Sustainable Intensification and Conservation Agriculture

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What is sustainable intensification?
The term sustainable intensification has become popular in recent years and while its definition can vary, it can be considered in both a narrow and a broader sense. The narrow definition applies to the pursuit of the dual goals of higher biological yields (output) and productivity (efficiency of use of production inputs) with fewer negative consequences on the environment (such as in situ land degradation and negative externalities) while building resilience (stability of performance and ability to recover from biotic and abiotic shocks), natural capital (biodiversity and soil health) and at the same time enhancing the flow of environmental services (such as water and water cycle, nutrients and nutrient cycles, control of soil erosion, pollination services) (FAO, 2011; Foresight, 2011). This ‘holistic’ approach integrated production systems development and landscape management in rainfed and irrigated landscapes.

In the broader context, sustainable intensification encompasses the minimization of food wastage, as well as human and economic dimensions of socio-cultural aspirations, organizations and social equity and economic growth. It also implies improving the capacities of people and their institutions to deliver and use inputs efficiently, manage systems, distribute and use outputs efficiently so as to avoid excessive wastage, and harness large-scale ecosystem services that benefit producers and consumers alike. However sustainable intensification is defined, it is necessary to achieve and sustain increased yields in ways that do not harm the resource base and the environment, and even improve them. In recent years, these conditions are beginning to be met in many parts of the world with the spread of Conservation Agriculture (CA).

Conservation Agriculture and sustainable intensification
The ‘Green Revolution’ paradigm for production intensification has been guided by: (a) the improvement of genetic potentials of crop and animal genotypes; (b) greater application of external inputs of agrochemicals for plant nutrition and pest (weeds, pathogens, insects, parasites) control; and (c) increased mechanical disturbance of exposed soil and terrain with tillage for crop establishment and other farming operations. The implicit assumption with this approach is that agriculture production systems are essentially closed and must be treated as such with the assumption that if more output is required, then more inputs must be applied. This approach is now known to be ecologically intrusive and economically and environmentally unsustainable, and leads to land and environmental degradation and sub-optimal factor productivities and yield levels that are difficult and expensive to maintain over time.

CA fits within the sustainable intensification paradigm of producing more from less purchased inputs; enhancing the resource base and its productivity and ecosystem service provision capacity over time. Thus, it is not intensification in the classical sense of greater use of inputs to obtain greater output but rather of the intensification of knowledge, skills and management practices and the complementary judicial and precise use of other inputs. In CA systems, outputs of desired products and ecosystem services are built on three interlocked principles of: no or minimum mechanical soil disturbance, maintenance of soil mulch cover and diversified cropping system. Practices based on these principles and supported by other “good agricultural practices” provide a robust and sustainable ecological underpinning to any rainfed or irrigated production system including arable, horticulture, agroforestry, plantation, pasture, crop-livestock, and mixed systems, thereby predisposing them to respond efficiently to any applied production inputs to achieve intensification. This approach does not attempt to have no impact on
the environment, but to limit any environmental footprint to a level below the natural recovery capacity. At the landscape and large area level, CA offers large scale ecosystem service benefits that are not possible under tillage agriculture. Two well-known examples are the carbon offset trading scheme in Alberta, and the water services in Parana basin in Brazil (Kassam et al., 2013). Many of the benefits under the no-till component and under the mulch cover component are not necessarily possible under tillage agriculture. Beneficial biological activity, including that of plant roots and soil microorganisms, thus occurs in the soil where it maintains and rebuilds soil architecture, competes with potential in-soil pathogens, contributes to soil organic matter and various grades of humus, and contributes to capture, retention, chelation and slow release of plant nutrients. The key feature of a sustainable soil ecosystem is the biotic actions on organic matter in suitably porous soil. Thus, ‘conservation-effectiveness’ encompasses not only conserving soil and water, but also the biotic bases of sustainability.

CA principles are universally applicable to all agricultural landscapes and land uses, with locally formulated adapted practices. Already, in 2010, CA had spread over more than 125 M ha of arable cropland globally (9% of cropland), and in 2013 the area under CA is about 155 M ha (10.9% of cropland). CA is an example of the agro-ecologically based sustainable intensification approach that requires lower amounts of all production inputs including energy, seeds, agro-chemicals, machinery, and time, and offers greater productivity than the non-CA counterpart systems. CA also provides an alternate approach to achieving sustainable intensification in low-input agriculture using traditional varieties and methods of maintenance of soil fertility.

Looking ahead

As with any new approach aiming to improve farming systems, adoption of CA has constraints that must be overcome. The spread of CA internationally offers lessons which show that constraints can be and are being overcome by farmers, rich or poor, large or small, through locally-formulated solutions involving a range of public and private sector stakeholders working together with farmers along different pathways of adoption (Jat et al., 2014). However, a more structured response to the opportunities presented by CA calls for a realignment of agricultural institutions and service providers, and greater investments in research, extension and education, as well as providing evidence for updating agriculture development policies to enable CA to become mainstreamed everywhere.

References


