



Combating Desertification, Land Degradation and Climate Change :

Management of Drylands

T. S. Chouhan



SCIENTIFIC
PUBLISHERS

Combating Desertification Land Degradation and Climate Change: Management of Drylands

By

Dr. T. S. Chouhan

Department of Geography

University of Rajasthan

Jaipur (India)



Published by
SCIENTIFIC PUBLISHERS (INDIA)

Jodhpur –
5 A, New Pali Road
P.O. Box 91
Jodhpur - 342 001 INDIA
Phone : 0291-2433323
Fax : 0291-2624154
E-mail : info@scientificpub.com

© 2018, Author

All rights reserved. No part of this publication or the information contained herein may be reproduced, adapted, abridged, translated, stored in a retrieval system, computer system, photographic or other systems or transmitted in any form or by any means, electronic, mechanical, by photocopying, recording or otherwise, without written prior permission from the publisher.

Disclaimer: Whereas every effort has been made to avoid errors and omissions, this publication is being sold on the understanding that neither the editors (or authors) nor the publishers nor the printers would be liable in any manner to any person either for an error or for an omission in this publication, or for any action to be taken on the basis of this work. Any inadvertent discrepancy noted may be brought to the attention of the publisher, for rectifying it in future editions, if published.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

ISBN: 978-93-88043-08-3
eISBN: 978-93-88043-09-0

Visit the Scientific Publishers (India) website at
<http://www.scientificpub.com>
Printed in India

About the Author



Professor (Dr.) T.S. Chouhan, former Senior Guest Faculty Member in the Department of Geography, University of Rajasthan, Jaipur (India). He is engaged in teaching and research in the fields of environmental geography, remote sensing and its applications, geography of arid lands, agricultural geography, cartography, GIS, GPS Applications, Geospatial Technology, Geoinformatics and Integrated Area Development etc. Dr. Chouhan has over 35 years of experience in teaching and research in interdisciplinary subject.

Dr. Chouhan has participated in number of International Conferences and Presented Research Paper and Chaired the Technical Sessions. He has visited Brazil, Morocco, Saudi Arabia, Tunisia, Argentina, Germany and France etc.

Dr. Chouhan has worked intensively on the following project:

- (i) Ecology of Tropical Deserts in Special Reference to Arid Land Physiology (UNESCO Project Encyclopaedia of Life Support System).
- (ii) Desert Eco System in India (UNESCO Project Encyclopaedia of Life Support System).
- (iii) Ecology of Tropical Deserts in Special Reference to Biogeography and Evolution of Desert Animals (UNESCO Project Encyclopaedia of Life Support System).

He has also completed one UGC major Research Project on “Geo-informatics for Combating Land Degradation and Desertification in fragile Aravalli foothills eco system of Rajasthan”.

He has to his credit more than 70 research papers published in reputed journals in India and abroad and is the author of more than two dozen well acclaimed books. He has been guiding research work for the last more than two decades and supervised more than fifty doctoral theses.

Dr. Chouhan is a recognized consultant/expert to the Government of Rajasthan, Planning Department (Gr. IV), Jaipur in various fields like Wasteland Development, Forestry, Land Management, Water Conservation, Remote Sensing and Cartography. Presently he is working on the following research projects : Application of Satellite Remote Sensing Technology in Planning Natural Resources of Rajasthan; Environmental Protection and Management of Biodiversity in Rajasthan; Development of Wastelands on Watershed basis in Rajasthan; District Planning Atlas of Rajasthan (Based on GIS Applications) and Natural Disaster Management in Rajasthan using Remote Sensing and GIS.

Dr. Chouhan holds the membership of various International, National and Regional Academic Societies contributing in most valuable manner.

Foreword

Dr. J. K. JAIN

Ex. Head, Department of Geography

Jai Narayan Vyas University, Jodhpur, India

It is generally believed that desertification and land degradation are primarily due to misuse and degradation of natural resources by human-induced efforts and their domesticated animals in arid, semi-arid and dry sub-humid regions of the world. There are, however, two conflicting views on the subject of trends towards increasing aridity. According to the first view, the era of long period droughts as a consequential impact is likely to further worsen the situation. This hypothesis is based on the expansion of the cold air from the polar zones, which has caused equatorward shifting of the major high-pressure belts that limits the advances of the Inter-tropical front from the equatorial regions. The second aspect, to which most biologists and agriculturalists now subscribe, that desert expansion in recent years has been entirely due to human interference with the ecosystem.

The world is presently facing two severe problems, viz., decrease in the productivity as the resultant impact of desertification and land degradation and its feared impact on reduction of food production. The other problem is the unchecked growth of population. The production of food/grains increases slower than the increase in the population as the present trend reveals and its further acceleration due to desertification and land degradation could result in devastation. Therefore, the problem needs to be addressed in the earnest manner to avoid hue and cry for food and survival of the humanity. The social and human dimensions of desertification are equally relevant with stress on physical degradation and resultant social changes as impact.

Efforts made by the international agencies and country governments to arrest the problem could not yield requisite success due to various reasons explained in the book implicitly and explicitly. The situation highlighted through the publication is evident that about 40% of the global land is arid, semi-arid and dry sub-humid, which is severely prone to desertification and land degradation and the population inhabited in such regions is more than 47% of the total world population. Although the arid, semi-arid and dry sub-humid regions respectively cover 12%, 18% and 10% of the global area but the inter-continental and inter countries variations significantly vary. Further the specific situations need specific treatment of the problem keeping in view the geo-physical and climatic conditions. The citations given in the book reveal that there

cannot be a single universal system of combating desertification and land degradation problems. The efforts made by international and country governments for replication of success stories of one region to other parts could not yield similar results as no efforts could be made to assess the local acceptability of area and the people. The lessons need to be learnt, as the process of combating desertification is cost-effective and time-consuming.

Many International agencies and developed countries have come forward for helping the developing and underdeveloped countries for treatment of the problems. Technical and financial assistance has been liberally provided but the results could not be visible in view of various factors. The major factor for unsuccessful or insignificant success was lack of awareness generation among the people and their active association in formulation and implementation of programmes. There is necessity to learn lessons from the past and more in right perspective as the people in dryland areas are facing severe problems and have no courage to wait for further duration in view of faulty implementation process.

Desertification and land degradation are inversely related to poverty and recurrent droughts are the resultant impacts responsible to worsen the situation. The assistance for facing the drought-hit population is human cause for survival of the people but the affected countries need to develop conditions to face their problems as assistance is not the ultimate remedy of the problem. This adversely affects the developmental efforts of the country governments and the primary need becomes to save the affected population. The examples quoted are lessons to initiate remedial measures to save the fertility of the land and survival of vegetative cover. The climatic surfaces of the dryland areas need to be focused on aridity determination with potential impact of climatic variations on desertification. The mitigation measures of droughts need to be incorporated in the context as these have significant impact on the nature and dynamics of vegetation growth and resilience in the drylands.

The population growth in dryland regions is alarming which hampers the efforts of developmental process as the growth of net domestic product is mitigated by the population growth. The measures suggested for combating desertification and land degradation need to be applied keeping in view of the areas-specific conditions. There is an urgent need for developing political will to implement the suggested measures in a well defined timeframe.

Water management is the prime necessity in dryland regions as water is very scarce. Study of water resources of dryland areas is very relevant and this needs to be taken as an indicator of social and economic situation of the people of these area; Positive and negative impacts of desertification need to be assessed with stocktaking the impact of

combating measures for changes in the dryland areas. The national governments need to derive strategy for efficient water management available from rainfall and underground sources. There is necessity to enforce the measures for water saving devices as well as adoption of suitable cropping management for specific regions. Adoption of biotechnology is the ultimate answer to solve various problems of land degradation.

The cultivators of the dryland areas are very knowledgeable of the problems, but they possess traditional practices. Their knowledge need to be equipped with technological support as this is the best mode of application of requisite measures. Every national and local government need to develop its own research system and feasibility studies need to incorporate the cultivators, as their experiences are quite relevant. This can help in developing extension efforts for encouraging sustainable development of dryland areas.

The book is useful for the country governments, planners, geographers and agronomists, and ultimately to the ordinary people who are the victim of the problems. The publication is the signpost pointing towards the exit from the trap. The future of the human species will depend upon whether or not the advice is taken.

J. K. JAIN

Date: June 5, 2018

Place: Jodhpur

Preface

The term “desertification” was employed in 1949 by the French forester Aubreville, who used the term to refer to the displacement of tropical rain-forest by secondary savannah and scrub in those parts of Africa, where forest was being cleared and burned to provide land for cultivation (WMO-UNEP, 1996). Aubreville concluded that the process was especially active in the sub-humid tropics of Africa and was akin to the creation of deserts in the formerly forested areas. The extent of accelerated soil erosion induced by indiscriminate felling of forests and woodlands in Africa and changes in the soil-water budget and hydrological cycle were understood as some of the factors leading to land degradation. There was also a growing recognition of the part played by human activities and climate changes such as prolonged and frequent droughts aggravating land degradation. This led to formally defining desertification as “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities” (UNCED, 1992), which is used as the basis of the UNCCD.

Desertification and land degradation are admittedly impressive terms and have unusual relationship. This is a worldwide problem but in view of its very slow effect, very insignificant attention is paid especially in developing countries. The people living in the affected areas are facing various problems and recurrent droughts are the resultant impact, causing misery to humans, livestock and environmental deterioration. Declining productivity, combined with world population expansion, fluctuations in climate and increasing encroachment on productive lands by roads and cities during drought period constitute an alarming threat to the global life support system. In addition, there are social and human dimensions of desertification, the physical degradation and social change.

Desertification directly affects and puts at risk the livelihoods of more than one billion people, who are directly dependent on land for their survival. Desertification is the degradation of productive land with variable impacts over drylands in the form of droughts, and in irrigated areas as water-logging, salinity and alkalinity. The intensity of the problem lies in the fact that on one side the productivity of land is decreasing constantly and on the other side the population growth is alarmingly high. Main problematic areas are the world's drylands including the Savannas of Africa, the Great Plains and the Pampas of the Americas, the steppes of Asia, the outback of Australia and the margins of the Mediterranean. Desertification is occurring to such a degree that some lands can no longer sustain life.

Drylands of today, have been central in the evolution of humankind, These are the lands that sustained our transition from hunting to pastoralism and agriculture. They still provide much of our grain and livestock and provide the habitat that supports most of the remaining big game animals. They also support a burgeoning human population, but with increasing insecurity as the available land per capita diminish. In this sense, the world is proceeding on the path of destruction and alarms for immediate corrective measures to rectify the problem until it is too late.

Desertification and land degradation affect mainly the arid and semi-arid areas of the earth, but though it may be accelerated by droughts and famines, it is rarely caused by it. On the contrary, their causes are man-made. Desertification is a symptom of the disease of under-development. It results from the combination of social and economic factors, including overgrazing, deforestation, expansion of intensive cash cropping on the marginal land more suitable for pastoralism, poor management of boreholes to water stock and the settling of previously nomadic people, nature and dynamics of vegetation growth and resilience in the drylands.

Desertification also tends to occur more commonly in semi-arid than in arid areas. When rainfall is at least moderately reliable, the desperation to grow more food is higher; and when the ground cover begins to disappear, rains may be heavy and frequent enough to do real damage to the exposed topsoil. The natural causes of desertification and land degradation are eminent and no efforts can succeed on natural disasters. However, the intensity of severity can be minimized with sincere efforts. Human induced effects are very severe, even more than natural hazards; the stoppage of further deterioration is the immediate action to be taken by the human beings, societies, national and local governments. The measures to combat desertification are cost effective and require planned efforts. The on-site and off-site economics need to be ascertained and economic impact and relationship with desertification are the relevant factors of application mode.

The causes of desertification and land degradation cannot be generalized as the reasons for each area are certainly different, but the general issues, which are common in all the regions, need to be addressed with international, national and local efforts. Desertified land can recover, provided enough good soil remains in place and provided local climates have not changed too radically, the land recovers slowly. Once the process to recover is initiated, the impact starts regaining the fertility and ecology.

Therefore, desertification and land degradation need to be understood through various facets, like the causes and severity of the problem particularly in different areas of the world, the natural and manmade reasons for the problem. Unless the problem is not understood fully, further course of actions is completely futile. The second part of the problem is stoppage of the problems identified for each area and making all out efforts at all the levels stalling from the people at gross root upto the international levels. The third and ultimate issue is rectification of the problems to make the world prosperous

Desertification is a complex phenomena resulting from the factors of physical, biological, socio-economic, cultural and political nature. Desertification is not confined to the desert areas of the arid region, but relates to the land degradation in significant area falling within the arid, semi-arid and dry sub-humid regions. Land degradation has a direct impact on land and other natural resources, which results in reduced agricultural productivity, loss of bio-diversity and vegetation cover, decline in groundwater and availability of water in the affected regions. All these lead to a decline in the quality of life, eventually affecting the socio-economic status of the region. About 40% of the total global land is degraded in some form or the other

and the problems of land degradation have reached serious proportions threatening the very existence of the people.

United Nations Convention to Combat Desertification (UNCCD) was adopted on 17th June 1994, which stressed the need for integrated efforts and long term strategies on cross-sectoral issues such as environmental conservation, agricultural productivity, sustainable energy and fodder production and use, efficient management of land, water and other natural resources, developmental activities for the local communities to improve their living standards. The UNCCD has provided a platform for addressing these issues in the global context. The study of water in dryland areas is the need of time. For assessment of the impact of combating measures of desertification need to incorporate social and economic indicators to assess and monitor changes in the dryland areas.

The International Organizations have yielded in alarming the world community to take suitable measures including technological and financial assistance for combating the desertification, but the ultimate approach is to be formed by the national governments keeping in view the local conditions as neither common yardstick can be framed and nor it is applicable in every part of the world. The climatic conditions and area specific situations need to be kept in view while formulating any strategy by national or local governments for combating the desertification and land degradation.

Efforts have been made to site various examples of applications and it is an accepted fact that the success stories of one region cannot be applied in similar manner in other parts of the world, without suitable changes in view of area specific conditions and without taking whole hearted support of the local community in view of their socio-economic situations. Therefore, country governments are required to formulate suitable action plans by associating their own experts of all related disciplines and the people who are facing the problems as well as well aware with the implementation strategy for their own benefits.

Combating desertification and land degradation is a costly process and requires reasonable time to rectify the situations. The people of the area especially the cultivators are well conversed with the situations their traditional knowledge need to be upgraded with technological developments relevant to area and such practices for combating desertification are the best way to initiate the process. There is also necessity of concurrent evaluation with the flexible approach to rectify the practices for further development.

There is need for intensive and extensive research to evolve strategy for reversal of the course of desertification through feasibility studies. The technical know-how relevant to local area can encourage people for sustainable management of drylands. It is therefore, necessary to take the earnest efforts for combating desertification for the well-being of the mankind keeping in view the present and future, where the world is likely to face serious challenges of population increase.

Acknowledgements

The author is grateful to the International Organizations and National Governments for their earnest efforts made for combating desertification and land degradation. In addition, the contributions made by various learned personnels in this field also deserve due recognition. I express my heartiest gratitudes for their sincere efforts for awakening the world community with their views and warning about the problems. The efforts made by all the concerns are not to depict the worst situation ahead but to alarm them with the problems and convince for the future consequences to take adequate measures.

I am thankful to our colleagues for inspiring us for initiating the tedious task and express our gratitude for encouraging us in one way or the other to publish this book.

I shall be failing in my duty, if I do not express my sincere thanks to my wife Vidhya Chouhan, who strived hard during preparation of this publication.

T. S. Chouhan

Contents

Foreword	iii
Preface	vii
Acknowledgements	x

1. Introduction	1
1. Desertification and Land Degradation	1
1.1 Definition of Desertification and Land Degradation	4
1.2 Desertification and land Degradation: The Background:	5
1.3 Sustainable Land Use	9
1.4 Variability in Drylands	9
1.5 Implications for the Study of Desertification	10
2. Status of Drylands, Desertification and Land Degradation	12
2.1 Desertification, Land Degradation and Poverty in Drylands	12
1. Estimated Dryland and Population Affected	14
2. Estimates of Corrective Measures	15
3. Poverty in Drylands	16
2.2 Extent and Distribution of Drylands	20
1. Criteria for Assessment of Desertification	24
2. Estimates of Extent of Desertification	25
3. Social Impact of Desertification	28
4. Estimates of Rates of Desertification	29
2.3 Land-use in Different Dryland Regions of the World	31
(i) Africa	31
(ii) Asia	32
(iii) Mediterranean Europe	33
(iv) Australia	33
(v) North America and Mexico	33
(vi) South America	34
2.4 Extent of Desertification and Land Degradation in Asia	34
Continent	34
1. Afghanistan	35
2. Bangladesh	37
3. China	38
4. Indonesia	39
5. Iran	41

6.	Mongolia	43
7.	Nepal	44
8.	Thailand	44
9.	Vietnam	45
2.5	Status of Drylands and Desertification and Land Degradation in India	46
1.	General Topography	46
2.	Bio-Climatic Regions	51
3.	Type and Extent of Land Degradation	51
4.	Climate and Desertification	52
5.	Major Factors Causing Desertification	53
6.	Impacts of Desertification	54

3. Integrated Indicators of Desertification and Land Degradation **56**

3.1	Hydrological Indicators	61
3.2	Physical Indicators	65
1.	Soils	68
2.	Water Indicators	72
3.	Relative Reflectance Indicator	74
3.3	Ecological and Environmental Indicators	74
1.	Vegetation	80
2.	Animal Indicators	82
3.4	Social and Economic Indicators	89
1.	Types of and Changes in Land and Water use	89
2.	Settlement Patterns	93
3.	Human / Biological Indicators	95
4.	Social Process Parameters	97

4. Processes and Causes of Desertification and Land Degradation **99**

4.1	Climatic Surface and Designation of Aridity Zones	99
4.2	Climatic Variability and Change in Drylands	107
4.3	Soil Degradation/ Land Degradation	119
4.4	Soil Degradation/ Land Degradation in Drylands	127
4.5	Soil Erosion	135
A.	Water Erosion	138
B.	Wind Erosion	143
4.6	Soil Deterioration	148
(A)	Processes of Chemical Deterioration	148
(B)	Processes of Physical Deterioration	154
4.7	Causes of Soil Degradation /Land Degradation	158

4.8	Soil Degradation and Vegetation	168
	(A) Characterizing Vegetation	171
	(B) A Global Vegetation Assessment: NDVI and GVI	172
	(C) Interpreting the Soil Degradation and Vegetation Map	172
	(D) Spatial Patterns Within Drylands	173
5.	Consequences of Desertification and Land Degradation	175
5.1	Geographical Regions	178
	1. Dryland types	179
	2. Problems of Delineating Dryland Boundaries	180
5.2	Soil Degradation / Land Degradation	186
	1. Severity and Distribution of Desertification and Land Degradation	186
	2. Soil Degradation in Susceptible Drylands	191
5.3	Water Erosion	194
5.4	Wind Erosion	197
5.5	Chemical Deterioration	200
5.6	Physical Deterioration	203
5.7	Causes of Soil Degradation and Land Degradation	206
5.8	Soil Degradation Severity and Vegetation	212
	1. Characterizing Vegetation	212
	2. Global Vegetation Assessment	213
	3. Interpreting Soil Degradation and Vegetation Map	214
	4. Spatial Patterns of Drylands	215
6.	Combating Processes of Desertification and Land Degradation	216
6.1	Improving Rainfed Cropping	218
6.2	Improving Irrigated Cropping	227
6.3	Controlling Desertification by Improved Livestock Raising	235
	1. Improving Animal Quality	236
	2. Reducing Stock Levels	238
	3. Improving Rangelands	239
	4. Digging of More Wells	242
	5. Regulating Nomads	243
	6. Prospects for Livestock Development	246
	7. Livestock Dilemma	247
6.4	Controlling Desertification by Planting Trees	247
	1. Large-Scale Fuel-wood Plantations	247
	2. Social Forestry	248
	3. Community Forestry	251

7. Desertification and Land Degration in India	256
PART-A	
7.1 Geographical Background	256
1. Geology	257
2. Physiography	258
7.2 Problems of Desertification and Land Degradation	260
1. Regions of absolute water deficit	266
2. Regions of relative water deficit	267
3. Regions provided with water resources but use less optimally	267
4. Population demography	268
5. Livestock	269
7.3 Processes and Causes of Desertification in India	274
1. Unsustainable agricultural practices	275
2. Unsustainable water management practices	275
3. Land use change	275
4. Deforestation	275
5. Industrial and mining activities	275
6. Demographic pressures	276
7.4 Processes of Desertification	277
1. Wind Erosion	277
2. Water Erosion	277
3. Soil Salinity and Alkalinity	278
4. Water Logging	279
7.5 Desertification Problems in thar Desert	279
7.6 Studies and efforts made by Government of India	281
7.7 Institutional Framework	285
7.8 Assessment of Desertification and Land Degradation	289
PART-B	
Degree, Extent and Treatment of Desertification Hazards in India	294
7.9 Methodology	295
7.10 Degree and Extent of Desertification Hazard	297
(A) Degree of Desertification Hazard	301
(B) Vulnerability of Land to Desertification Processes	302
(C) Bio-climatic Zones of the Problematic States	304
(D) Magnitude of the Problem and its Treatment	306
(E) Conclusion	307
1. Approach for Arid Regions	307
2. Semi- Arid Regions	308
3. Sub-Humid Regions	309

PART-C**Desertification and Human Response - Indian Experience 333**

7.11	Extent and Causes of Desertification	335
7.12	Extent of Desertification	335
7.13	Causes of Desertification	338
7.14	Physical Factors	338
1.	Variability in Rainfall Pattern	338
2.	Climatic Shifts	339
3.	Moisture Factor	339
4.	Albedo Factor	339
5.	Carbon-di-oxide Factor	340
6.	Dust Particles Factor	340
7.	Accumulation and Accretion of Sand and Sand Dunes	340
8.	Geological and Geo-morphological Factors	340
9.	Soil Characteristics	343
10.	Recurrence of Droughts	349
11.	Wind Erosion	349
7.15	Anthropogenic Factors	351
1.	Pressure of Human Population	351
2.	Changes in Land use Pattern	354
3.	Deforestation	360
4.	Land Degradation and Desertification	361
5.	Water Management Problems	361
6.	Use of Chemical Fertilizers and Chemical Pesticides	369
7.	Deterioration in Ethnic Values	369
8.	Flora and Fauna	369
7.16	Results and Distribution of Desertification in India	369
7.17	Combating Measures	372
7.18	Conclusions and Suggestions	372
1.	Management of Land Resources	373
2.	Management of Water Resources	374
3.	Human Resource Management	375
4.	Controlling Human Interface	375

8. Bio-Diversity in Susceptible Drylands 412

8.1	Human Impact on Biodeversity	414
1.	Ecological Consequences of Forest Destruction	415
2.	The Problem of Environmental Degradation	415
3.	Desertification and Land Degradation by Human Impact	416
4.	Desertification and Land Degradation Through Livestock	417
5.	Drought Proofing Measures	417

8.2	Valuing Biodiversity	418
8.3	Policy Responses	420
1.	Policy Measures to Mitigate Land Degradation and Desertification	421
2.	Livestock Breed Improvement Programme	422
3.	Bio- Diversity Imbalance Through Chemical Fertilizers and Pesticides	422
8.4	Conclusions	424
9.	Dryland Plants and their uses	423
9.1	Plant Communities and Coping Strategies	426
1.	Plant Communities in Various Drylands	426
2.	Coping Strategies	427
9.2	Centres of Dryland Plant Diversity	429
9.3	Use of Dryland Plants	433
9.4	Conservation Analysis	441
9.5	Conclusions	441
10.	Carbon Sequestration in Drylands	442
10.1	Rationale for Sequestering Carbon in Drylands	443
10.2	The Carbon Story	445
10.3	Evidence of Carbon Storage	446
10.4	Possible effects of Climate change on Carbon Storage in Dryland Soils	448
10.5	Feasibility of Carbon Storage in Drylands	450
1.	Treating the Problem	451
2.	Interpreting the Information for Forecast	452
3.	Importance of Weather Forecasts in Dryland Regions	452
4.	Strategy for Future	452
10.6	Conclusions	454
11.	Saline Soils in the Drylands: Extent of the Problem and Prospects of Utilization	456
11.1	Global Extent of Salt-Affected Soils	456
11.2	Land-use Practices that lead to the Salinization of Cropland	463
11.3	A Crisis for Dryland Irrigated Agriculture	464
1.	Areas of Concerns	466
2.	Soil Resilience	467
3.	Rate of New Soil Formation	468
4.	Soil Degradation Rate	468
11.4	Methods of Preventing and Repairing Salt Damaged Soils	469
11.5	New Solutions to Salinity Problems	470

1. Inputs and Improved Technology	472
2. Time Scale	473
3. Preventive Measures	473
4. Curative Measures	474
11.6 Conclusions	475
12. Population and Desertification	476
12.1 Expressing Population Characteristics	477
1. Economic Development	479
2. Desertification and underdevelopment	480
3. Role of Government	482
12.2 Population in Global Drylands: Data Sources and Methods	486
12.3 Population in Global Susceptible Drylands	486
13. Poverty and Environmental Degradation	490
13.1 Poverty, Natural Capital and Investment	492
1. Poverty and Population Growth	494
2. Poverty and Desertification	495
3. Poverty and Famine	495
4. Linkage Between Desertification and Poverty in Drylands of the World	496
13.2 Mining the Future	502
1. Efforts by Government to treat degraded lands	502
2. Micro Level Efforts	504
13.3 Poverty Mitigation and Degradation	505
1. Poverty Eradication	506
2. Introduction of Self-employment Activities for Poverty Mitigation	508
13.4 Poverty as a Disabling Factor	508
1. Accelerating the Economy	509
2. Idle Working Force	509
13.5 Conclusion	510
14. Programmes for Combating Desertification and Land Degradation	511
14.1 Efforts of UNCCD so far for Combating Desertification and Land Degradation	512
14.2 Activities of UNCCD at Global and Inter-regional Level	513
14.3 New Initiatives for Combating Desertification	527
14.4 Information Dissemination and Awareness Raising	535
14.5 Social sector and Community development programmes	536
14.6 Programmes specifically for Poverty eradication	539

14.7	Technologies for Combating Desertification	545
14.8	Role of Non-Governmental Organization in Combating desertification and land degradation	554

Bibliography	559
---------------------	------------