Developing environmental principles, criteria, indicators and norms for potato production in South Africa through field surveys and modelling

A.C. Franke a,⇑, J.M. Steyn b, K.S. Ranger c,d, A.J. Haverkort a,b
a Agrosystems Research, Plant Sciences Group, Wageningen University and Research Centre, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands
b Department of Plant Production and Soil Science, University of Pretoria, Pretoria 0002, South Africa
c Potatoes South Africa, Private Bag X135, Pretoria 0001, South Africa
d Ranger Consulting, 3 Laborie Street, Courtrai South Paarl 7646, South Africa

The sustainability of agricultural production is linked to the environment from which it draws its resources. Potato production in the Sandveld in the South African Western Cape occurs in the Cape Floral Kingdom: a vulnerable and globally significant biodiversity hotspot. A scientific approach defining and monitoring sustainability criteria and indicators is required to improve the sustainability of potato production in such a sensitive area. In this paper we propose principles related to the ecological impact of potato production (nature preservation, water preservation and the minimization of chemical and carbon-dioxide emissions) and their derived criteria related to land clearing, irrigation, emissions, and others. Next we defined calculable and measurable indicators of the efficiency with which resources are used, such as proportion of land cleared, water use by the crop, amount of biocides used, the embodied
energy of biocides, and the energy needed for farming operations versus the potato yields obtained. In depth interviews were held with 14 farmers representing 20% of the total potato production area to obtain the current values of these indicators. These were compared to model outcomes of two main sustainability indicators: land and water use efficiency. The land use efficiency varied least between growers, from (36 to 58 Mg (tonnes) ha_1), water use efficiency returned values between 3 and 9 g potato l_1 water, while chemical fertilizer phosphorus use efficiency varied most at 98 and 995 g potato g_1 P applied. Model outcomes confirmed some of the trends revealed by the survey, e.g. growing potatoes in winter and growing them with less than optimal water offers possibilities to double water use efficiency. Ways to derive indicator threshold norms are proposed based on the knowledge of physical and biological processes determining resource availability, the observed variation among farmers and the model outcomes. Knowing indicator values, their range and the

means to improve resource use efficiency will aid in establishing sustainability norms by providing a quantitative approach to any environmental certification scheme that wishes to licence the delivery of potatoes from the Sandveld.