technologies ... 43
10.5.5 Market-based interventions ... 44
10.5.6 Climate smart agriculture ... 44
10.5.7 Resources for addressing the problem ... 45
10.5.8 Project monitoring and review ... 45
10.6 Results ... 46
10.7 Lessons learnt and benefits ... 47
10.8 Conclusion ... 50

11 Case study F — Restoration after woody clearing to improve livelihoods in the D'Nyala Nature Reserve and Shongoane village, Limpopo Province, South Africa ... 51
11.1 General ... 51
11.2 Context ... 51
11.2.1 Location ... 51
11.2.2 Physical features ... 52
11.2.3 Socio-economic features ... 53
11.2.4 Interested parties ... 54
11.3 Land degradation problems faced ... 54
11.3.1 Types of land degradation observed ... 54
11.3.2 Drivers of land degradation ... 54
11.3.3 Risk of future land degradation — Resilience ... 54

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

11.4 Objectives ... 54
11.5 Interventions ... 54
11.6 Results ... 55
11.7 Lessons learnt and benefits ... 57
11.8 Conclusion ... 57

12 Case study G — Regional cooperation to combat desertification and drought: The ECONORMAS programme in Argentina, Brazil, Paraguay and Uruguay ... 57
12.1 General ... 57
12.2 Context ... 58
12.2.1 Location ... 58
12.2.2 Physical features ... 59
12.2.3 Socio-economic features ... 60
12.2.4 Interested parties ... 61
12.3 Land degradation problems faced ... 61
12.3.1 Evaluation approach ... 61
12.3.2 Valles Calchaquíes, Argentina ... 63
12.3.3 Irauçuba, Brazil ... 63
12.3.4 Chaco, Paraguay ... 63
12.3.5 Tala, Uruguay ... 64
12.4 Objectives ... 64
12.5 Interventions ... 64
12.6 Results ... 65
12.6.1 Successful experiences ... 65
12.6.2 Examples of good practices ... 66
12.7 Lessons learnt and benefits ... 69
12.8 Conclusion ... 69

Bibliography ... 70

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 5, *Life cycle assessment*.

A list of all parts in the ISO 14055 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

Introduction

Land degradation and desertification are fundamental and persistent problems that have long been recognized. They are caused by climate variability (e.g. drought and floods), other natural factors and unsustainable human activities, such as over-cultivation, overgrazing, deforestation, over-extraction of water, impacts of construction activities and unsustainable irrigation practices. These activities can lead to loss of vegetation and biodiversity, declining water supply and poor water quality, soil erosion and the loss of soil fertility and structure. The consequences in the medium to long term are loss of agricultural and economic productivity, loss of soil quality and function and loss of ecosystem services, including biodiversity loss and adverse social impacts.

The IPCC Special Report on Climate Change and Land, Summary for Policymakers, noted that "human use directly affects more than 70 % of the global, ice-free land surface" and that "about a quarter of the Earth's ice-free land area is subject to human-induced degradation"[3]. Le et al.[4] estimated that at least 3,2 billion people were affected [by land degradation], while Barbier and Hochard[1][2] estimated that 1,33 billion people were affected, of which 95 % were living in developing countries[5].

Land degradation is a driver of climate change through loss of carbon stocks in vegetation and soil, albedo changes and reduced capacity to sequester carbon as soil fertility declines. Furthermore, land degradation is exacerbated by climate change; for example, through reduction in ground cover caused by increased incidence of drought, and enhanced erosion caused by increased frequency and intensity of storms.

Recognizing the significance of land degradation leading to desertification in dryland areas, the United Nations Convention to Combat Desertification (UNCCD)[6] was developed to combat desertification and mitigate the effects of drought in dryland regions, particularly in sub-Saharan Africa. The UNCCD recognizes desertification as a social and economic issue as much as an environmental concern. Therefore, it has a major focus on fighting poverty and promoting sustainable development in areas at risk of desertification. Parties to the UNCCD agreed to implement national, regional and subregional action programmes, and to seek to address causes of land degradation, such as unsustainable land management. This document is intended to complement and support the activities of the UNCCD by providing guidance to land managers on the establishment of good management practices that, when implemented, will reduce the risk of land degradation and desertification and assist in rehabilitation of lands affected by degradation. Land managers expected to benefit from the document include land users, technical experts, private and public organizations, and policymakers involved in the management of land resources for ecological, productivity, economic or social objectives.

The purpose of this document is to provide case studies, in support of ISO 14055-1, on the management of land degradation from all hemispheres of the globe and across tropical, sub-tropical and temperate climates, and from a variety of topographical areas, including deserts, wetlands and marginal landscapes. Participating communities include those with poor economic profiles and limited resources, and those evidencing some wealth and access to technology and the benefits of research.

This document aims to make ISO 14055-1 more relevant and understood, and to promote its use through an illustration of regional case studies and examples that support the Sustainable Development Agenda 2030[7] of SDG 15 (life on land) and SDG 13 (climate action). This document engages a broad range of stakeholders and countries to benefit from their initiatives in combatting environmental degradation and desertification.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

Documents
Document Sharing Hub

Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification —

Part 2:
Regional case studies

1 Scope

This document provides regional case studies of good practices in land management to prevent or minimize land degradation and desertification in support of ISO 14055-1:2017.

The case studies are presented to facilitate the application of ISO 14055-1 across a wide of range of geographical and local conditions.

NOTE The cases studies are presented as different ways of applying good practice and do not preclude alternative ways of applying good practices in accordance with ISO 14055-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14055-1:2017, *Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification — Part 1: Good practices framework*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14055-1:2017 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Abbreviated terms

AVCF	agricultural value chain finance
BAMB	Botswana Agricultural Marketing Board
C-BP	clearing and brush packing (in brush packing restoration method)
CBO	community-based organization
CEDA	Citizen Entrepreneurial Development Agency, Botswana
CLDS	composite land development sites

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

CNFR	Comisión Nacional de Fomento Rural (National Rural Development Commission), Uruguay
CO	clearing only (in brush packing restoration method)
CONICET	Consejo Nacional de Investigaciones Científicas y Técnicas (National Scientific and Technical Research Council), Argentina
CRILAR	Centro Regional de Investigaciones Científicas y Transferencia Tecnológica de La Rioja (Regional Center for Scientific Investigation and Technology Transfer of La Rioja), Argentina
CRS	clearing and re-seeding (in brush packing restoration method)
CRS-BP	clearing, re-seeding and brush packing (in brush packing restoration method)
CSA	climate smart agriculture
CSRS-BP	clearing, soil disturbance, re-seeding and brush packing (in brush packing restoration method)
DPAP	Drought Prone Area Programme, India
DPSIR	drivers/pressure/state/impact/response
EU	European Union
FAO	Food and Agriculture Organization
GIS	geographic information system
HDI	human development index
ICAR	Indian Council of Agricultural Research
IFD	intervenciones físicas demostrativas (demonstrative physical interventions), ECONORMAS programme
IICA	Inter-American Institute for Cooperation on Agriculture
IMSD	Integrated Mission for Sustainable Development, India
IPM	integrated pest management
ISPAAD	Integrated Support Programme for Arable Agriculture Development, Botswana
KAZA TFCA	Kavango–Zambezi Transfrontier Conservation Area, Bostwana
LADA	Land Degradation Assessment in Drylands, Argentina
LDN	land degradation neutrality
LULC	land use/land cover
NDB	National Development Bank, Botswana
NDVI	normalized difference vegetation index
NGO	non-governmental organization

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

ONDTyD	Observatorio Nacional de Degradación de Tierras y Desertificación (National Observatory of Land Degradation and Desertification), Argentina
PBE	Proyecto Básico y Ejecutivo (basic and executive project), ECONORMAS programme
RS	remote sensing
SDG	Sustainable Development Goal
SEZ	special economic zone
SFR	Sociedad De Fomento Rural (Rural Development Society), Uruguay
SLM	sustainable land management
UC	no clearing (control plot) (in brush packing restoration method)
UNCCD	United Nations Convention to Combat Desertification
UNSDF	United Nations Sustainable Development Framework
USD	United States dollar
WAWD	Water Access and Wasteland Development, Pragya project, India
WMP	Watershed Management Programme, India

5 Presentation of case study examples

This document provides examples of measures undertaken to reduce the impact of land degradation. Wherever possible, the examples were selected to demonstrate challenges in different climatic zones – temperate, sub-tropical, tropical – as well as different geographical regions (see Figure 1). The studies have been compiled according to a template so that the logic of each study is properly described, and the relevant good practice emphasized. The relationship between the template and the relevant guidance is shown in Figure 2.

The case studies provide examples of the application of technology, the development of restoration and conservation techniques, stakeholder engagement and innovation, and the alignment of socio-cultural practices. Some projects have been undertaken with international co-operation and support and the participants are described in the study.

The vernacular is used in many case studies and the description of some terms can be found from other sources.

The actions, results, proposals and conclusions described or made within each case study are solely with respect to the particular case study conditions and not intended as a general requirement, recommendation or permission in relation to the use or application of ISO 14055-1:2017.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

Key

Symbol	Location	Clause	Case study	Focus
1	Costa Riojana	6	A	Community education and sustainable livelihoods
2	Madhya Pradesh	7	B	Use of GIS and RS
3	western Rajasthan	8	C	Sand dune stabilization
4	Ladakh-Kinnaur	9	D	Water supply for irrigation and household use
5	Pandamatenga	10	E	Food security and value chain analysis
6	D'Nyala Nature Reserve	11	F	Restoration after woody clearing
7	Valles Calchaquíes	12	G	Regional cooperation to combat desertification and drought
8	Irauçuba			
9	Chaco Paraguayo			
10	Tala			

NOTE Source: Base map: http://equal-earth.com.

Figure 1 — Location of case study examples

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

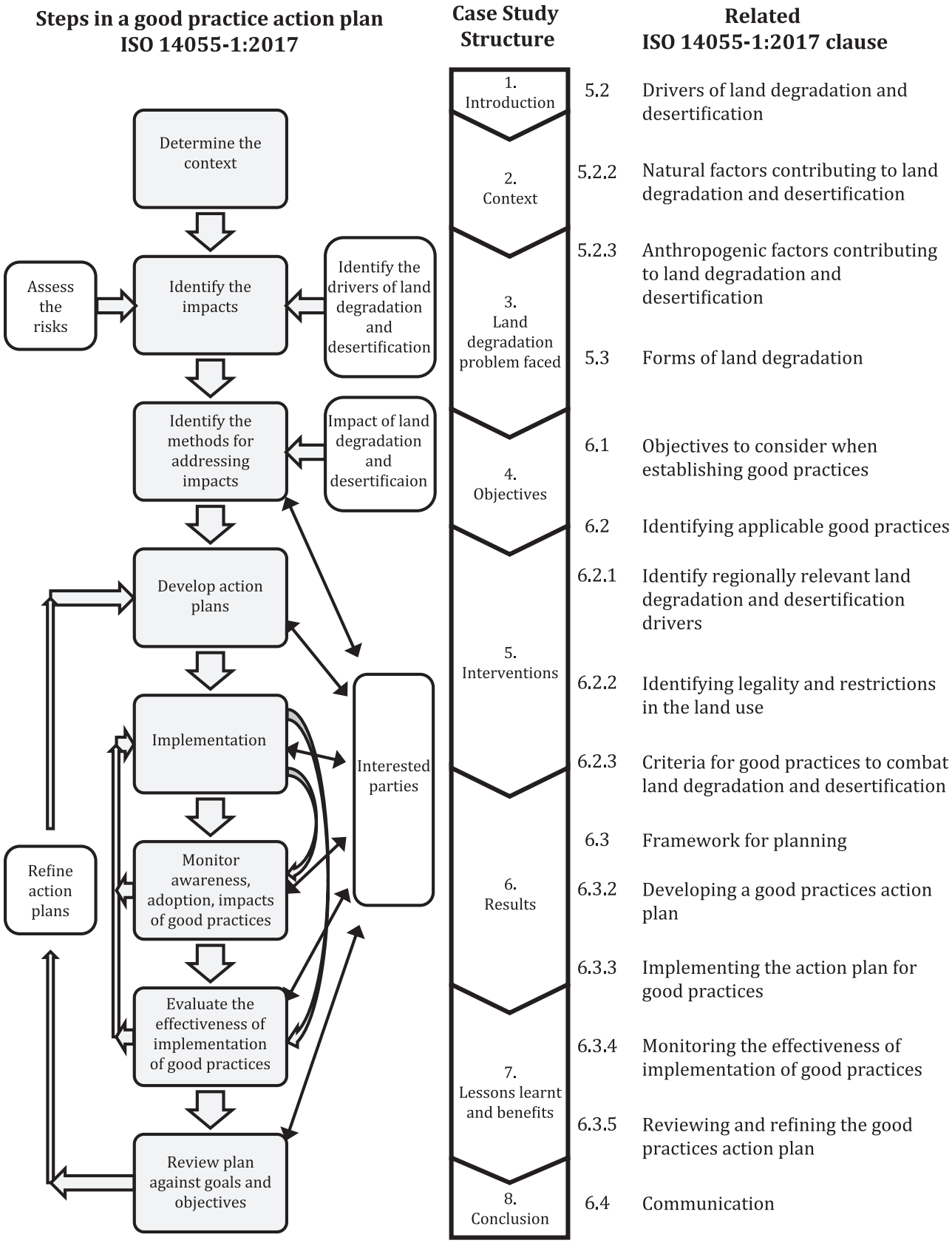


Figure 2 — Case study structure and related ISO 14055-1:2017 clause

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

6 Case study A — Community education and sustainable livelihoods for land degradation management in the sub-montane La Rioja province, Argentina

6.1 General

In 2011, Argentina formed the National Observatory of Land Degradation and Desertification (ONDTyD) as a network of institutions and researchers. This was an outcome of the report on evaluation of desertification in Argentina, under the Food and Agriculture Organization (FAO) Land Degradation Assessment in Drylands (LADA) project[9]. In 2013, the Regional Center for Scientific Investigation and Technology Transfer of La Rioja (CRILAR), under the National Scientific and Technical Research Council (CONICET), located in Anillaco, La Rioja province, became a member of the ONDTyD. The province of La Rioja is located in the northwestern sub-montane region of Argentina and is a semi-arid area which faces severe droughts and desertification.

The Costa Riojana, La Rioja, was selected as a pilot site for an ONDTyD project to collect information about the state, trends and risks of soil degradation and desertification in the area. The purpose was to develop recommendations for the prevention, control and mitigation of damages to the land, so as to assist the decision-making process in relation to environmental management by both the private and public sectors. The members of the ONDTyD project team are from the CRILAR-CONICET.

First, the people of the pilot site, including the representatives of the community, were invited to a workshop that had been organized. After analysing the answers, it was concluded that one of the main causes of desertification during the previous years was the indiscriminate cutting down of mesquite trees (*Prosopis* sp.).

Next, an alternative was proposed: to incorporate the mesquite fruit into the human diet. This would not only promote a healthy diet, but would also promote a sustainable process that would use each and every available resource without damaging or negatively impacting the environment.

One challenge was weather conditions that restrict the use of large portions of the land for agricultural activity. This also resulted in a growing desire to generate work opportunities and productive projects to improve the quality of life for the residents of the area. It was concluded that the most viable solution was the use and care of the mesquite tree. After years of evolution in the area, the native mesquite tree, or “algarrobo” in Spanish, is able to survive the lack of water and climatic variations. The trees survive plagues, their production costs are low and they do not involve much care.

There are different mesquite species, e.g. white mesquite (*Prosopis chilensis*) and black or sweet mesquite (*Prosopis flexuosa*), which are frequent in the Costa Riojana and have multiple applications. Unfortunately, the main demand is for the wood, which is used for firewood due to its high heat capacity, causing deforestation, soil erosion and loss of the vegetation cover.

There are multiple advantages in focusing on the mesquite fruit that would improve the quality of the life of the residents of the area. First, they are excellent sources of protein and good carbohydrates. Second, they can either be consumed fresh or processed. Third, they would help to control nutrition problems in rural areas. Finally, their industrialization would generate new job opportunities.

The mesquite fruit is a pod with pulp (smaller in the white mesquite tree and larger in the black one) that contains many seeds that can be used to feed animals. Unfortunately, only a few do so. The pulp corresponds to the mesocarp, it is sugary, very sweet, sticky, visibly developed, with an approximate thickness of 1,5 mm to 2,0 mm. The natives used it in pre-Hispanic times. This was verified in archaeological remains.

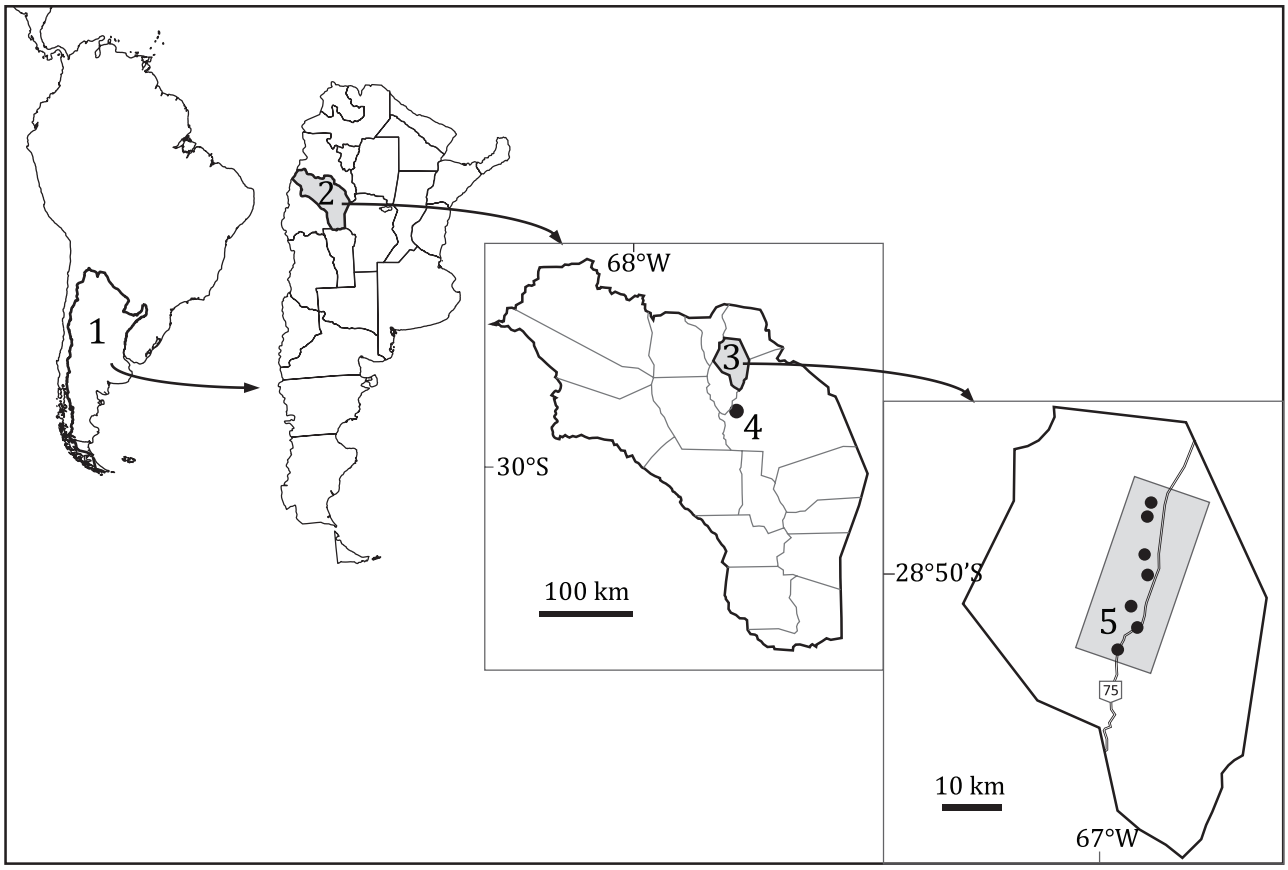
The use of the mesquite fruit is the solution for many problems of the pilot site Costa Riojana. It would improve a healthy diet, would help nutrition and would generate jobs opportunities, while avoiding soil degradation and desertification.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

6.2 Context

6.2.1 Location

The ONDTyD pilot site of Costa Riojana, is located in La Rioja province, northwestern Argentina (see Figure 3). The area under study is bounded by a polygon with the following coordinates: northeast corner at 28° 45′ 16,90″ S 66° 48′ 28,17″ W; northwest corner at 28° 42′ 10,73″ S 66° 57′ 10,51″ W; southwest corner at 28° 57′ 56,41″ S 67° 3′ 31,91″ W; and southeast corner at 29° 0′ 44,40″ S 66° 56′ 46,81″ W.



Key

1 Argentina

2 Costa Riojana (La Rioja Province) in Argentina

3 Castro Barros Department in the La Rioja Province

4 La Rioja city

5 study area and sites along Highway 75 in Castros Barros Department

NOTE Source: http://equal-earth.com; https://commons.wikimedia.org/wiki/File:Argentina_-_mapa_de_las_provincias.svg.

Figure 3 — Location of the ONDTyD pilot site at Costa Riojana

6.2.2 Physical features

6.2.2.1 Climate

The climate is semi-arid, with rainfall that does not exceed 180 mm per year. The minimum winter absolute temperature can reach –12 °C and the maximum absolute summer temperature is 38 °C. The average annual temperature is 16,8 °C (2000 to 2008 period). Frost occurs between the months of June

© ISO 2022 – All rights reserved

Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

and September. There is a large daily thermal amplitude, which can reach up to 21,3 °C. During July and August, the Zonda (a warm and dry wind) is characteristic.

6.2.2.2 Topography

The pilot site covers an area of 43 200 ha, limited by the northeastern flank of the Sierra de Velasco to the west and the mountains of Punta and Mazán to the east. The populations settle in the foot hills of the eastern slope of the Velasco, at an average altitude of 1 400 m above sea level.

6.2.2.3 Soil

The soil can be divided into that of the valley, the flood zone, the piedmont and the mountains.

The valley is characterized by low slopes (between 1 % and 2 %) and moderate to high bare ground cover. The soil in the valley has the characteristics of that of the Aridisols type. This soil is typical of desert areas, and has low organic matter content, light colours, little development or direct absence of horizon A, high porosity and low abundance of roots. The texture is predominantly sandy and silty and has no effective depth limitation.

The flood zone is located adjacent to the channel of the transitory river that acts as a collector of the mountain slopes to the west. Its name comes from its sporadic flood during the rainy season. These characteristics determine a low coverage of bare soil due to the presence of algarrobo trees (*Prosopis* spp.). The soil is predominantly clayey, with a more developed horizon A, a higher content of organic matter compared to the valley and a high abundance of roots.

In the piedmont, the slopes follow the altitudinal gradient, with values of 2 % at the base and up to 30 % at higher altitudes. The coverage of bare soil is low to moderate due to an increase in vegetation cover with increasing altitude. The soil is predominantly open, with a variable A horizon, that can range from absent to moderately developed. It presents greater limitation to effective depth relative to the valley, and it is mostly porous but also with the presence of lumps in lands with agricultural use.

The Sierras, with the highest altitudes, have the highest slopes, exceeding 30 %. The soil has similar characteristics of that of the piedmont, but with a higher content of organic matter and dark brown colour.

6.2.2.4 Natural vegetation

The vegetation in the valley region corresponds to the northern portion of the Monte[8]. It is an open shrub steppe dominated by *Larrea cuneifolia* “jarilla”, and accompanied by *Bulnesia retama* “retamos”, fabaceas shrubs and cactaceas. Herbs and grasses are scarce and their abundance depends on the seasonal pulses of rainfall. The forests are open and marginal to transient rivers, with *Prosopis chilensis* and *Prosopis flexuosa* “algarrobo” (known as mesquite in the United States of America and Mexico) as the dominant tree species. The piedmont vegetation becomes more abundant due to the increase in the humidity that follows the altitudinal gradient. Here, as characteristic species of the Monte vegetation appear *Flourensia fiebrigii,* and *Trichocereus terscheckii* “cardón” in the alluvial fans. Following the permanent rivers, in the riparian forests thrive the trees *Acacia visco* “visco”, *Lithrea molleoides* “molle” and *Schinus fasciculata* “moradillo”.

6.2.3 Socio-economic features

6.2.3.1 Land use and governance (tenure, customary access arrangements)

The predominant land use in the pilot site is a small-scale agricultural production of fruit trees (mainly vine, olive and walnut) and extensive livestock. The farmlands are arranged as small farms of up to 1 ha within the boundaries of the villages. Both irrigation water and water for human consumption come from the permanent rivers of the Sierra. There are two intensive wine productions located in the valley, which use drilling water, drip irrigation and agro-chemicals.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

In the pilot site, the following conditions and processes currently impact on land degradation: extraction of firewood in the valley (mainly algarrobos and retamos), lack of territorial planning, water scarcity and conflicts associated with its use, loss of productivity and economic profitability of small holder farms, ignorance of agricultural good practices and alternative forms of sustainable production, lack of association activism, dependence on state employment, absence of protected areas, and poor awareness of the ecosystem services that provide for the native flora and fauna.

6.2.3.2 Population/demographic/socio-cultural setting

The pilot site has a population between 300 and 2 000 residents distributed in small villages. Their main activities are the harvest of vineyards, walnuts, olives and fruits, as well livestock (mainly goats and cows).

6.2.4 Interested parties

The main goal of ONDTyD project is to provide information about the state, tendencies and the risk of land degradation and desertification, in order to:

a) develop ideas and proposals;

b) promote the prevention, control and mitigation of land degradation and desertification.

This information can be used by both public and private organizations in charge of decision-making in relation to this issue. To make this possible, potential interested parties are identified, including among the general population, government, universities and research institutions.

6.3 Land degradation problems faced

6.3.1 Types of land degradation observed

The types of land degradation observed were degradation of the ecosystem structure and biodiversity, and biomass decrease:

— after clear cutting, there is natural replacement of the forest with secondary forests of reduced productivity, which results in a reduction in biomass and a decrease in species diversity, as well as a reduction in carbon stocks;

— great areas of woodlands were cleared and transformed to open space for agriculture purposes that later were abandoned [see Figure 4 a)];

— there is natural wind and water erosion, frequently aggravated by human activities (anthropic erosion), such as agriculture and over-catching.

One of the main problems of the ONDT y D Costa Riojana pilot site is that people cut down the native tree “white algarrobo” *Prosopis chilensis* and “black algarrobo” *Prospis flexuosa* to obtain firewood, ignoring provincial laws that penalize this practice [see Figures 4 b) and 4 c)].

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

a) Dismantling of the native vegetation

b) Cutting down of algarrobo

c) Trucks transporting firewood from *Prosopis* sp.

NOTE Photo credit: ONDTyD project group.

Figure 4 — Land disturbances

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

6.3.2 Drivers of land degradation

The drivers of land degradation identified were:

— unsustainable agricultural practices, such as:

  — dismantling of native mountain vegetation without previous planning;

  — historical overgrazing;

  — biomass extraction for non-sustainable energy;

  — indiscriminate cutting of algarrobo trees to obtain firewood and wood;

— anthropogenic disturbance involving agriculture and their associated industries generates agro-industrial wastes that produce habitat loss and fragmentation of the wildlife as well as the loss of biodiversity;

— the use of firewood and crop residues as energy sources reduces the content of organic matter, vegetation and forest cover and can also affect rain fall patterns, as well as the hydrology of watersheds.

6.3.3 Risk of future land degradation — Resilience

Some of the risks for land degradation are the indiscriminate use of firewood and wood, as well as the clearing of land for agriculture that is then abandoned due to very high economic costs and lack of profitability. All these practices can be avoided.

Other problems include the lack of education about alternative practices for sustainable land management (SLM), historical overgrazing and dismantling of native mountain vegetation without previous planning.

The lack of information and knowledge of the native flora and fauna is aggravated by the water deficit.

Anthropogenic disturbance involving agriculture and their associated industries generates agro-industrial wastes. As a consequence, it produces habitat loss and fragmentation of the wildlife and loss of biodiversity (see Figure 5).

NOTE Photo credit: ONDTyD project group.

Figure 5 — Olive pomace being loaded into a truck for application on the fields

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

6.4 Objectives

Among the principal goals of the project are the following:

— recovery of degraded areas with algarrobo (*Prosopis* sp.) through the planting of seeds, and practices that use the minimum amount of water;

— avoidance of the indiscriminate cutting of algarrobo trees to obtain firewood and wood, and promote the valuable of the fruits for human consumption;

— creation of added value to the fruits by selling them (processed) as flour or pudding;

— production of edible fungi on agro-industrial waste and use of any of the remainder for feeding of the local cattle.

6.5 Interventions

Since the beginning of the project in 2013, surveys and evaluations have been made of the pilot site. Researchers from CRILAR-CONICET discovered numerous archaeological sites that indicate the use of algarrobo by native people as their food source. The presence of mortars, conanas and seeds demonstrated the elaboration of algarrobo flour (see Figure 6).

a) Rock mortars

b) Close-up of a mortar

NOTE Photo credit: ONDTyD project group.

Figure 6 — Presence of pre-Hispanic mortars

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TR 14055-2:2022

The following observations were made:

— the land degradation was due to the indiscriminate cutting of algarrobo trees to obtain firewood and wood;

— ancestral practices used since pre-Hispanic times, such as the use of algarrobo fruit for human consumption, had been abandoned.

Several intervention activities were carried out at the pilot site, as follows:

— Members of the pilot site study began to give workshops to develop understanding of these matters in the schools of the area. General meetings were also conducted to raise awareness of these problems. Posters were distributed to explain degradation and desertification in 10 schools of Costa La Rioja.

— The first mechanical mill (see Figure 7) was acquired for an agrarian school, which incorporated the milling of algarrobo flour. In each grinding, 10 % of the production is given to the school.

— An edible fungi was produced on agro-industrial residues (pomace from the elaboration of olive oil, grape pomace, walnut shell and remnant of the milling process of algarrobo tree).

Finally, trials of reforestation with *Prosopis flexuosa* and *Prosopis chilensis* with irrigation only in the initial stage are being carried out. These trials have been successful so far (see Figure 8).

NOTE Photo credit: ONDTyD project group.

Figure 7 — First algarroba mill installed in an agro-technical school within the pilot site

© ISO 2022 – All rights reserved

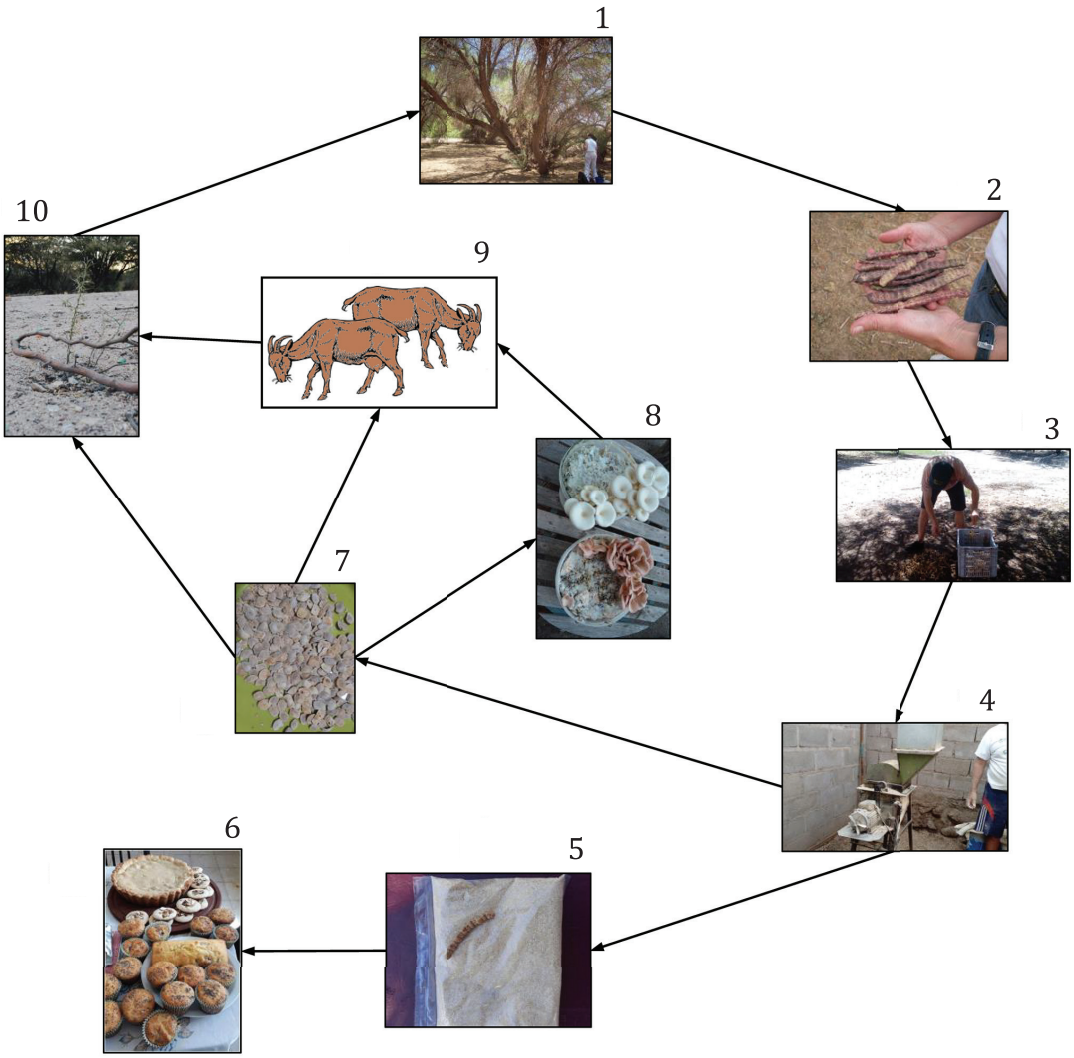
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

NOTE Photo credit: ONDTyD project group.

Figure 8 — Afforestation with only an initial irrigation using hydrogel

The project applied a circular economy approach (see Figure 9), whereby it can be made sustainable with minimal environmental impact. The algarrobo fruits are used to make flour. The flour is used to elaborate human food. Then, the residue of the flour is reused to obtain seeds and then the seeds are used for reforestation. In addition, with other agro-industrial wastes (olive oil, wine, walnut shells) as soil compost, edible fungi is grown and produced. Their fructifications are used for human consumption (girgolas), while the rest of the residue, together with the mycelium of the fungus, is recovered for feeding goats.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022



Key

1 algarrobo mezquite tree
2 fructification
3 harvesting of the fruits
4 flour mill machine for grinding the algarrobo seeds
5 flour produced from algarrobo
6 breads and puddings from algarrobo flour
7 agro-industrial waste from the processing activities
8 girgolas (mushrooms) are grown using the agro-industrial waste residue
9 goats feed on the organic waste residue and contribute to natural fertilisation
10 seedlings grow on hydrogel from agro-industrial wastes and organic fertilisers

NOTE Photo credit: ONDTyD project group.

Figure 9 — Circular economy based on the algarrobo

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

6.6 Results

The interventions were found to have resulted in the following achievements:

— reduction of the indiscriminate use of firewood and wood, thus avoiding logging as the main cause of land degradation;

— reduction of the impact of land degradation through forestation;

— provided availability of mills for the whole community and for the possibility of continuity with the acquisition and use of more mills in other towns or localities;

— rescue of an ancestral cultural food such as the algarroba, adapting it to the current consumer demands (food security), given its high nutritional value and suitability for celiacs (incorporated to Argentine Food Code in 2014);

— rescue of lignocellulolytic edible fungi (*Pleurotus* sp.) growing on agro-industrial substrates (see Figure 10);

— better quality cattle feed and sustainable feeding practices.

NOTE Photo credit: ONDTyD project group.

Figure 10 — Girgolas (*Pleurotus sp.)* growing on agro-industrial substrates

6.7 Lessons learnt and benefits

The interventions resulted in benefits for the community and there were lessons learnt in implementation of the interventions:

— The workshops and lectures in schools have allowed children to stimulate their thinking and to reconfigure their actions by disseminating good practices in their families.

— The planning of ideas was well accepted, but the stage of implementation is slower. In one of the agro-technical schools, the mill has been used but the algarroba flour was not used as food. The consumption of algarroba flour is a challenge, and several certifications that would give added value to the product (as a product suitable for celiacs, an organic product and conformity with International Standards, since the pods are currently extracted from the field).

— It is important to evaluate the advantages and disadvantages of different types of mills according to where they would be located, e.g. in a populated town. It would be easier to place a mill in a

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022

permanent place. However, if houses are scattered, then a portable mill would be more convenient for the inhabitants.

— The native algarrobos tree grows well in the soil conditions of the desert. In this context, reforestation is not necessary. Nevertheless, care and protection of the algarrobo trees is critical to allow them to grow to a mature age.

6.8 Conclusion

Based on the experience at the pilot site, the following actions were proposed by the ONDTyD:

— identify the drivers of land degradation including the impact of past/current practices;

— raise awareness among the population about the problems generated by the use of unsustainable management practices;

— diminish land degradation by locally improving sustainable environmental practices;

— recover ancestral feeding practices, adapting to the new demands of the current consumer;

— mitigate the environmental impact by preventing the algarrobo felling and giving value to the flour obtained from their fruits;

— achieve the use of each stage of algarrobo flour production, mitigating environmental impacts;

— encourage the production of new foods with high nutritional value;

— improve the quality of life of the local population by generating new jobs through a circular economy approach (see Figure 9).

The activities can be aligned with SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

7 Case study B — Use of GIS and RS to support spatial planning for drought resistance in continental marginal lands in India

7.1 General

Nearly 228,3 mha (69 %) of India's total geographical area is under dry lands and 105,8 mha (25 %) areas of the country have been affected by desertification. In 1994, the Ministry of Rural Development, Government of India, launched a Watershed Management Programme (WMP) under the Drought Prone Area Programme (DPAP). The main purpose of this programme was to use a scientific approach for conserving the soil and water resources and optimizing their utilization for increased/sustainable agricultural productivity, regeneration of natural vegetation, and better livelihood opportunities for the people living in the arid regions of the country.

In this clause, the use of the spatial analysis strategy of using remote sensing (RS) and geographic information tools for planning the resulting interventions for combatting soil erosion is presented. The case study area is in the DPAP areas of Jhabua and Dhar districts of Madhya Pradesh, India. A composite land development sites (CLDS) approach was applied with the aid of RS satellite data, other ancillary information and geographic information system (GIS) environment for implementing various watershed management plans in the selected region.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TR 14055-2:2022