CONTENTS

Foreword iii
Acronyms xvii
List of contributors xv
Acknowledgements xvi
Executive summary xix

Chapter I – INTRODUCTION 1

Chapter II – COLD, SEMI-ARID ASIA 9
  Summary 9
  Introduction 9
  Buryatia 11
  People’s Republic of China 14
  Kyrgyzstan 16
  Mongolia 19
  Risk in herding 27
  Strategies for cold semi-arid grazing land 28

  Summary 31
  Selection criteria 33
  Study sites and sample households 33
  Ecological and natural conditions of the study sites 34
  Land-forms and altitude range 37
  Soils 37
  Climate 38
  Vegetation forms and species composition 38
  Pasture condition 40
  Human population 46
  Current management 48
  Timing and pattern of herd movement and household 49
  Seasonal availability of other resources (water, natural salt licks, etc.) 50
  Community decision-making 52
  Movement patterns 52
Turgen sum 56
Rinchinkumbe sum 58
Exceptional 1999 summer and 2000 winter-spring movements in Turgen 59
Trees 61
Community and households 61
Work outside the household 62
Production estimates 63
Fodder balance 63
Community participation 65
Discussion 67

Chapter IV – Mongolia case study 2: Haymaking from natural pasture in Arkhangai, Mongolia V.I. Lkhagvajaw and B. Erdenebaatar 69
Summary 69
Introduction 69
Experimental treatments and techniques 71
The experimental sites 71
Results 74
   Effect of irrigation 74
   Effects on total phytomass 75
   Burgast (Site 2) 76
   Khusluurt (Site 3) 77
Cart design 78
Conclusions 78

Chapter V – China’s pasture resources Zizhi Hu and Degang Zhang 81
Summary 81
Introduction 82
Soils 83
Vegetation 84
Climate 85
   The East Monsoon Zone 85
   The western arid and semi-arid area 85
Features of Agricultural Zones 85
   The northeast 86
   Inner Mongolia and along the Great Wall 86
   Yellow River, Huai River and Hai River 86
   Loess Plateau 86
   Middle and lower reaches of the Yangtze River 86
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The southwest</td>
<td>86</td>
</tr>
<tr>
<td>South China</td>
<td>86</td>
</tr>
<tr>
<td>Gansu and Xinjiang</td>
<td>87</td>
</tr>
<tr>
<td>Qinghai-Tibet</td>
<td>87</td>
</tr>
<tr>
<td>Ruminant livestock production systems</td>
<td>87</td>
</tr>
<tr>
<td>Farm type and size</td>
<td>87</td>
</tr>
<tr>
<td>Livestock species and breeds</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>89</td>
</tr>
<tr>
<td>Yak (<em>Bos grunniens</em>)</td>
<td>89</td>
</tr>
<tr>
<td>Buffalo (<em>Bubalus bubalis</em>)</td>
<td>90</td>
</tr>
<tr>
<td>Sheep (<em>Ovis aries</em>)</td>
<td>90</td>
</tr>
<tr>
<td>Goats (<em>Capra hircus</em>)</td>
<td>91</td>
</tr>
<tr>
<td>Horse (<em>Equus caballus</em>)</td>
<td>91</td>
</tr>
<tr>
<td>Camel (<em>Camelus bactrianus</em>)</td>
<td>91</td>
</tr>
<tr>
<td>Swine (<em>Sus scrofa domestica</em>)</td>
<td>91</td>
</tr>
<tr>
<td>Feeding systems</td>
<td></td>
</tr>
<tr>
<td>Extensive grazing system</td>
<td>91</td>
</tr>
<tr>
<td>Tethering</td>
<td>92</td>
</tr>
<tr>
<td>Uncontrolled grazing</td>
<td>92</td>
</tr>
<tr>
<td>Integration of livestock into farming systems</td>
<td></td>
</tr>
<tr>
<td>Beef production with maize stover</td>
<td>92</td>
</tr>
<tr>
<td>Sheep production with ammoniated straw</td>
<td>93</td>
</tr>
<tr>
<td>Socio-economic conditions</td>
<td></td>
</tr>
<tr>
<td>Legislation</td>
<td>93</td>
</tr>
<tr>
<td>Extension and veterinary services</td>
<td>93</td>
</tr>
<tr>
<td>Market constraints</td>
<td>94</td>
</tr>
<tr>
<td>Pasture and forage resources</td>
<td></td>
</tr>
<tr>
<td>Area and distribution of grassland</td>
<td>94</td>
</tr>
<tr>
<td>Grassland classification</td>
<td></td>
</tr>
<tr>
<td>The Vegetation-habitat Classification System</td>
<td>94</td>
</tr>
<tr>
<td>The Comprehensive and Sequential Classification System</td>
<td>95</td>
</tr>
<tr>
<td>Grassland types</td>
<td>96</td>
</tr>
<tr>
<td>Index of grass yield</td>
<td>96</td>
</tr>
<tr>
<td>Grassland protection</td>
<td>96</td>
</tr>
<tr>
<td>Grassland nature reserves</td>
<td>97</td>
</tr>
<tr>
<td>Dominant plants of the main grassland zones</td>
<td></td>
</tr>
<tr>
<td>Dominant plants of the Temperate Steppe</td>
<td>97</td>
</tr>
<tr>
<td>Dominant plants of the Alpine Steppe</td>
<td>98</td>
</tr>
<tr>
<td>Dominant plants of the Temperate Desert</td>
<td>98</td>
</tr>
<tr>
<td>Dominant plants of the Alpine Desert</td>
<td>98</td>
</tr>
<tr>
<td>Dominant plants of the Warm Shubby Tussock</td>
<td>98</td>
</tr>
<tr>
<td>Dominant plants of the Tropical Shubby Tussock</td>
<td>98</td>
</tr>
</tbody>
</table>
Dominant plants of the Temperate Meadow 98
Dominant plants of the Alpine Meadow 98
Dominant plants of Marshes 99

Opportunities for pasture improvement 99
  Grassland use 99
  Grassland deterioration and control strategies 99
  Grassland improvement 100
  Closure 100
  Reseeding 100
  Surface tillage 100
  Burning 101
  Forage grasses and artificial grassland 101
  Forage cereals 101
  Grain legumes as forage 102
  Root tuber, stem tuber and melon forages 103
  Other cultivated forages 103
  Aquatic forage crops 103

Cultivars and seed production 104
  Seed production 105

Defining economic zones of grassland agro-ecosystems 105
  Grassland zones 105

Current grassland situation and proposed strategy for each zone 106
  Inner Mongolia–Ningxia Arid Grassland Zone 106
  The Northwest Desert-shrubland 109
  Qinghai-Tibet Alpine Shrublands Zone 110
  Northeast Forests Zone 111
  Loess Plateau and Huang-Huai-Hai Plain Zone 111
  Southwest Karst Shrubland Zone 112
  Southeast Evergreen Broadleaf Forest-shrubland Zone 113
  Research and Education 113

Chapter VI – China case study 1: Studies on traditional transhumance and a system where herders return to settled winter bases in Burjin county, Altai prefecture, Xinjiang, China  Wan Lin Wang 115

  Summary 115
  Introduction 115
  Fodder production and Project 2817 117
  Livestock 119
    The Kazakh horse 120
    Kazakh cattle 120
    Kazakh sheep 120
    Others 120
Natural pasture management
 The groups studied
  The Treatment Group
  The Control Group
 Studies on the treatment group (Project households)
  Crop production by the Treatment Group
  Animal production by the Treatment Group.
 Seasonal pasture and livestock movement
  Winter pasture
  Spring and autumn pastures
  Summer pasture
 Studies on the control group (Nomadic households)
  The population of the Control Group
  The pastures of the Control Group
  The basic transhumance pattern of the Control Group
  Livestock production of the Control Group
  Livestock production of the two groups
 Agricultural income and expenditure
  Differences in economic status
 Project achievements

Chapter VII – China case study 2: Cold-resistant lucerne (Medicago sativa) for northern Xinjiang Jichun Min
 Summary
 Introduction
 Testing sites
 Development of ‘Xinmu no. 3’ lucerne
 Studies on other cultivars
 Seed multiplication
 Discussion

Chapter VIII – China case study 3: Pastoral systems, change and the future of the grazing lands in Tibet Tashi Nyima
 Summary
 Introduction
 Tibet Autonomous Region
 Livestock and livestock production
 Biophysical environment
 Soil, vegetation and major types of grazing land
 Alpine meadow soil
Subalpine meadow soil 156
Alpine steppe soil 156
Subalpine steppe soils 156
Mountain shrubby-meadow soil 157
Alpine desert soil 157
Subalpine desert soil 157
Meadow soil and marshland soils 157
Taupe soil and Brown soil 157
Nutrient and mineral contents of major soil types 157
Major pasture types 158
Agro-ecological zones 159
Livestock production systems 161
Crop-based livestock production system 162
Agropastoral production system 164
Pure pastoral production system 164
Agrosilvipastoral mixed production 166
Livestock production potential 167
Pasture carrying capacity 167
Potential of crop residues as animal feed 169
Feed-production potential 170
Potential for livestock breed improvement 171
Changing trends of pastoral systems and livestock production in Tibet 172
The number of livestock: quantitative increase towards qualitative improvement 172
Pasture management: towards a responsibility system 173
Grazing land development: towards intensified management 174
Meat production: hope from increasing the offtake rate of livestock 175
Milk: increasing market demand but stagnant production levels 176
Meat and milk production: the driving forces of their growth 178
Meat and milk production: where are they going? 180
Future grazing land (rangeland) needs for feeding the increasing population 182
Recommendations 184
Using the niches of the unique grazing lands and their biodiversity 184
Accelerating the development of livestock production in the crop-based systems 186
Promoting integrated stable development of livestock production in the pastoral system 187
Speeding up development of urban and peri-urban intensified livestock production 187

Chapter IX – The western Himalaya 189
Summary 189
Grazing rights and fees 232
Livestock 232
Livestock products 234
Livestock health 234
Wild herbivores 234
Fodder and feed supply 234
Constraints of the system 235
Conclusions 236
  Pastoralists’ perceptions of problems and needs 236
  Potential of the systems 237
  Prospects for improving management 237

Chapter XII – PAKISTAN CASE STUDY 2: HIGH ALTITUDE PASTORAL SYSTEMS IN MALAKAND DIVISION, PAKISTAN Khan Sanaullah and Ahmed Mukhtar 239
Summary 239
Introduction 239
Objectives of the study 240
General trends in hillside development 241
  Land ownership and settlement 241
  Plantation 242
  Impact of hillside development on nomadic graziers 243
  Nomadic graziers’ perception of problems 246
Conclusions 247
Recommendations 248

Chapter XIII – THE EASTERN HIMALAYA 251
Summary 251
Introduction 251
Bhutan 252
Nepal 253

Chapter XIV – BHUTAN CASE STUDY 1: TRAHSUMANT CATTLE RAISING IN WESTERN BHUTAN Tsering Gyaltsen and B.N. Bhattarai 255
Summary 255
Study area 255
  The nothouse arrangement 256
  Feed and fodder resources 257
  Pastures at Thombu 260
The reasons for transhumance 262
Transect walk 264
General recommendations
   Traditional transhumance benefits farmers and has advantages
   Disadvantages of the system
   Strategies suitable for immediate implementation

Chapter XV – BHUTAN CASE STUDY 2: YAK HERDERS IN SOE YAKSA, CHENTOK GEOG, BHUTAN, IN 1999–2000
   Tsering Gyaltsen and B.N. Bhattarai

   Summary
   Background
   Grazing lands
   Improved pasture and sown fodder
   Collection of wild plants
   Traditional culture
   Conditions governing the keeping of Monastery yaks
   Constraints perceived by herders
   Suggestions for intervention

Chapter XVI – NEPAL CASE STUDY: HIGH ALTITUDE PASTORAL SYSTEMS OF SAILUNG AND THODUNG REGIONS, RAMECHAP DISTRICT, NEPAL
   S.M. Pradhan, D. Pariyar, K.K. Shrestha and J.R. Adhikary

   Summary
   Background
   The Sailung system
      The herding system
   The Thodung system
   Constraints and suggestions

Chapter XVII – FUTURE DIRECTIONS

   Summary
   Introduction
   The pastures
   Major problems and constraints
      Legal and land tenure problems
      Impact of political and social change
      Changes due to decollectivization
   Technical constraints
      Poor pasture condition
      Other technical constraints
   Socio-economic constraints
   Marketing
Conclusions by zone
  Conclusions from the Himalayan studies 297
  Pasture condition in the Hindu-Kush-Himalaya 298
Conclusions from the Cold Semi-Arid studies 299
Possibilities for pasture improvement – feasibility 299
Interventions on grazing lands in the light of constraints involved 300
  In the Himalaya 300
  For cold semi-arid areas 301
  Need for more information on vegetation and trends 302
  Environmental impact 302
The future of herding as a lifestyle 304
  Possible interventions for settled or agropastoral stock owners 305
  Possibilities for improving feed supply 305

REFERENCES CITED AND OTHER SOURCES USED 307

GLOSSARY 315

INDEX 319