Assessment Methods to Achieve Sustainability

Bryan Jenkins, University of Adelaide

Abstract: Based on the four phases of the adaptive cycle, assessment methods are identified for when sustainability limits are threatened. While impact assessment is suitable for the exploitation phase before sustainability limits are threatened; cumulative impact assessment is suited to the accumulation phase as sustainability limits are being reached; resilience assessments are appropriate when systems are subject to disturbances that threaten their viability; and recovery assessments are required when sustainability limits have been exceeded and management interventions are needed in the reorganisation phase. Cumulative assessments of greenhouse gases led Australia to transition to a decarbonised economy. This requires closure of coal-fired power stations. However, there is no requirement to address the significant impacts on workforce and communities associated with closures. A resilience assessment ranked mountain ash forests in the Central Highlands as "critically endangered". This led the Victorian Government to introduce a program to phase-out logging of mountain ash and transition to plantation timber. In the recovery assessment for the Anglesea coal mine closure, the Victorian Government is planning with Alcoa and the community to handover the site to a social enterprise as a tourist attraction. However, investigations raised concerns about water management and acidity in the Anglesea River Estuary. Assessments of transition to sustainability are needed. They need to be government-led and require community engagement in decision-making rather than just EIS processes.

Introduction

The paper sets out methods of assessment for sustainability based on Holling's adaptive cycle [1]. Impact Assessment (IA) is one of those methods. IA practice has focussed on proponents mitigating adverse effects of proposed developments and has achieved a degree of success. However, IA has not prevented overall development in threatening sustainability. Other methods are needed when sustainability is threatened.

The adaptive cycle is described with four phases of exploitation, accumulation, disturbance, and reorganisation. For each phase there is an associated method of assessment: impact assessment for the exploitation phase, cumulative assessment for the accumulation phase, resilience assessment for the disturbance phase, and recovery assessment for the reorganisation phase.

Case studies are provided. As a step to addressing the cumulative effects of greenhouse gas emissions, Hazelwood power station was closed. A resilience assessment of the disturbance due to logging of mountain ash forests is discussed. A recovery assessment for the closure of a coal mine near Anglesea is also presented.

In each of these cases, sustainability limits have been exceeded. Achieving sustainability involves closure of current activities and a transition to an alternative activity. This process is beyond what can be achieved by proponent-led impact assessment and needs a different procedural approach.

The Adaptive Cycle

The adaptive cycle describes how an ecological or social system can be sustained in obtaining resources for its survival, and its ability to accommodate disturbance and recover [1]. There are four phases: (i) exploitation – use or harvesting of resources; (ii) accumulation – storage of material or energy in the system; (iii) release – disturbance of the system; (iv) reorganisation – restructuring of the system after disturbance (Fig. 1). The adaptive cycle can be sustained if the resources continue to

be available and the system can recover from disturbance. Otherwise, the system may shift to an alternative (degraded) system state.

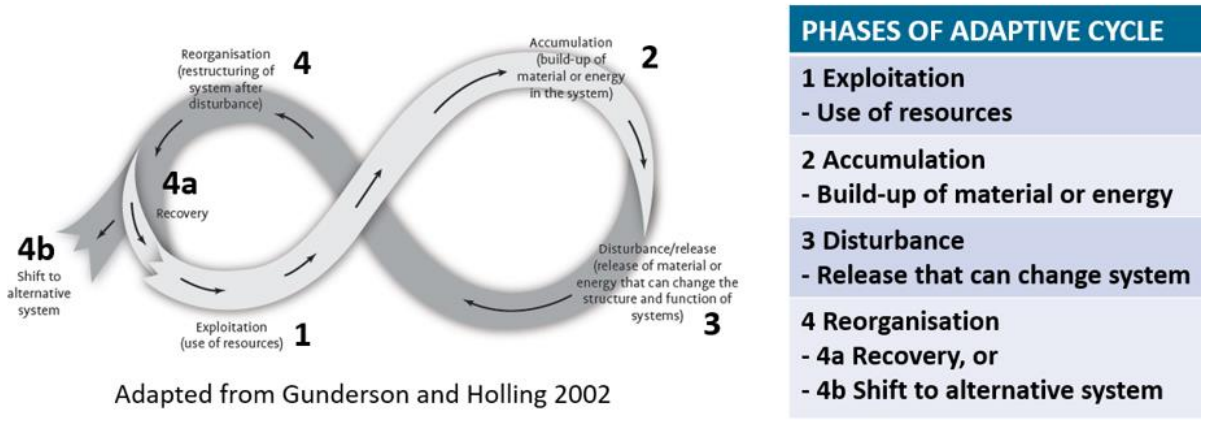

Figure 1: The adaptive cycle

Methods of Assessment

Associated with each adaptive cycle phase, there are different types of assessment (Fig. 2). Traditional project Environmental Impact Assessment is associated with the exploitation phase in examining new proposals for use of or impacts on environmental resources with the aim of reducing adverse effects through mitigation measures. Cumulative impact assessment is aligned to the accumulation phase by examining incremental impacts of proposals when added to other past, present (and reasonably foreseeable) actions. For the disturbance phase, there is resilience assessment which analyses failure pathways and critical variables on failure pathways and their thresholds associated with system collapse [2]. For situations when sustainability thresholds have been exceeded there are recovery assessments – the process of developing management interventions to address environmental damage and degradation – aligned with the reorganisation phase [3].

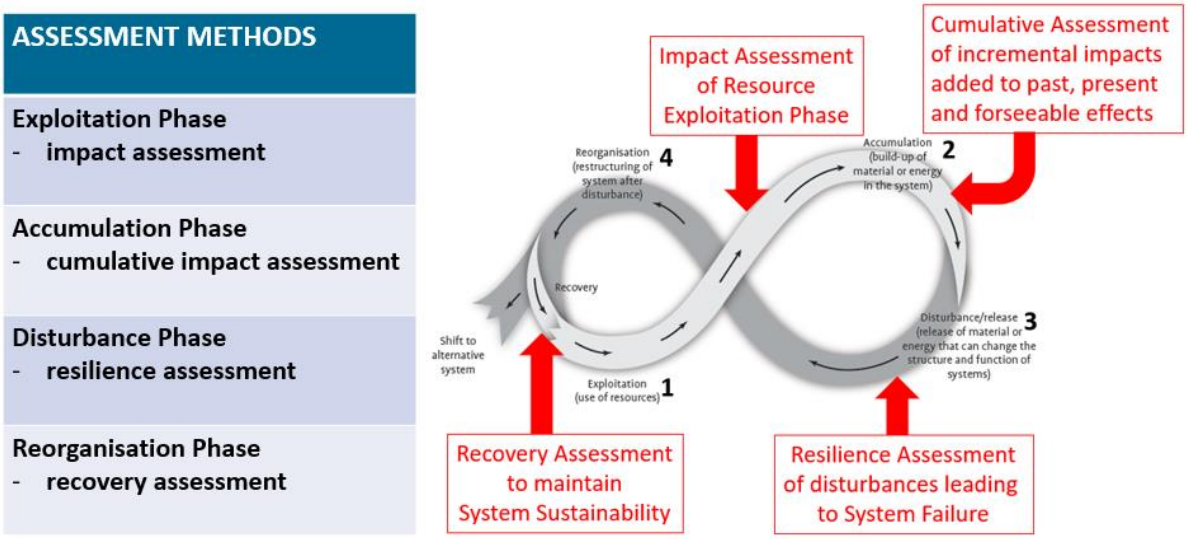

Figure 2: Methods of Assessment for Each Phase of the Adaptive Cycle

Cumulative Impact Assessment

Cumulative impact is the impact on the environment which results from the environmental impact of the action when added to other present and reasonably forseeable actions. Cumulative impact assessment is needed when the additive effects of proposals that individually are of minor or moderate significance but in total have an effect of major significance. A prime example is the release of greenhouse gas emissions from activities which individually are relatively small but when aggregated globally impact on global climate. This has led to global emission reduction targets to limit cumulative effects on climate. For Australia, coal-fired power plants are a major contributor with all having to be closed by 2050 for Australia to meet its emission reduction targets.

Hazelwood Power Station (1600 MW) which had the highest greenhouse gas emissions per MW (1.5 tCO_2/MW) was closed with no prior warning in 2016. This led to a loss of generating capacity and a significant loss of jobs (750 directly): the unemployment in Morwell rose to 17% in 2017 compared to 13% in 2013. A government assistance package was developed for affected workers, an Authority was established to work on economic transition strategies, and funding was provided for growth promotion and infrastructure. This resulted in a plant for extracting magnesium from flyash, a wind farm (185 MW) and solar power generation (70 MW) [4].

Resilience Assessment

Resilience is the capacity of a system to absorb disturbance and still retain its basic function and structure. The IUCN Red List of Ecosystems approach to ecosystem risk assessment is a sophisticated form of resilience assessment which defines ecosystem process and function (the adaptive cycle); diagnoses threats and pathways to ecosystem collapse (failure pathways); and, identifies indicators of decline and collapse (critical variables and their collapse thresholds) [5].

An assessment was undertaken of mountain ash forests in the Central Highlands of Victoria [6]. The range of the forest is limited to the wet and cool envelope of the Central Highlands. Old-growth mountain ash trees (over 120 years old) develop cavities that are important for nests and dens of arboreal marsupials and forest-dependent birds. Fire was the primary form of natural disturbance where high-severity fires would kill overstorey trees. Young seedlings germinate from the seeds released from the crowns of burned mature trees. The habitat value of the regrowth may take over a century to recover after fire. Logging is the primary form of human interference. With a rotation of 50-80 years, hollow-bearing trees are lost when cut, and there is insufficient time for cavities to form in the regrowth. Furthermore, the dense spacing of regrowth saplings increases fuel load and frequency of high-severity fires. If fire frequency is less than 20-30 years, then this is less than the time required for trees to reach sexual maturity and produce seed. Acacia woodland would then replace mountain ash forest. The resilience assessment concluded that the old-growth mountain ash forest was critically endangered and that hollow-bearing trees for endangered arboreal marsupials were also critically endangered [6].

In 2019, the Victorian Government announced the immediate protection of threatened species habitat and cessation of logging of old-growth forest. It also announced that logging of native forests would cease by 2030 with an initial step down in 2024. There would be investment in plantation timber (but the new plantations would not be ready to offset the reduction in harvest from stopping logging in native forests). There was a business support package to support the transition to plantation timber, an opt-out package and funding for mill site rehabilitation. There was worker support package for retraining and re-employment assistance as well as top-ups for redundancy payments. There was also a community support package for local business [7].

Recovery Assessment

Recovery assessment is the process of developing management interventions to address environmental damage and degradation. It requires proactive environmental improvements to achieve sustainable outcomes. The example chosen to demonstrate the need for recovery assessment is the closure of the coal mine and power station associated with the closure of the Point Henry aluminium smelter in 2015.

Consultation processes between Alcoa, government and the community occurred prior to the closure through the Alcoa Community Consultation Network and after closure through the Anglesea Futures Community Conversations led by the Victorian Department of Environment, Land, Water and Planning. The main community concerns were the conservation of heathland in the region, the Anglesea River and water management, rehabilitation of the mine and power station, and future land use. The outcomes of the consultations were a government commitment to incorporate 6,510 ha of heathland into a national park, a mine closure plan subject to government approval, and the site to be developed as an environmental tourist attraction by Project Eden with the mine pit to become a 100-ha lake filled by groundwater [8].

What was not adequately addressed was the sustainability of water management. The catchment contains pyrite which is chemically stable if undisturbed or submerged by groundwater, but exposed dry soil oxidises to sulphuric acid. Prolonged rainfall after dry periods can generate acidic flows that can exceed the buffering capacity of the Anglesea River estuary. In the past, major rainfall events after bushfires and drought have caused fish kills in the estuary. Recovery was dependent on freshwater or tidal flow flushing and neutralising acidic water [9]. Mine operations had involved groundwater dewatering (2ML/d), and mine pit pumping (2.5ML/d), treatment, use as cooling water and then discharge to the Anglesea River (4.5ML/d). The discharge increased the buffering capacity of the river. Since mine closure, this flow to the river has stopped. By 2019 increased acidity in the estuary has not recovered making the river uninhabitable for most species. The Shire has called for hydrogeological modelling to explain the hydrology of the complex system.

Transition Strategies

While there has been recognition of the need for transition strategies from the closure of unsustainable activities to the establishment of sustainable alternatives, both the scale and the timing of the transition packages have been problematic. The scale of the transition package needs to address the scale of the losses associated with the activity subject to closure. The generation capacity from new wind (185MW) and solar (70MW) that was established in the Latrobe Valley was substantially less than the capacity of the Hazelwood Power Station (1600MW) that was closed. The jobs generated by the new activities were less than those at Hazelwood. Furthermore, the generation capacity created was not available until many years after the closure of Hazelwood. Similarly, in the phased cessation of logging from native forests, the plantation timber would not be available in time to meet the wood supply gap.

The feasibility studies for new industries were not commenced until after power station closure or native forest logging cessation. The new skill requirements for worker retraining needed to be identified in advance of closure. The environmental investigations for new land use (in the case of Anglesea coal mine) and new industries (in the case of Hazelwood closure and logging cessation) needed to have been completed prior to closure.

There is the need for a regional sustainability transition strategy in advance of a project closure.

Assessments for Developments and Closures

Plant closures require a different approach to assessment compared to the impact assessment of proposed developments. Proposed developments to meet proponent's interests can be assessed by proponent-led impact assessment. However, transitions to alternative sustainable futures need government coordinated sustainability assessments in partnership with industry and communities. Community engagement through the impact assessment process is insufficient. Transition strategies need engagement of industries involved in closure as well as those involved in sustainable alternatives, and the workforce and communities involved in the transition.

References

[1] Holling C and Gunderson L (2002) Resilience and the Adaptive Cycle, in Gunderson L and Holling C (ed) Panarchy: Understanding Transformations in Human and Natural Systems, Island Press, Washington.

[2] Jenkins B (2016) Sustainability analysis of the management approach for six New Zealand lakes. Lake and Reservoir Management, 32(2) p101-115.

[3] Jenkins B (2020) Recovery assessment: the process needed after impacts have exceeded sustainability limits. International Journal of Environmental Impacts: Management, Mitigation and Recovery, 3(3) p272-283.

[4] Wiseman J, Workman A, Fastenrath S, Jotzo F (2020) After the Hazelwood coal-fired power station closure: Latrobe Valley regional transition policies and outcomes 2017-2020. CCEP Working Paper 2010, Australian National University, Canberra.

[5] IUCN (2016) An Introduction to the IUCN Red List of Ecosystems: The Categories and Criteria for Assessing Risks to Ecosystems. IUCN, Gland Switzerland, 2016.

[6] Burns E, Lindenmayer D, Stein J, Blanchard W, McBurney L, Blair D, Banks S (2015) Ecosystem assessment of mountain ash forest in the Central Highlands of Victoria, south-eastern Australia. Austral Ecology 40 p386-399.

[7] Victorian State Government (2021) Victorian Forestry Plan. Department of Jobs, Precincts and Regions, Melbourne.

[8] Victorian State Government (2018) Anglesea Futures Land Use Framework. Department of Environment, Land, Water and Planning, Melbourne.

[9] Sharley D, Amos C, Pettigrove V (2012) Factors Affecting the Ecology of the Anglesea River. Final Report to the Corangamite Catchment Management Authority.