## Contents

List of Figures 9

List of Tables 11

1 Introduction 13
   1.1 Motivation ........................................ 13
   1.2 Purpose of the work ................................. 14
   1.3 Structure of the work ............................... 15

2 Supply chains and their impact on the environment 17
   2.1 Supply chain management ............................. 17
   2.2 Sustainability of supply chains ...................... 20
   2.3 Concepts of green supply chain management .......... 22
   2.4 Carbon emissions resulting from supply chain activities 27
   2.5 Environmental regulations impacting supply chain decisions 30
      2.5.1 Overview of environmental regulations ........... 30
      2.5.2 Emission taxes .................................. 32
      2.5.3 Emission trading ................................. 33

3 Integrating the environmental dimension into SC decisions 37
   3.1 Network design decisions ............................ 37
   3.2 Inventory (ordering) decisions ....................... 40
   3.3 Production mix and production planning decisions .... 44
   3.4 Transport mode and transport planning decisions ...... 47
   3.5 Summary of existing models and relation to this work .... 49

4 The economic and environmental performance of dual sourcing 53
   4.1 Inventory management and the newsvendor model ........ 53
   4.2 Sourcing decisions ................................. 57
      4.2.1 Overview of sourcing concepts ................... 57
      4.2.2 Focus on dual sourcing .......................... 59
   4.3 Transport-focused dual sourcing framework ............. 65
   4.4 Single-period dual sourcing model .................... 68
      4.4.1 Basic dual sourcing model ....................... 68
      4.4.2 Dual sourcing with transport emission limit ........ 72
      4.4.3 Dual sourcing model with linear transport emission tax 73
      4.4.4 Dual sourcing model with emission trading for transport 75
   4.5 Numerical analyses ................................. 80
      4.5.1 Basic dual sourcing model ....................... 81
### Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5.2 Dual sourcing model with transport emission limit</td>
<td>82</td>
</tr>
<tr>
<td>4.5.3 Dual sourcing model with linear transport emission tax</td>
<td>84</td>
</tr>
<tr>
<td>4.5.4 Dual sourcing model with emission trading for transport</td>
<td>88</td>
</tr>
<tr>
<td>4.6 Comparison and implications for management and policy-making</td>
<td>96</td>
</tr>
<tr>
<td>5 Conclusions, limitations and further research opportunities</td>
<td>101</td>
</tr>
<tr>
<td>Bibliography</td>
<td>105</td>
</tr>
</tbody>
</table>