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HOLISTIC FARM PLANNING – USING AN ECOSYSTEM APPROACH TO ADVANCE FARM PLANNING INTO THE FUTURE

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Abstract

Land evaluation historically uses environmental data to evaluate the productive capacity of land and is the basis of farm planning. However, there is an increasing recognition that land evaluation needs to evolve beyond the almost singular focus on production values to take a wider, more holistic view. This broader assessment needs to account for impacts on receiving environments as well as include consideration of the other ecosystem services provided by agricultural landscapes. We suggest that embedding farm-planning within an ecosystems approach provides the pathway to operationalise this shift. This would require land evaluation to take a less pedocentric approach to include other environmental as well as cultural information, such as stocktakes and state of water resources, measures of biodiversity or identifying sites of cultural significance. It is common for soil or biodiversity conservation to be dealt with in isolation from each other, both at the policy and farm scales, which narrows the opportunities to increase farm sustainability and resilience. New approaches are needed to achieve wider outcomes across the landscape. We present a way forward that takes a more holistic approach to farm planning, bringing together business, environment and cultural goals and in doing so allows for social, cultural, environmental and production values to be recognised and enhanced while focusing on farm performance.

Introduction

The ecosystem approach to resource management, a multi-disciplinary approach to assess the multi-functionality of natural resources based on the concepts of natural capital and ecosystem services, is rapidly developing (Banwart, 2011). Costanza & Daly (1992) define natural capital as the 'stocks of natural assets that yield a flow of ecosystem goods or services into the future'. Ecosystem services are defined as 'the benefits people obtain from ecosystems' (MEA, 2005). The notion of natural capital comes from framing the contribution of natural resources alongside manufactured capital (factories, buildings, tools), human capital (labour, skills) and social capital (education, culture, knowledge) to the economy (Daly, 1995) (Figure 1). The ecosystems approach has its origins in ecological economics, recognising that the economy is a subsystem of the ecological system and that sustainable economic activity needs to operate within the biophysical limits of the natural environment (Rockstrom, et al., 2009) (Figure 1). Natural resource scarcity, which includes the ability of the environment to assimilate emissions, is nowadays the limiting factor of economic development and human wellbeing.

The ecosystem approach to resource management is based on two main principles:

- *Maintaining healthy natural capital stocks for ecosystem services provision*: preserving and enhancing natural capital stocks including biodiversity, soils and water bodies, is the way to influence provision of ecosystem services and make sure the services needed are provided. Investing in ecological infrastructure (biodiversity restoration and conservation, soil conservation practices…) should be a priority in any managed landscape to ensure the sustainability of the land use.
- *Land use and management within ecological boundaries*: land use choice, intensity and management should take into account the capability (McBratney, et al., 2014) of the land they depend on and of the receiving environments they are linked to. Different landscapes have different capabilities (soil type, elevation, climate, biodiversity…) and different ecological boundaries within which land use needs to operate in order to limit environmental footprints and ensure the sustainability of ecosystem services provision.

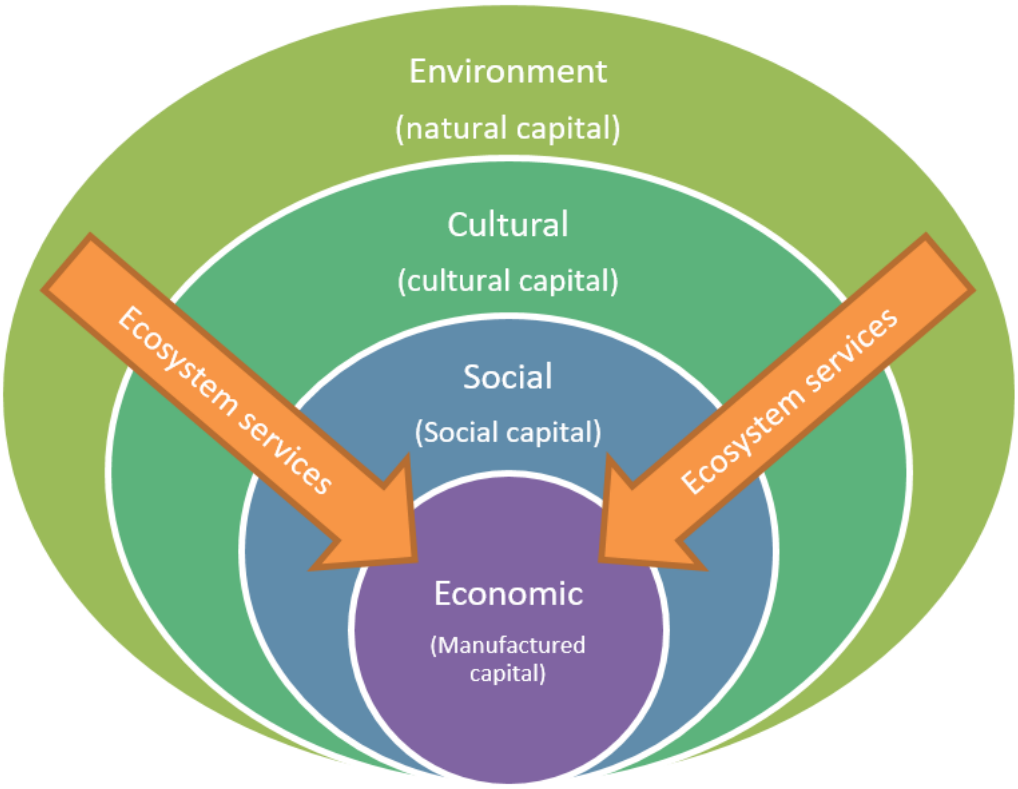

Figure 1: the four pillars of strong sustainability and links to concepts of the ecosystems approach (modified from (Daly, 1995)).

Land evaluation is defined as 'the assessment of land performance when used for a specified purpose' (FAO, 2007). As such it goes beyond the description and quantification of soil characteristics (i.e. stocks) to include an assessment of the 'fitness of a soil to function' under specific climate and management for sustained production. In New Zealand, land use capability classification is the basis for assessing the suitability for sustained production taking into account the physical limitations the land may have (Lynn, et al., 2009). Land evaluation and farm planning in New Zealand has its origins in soil and water conservation. The approach has

received extensive and successful application in New Zealand and overseas since at least the 1940s (Manderson and Palmer, 2006).

Common criticisms about land evaluation to date include the qualitative nature of the assessment, the lack of consideration of benefits beyond food and fibre, the limited investigation of the intensity of a use or practice and impacts on receiving environments, and the lack of consideration of cultural values (Dominati, et al., 2016b).

Over the decades land evaluation and planning has expanded to address on-farm issues beyond soil erosion, to include for example nutrient management, riparian planting and management, and water quality and thus has become an increasingly important part of farm business planning. When applied according to original principles, farm planning is also useful for helping landholders identify and evaluate how changes in land use and management can result in profit and production gains and environmental enhancements. This is for example reflected in the whole farm plans which are a key component of Horizons Regional Council's, Sustainable Land Use Initiative (SLUI), which include an analysis of the farms business as well as an assessment of the biophysical resources of the farm (Manderson, et al., 2013). Beef and Lamb NZ 's Land Environment Planning Tool Kit also addresses both production and environmental issues on-farm in the Level 2 and 3 farm plans (Synge, et al., 2013). The approach is also being used in the provision of spatial data for effluent management and improving the precision of fertiliser application. Regional land and water plans are increasingly using farm plans as a vehicle for implementation.

Given farm plans will remain — at least in the near future — an important vehicle in on-farm decision making, it is important that the limitations in the evaluation process continue to be tackled (Dominati, et al., 2016b) and that current processes evolve to capture new emerging challenges, such as the integration of indigenous biodiversity into farm planning and adaptation to future climates.

Given the increasing recognition that land evaluation needs to evolve beyond the almost singular focus on production values to take a wider, more holistic view, a broader assessment needs to account for impacts on receiving environments as well as include consideration of the other ecosystem services provided by agricultural landscapes. We suggest that embedding farm-planning within an ecosystems approach provides the pathway to operationalise this shift.

Using the ecosystems approach for land evaluation and farm planning

Broadening the assessment of the sustainability of a farm system would require land evaluation to extend beyond just a pedocentric approach to include other environmental as well as cultural information, such as stocktakes and state of water resources, measures of biodiversity or identifying sites of cultural significance. It is common for soil or biodiversity conservation to be dealt with in isolation from each other (Maseyk, et al., 2018), both at the policy development and implementation. This lack of integration narrows the opportunities to utilise these aspects to increase farm sustainability and resilience. New approaches are needed to achieve wider outcomes across the landscape.

Land evaluation and farm planning rarely examines the influence of land use and management intensity on a range of ecosystem services and environmental, cultural and social values provided by agro-ecosystems. Maseyk et al., (2017) pointed out that decision-making that

ignores the full range of ecosystem services allows trade-offs between services to be implicit, silent, and unaccounted for. The explicit consideration of consequences of land use and management practice choices on the condition of natural capital stocks and flows of services using an ecosystem approach would inform and drive natural resource management decision making. Below, we present a way forward that takes a more holistic approach to farm-planning, bringing together business, environment and cultural goals and in doing so allows for social, cultural, environmental and production values to be recognised and enhanced while focusing on the farm performance as a business.

The proposed approach incorporates the conceptual soil natural capital ecosystem service framework of Dominati et al. (2010), which was extended by Maseyk et al., (2017) into the land evaluation and farm planning process. Ecological theory provides the relationship between stocks and processes and supports the premise that the manipulation of key stock attributes changes ecosystem function and service provision. Land evaluation is embedded in geology, geomorphology and soil science, and in actual practice, puts heavy emphasis on an agro-technical analysis. Farming systems analysis and planning is more focused on socio-economic constraints to the production system. Bringing these three domains together enables a more in depth investigation of the interactions between the intensity of a use and practice and the natural and built capital stocks as they influence the provision of all services (Mackay, et al., 2018). Further, farm businesses can be analysed in an integrated way that includes all services, not just through a production and financial lens.

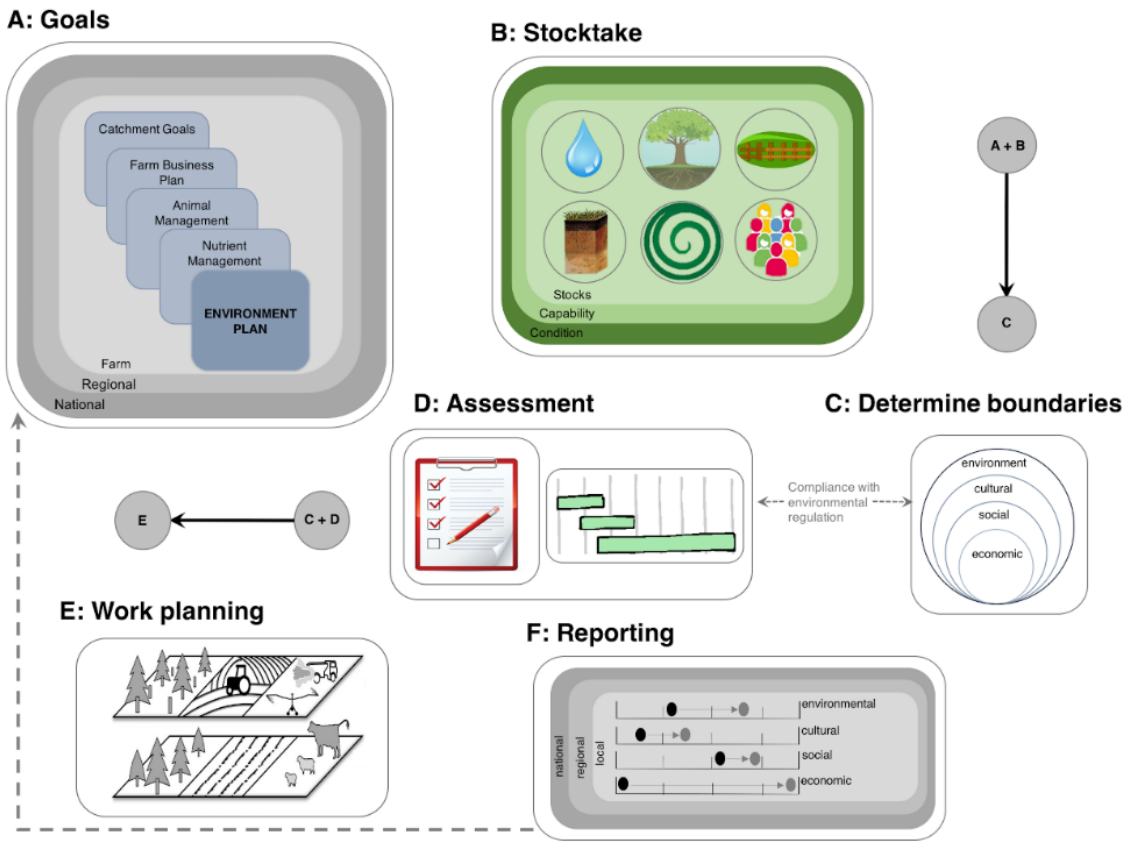

Figure 2: A conceptual diagram of the farm planning process using a whole farm plan. Components are not distinct and do not operate in isolation, linkages are indicated by circles and arrows. (Schematic in box E adopted from Dominati, et al., 2016a) (Maseyk, et al., 2018).

The land evaluation and farm planning process starts with **goal setting** (Maseyk, et al., 2018). All the objectives the landowner may have for the farm, business and family need to be included but wider goals also need to be taken into account. Other targets such as biodiversity or water quality targets operate at District, Regional or National scales. Thus, the goal-setting exercise needs to be able to translate these broader outcomes to farm-scale targets that can be included as an integral part of the land evaluation and farm business planning process.

The next step is **a stocktake** of farm resources including an inventory of existing capital in terms of stocks, capability and condition (quality and quantity), across all the farm assets including natural (e.g. soils, waterways, wetlands, vegetation, significant species), social (e.g. staff safety and well-being), cultural (e.g. access to sites of significance, use of cultural practices), and manufactured capital (e.g. farm infrastructure, roads). Including all the natural resources ("stocks") and their condition represents a new step in the process. Likewise, the analysis of the strengths and weakness of all the farm natural resources represents a step beyond the current process, as does the analysis of the opportunities and threats to all stocks and services (SWOT analysis) (Maseyk, et al., 2018).

The landowner then needs to **define environmental, cultural, and social boundaries** (Maseyk, et al., 2018) within which economic activity can occur. This step will be informed by the two previous ones, and also guided by, but not restricted to, environmental regulations. Environmental regulation can help to parameterise environmental limits (e.g. policies targeted at maintaining water quality may define allowable nutrient leaching limits) and thus related performance targets, with keeping in mind that restricting management practice on-farm to only the minimum required to be compliant curtails opportunities to manage the farm towards long-term sustainability and increasing resilience. The inclusion of **boundaries** to reflect a finite service (e.g. filtering) or conditions (e.g. limits on emissions) within which the farm has to operate, while appearing to be a new element in the planning process, is already an integral part of the farm systems planning and modelling. For example, landowners already operate with a range of financial, social, cultural environmental boundaries. The landowner will define some of these boundaries at the farm scale (related to sustaining the quality of natural capital stocks, such as soil quality through to financial and person social values). Some boundaries will be defined at the catchment scale and relate to desired community (thresholds on nutrient losses, sediment) and consumer (practice and produce quality) outcomes. Other boundaries will be defined at the national scale (greenhouse gas emissions to air). Currently many of these caveats go unreported. These boundaries are critical for sustaining long-term capacity. However they are frequently undermined in single use landscapes. The more apparent the wider consequences of public and private choices are, the less likely they are to be ignored in the decision making process. A feature and capability of farm system models into the future will be the ability to define and include ecological boundaries within which resources should be managed (Dominati, et al., 2016c).

Assessment of the current performance in relation to goals is the next step (Maseyk, et al., 2018). The landowner should assess the inventory of capital in the context of stated goals and targets to identify missing stocks required to achieve on-farm goals and off-farm objectives such as regional biodiversity objectives. This step identifies opportunities to introduce new farming practices or consider land use change for parts of the farm.

The two previous steps then enable a **work plan** to be put together by identifying and scheduling management actions required to sustain or enhance capital to achieve stated farm aspirations and environmental, cultural, and social targets and shift from current performance to target performance (Maseyk, et al., 2018).

The last step is **monitoring and reporting** change in underlying assets (Maseyk, et al., 2018). System should be put in place to measure and track current outputs and performance towards goals using a range of indicators identified both at the farm scale and beyond. This reporting will feedback into future goal-setting. Such system should include the quantification of a measure for each service associated with identified goals. The measures whether dollars, weights , time distance, area, index or scale, etc. to be useful need to be linked to landscape or management units, and responsive to practice change and meaningful to the land owner. In some cases the direction of travel of a service, because of a change in a practice or use, maybe all that is either required or possible with current knowledge. Inclusion of services as part of the monitor and reporting programme enables risks to the long-term sustainable use of the underlying resources to be identified at an earlier stage in the process.

Conclusion

Expanding the current process used in land evaluation and farm planning by embedding a natural capital ecosystem service element addresses a number of the common criticisms of the current approach to land evaluation and farm planning. It provides a structured platform for assessing and reporting on the benefits obtained from a landscape, beyond food and fibre. It also addresses the concerns of Maseyk et al., (2017) that decision making that ignores the full range of ecosystem services allows for trade-offs between services and benefits to be implicit, silent, and unaccounted for. This already occurs tacitly to some extent in that farmers do recognise many of the other services provided by their natural resource and manage accordingly although it is not a formal process and therefore there are always room for improvement. The proposed approach, by introducing more quantitative elements to the land evaluation and farm planning process, addresses the inability of the current process to assess the impact the intensity of use has on natural capital stocks and receiving environments. Inclusion of greater stakeholder and community participation in defining and setting boundaries within which resources have to be managed ensuring the preservation of natural capital stocks and function of receiving environments, recognises that farms are not isolated but part of wider landscapes. It also recognises that critical stakeholders and the community are more than spectators, but are an integral part of determining the balance between economic, environmental, social and cultural outcomes.

In the framework presented for farm planning, aspirations and performance targets are simultaneously identified and considered across all aspects of the farm-business and across a full range of values (environmental, cultural, social, and economic) and directly linked to capability and condition of the farm assets, including the current and potential condition of natural capital stocks and the management actions required to effect change. Considering all values side by side will also enable consideration of future economic opportunities in the context of sustainable management of on-farm resources and the best use of land by adding additional enterprises into the farm system.

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