Abstract: ***Dutch Viticulture in sea-level altitude Regions: Survey-Based Analysis of Management Practices***

As a starting winemaker who started a vineyard with a few friends in the Netherlands two years ago, I encountered various viticultural challenges that could have been better addressed better through prior research. Walking into issues ranging from drainage problems to disease management and pests motivated this investigation into Dutch-specific practices. When considering starting our vineyard, we spoke extensively with Ron and Monique Langeveld of Wijngaard Dassemus, whose work in sustainable viticulture under challenging Dutch conditions served as inspiration. Their success with disease resistant varieties and innovative management techniques demonstrated that quality wine production was possible in the Netherlands, yet there was no clear set of best practices that I could find. This personal experience, combined with high hopes for the future of Dutch wine, drove me to this topic. I would like to thank all respondents for taking the time to fill out the survey and helping me find the answers.

Problem/objective: The Netherlands represents one of Europe's more challenging environments for viticulture, with most agricultural land lying below 10 meters above sea level and a vast portion even below sea level. This creates specific challenges including poor natural drainage, frost risk from cold air pooling, and complex water management influenced by both natural precipitation and artificial controls. While climate change has made Dutch viticulture increasingly viable, with growing season temperatures increasing by 9% and sunshine hours by 20% between in the last decades. The fundamental challenges of maritime climate, high disease pressure, and topographical limitations remain. This study investigates three questions: First, do the (near) sea-level areas of the Netherlands provide circumstances requiring specific vineyard management approaches distinct from international best practices? Second, if such circumstances exist, what specific factors can be identified as unique compared to other wine regions? Third, what practical best practices can be identified to assist aspiring winemakers in the Netherlands?

Methodology: Primary research was conducted through an online survey distributed to vineyard operators across the Netherlands, specifically targeting the regions around sea level, while excluding Limburg due to its distinct topographical advantages. Despite challenges in recruitment, ten respondents provided comprehensive data representing diverse operational approaches, from urban demonstration projects to established commercial vineyards with operational histories ranging from 2 to 24 years. The survey collected both quantitative data (elevation, drainage systems, grape varieties, wire heights) and qualitative insights (decision-making rationales, practical challenges, management philosophies). This was complemented by comparative analysis with similar cool-climate regions including England, Belgium, northern France, and Canada, allowing validation of Dutch practices within international context.

Content: The research reveals that Dutch low-altitude viticulture indeed requires distinctive management approaches. Drainage emerges as the most critical factor, with nine of ten respondents

identifying it as essential regardless of site elevation or soil type. Unlike hillside wine regions with natural drainage, Dutch operations require artificial infrastructure coordinated with municipal water authorities, as polder management directly affects vineyard drainage effectiveness. Disease-resistant grape varieties (PIWIs) achieved a high (8/10) adoption among respondents, with varieties like Johanniter and Souvignier Gris demonstrating proven performance across diverse conditions. This high adoption enables getting organic certification while maintaining commercial viability in high-humidity maritime conditions where traditional varieties would require intensive spray programs. The surveyed operations employ organic soil management, though several continue targeted fungicide use, indicating a pragmatic approach balancing sustainability with practical disease control needs. Innovative practices include Wijngaard Dassemus's curtain pruning at 1.80m and roller-crimping of cover crops, demonstrating Dutch viticulture's experimental dynamism. International comparison validates these approaches - English, Belgian, and northern French operations face similar maritime disease pressure and marginal temperatures, confirming the importance of drainage, disease management, and appropriate trellising systems. However, Dutch innovations in flat-terrain management and comprehensive PIWI-organic integration represent unique contributions to cool-climate viticulture knowledge.

Conclusion: This research confirms that Dutch low-altitude viticulture faces unique conditions requiring specific adaptations to create a viable operation. The combination of flat topography, maritime climate, and polder water management creates challenges not found in classical wine regions, necessitating artificial drainage as essential infrastructure, disease-resistant varieties as practical necessity, and adaptive management systems responsive to variable conditions. Despite these challenges, Dutch producers demonstrate that commercial success remains achievable, with operations producing wines selected for premium markets. The transformation of marginal conditions into opportunities for innovation positions Dutch viticulture as a place for adaptation and innovation. As climate change continues to improve change and perhaps improve conditions while simultaneously increasing weather variability, Dutch innovations in sustainable production, water management, and resistant varieties could offer lessons for global viticulture. Future research priorities include long-term PIWI performance documentation, economic analysis of management systems, and continued investigation of innovations. Through systematic knowledge sharing and continued experimentation, the Netherlands can develop a distinctive wine industry that contributes novel solutions to international cool-climate viticulture while producing quality wines reflective of unique Dutch terroir.