Mannava V. K. Sivakumar · Raymond P. Motha (Eds.)

Managing Weather and Climate Risks in Agriculture

World Meteorological Organization

India Meteorological Department

Government of India,
Ministries of Science and Technology
and Earth Sciences

Mannava V. K. Sivakumar
Raymond P. Motha
Editors

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With 134 Figures

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Dr. Mannava V.K. Sivakumar
Agricultural Meteorology Division
World Meteorological Organization
7bis, Avenue de la Paix
1211 Geneva 2
Switzerland

Dr. Raymond P. Motha
USDA/OCE/WAOB
1400 Independence Ave. SW
Room 5133
Washington D.C. 20250
USA

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Foreword

Decision making in agricultural production is a complex process in which many risks need to be considered for an informed decision to be made. Farmers face many types of risks related to production, marketing, legal, social and human aspects. In many parts of the world, weather and climate are one of the biggest production risk and uncertainty factors impacting on agricultural systems performance and management. Extreme climatic events such as severe droughts, floods, cyclonic systems or temperature and wind disturbances strongly impede sustainable agricultural development. Hence weather and climate variability is considered in evaluating all environmental risk factors and coping decisions.

Coping with agrometeorological risk and uncertainties is the process of measuring or otherwise assessing agrometeorological risks and uncertainties and then developing strategies to cope with these risks. There are many challenges. In many developing countries technology generation, innovation and adoption are too slow to sufficiently counteract the increasingly negative effects of degrading environmental conditions. Even in the high rainfall areas, increased probability of extreme events can for example cause increased nutrient losses due to excessive leaching, runoff and water logging. Lack of attention to preparedness and response strategies is a major challenge.

Currently there are many opportunities that can assist in coping effectively with agrometeorological risks and uncertainties. One of the most important strategies is improved use of climate knowledge and technology, which includes the development of monitoring and response mechanisms to current weather. By providing new, quantitative information about he environment within which the farmers operate or about the likely outcome of alternative or relief management options, uncertainties in crop productivity can be reduced. Quantification is essential and computer simulations can assist such information and may be particularly useful to quantitatively compare alternative management and relief options in areas where seasonal climatic variability is high and/or that are prone to extremes. Given the current recognition of the importance of preparedness to cope with risks and uncertainties as compared to the practice of reactive responses, it is necessary to take stock of the opportunities that exist in coping with agrometeorological risks, to develop suitable practices/strategies and to disseminate them widely.

It is with this background that WMO had organized the International Workshop on Agrometeorological Risk Management: Challenges and Opportunities in conjunction with the 14th Session of the Commission for Agricultural Meteorology of WMO held in New Delhi, India. The workshop was co-sponsored by the Asia-Pacific Network for Global Change Research (APN), the Bureau of Meteorology, Australia; the Centre Technique de Coopération Agricole et Rurale – Technical Centre for Agricultural and Rural Co-operation (CTA); the Food and Agriculture Organization of the United Nations (FAO); the India Meteorological Department, Météo-France; the Ministries of Science and Technology and Earth Sciences, Government of India; the UK Met Office; and the United States Department of Agriculture (USDA).

The workshop reviewed the components of farmers' agrometeorological coping strategies with risks and uncertainties in different regions of the world and discussed the major challenges to these coping strategies, such as reducing the vulnerability of different agro-ecosystems to weather and climate related risks and uncertainties, access to technological advances, particularly in developing countries, and attention to preparedness and response strategies. Structural measures such as irrigation, water harvesting etc., and non-structural measures such as use of seasonal to inter-annual climate forecasts and improved application of medium-range weather forecasts for strategic and tactical management of agriculture were addressed. A special evening symposium on weather risk insurance for agriculture reviewed the use of crop insurance strategies and schemes to reduce the vulnerability of the farming communities to agrometeorological risks.

I hope that the papers presented in this book will serve as a significant source of information to all agencies and organizations involved with designing and implementing appropriate strategies and related services to farmers in their efforts cope with weather and climate risks.

M. Jarraud
Secretay-General
World Meteorological Organization

Preface

In many parts of the world climate change and extreme climatic events such as severe droughts, floods, storms, tropical cyclones, heat-waves, freezes and extreme winds are one of the biggest production risk and uncertainty factors impacting agricultural systems performance and management. These events direct influence on the quantity and quality of agricultural production, and in many cases adversely affect it. Although agrometeorology particularly deals with production risks and evaluation of possible production decisions, to solve local problems of farming systems the other risk factors have to be taken into account. Inappropriate management of agroecosystems, compounded by severe climatic events such as recurrent droughts, from West Africa to northern Sudan, have tended to make the drylands increasingly vulnerable and prone to rapid degradation and hence desertification.

In the context of the need for increased agricultural productivity to meet the food and nutritional needs of the growing populations in the world, coping with agrometeorological risk and uncertainties is a very important issue and there are many challenges as well as opportunities as explained in the foreword by Mr M. Jarraud, the Secretary-General of WMO. Accordingly, the Management Group of the Commission for Agricultural Meteorology (CAgM) of WMO recommended the organization of the International Workshop on Agrometeorological Risk Management: Challenges and Opportunities from 25 to 27 October 2006 in New Delhi, India in conjunction with the 14th Session of the Commission for Agricultural Meteorology of WMO. The workshop, hosted by the India Meteorological Department (IMD) and the Ministry of Science and Technology and Earth Sciences of the Government of India, was attended by 188 participants from 78 countries. The specific objectives of the workshop were:

- To identify and assess the components of farmers' agrometeorological coping strategies with risks and uncertainties in different regions of the world, e.g. extreme climatic events (droughts, floods, cyclonic systems, temperature and wind disturbances etc.), inadequate attention to agroclimatic characteristics of a location, lack of timely information on weather and climate risks and uncertainties, lack of crop diversification etc;
- To discuss the major challenges to these coping strategies with agrometeorological risks, such as reducing the vulnerability of different agro-ecosystems to weather and climate related risks and uncertainties, access to technological advances -- particularly in developing countries --, attention to preparedness and response strategies, to agrometeorological services, to training of intermediaries between NMHSs and farmers etc;

- To review the opportunities for farmers to cope with agrometeorological risks and uncertainties in different parts of the world, e.g. with structural measures (irrigation, water harvesting, microclimate management and manipulation and other preparedness strategies) and non-structural measures (use of seasonal to inter-annual climate forecasts, improved application of medium-range weather forecasts) for strategic and tactical management of agriculture;
- To provide on-farm examples of appropriate coping strategies for minimizing agrometeorological risks and uncertainties and of sustainable agriculture;
- To review, through appropriate case studies, the use of crop insurance strategies and schemes to reduce the vulnerability of the farming communities to agrometeorological risks;
- To discuss and recommend suitable policy options, such as agrometeorological services for coping with agrometeorological risks and uncertainties in different parts of the world.

Altogether there were 8 sessions (including opening and closing session) in the workshop during which 25 invited papers were presented. In the workshop sessions, firstly weather and climate events and risks to farming from droughts, floods, cyclones and high winds, and extreme temperatures were identified through risk and risk characterization. Papers on approaches to dealing with risks highlighted preparedness planning, risk assessments and improved early warning systems which can lessen the vulnerability of society to weather and climate risks. Enterprise diversification, contract hedging, crop insurance, weather derivatives and weather index insurance play a key role in developing agricultural risk management strategies. A special session examined the use of crop insurance strategies and schemes to reduce the vulnerability of the farming communities to risks posed by weather and climate extremes.

A number of strategies were identified to cope with risks. These include the use of seasonal forecasts in agriculture, forestry and land management to assist alleviation of food shortages, drought and desertification. The use of integrated agricultural management and crop simulation models with climate forecasting systems give the highest benefits. Strategies to improve water management and increase the efficient use of water included crop diversification and better irrigation. Especially important was the application of local indigenous knowledge. A combination of locally adapted traditional farming technologies, seasonal weather forecasts and warning methods were important for improving yields and incomes. Challenges to coping strategies were many and identified in several papers. Particularly important was the impact of different sources of climate variability and change on the frequency and magnitude of extreme events. Lack of systematic data collected from disasters impeded future preparedness, as did the need for effective communication services for the timely delivery of weather and climate information to enable effective decision making. Finally a range of policy options to cope with such risks were presented. These included contingency planning, use of crop simulation modelling, and use of agrometeorological services.

All the participants in the workshop were engaged in discussions on these papers and developed several useful recommendations for all organizations involved in agrometeorological risk management, particularly the National Meteorological and Hydrological Services. These have been presented in the final paper in this book.

As Editors of this volume, we would like to thank all the authors for their efforts and for their cooperation in bringing out this volume in time. We are most grateful to the India Meteorological Department (IMD) and the Ministry of Science and Technology and Earth Sciences of the Government of India for hosting this meeting and to the Secretary-General of WMO for his continuous support and encouragement.

M.V.K. Sivakumar
R.P. Motha
Editors

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List of Contributors

Y.M. Abdullahi
Ahmadu Bello University
National Agricultural Extension
and Rural Living Services
Zaria, Nigeria
E-mail: ymabdullahi@yahoo.com

P.L. Abramides
Instituto Agronômico
Av- Barão de Itapura, 1481
13.020-902 ,Campinas
Sao Paulo, Brazil
E-mail: pedro@apta.sp.gov.br

N.I. Bakheit
Sinnar University
Faculty of Agriculture,
Abu Naama, Sinnar, Sudan
E-mail: Nagibrahim@hotmail.com

G.C. Blain
Instituto Agronômico -Ciiagro
Av- Barão de Itapura, 1481
13.020-902 ,Campinas
Sao Paulo, Brazil
E-mail: gabriel@iac.sp.gov.br

Lučka Kajfež Bogataj
University of Ljubljana
Agronomy Department
Jamnikarjeva 101, 000
Ljubljana, Slovenia
E-mail: lucka.kajfez.bogataj@bf.uni-lj.si

Michael A. Brady
Global Observation of Forest
and Land Cover Dynamics
(GOFC-GOLD) Project Office
c/o Canadian Forest Service
5320-122 St.,
Edmonton AB, Canada T6H 3S5
E-mail: mbrady@nrcan.gc.ca

A.P.C. Brunini
Instituto Agronômico –Ciiagro-Cepa
Av- Barão de Itapura, 1481
13.020-902, Campinas
Sao Paulo, Brazil
E-mail: andrew@cepaempresa.com.br

O. Brunini
Instituto Agronomico
R. Fernao de Magalhaes 1080
Sao Paulo, Brazil
E-mail: brunini@iac.sp.gov.br

J.P de Carvalho
Instituto Agronômico
Av- Barão de Itapura, 1481
13.020-902, Campinas
Sao Paulo, Brazil
E-mail: jotape@iac.sp.gov.br

N. Chattopadhyay
India Meteorological Department
Agrimet Division
Shivajinagar
Pune, India
E-mail: agrimet_pune@yahoo.com

Adams Chavula
Agricultural Meteorologist
Malawi Meteorological Services
Blantyre, Malawi
Email: adamschavula@metmalawi.com

Ivan A. Csiszar
University of Maryland
Department of Geography
2181 LeFrak Hall
College Park, MD 20742, U.S.A.
E-mail: icsiszar@hermes.geog.umd.edu

Y.M.T. Da Anunciaçao
Instituto Nacional de Meteorologia
Eixo Monumental Via S1
70680-900, Brasília
DF, Brazil
E-mail: marina.tanaka@inmet.gov.br

H.P. Das
India Meteorological Department
Agrimet Division
Shivajinagar
Pune 5, India
E-mail: hpd_ag@rediffmail.com

C. Derry
University of Western Sydney
Hawkesbury Campus
Locked Bag 1797
Penrith South D.C. NSW1797, Australia
E-mail: c.derry@uws.edu.au

P.C. Doraiswamy
United States Department
of Agriculture (USDA)
Agricultural Research Service
1400 Independence Avenue, S.W.
Room 114, Hydrology and Remote Sensing
Laboratory
Washington, D.C. 20705, U.S.A..
E-mail: pdoraiswamy@hydrolab.arsusda.gov

J. Eitzinger
Institute of Meteorology
Univ. of Natural Resources
and Applied Life Sciences (BOKU)
Peter Jordan Str. 82
A-1190 Wien, Austria
E-mail: josef.eitzinger@boku.ac.at

L.T.G. Fortes
Instituto Nacional de Meteorologia
Eixo Monumental Via S1
70680-900, Brasília
DF- Brasil
E-mail : lfortes@inmet.gov.br

William J. de Groot
Natural Resources Canada
Canadian Forest Service
5320-122 St., Edmonton, AB
Canada T6H 3S5
E-mail: bdegroot@nrcan.gc.ca

Johann G. Goldammer
The Global Fire Monitoring Center
Max Planck Institute for Chemistry
c/o Freiburg University
Georges-Koehler-Allee 75
D - 79110 Freiburg, Germany
E-mail: johann.goldammer@fire.uni-freiburg.de

John Hay
Institute for Global Change
Adaptation Science
Ibaraki University
Mito City, Japan
E-mail: johnhay@mx.ibaraki.ac.jp

Ulrich Hess
World Food Programme (WFP)
Via C.G.Viola 68
Parco dei Medici
Rome, Italy
E-mail: ulrich.hess@wfp.org

Peter Höppe
Department of Geo Risks Research
Munich Reinsurance Company AG
D-80791 Munich, Germany
E-mail: phoeppe@munichre.com

A.K.S. Huda
University Western Sydney
Hawkesbury Campus
Locked Bag 1797
Penrith South D.C. NSW1797, Australia
E-mail: s.huda@uws.edu.au

Christopher O. Justice
University of Maryland
Department of Geography
2181 LeFrak Hall
College Park, MD 20742, U.S.A.
E-mail: justice@hermes.geog.umd.edu

Tom Keenan
Weather Forecasting Group
Bureau of Meteorology Research Centre
GPO Box 1289K
Melbourne, VIC, Australia 3001
E-mail: T.Keenan@bom.gov.au

B. Lal
India Meteorological Department
New Delhi, India
E-mail: lalrp@yahoo.com

T. Hind-Lanoiselet
New South Wales Department
of Primary Industries
Wagga Wagga Agricultural Institute
PMB Wagga Wagga
NSW 2650 Australia
E-mail: tamrika.hind@dpi.nsw.gov.au

Felino P. Lansigan
INSTAT and SESAM
University of the Philippines Los Banos (UPLB)
4031 Laguna,Philippines
E-mail: fplansigan@yahoo.com/fpl@instat.uplb.edu.ph

Tim J. Lynham
Natural Resources Canada
Canadian Forest Service
1219 Queen St. East,
Sault Ste. Marie, ON, Canada P6A 2E5
E-mail: tlynham@nrcan.gc.ca

Byong Lyol Lee
Korea Meteorological Administration
208-16 Seodun-dong, Gwonson-gu
Suwon 441-856, Republic of Korea
E-mail: bllee@kma.go.kr

G. Maracchi
I.A.T.A. - C.N.R.
National Research Council
Institute of Agrometeorology & Environmental Analysis for Agriculture
P.le delle Cascine, 18
I-50144 Florence, Italy
E-mail: g.maracchi@ibimet.cnr.it

A. Dalla Marta
Department of Agronomy
and Land Management
University of Florence
Piazzale delle Cascine, 18 50144
Florence, Italy
E-mail: anna.dallamarta@unifi.it

L. Martinelli
Department of Agronomy
and Land Management
University of Florence
Piazzale delle Cascine, 18 50144
Florence, Italy
E-mail: luca.martinelli@unifi.it

Holger Meinke
Department of Plant Sciences
Wageningen University
P.O. Box 430
NL 6700 AK Wageningen, The Netherlands
E-mail: holger.meinke@wur.nl

Keith Menzie
United States Department
of Agriculture (USDA)
World Agricultural Outlook Board
Office of the Chief Economist
1441 Independence Avenue, S.W.
Room 4438 South Building
Washington, D.C. 20250, U.S.A.
E-mail: kmenzie@oce.usda.gov

Elijah Mukhala
SADC Secretariat
Food Agriculture and Natural
Resources Direcotorate
P/B 0095
Gaborone, Botswana
Email:emukhala@yahoo.com

Raymond P. Motha
United States Department
of Agriculture (USDA)
Office of the Chief Economist
World Agricultural Outlook Board
1441 Independence Avenue, S.W.
Room 4419 South Building
Washington, D.C. 20250, U.S.A.
E-mail: rmotha@oce.usda.gov

G. Murray
New South Wales Department
of Primary Industries
Wagga Wagga Agricultural Institute
PMB Wagga Wagga NSW 2650 Australia
E-mail: gordon.murray@dpi.nsw.gov.au

V.R.K. Murthy
Acharya N.G.Ranga Agricultural University
College of Agriculture,
Department of Agronomy
Rajendranagar, Hyderabad-500 030
Andhra Pradesh, India
E-mail: vrkmurthy11@hotmail.com

M. Nikolaev
Agrophysical Research Institute (ARI)
Grazhdansky pr. 14
195220 St. Petersburg, Russia
E-mail: clenrusa@mail.ru

Kevin O'Loughlin
Bushfire Cooperative Research Centre
Level 5, 340 Albert St. East
Melbourne, VIC, Australia 3002
E-mail: kevin.oloughlin@bushfirecrc.com

S. Orlandini
Department of Agronomy
and Land Management
University of Florence
Piazzale delle Cascine, 18
I - 50144 Florence, Italy
E-mail address: simone.orlandini@unifi.it

M. Pasqui
Institute of Biometeorology –
National Research Council
Laboratory for Meteorology
and Environmental Modelling
Via Caproni, 8
I – 50145 Florence, Italy
E-mail: m.pasqui@ibimet.cnr.it

F. Piani
Institute of Biometeorology –
National Research Council
Laboratory for Meteorology
and Environmental Modelling
Via Madonna del Piano, 10
I – 50019 Sesto Fiorentino (FI), Italy
E-mail: f.piani@ibimet.cnr.it

P. Prashad
ICICI Lombard Bank
Zenith House, Keshavrao Khade Marg
Mahalaxmi
Mumbai 400 034, India
E-mail: pranav.prashad@icicilombard.com

Hou Qiong
Inner Mongolia Meteorological Institute
No.49 Hailar Street, Hohhot,
Inner Mongolia, China, 010051
E-mail: Qiong_hou@sina.com

Y. Ramakrishna
Central Research Institute
for Dryland Agriculture (CRIDA)
Santoshnagar
Hyderabad 500059, India
E-mail: ramakrishna.ys@crida.ernet.in

G.G.S.N. Rao
Central Research Institute
for Dryland Agriculture (CRIDA)
Santoshnagar
Hyderabad 500059, India
E-mail: ggsnrao@crida.ernet.in

V.U.M. Rao
Central Research Institute
for Dryland Agriculture (CRIDA)
Santoshnagar
Hyderabad 500059, India
E-mail: vumrao@crida.ernet.in

A.V.M.S. Rao
Central Research Institute
for Dryland Agriculture (CRIDA)
Santoshnagar
Hyderabad 500059, India
E-mail: vumrao@crida.ernet.in

K.V. Rao
Central Research Institute
for Dryland Agriculture (CRIDA)
Santoshnagar
Hyderabad 500059, India
E-mail: vumrao@crida.ernet.in

L.S. Rathore
National Centre for Medium Range
Weather Forecasting
A-50, Institutional Area, Phase II, Sector-62
NOIDA (UP), 201 307, India
E-mail: lsrathore@ncmrwf.gov.in

James Salinger
National Institute of Water
and Atmospheric Research (NIWA)
P.O. Box 109-695, New Market
Auckland, New Zealand
E-mail: j.salinger@niwa.co.nz

Wang Shili
Institute of Eco-environment
and Agrometeorology
Chinese Academy of Meteorological Sciences
No. 46 Zhongguancun, Nandajie
Beijing, China,100081
E-mail: wangsl@cams.cma.gov.cn

R.N. Spooner-Hart
University Western Sydney
Hawkesbury Campus
Locked Bag 1797
Penrith South D.C. NSW1797,Australia
E-mail: r.spooner-hart@uws.edu.au

C.J. Stigter
Agromet Vision and INSAM
Groenestraat 13, 5314 AJ, Bruchem,
The Netherlands & Jl. Diponegoro 166,
68214 Bondowoso, Indonesia
E-mail: cjstigter@usa.net

Roger C. Stone
Australian Centre for Sustainable Catchments
Faculty of Sciences, University
of Southern Queensland,
Darling Heights, Toowoomba, Australia, 4350
E-mail: stone@usq.edu.au

Andreja Sušnik
Environmental Agency
of the Republic of Slovenia
Agrometeorological Department
Vojkova 1b, 1000
Ljubljana, Slovenia
E-mail: andreja.susnik@rzs-hm.si

Lourdes V. Tibig
Philippine Atmospheric, Geophysical
and Astronomical Services Administration
(PAGASA)
PAGASA Science Garden Complex
Agham Road, Quezon City, Philippines
E-mail: lvtibig@yahoo.com

M. Trnka
Institute of Agriculture Systems
and Bioclimatology
Mendel University of Agriculture and Forestry
Zemedelska 1
61300 Brno, Czech Republic
E-mail: mirek_trnka@yahoo.com

I. Uskov
Agrophysical Research Institute (ARI)
Grazhdansky pr. 14
195220 St. Petersburg, Russia
E-mail: office@agrophys.ru

A. Utset
Instituto Tecnologico Agrario de Castilla y
Leon (ITACYL)
Ctra. Burgos km 119
47071 Valladolid, Spain
E-mail: utssuaan@jcyl.es

R.E. Rivero Vega
Meteorological Centre
of Camagüey Province,
Camagüey, Cuba
E-mail: roger@cmw.insmet.cu

Constantino Alarcón Velazco
Servicio Nacional de Meteorología
e Hidrología (SENAMHI)
Jr. Cahuide N° 785 Jesus María
Lima 11. Perú
E-mail: calarcon@senamhi.gob.pe

Nguyen van Viet
Agrometeorological Research Centre
Institute of Meteorology and Hydrology
Ministry of Natural Resources
and Environment
5/62 Nguyen Chi Thanh Street
Dong Da District
Hanoi, Viet Nam
E-mail: agromviet@hn.vnn.vn

Donald A. Wilhite
National Drought Mitigation Center
University of Nebraska-Lincoln
819 Hardin Hall
Lincoln, NE 68583-0988, U.S.A.
E-mail: dwilhite@unlnotes.unl.edu

Tan Ying
China Agricultural University
College of Humanity and Development,
Department of Media and Communication
Beijing, China
E-mail: tanying9966@sohu.com

Wang Yingshun
Xilinhot National Climate Observatory
of Inner Mongolia
No.10 of Group 11 in Eerdemuteng Street,
Xilinhot City
Inner Mongolia, China, 026000
E-mail:Wys5959@yahoo.com.cn

Zheng Dawei
China Agricultural University
Department of Agricultural Meteorology
College of Resources and Environment
Beijing, China
E-mail: zhengdawei44@263.net

Z. Zalud
Institute of Agriculture Systems
and Bioclimatology
Mendel University of Agriculture
and Forestry
Zemedelska 1
61300 Brno, Czech Republic
E-mail: zalud@mendelu.cz

CHAPTER 1

Extreme Weather and Climate Events, and Farming Risks

John Hay

1.1 Introduction

Extreme weather events, and climatic anomalies, have major impacts on agriculture. Of the total annual crop losses in world agriculture, many are due to direct weather and climatic effects such as drought, flash floods, untimely rains, frost, hail, and storms. High preparedness, prior knowledge of the timing and magnitude of weather events and climatic anomalies and effective recovery plans will do much to reduce their impact on production levels, on land resources and on other assets such as structures and infrastructure and natural ecosystems that are integral to agricultural operations. Aspects of crop and livestock production, as well as agriculture's natural resource base, that are influenced by weather and climatic conditions include air and water pollution; soil erosion from wind or water; the incidence and effects of drought; crop growth; animal production; the incidence and extent of pests and diseases; the incidence, frequency, and extent of frost; the dangers of forest and bush fires; losses during storage and transport; and the safety and effectiveness of all on-farm operations (Mavi and Tupper 2004).

Figure 1.1 illustrates how the climate influences agricultural production – specific climatic conditions, including absence of extremes, are required for optimum production. There are major gaps between the actual and attainable yields of crops, largely attributable to the pests, diseases and weeds, as well as to losses in harvest and storage.

When user-focused weather and climate information are readily available, and used wisely by farmers and others in the agriculture sector, losses resulting from adverse weather and climatic conditions can be minimized, thereby improving the yield and quality of agricultural products. While most emphasis should be placed on preparedness and timely management interventions, there will always be a need for the capacity to recover quickly and minimize the residual damages of adverse events and conditions (Stigter et al. 2003).

This paper focuses on a risk-based approach to managing the detrimental consequences of extreme weather events and climatic anomalies such as those described above. Basic concepts related to risk and to risk management are explained, followed by a discussion of farming risks. Details of risk characterization procedures are provided, along with some practical examples. Given the important consequences of climate change for agriculture, attention is given to projection of risk levels into the future. Again some practical examples are provided. Finally, relevant aspects of risk management are discussed. Overall conclusions are also presented.

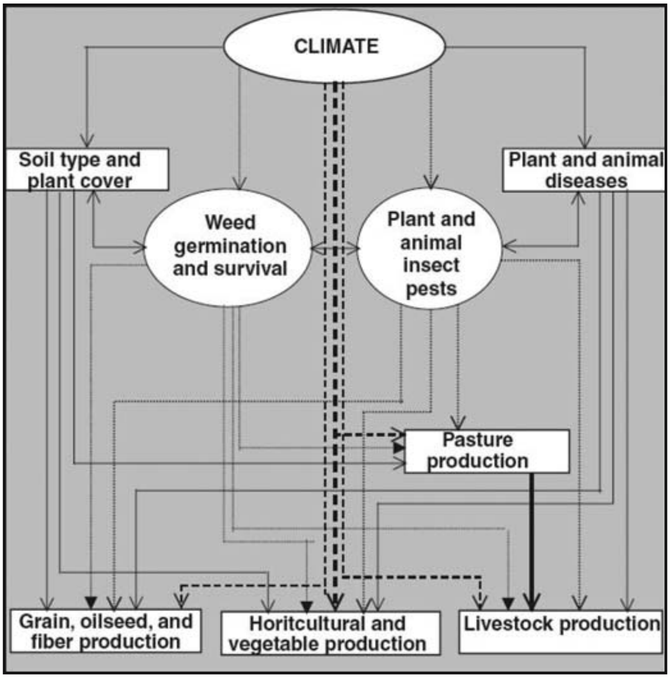

Fig. 1.1. The role of climate in agricultural production (from Mavi and Tupper 2004).

Why a risk-based approach? In recent decades there have been major advances in short-term and seasonal weather forecasting, as well as in long-term climate modelling. These have yielded major improvements in early warnings and advisories as well as in longer-term planning. This is resulting in increasing emphasis on proactive rather than reactive management of the adverse consequences of extreme weather events and anomalous climatic conditions on agriculture. It is also increasing the diversity of options available to farmers and others in the agriculture sector to manage those impacts. Increasingly, farm managers and other practitioners are seeking more rational and quantitative guidance for decision making, including cost benefit analyses. As will be demonstrated in the following sections, a risk-based approach to managing the adverse consequences of weather extremes and climate anomalies for agriculture goes a long way towards meeting these requirements. It also provides a direct functional link between, on the one hand, assessing exposure to the adverse consequences of extreme weather and anomalous climatic conditions and, on the other, the identification, prioritization and retrospective evaluation of management interventions designed to reduce anticipated consequences to tolerable levels.

Finally, risk assessment and management procedures have already been embraced by many sectors in addition to agriculture – e.g. health, financial, transport, energy, and water resources. As will be shown in the following section, a risk-based approach provides a common framework that facilitates coordination and cooper-