

Ecosystem Science and Applications

Dryland East Asia

Land Dynamics Amid Social and Climate Change

Jiquan Chen, Shiqiang Wan,
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Jiaguo Qi, Garik Gutman, Ge Sun,
Martin Kappas (Eds.)

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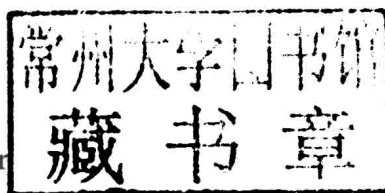
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Abbreviations

3Ns and YRB	Three North and the Yangtze River Basin
ADB	Asia Development Bank
AI	Aerosol Index
ANPP	Aboveground Net Prime Productivity
AO	Arctic Oscillation
AOD	Aerosol Optical Depth
AP	Annual Precipitation
AVHRR	Advanced Very High Resolution Radiometer
BII	Biodiversity Intactness Index
BNPP	Belowground Net Prime Productivity
BSC	Biological Soil Crusts
C	Carbon
CAI	Cellulose Absorption Index
CAS	Chinese Academy of Science
CBD	Convention on Biological Diversity
CBRM	Community-Based Resource Management
CCFP	Cropland Conversion to Forests Program
CMG	Climate Modeling Grid
CMS	Carbon Monitoring System
CNH	Coupled Natural and Human
CRU	Climatic Research Unit
CSDF	French Scientific Committee on Desertification
CST	Committee on Science and Technology
DC	Duolun Cropland
DCA	Drylands of Central Asia
DDP	Dryland Development Paradigm
DEA	Dryland East Asia
DLDD	Desertification/Land Degradation and Drought
DNA	Drylands of North America
DPSIR	Driving Force-Pressure-State-Impact-Response
DS	Duolun Steppe
DTR	Diurnal Temperature Range
DWG	Dryland Working Group
ECVs	Essential Climate Variables
EDN	European DesertNet
EEA	European Environment Agency

ENSO	El Niño-Southern Oscillation
EOS	Earth Observing System
ER	Ecosystem Respiration
EROS	Earth Resources Observation and Science
ESA	Ecosystem Science and Applications
ESIP	Earth Science Information Partner
ESS	Earth System Science
ESSP	Earth System Science Partnership
ET	Evapotranspiration
ETM	Enhanced Thematic Mapper
EVI	Enhanced Vegetation Index
FAO	Food and Agriculture Organization
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FLAASH	Fast Line-of-Sight Atmospheric Analysis of Spectral Hypercubes
fPAR	Fraction of Photosynthetically Active Radiation
GMAO	Global Modeling and Assimilation Office
GCM	Global Climate Model
GCMs	Global Circulation Models
GCOS	Global Climate Observing System
GDOS	Global Drylands Observing System
GDP	Gross Domestic Product
GEP	Gross Ecosystem Productivity
GfGP	Grain for Green Program
GIMMS	Global Inventory Modeling and Mapping Studies
GMAO	Global Modeling and Assimilation Office
GPCC	Global Precipitation Climatology Centre
GPCP	Global Precipitation Climatology Project
GPP	Gross Primary Productivity
GS	Gansu Province
HDI	Human Development Index
H-E	Human-Environmental
HEC	Human-Environment-Climate
HPRS	Household Production Responsibility System
HS	Human System
HYDE	History Database of Global Environment
IGBP	International Geosphere-Biosphere Programme
IGSNRR-CAS	Institute of Geographic Sciences and Natural Resources Research, CAS
IM	Inner Mongolia Autonomous Region
LAI	Leaf Area Index
LC	Land Cover
LCLU	Land Cover and Land Use
LCLUC	Land Cover and Land Use Change
LDA	Land Degradation Assessment
LDCM	Landsat Data Continuity Mission

LTK	Local Traditional Knowledge
LUE	Light Use Efficiency
LUR	Land Use Rights
LUT	Look Up Tables
MA	Millennium Assessment
MAIRS	Monsoon Asia Integrated Regional Study
MAT	Mean Annual Temperature
ME	Metabolisable Energy
MEA	Millennium Ecosystem Assessment
MERRA	Modern Era Retrospective-Analysis for Research and Applications
MG	Mongolia
MISR	Multi-angle Imaging Spectro-Radiometer
MODIS	Moderate Resolution Imaging Spectroradiometer
MSP	Medium Scale Project
MSS	Multispectral Scanner
N	Nitrogen
NAM	Northern Annular Mode
NAO	North Atlantic Oscillation
NARCM	Northern Aerosol Regional Climate Model
NASA	National Aeronautics and Space Administration
NBAR	Nadir BRDF-Adjusted Reflectance
NBSA	National Bureau of Statistics of China
NCAR	National Center For Atmospheric Research
NCEP	National Centers for Environmental Prediction
NDI	Normalized Difference Index
NDVI	Normalized Difference Vegetation Index
NEE	Net Ecosystem Exchange
NEESPI	Northern Eurasia Earth Science Partnership Initiative
NEP	Net Ecosystem Production
NFCP	Natural Forest Conservation Program
NFPP	Natural Forest Protection Program
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Production
NS	Natural System
NX	Ningxia Hui Autonomous Region
OLI	Operational Land Imager
OLS	Ordinary Least Squares
OMI	Ozone Monitoring Instrument
ORCHIDEE	Organizing Carbon and Hydrology in Dynamic Ecosystems
OS	Observation System
PAR	Photosynthetically Active Radiation
PES	Payment for Environmental Services
PPFD	Photosynthetic Photon Flux Density
PPP	Purchasing Power Parity
PRI	Photosynthetic Reflectance Index

PSR	Pressure-State-Response
PSURC	Pressure-State-Use-Response-Capacity
RAS	Russian Academy of Sciences
RCM	Regional Climate Model
RS	Remote Sensing
SACRI	Soil Adjusted Corn Residue Index
SAR	Synthetic Aperture Radar
SAVI	Soil-Adjusted Vegetation Index
SCP	Sand Control Program
SD	Standard Deviation
SeaWiFS	Sea-Viewing Wide Field-of-View Sensor
SK	Seasonal Kendall
SKFPs	State Key Forestry Programs
SLM	Sustainable Land Management
SMK	Seasonal Mann–Kendall
SOM	Soil Organic Matter
SRB	Surface Radiation Balance
SRTM	Shuttle Radar Topography Mission
SSC	Science Steering Committee
START	System for Analysis, Research and Training
START TEA	START Tropical East Asia
SWC	Soil Volumetric Water Content
TEA	Tropical East Asia
TIRS	Thermal Infrared Sensor
TM	Thematic Mapper
TNSFP	Three Norths Shelterbelt Forest Program
TOMS	Total Ozone Mapping Spectrometer
TPN	Thematic Program Network
UHDZ	Ürümqi High-tech Development Zone
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	UN Framework Convention on Climate Change
USGS	U.S. Geological Survey
VI	Vegetation Index
VPD	Vapor Pressure Deficit
WAD	World Atlas of Desertification
WBM	Water Balance Model
WCDP	West China Development Program
WIST	Warehouse Inventory Search Tool
WMO	World Meteorological Organization
WRF	Weather Research and Forecast
XD	Xilinhot Degraded Steppe
XF	Xilinhot Fenced Steppe
XJ	Xinjiang Uygur Autonomous Region

Preface

Among many pressing challenges facing the world today, understanding global changes and their consequences to society have not been well-investigated at regional levels. Based on previous and active research conducted in the Dryland East Asia (DEA) region of Northern Eurasia, various teams have built rich databases on climate, socioeconomic changes, remote sensing products, direct measurements of vegetation, soil, carbon and water fluxes, and demography at county/prefecture levels. One of the greatest challenges in this context is to develop a full picture and synthesis on how dryland ecosystems respond to changes in climate, environment, and human activities. This volume is designed to summarize the accumulated knowledge thus far and to direct future efforts of investigations. A new paradigm—coupled natural and human (CNH) systems—has evolved in recent years as a unifying concept for interdisciplinary research toward the goal of a sustainable society and environment. We instructed the contributors to use the CNH concept in developing their chapters. Our longer-term goal is to develop a synthesis of the data and knowledge on the coupled DEA systems at multiple temporal and spatial scales. We are fully aware that highly variable and changing climatic conditions influence the land cover, land use, and land conditions dynamically and interactively. Likewise, socioeconomic pressures influence land change dynamics and have complex biogeophysical and biogeochemical consequences that cascade through the elements of CNH systems.

A workshop was organized at Henan University in Kaifeng, China during July 18–20, 2011 with co-sponsorship of the Land-Cover and Land-Use Change (LCLUC) Program of NASA, Henan University, and National Natural Science Foundation of China (NSFC). During the workshop, over 40 participants, all active researchers on DEA or other dryland ecosystems, brought up many stimulating questions and suggestions for forming a synthesis study. Two review papers and these book chapters involved 76 authors from 7 countries. These publications move the scientific community closer to understanding processes in DEA. One particular notification for this text is about the administrative boundaries used in almost all chapters. DEA happened to be a region that has experienced some changes in administrative boundaries at provincial, national, and international levels in recent years. Here, we define DEA as a scientific study area, rather than accurate political region; although, we attempted to get the

most accurate information from various governments. Some maps were re-used from published literature where full citations are provided for the responsibility of the data sources.

Many students and researchers at the College of Life Sciences, Henan University provided excellent services that made the workshop a great success. The text of the 19 chapters in this book has been improved through the constructive contributions of both the editors and many reviewers, including Kirsten M. de Beurs, Peilei Fan, Xiaoming Feng, Pavel Groisman, Arnon Karnieli, Shilong Piao, Gabriel Senay, Andres Vina, and Ming Xu. Many others (Chenlu Zhang, Cancan Zhao, Yinzhan Liu, Tingjuan Wu, Lei Wang, Fude Shang, Rumin Gao and Weikai Bao, etc.) also helped with some technical parts of this volume. Dr. Li Zhang of the Chinese Academy of Sciences spent a great deal of time and assistance for the final illustrations—we owe her a sincere thank you. We owe much to Dr. Bingxiang Li of the Higher Education Press (HEP), who has been a long-time supporter of the research in DEA and the current volume. The careful managing editorial work of Yan Guan, Alona Gutman, and Lisa Delp Taylor were critical for the completion of this book. Stephanie Dawson of De Gruyter provided speedy support for the establishment of the book series and proposal reviews on Ecosystem Science and Applications (ESA).

The Editors