Prospects for ecological intensification of Australian agriculture

by Z. Hochman, P.S. Carberry, M.J. Robertson, D.S. Gaydon, L.W. Bell, P.C. McIntosh

European Journal of Agronomy, Volume 44 (January 2013), Pages 109–123

World population growth, changing diets and limited opportunities to expand agricultural lands will drive agricultural intensification in the decades ahead. Concerns about the reliance of past agricultural intensification on non-renewable resources, about its negative impacts on natural resources both on and off farm and on greenhouse gas emissions, provide an imperative for future agricultural intensification to become ecologically efficient. We define ecological intensification of agriculture (EIA) as: producing more food per unit resource use while minimising the impact of food production on the environment. Achieving it will require increased precision in the use of inputs and reduction in inefficiencies and losses. It will also require a more holistic view of farming, going beyond efficiencies of single inputs into a single field in a single season to consideration of efficiencies of whole systems over decades.

This paper explores the ecological intensification issues facing agricultural production in Australia where opportunities for agricultural intensification are centred on more efficient use of limited and unreliable water resources in both dryland and irrigated agriculture. Ecological efficiencies can be achieved by better matching the supply of nutrients to crops' requirements both temporally and spatially. This has the added benefit of minimising the opportunities for excessive nutrients to impact on soil health (acidity and dryland salinity) and water quality (pollution of groundwater and eutrophication of lakes and rivers). Opportunities for ecologically efficient intensification are also identified through better integration of crop and livestock enterprises on mixed crop–livestock farms.

We define nine desirable attributes of an EIA system: (1) increased agricultural production; (2) efficient use of limited resources; (3) minimal impact on global warming; (4) minimal negative on-site impacts; (5) minimal negative off-site impacts; (6) minimal risk and maximum resilience; (7) preservation of biodiversity in agriculture; (8) preservation of biodiversity in nature and; (9) positive social outcomes.

We focus on four technologies and production systems emerging in Australian agriculture: climate risk management; precision agriculture; crop–livestock integration and deficit irrigation. For each of these systems we identify how well they are likely to match the nine

desirable attributes of an EIA system. While it seems unlikely that any single technology can satisfy all nine desirable attributes, there is hope that in combination emerging and future technologies will progress Australian agriculture towards greater productivity and ecological efficiency.

This paper should challenge all agronomists to be concerned with producing more food per unit resource use while minimising the impact of food production on the environment. They can contribute to these goals through technologies that reduce inefficiencies and losses in farming systems by enabling increased precision in the use of inputs. Given adequate information farmers are likely to pursue the first two desirable attributes of an EIA system. Technologies that satisfy the first two criteria may or may not support the remaining 7 attributes. To ensure that new technologies embrace all nine desirable attributes, policy support will most likely be required to re-enforce farmers' natural inclination for positive land stewardship.

Contact the author: Zvi Hochman

Email: zvi.hochman@csiro.au

URL to paper:
http://www.sciencedirect.com/science/article/pii/S1161030111001195