Aeolian transport of nourishment sand in beach-dune environments
van der Wal, D.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
ACKNOWLEDGEMENTS

This study started with a one-year project on behalf of Rijkswaterstaat to survey the ‘Ecological effects of beach nourishment’. I wish to thank Pim Jungerius (Universiteit van Amsterdam) and Wim van der Putten (Nederlands Instituut voor Oecologisch Onderzoek), for initiating this project. I thank the project managers Roeland Hillen, Joost de Ruig (Rijksinstituut voor Kust en Zee) and Moniek Löffler (Dienst Weg- en Waterbouwkunde) for their efforts.

Thanks to the support from Bas Arens, John van Boxel and Frank van der Meulen (Universiteit van Amsterdam), thanks to financial support from Dick Rakhorst on behalf of Rijkswaterstaat (Directie Noord-Holland), and thanks to a grant from the dr. ir. Cornelis Lely Stichting, I was able to continue this study and to complete the thesis.

I am grateful to my promotor Pim Jungerius, especially for getting me acquainted with coastal research and for giving me a lot of freedom to conduct my studies. I thank my co-promotor and supervisor John van Boxel for his support, concern, co-operation with the modelling and fruitful discussions on many aspects of the research. Bas Arens is thanked for guidance and involvement with the field work. They, as well as the other members of a multi-disciplinary board of supervisors, viz. Aart Kroon (Universiteit Utrecht), Moniek Löffler, Maaike Veer, Frank van der Meulen, Jan Mulder (RIKZ), Wim van der Putten and Dick Rakhorst, are thanked for advice on the research and suggestions for improving the manuscript.

I gratefully acknowledge Tonny Overdiep, Dirk Visser and Kees Visser (Rijkswaterstaat, Ameland), Ruud Buursink and Kees Vriesman (Hoogheemraadschap Uitwaterende Sluizen in Hollands Noorderkwartier) and Tjip Vonk, Lück Overmars and Jan van Grondelle (Rijkswaterstaat, Directie Noord-Holland) for logistic support during field work on the beaches of Ameland and Den Helder.

RIKZ kindly provided water level, wave height and height data, and information on several nourishment projects. I am obliged to Bram Vos (former Instituut voor Bodemvruchtbaarheid) for the use of the wind tunnel.
Paul van Dijk is acknowledged for spontaneous field assistance, discussions on the SAFE model, and proof-reading of Chapter 6 of this thesis. I am grateful to Karl Nordstrom for reviewing Chapter 3. I thank Gerard Heuvelink for discussions on statistics, and Eugene Sabajo, Ed de Water and Leo Hoitinga (Fysisch Geografisch en Bodemkundig Laboratorium) for technical support.

Caja van der Woude, Jean Melounou, Stéphane Rognon en Robert Colombo are acknowledged for grain-size and carbonate analysis of many samples. I also greatly appreciate the assistance of Caja during the first field work on Ameland. Eugene Farrell and Doug Sherman provided help and company during the second field work on Ameland.

I wish to thank Marieke Eleveld for support, especially for assistance with surveying. She also commented on parts of the text.

Finally, I thank Ingrid and Eric for their support during the years involved in preparing this thesis.
CHAPTER 1

INTRODUCTION

SCOPE

Beach nourishment is used worldwide as a method for restoring and maintaining coastal areas threatened by structural marine erosion. Beaches are nourished either for recreational use or as a means of protecting the coastline by absorbing wave energy and to counteract further erosion of the original beach and dune and preventing damage to coastal property. Beach nourishment implies a direct supply of sand to the beach. In recent years, the primary source of sand for beach nourishment has been offshore deposits. These are dredged from the seabed, transported to the beach, and either dumped or pumped into the littoral zone (Komar, 1998). The fill is redistributed over the coastal profile during the lifetime of the nourishment by ambient marine and aeolian processes. Most sand will eventually be lost from the considered coastal stretch, as the basic cause of erosion and the negative sand budget often continues to exist after nourishment. Periodic replenishment is, therefore, often necessary. Yet, beach nourishment is often preferred to coastal protection schemes that use hard structures, because so many of these have resulted in subsequent loss of the beach by reflection effects (National Research Council, 1995; Bird, 1996).

In the Netherlands, nourishment appears to be an effective and economical measure to be carried out flexibly at places with highest urgency (Rijkswaterstaat, 1988; Davison et al., 1992). More than 170 nourishment projects have been executed at about 50 coastal stretches (see Appendix). The coast has been nourished for various reasons, but the main reason was to safeguard the low-lying hinterland against flooding from the sea (Hillen & Roolse, 1995). A large part of the Dutch coastline consists of beaches bordered by shore-parallel foredunes of 10 to 20 m in height, which form the principal sea defence. More than half of this coastline is subject to erosion (De Ruig & Hillen, 1997).

Since the early fifties, weak dune areas were strengthened by artificial nourishment of type a, b and c in Fig. 1.1, to bring the dunes in line with the safety standard, as laid down under the Delta Act of 1953 (Deltacommissie, 1961). Since 1992, dunes along the Dutch coast all fulfill the safety
Paul van Dijk is acknowledged for spontaneous field assistance, discussions on the SAFE model, and proof-reading of Chapter 6 of this thesis. I am grateful to Karl Nordstrom for reviewing Chapter 3. I thank Gerard Heerink for discussions on statistics, and Eugene Sabajo, Ed de Water and Leo Holunga (Fysisch Geografisch en Bodemkundig Laboratorium) for technical support.

Caja van der Woode, Jean Melounou, Stéphane Rognon en Robert Colombo are acknowledged for grain-size and carbonate analysis of many samples. I also greatly appreciate the assistance of Caja during the first field work on Ameland. Eugene Farrell and Doug Sherman provided help and company during the second field work on Ameland.

I wish to thank Marieke Elenveid for support, especially for assistance with surveying. She also commented on parts of the text.

Finally, I thank Ingrid and Eric for their support during the years involved in preparing this thesis.