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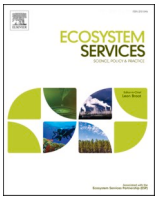

Full Length Article

Payments for Ecosystem Services opportunities for emerging Nature-based Solutions: Integrating Indigenous perspectives from Australia

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ABSTRACT

With recent growing interest and potential investment in nature-based solutions (NbS), a local, regional and global level understanding of what kinds of mechanisms or arrangements work effectively to deliver the required biodiversity and climate change outcomes is essential. This paper presents the status and opportunities for Payment for Ecosystem Services (PES) arrangements in Australia, with a focus on Indigenous peoples in northern Australia. We reviewed 62 studies related to the distribution and extent of the predominant PES schemes globally and nationally in Australia, including different ecosystems (e.g. forest, water, savannas, etc.), spatial scale (e.g. local, regional or global), types of payment methods used for ecosystem services (ES) transactions, types of ES providers and beneficiaries, funders, users, and contract arrangements and related challenges. Globally, 54% of the studies were supported by government investment, 17% by private–public, and only 29% by private investment. 80% of studies focused on forests as the most common ecosystem for PES, with 61% of the PES arrangements implemented at a local scale, 16% at a catchment scale and the rest (23%) at a national scale. In 33% of the studies, a single ES is the focus for the system, i.e. water quality or carbon sequestration; in 37% of studies a bundled approach was followed where typically > 1–2 services are included as a bundle; and in another 7% stacked ES were included. Within Australia, six main schemes were considered to be PES, i.e. Conservation Agreements, Water trading (buyback) in the Murray Darling Basin, Reef Credits, Carbon Farming, the Queensland Land Restoration Fund, and the Indigenous Protected Areas and Caring for Country programmes on Indigenous lands. About 90% these programmes are funded by the Australian Government, focusing on carbon or biodiversity outcomes, with little consideration of Indigenous values. From an Indigenous perspective, a bottom-up PES approach incorporating the social and cultural aspirations of Indigenous people is preferred. Traditional management with low transaction costs, combining both socio-economic and environmental attributes as verifiable measures, can yield conservation as well as positive socio-economic outcomes for Indigenous communities in Australia and elsewhere. Empowering local communities, recognising and supporting their skills and knowledge, ensuring equitable and just distribution of funds, sustainable and reliable co-designed incentives are essential for the success of these fast-emerging opportunities.

1. Introduction

There is a growing recognition of human interdependence with the rest of nature and the need to protect biodiversity, mitigate climate change, enable secure food and water, and to manage and avoid drastic climatic events. Among others, international initiatives such as the UN-led Millennium Ecosystem Assessment (MA, 2005), the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES, 2022), seminal expert studies (Costanza et al., 1997; Costanza et al., 2014; Daily and Matson, 2008; Dasgupta, 2021; Dasgupta et al., 2019; de Groot et al., 2012) and many Non-Government Organisations and local initiatives (The Nature Conservancy, 2020) have unequivocally highlighted that human economies and well-being are dependent on the rest of nature and its services.

Of the total global Gross Domestic Product (GDP) estimated at US$ 96 trillion per year (in 2021 values), more than half is moderately or highly dependent on ecosystem services. In addition, there are many non-marketed ecosystem services that directly contribute to human well-being and are not counted in GDP. The total for both has been conservatively estimated at US$148 trillion[1] implying about US$100

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[1] US$124 trillion in $2011 (Costanza et al., 2014) converted to 2021 values.

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trillion attributable to ecosystem services. Also, in supporting the market economy ecosystems incur significant losses, called externalities, due to human activities such as pollution of land, air, and water resources. These 'externalities' are not accounted for in market transactions. To date, the conservatively estimated cost of such externalities is US$9 trillion per year (Deutz et al., 2020; UNEP, 2021). However, a minuscule proportion of GDP (1.5%, equating to US$ 133 billion per year) flows back to ecosystems to fix externalities required for restoring or repairing degraded ecological systems via nature-based solutions, and 86% of these funds are provided through the public sector with the remainder from the private sector (Deutz et al., 2020). Overall, much has been extracted from natural ecosystems to support our economies and lifestyles but very little has been invested to date. Given our dependence on water, air, climate, food services, and other ecosystem services that cannot be substituted, finding solutions that help improve and restore ecological systems while enhancing human well-being are essential.

Nature-based Solutions (NbS) involve protecting, sustainably managing, and restoring natural or modified ecosystems, as well as addressing societal challenges effectively and adaptively while simultaneously supporting human well-being and biodiversity benefits, and these are becoming widely popular. One such NbS approach is Payment for Ecosystem Services (PES). Over the last few years, PES has received great attention in developed and developing countries (Schomers and Matzdorf, 2013). PES also offers pathways to internalise environmental externalities, largely caused by the corporate/private sector in the process of producing goods, and to support conservation by minimising or mitigating the impact of human actions on ecosystems (Pagiola, 2008; Suhardiman et al., 2013). A fundamental basis of the PES approach is to use financial incentives to better manage the many undervalued and over-used ecosystem goods and services that are non-tradable commons, such as biodiversity, water quality, climate regulation, and landscape beauty. Applying the PES approach can help rectify the problem of externalities, in addition to addressing enduring and growing coupled ecological and human crises. If prudently developed, designed, and applied, PES schemes can use financial incentives to better manage ecosystem services that have no costs as public goods and services that are considered to be free (Pattanayak et al., 2010; Schomers and Matzdorf, 2013). A good example is greenhouse gas (GHG) emissions trading schemes or carbon farming schemes where users of the natural systems (e.g. coal or gas companies) pay for emitting greenhouse gases (GHG; CO_2, NO_2, CH_4, etc.) that pollute the environment, cause climate change, and ultimately affect the sustainability of natural resources and well-being of people. The application of PES is equally important and growing in supporting conservation where custodians or managers of land are supported to conserve natural ecosystems, in response to mitigation, avoidance, restoration/repair or prevention of adverse environmental impacts of human activities. We acknowledge that PES offers only part of the solution, and should be applied in combination with ethical economic approaches, including fair and equitable governance systems, understanding local contexts, and complementary nature-focused policy initiatives.

For Indigenous Peoples and Local Communities (IPLCs), PES as an approach or mechanism can contribute to supporting people's conservation efforts for astutely managing lands across the globe. Currently, IPLCs are estimated to manage and/or own almost 65% of the total global land area through customary and community-based tenure arrangements (Rights and Resources Initiative, 2023). There is also a growing wider recognition that IPLCs' managed lands/resources are not exploited or depleted as compared with mainstream usage, and that their lands are managed more sustainably (Dawson et al., 2021; IPBES, 2019; IPBES, 2022; Sangha, 2020). However, in terms of experiencing ecological and humanitarian crises, the IPLCs are at the forefront and bear the brunt of climate change, floods, droughts, etc. (Reytar and Veit, 2017; WWF et al., 2021). Current economic approaches and development have resulted in environment-related inequity and injustice across the globe (Chan et al., 2017). At this point, PES can offer potential solutions to tackle these issues by supporting IPLCs in their efforts to restore, repair, and sustainably manage their lands and other resources to help offset environmental impacts, protect biodiversity, conserve nature, and offer sustainable environmental solutions to the global ecological crisis. Such an integrated approach can also contribute to enhancing IPLCs' well-being.

PES schemes, if designed and developed carefully in response to local needs and aspirations with a focus on supporting IPLCs with their stewardship, can potentially help address several UN-Sustainable Development Goals (SDGs). Focusing on supporting local communities to address various ecological crises can in return also help address humanitarian crises. For example, in rural communities where people's livelihoods depend on local ecosystems, improvements in natural ecosystems such as biodiversity protection or land restoration can offer jobs in remote areas where few economic opportunities exist (Dawson et al., 2021). SDGs that can benefit from investment in natural systems include: SDGs 1- no poverty; 2- zero hunger; 3- good health and well-being; 6- clean water; 8- decent work and economic growth; 10- reduced inequalities; 13- climate action; 14- life below water; and 15- life on land. Developing and customising PES schemes as per the needs and aspirations of the ES providers, including peoples' norms, moral values, and learning while respecting their stewardship, can deliver effective outcomes both for conservation and offsetting externalities, as well as for improving the well-being of local rural communities (Chan et al., 2017).

We acknowledge that currently there is a significant debate on green colonialisation in relation to emerging nature-based economies, and nonetheless, the IPLCs are expected to follow PES mainly for achieving targeted conservation outcomes as anticipated by others (especially funders) (Domínguez and Luoma, 2020; Urzedo and Robinson, 2023). However, if the PES mechanisms are co-developed and co-designed with IPLCs for appropriately considering their rights, value systems, ethics, governance and the principles of justice and equity, they can deliver both ecological and socioeconomic outcomes (Russell-Smith et al., 2022). The first and third authors of this paper have long-term experience in working with IPLCs, particularly in understanding local perspectives, economies, and building the policy case for Indigenous communities across northern Australia (Russell-Smith and Sangha, 2019; Russell-Smith et al., 2019a,b). We further emphasise that PES is one of a set of tools that can be used in pursuit of conservation, and people should be at the centre of the co-design process to develop PES as a 'system' for delivering effective nature-based solutions to address global environmental crises such as mitigating climate change and biodiversity decline.

In Australia, the adoption of ES and PES concepts has been relatively slow until recently (Keenan et al., 2019), with a few widely acknowledged schemes such as the Murray Darling Basin-Water Trading and Bush Tender/ EcoTender. The Carbon Farming Initiatives Act (2011) is the major legislation at the federal level to support activities addressing climate change, for example mitigating and sequestering GHG emissions (Australian Government, 2011). Only recently, with the Australian Government's interest in biodiversity and related emerging economic opportunities, new initiatives have emerged such as a proposed National Biodiversity Market and the Nature Repair Bill (currently under consideration in the Parliament as of 10 July 2023), or the Agriculture Biodiversity Stewardship program (commenced in 2021–22). However, to the best of our knowledge, there is no aggregated and detailed information on existing PES schemes in Australia to guide the development of future nature-based solutions.

We acknowledge that PES is a multi-faceted term with several diverse definitions, and shortcomings, and has evolved significantly over time since the 2000s. One of the earlier definitions Wunder (2005) conceived of PES as a market involving: 1. a voluntary transaction where 2. a well-defined environmental service, 3. is being bought by a (minimum one) service buyer, 4. from a (minimum one) service provider, 5. if

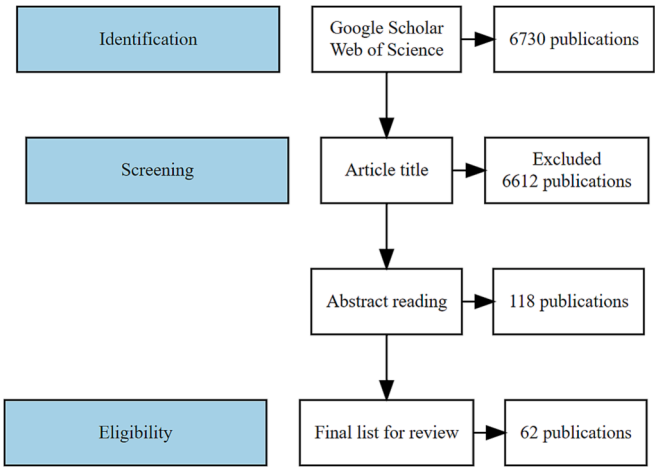

Fig. 1. The flow diagram describing the literature search from the databases (mainly Google Scholar and the Web of Science), focusing on PES from global and Australian contexts.

and only if the service provider secures service provision. However, most successful PES programmes do not fit this definition. Later, a more comprehensive definition by Muradian et al. (2010) reflected how successful PES schemes actually functioned and defined PES as a tool/mechanism to help transfer resources between social actors, with the aim of creating incentives to align individual and/or collective land use decisions with social interests in the management of natural resources. Such transfer of resources, monetary or non-monetary, are embedded in social relations, values and perceptions which play a critical role in designing PES mechanisms and related tools. Over time, the PES concept has significantly advanced to embrace preserving, restoring, or establishing (e.g. afforestation/reforestation) a change that brings improvement in one or more ecosystem services and delivers environmental benefits both on– and offsite. Our approach to this review is flexible (in line with Muradian et al., 2010) for including any kind of PES scheme and program that supports Indigenous stakeholders and interests.

In this paper, we review the PES-related literature from global and Australian sources, to understand the current status of PES, and inform the development of future PES schemes from an Indigenous perspective. Our aim is to identify challenges and opportunities for developing Indigenous-specific PES schemes. In doing so, we recognise that effective PES schemes rarely function as markets. They require significant government involvement and are often better thought of as institutions or agreements that use financial incentives to better manage common environmental assets – more akin to common asset trusts (Canning et al., 2021; Costanza et al., 2021). This approach is especially relevant for embracing Indigenous stewardship which comprises a large part of the Indigenous way of managing lands in Australia (Altman, 2012; Sangha and Russell-Smith, 2017; Russell-Smith et al., 2013). Currently, there are significant knowledge gaps in understanding the importance of engaging IPLCs in developing effective PES schemes, especially in countries like Australia where Indigenous land managers play a vital role in managing 50% of the National Reserve System. This paper offers a comprehensive perspective of the existing PES schemes in Australia that can inform the development of effective PES systems in the future while avoiding the problems of green colonisation and related long-term impacts on communities.

2. Methods

2.1. Literature review

A systematic approach (outlined in Fig. 1) was followed to search and review journal articles, reports and some grey literature on PES-related topics including PES approaches, design and implementation mechanisms. Google Scholar, Web of Science and other library-based databases were used as the main search engines to cover potential publications. The expertise of two authors having experience and well-established collaborations with PES experts from across the globe, also allowed us to scrutinise appropriate articles and ensure that relevant ones were not missed. For the literature search, a period of eight years, 2015–2023, was covered. We understand that the inception of PES design and implementation started earlier than this period of study, hence also considered some original sources of literature published in the past, particularly on the theoretical aspects.

Table 1
Attributes/characteristics followed in reviewing and extracting information from the final list of literature.

Criteria	Explanation
PES – aim, theory and/or practice, geographical context and background	Focus of the study, i.e. theoretical or practical, new perspectives in PES, geographical area, ecosystem type, etc.
Type of ES traded	Various kinds of ES traded (e.g. water quality, GHG emissions abatement, carbon sequestration, biodiversity, flood protection).
PES approach- Individual, layered, bundled ES	Examined whether the single, stacked or bundled ES approaches were applied for trading in the market.
Payments mechanism	How the cost of providing a service, or market price is determined.
Actors involved: sellers/providers, buyers/beneficiaries, and intermediaries	Who are the buyers or beneficiaries of ES, and intermediaries.
Funder, transaction types and payment method	We examined who is funding the project, what are the voluntary or compliance (regulatory compensation) payments, and different payment methods – cash, in-kind, or non-cash (social or community benefits).
Spatial Scale: local, national, regional and global	Implementation at the local, sub-national, regional, national and global scale.
Temporal scale: short-term (<10 years); medium (10–30 years), long term (>30 years)	We looked at the agreement period between parties, i.e. buyers and sellers of ES in each article.

We conducted a pilot search to refine and determine the actual search strings for searching literature. In general, a large volume of articles appeared using the term “payment for ecosystem services” and ‘Nature-based Solutions (NbS)”. To find an appropriate combination of search strings, we compared the results of search terms “Payments for ecosystem services”, “Payments for environmental services”, “NbS”, “PES mechanisms” and “Incentives for ecosystem services” for determining significant differences in the numbers of articles hit. In addition, the focus of our search was to downscale the search from the global to the Australian context, so we refined the search strings accordingly. Two different search strings selected using a Boolean operator for effective and meaningful literature search were: “payments for ecosystem services” AND “Australia”, “payments for ecosystem services” AND “Australia” AND “mechanism”. We conducted the final database search in December 2022 which resulted in 4,340 publications for the first string and 2,390 publications for the second string, all together accounting for 6,730 publications.

The literature screening process included both the exclusion and inclusion of relevant articles. In each search string applied, we considered the first 200 articles shown on search engines. Firstly, the screening of publications was to select an independent list of articles and remove the duplicates in both cases separately (Fig. 1). Secondly, after removing duplicates, we screened the articles with titles that mentioned ‘payment for ecosystem services’ and found 118 relevant articles. Thirdly, after title screening, we read the abstracts of those selected articles and included the articles based on the presence of PES cases from global, national, regional, and Australian contexts. As we screened the

Fig. 2. Various aspects of PES arrangements i.e. spatial and temporal scales, delivery of ES, payment types, and beneficiaries/buyers and providers/sellers of ES as revealed from the reviewed articles (n = 35 studies). NS- Not specified. Selected literature for review (Aboriginal Carbon Foundation, 2019; Australian Institute of Aboriginal and Torres Strait Islander Studies [AIATSIS], 2011; Badola et al., 2021; Báliková and Šálka, 2022; Banerjee and Bark, 2013; Barber et al., 2016; Briggs and Mey, 2020; Calvet-Mir et al., 2015; Cassola, 2010; Dacks et al., 2019; Deltares, 2013; Eigenraam et al., 2007; Grima et al., 2016; Hack et al., 2010; Higgins et al., 2012; Iftekhar et al., 2014; McAfee and Shapiro, 2010; Nelson et al., 2015; Nishimiya, 2010; Pagiola, 2008; Pagiola and Arcenas, 2013; Pfaff et al., 2019; Pissarra et al., 2022; Pittock et al., 2012; Porras et al., 2013; Raes et al., 2016; Ranjan, 2019; Reed, 2020; Salzman et al., 2018; Suhardiman et al., 2013; Suich et al., 2016; Tongson and Balasinorwala, 2010; Tran et al., 2016; van de Sand et al., 2014; Winer et al., 2012).

documents, we also included some topic-relevant articles that were missing from the searches. Ultimately, we listed 62 articles combining theoretical aspects of PES and case studies. We reviewed 35 studies that focused on *country*-specific contexts including 11 from Australia. We re-emphasize that our main objective was to review Australian studies, along with a good understanding of global PES perspectives.

2.2. Data analysis

We analysed the selected PES articles using a list of selected attributes as outlined in Table 1. Firstly, we considered the basic information such as year of publication, location of the case study (i.e. country), focus ecosystems (forest/water/lands), spatial scale (geographical, ecological) and the aim of the study. Secondly, we recorded specific information related to ecosystems and ES types. Thirdly, we covered the PES approach, i.e. how ES are traded in the market/exchange systems (single, layered, bundled). Fourthly, we covered how PES is implemented, especially how the market value of ES is determined. This was followed by the types of actors involved, i.e. ES providers, ES beneficiaries and intermediaries for each of the reviewed studies. Where data were available, we also looked at the funders, type of transactions and payment methods used in PES arrangements. Finally, we considered the spatial and temporal scales for the implementation of PES.

To do so, we extracted data from each reviewed paper in an Excel spreadsheet which was used for further data cleaning, processing, and analysis. Depending on the data quality, availability and comparability, 35 (out of 62) comprehensive PES studies fulfilled each selected attribute mentioned in Table 1, providing detailed information including case study examples from various countries. The remaining articles were primarily focused on theoretical or management aspects of PES in general.

All monetary values are reported in Australian dollars unless stated otherwise.

Table 2
Key features of PES (or PES-like) programmes (i.e. Conservation Agreements, Water Buyback for the Environment, Reef Credit, Carbon Farming schemes and Land Restoration Fund) in Australia (for details: see Appendix 1).

Programmes/ Schemes	Implementation mechanism	Finance sources (government/ private/ philanthropic)	Numbers of programmes/ projects	ES Providers	ES Beneficiaries	Spatial scale	Size/Value (AU $)	Duration
Conservation Agreements (incl. tenders/ auctions e.g. Bush Tender, Eco Tender) (2001–2012)	Compensate private landholders to undertake management actions on their lands of high natural and cultural values	Government, NGOs and private	More than 35 programmes across six states and 2 territories	Private landowners	State Governments, Businesses, NGOs, Philanthropic organisations, Individuals	Local	$291 million including Governments and NGOs investment	5–15 years and in perpetuity, subject to willingness and availability of funds
Water Buyback for Environment in the Murray-Darling Basin (2008–2017)	Purchase water entitlement rights from farmers to return water for the environmental flows	Government	1 programme supporting several projects across 4 states	Farmers/ Irrigators, Investors, Indigenous communities	Environmental Water Holders (Federal and State Governments and NGOs), Investors, Urban, Industrial and Recreational Users	Local or Catchment and Regional (Basin)	$2.60 billion	Ongoing since 2008
Reef Credit (2019-Current)	Farmers or land managers earn reef credits by undertaking approved fertiliser application and land management to improve water quality	Government, businesses, investment banks and philanthropists	11 projects	Farmers	Businesses, Investment banks and QLD State Government	Local or Catchment	Estimated value $2.5 million	Started only in 2019 (ongoing to date)
Carbon Farming (2012-Current)	Landholders, businesses and communities deliver carbon abatement by undertaking emissions reduction or carbon sequestration activities, e.g. vegetation and agriculture/soil management, and savanna burning.	Government	1,532 projects	Landholders, Industry, NRM managers, Indigenous communities	Federal and State Governments	National	$4.55 billion	Started in 2012, (ongoing to date)
Land Restoration Fund (2019-Current)	Farmers, landholders and Indigenous people undertake approved land management to receive carbon and co-benefit credits	Government	23 projects	Landholders, farmers, Indigenous communities	State Government	Local or Catchment	$100 million	Started in 2019 (ongoing to date)

3. Results

3.1. PES from a global context

About 35 (out of 62 reviewed) articles focused on the global context and covered a range of PES-related topics (i.e. ecosystem type, spatial and temporal scales, ES providers and beneficiaries, and details on payment methods). Among these 35 studies, 80% focused on forest ecosystems; 61% of PES arrangements were implemented at a local scale, 16% at a catchment scale and the rest 23% at a national scale (Fig. 2). Regarding the duration of the PES schemes, 67% of the studies reported short-term contracts spanning from 1 to 10 years, 10% medium-term (10–30 years), 10% were long-term (>30 years), and term for the rest 13% were unspecified. In 33% of the studies, the focus for trading comprised a single ES (i.e. water quality or carbon sequestration); in 37% of studies a bundled approach was followed where typically more than 1–2 services were traded as a bundle; and in another 7% ES were traded in stacks considering each ES in the stack (Fig. 2).

Regarding PES payments to ES providers, two-thirds of studies (76%) reported direct cash payments for undertaking intended management activities; 20% of studies reported a mix of cash and in-kind contributions from ES buyer/beneficiaries (e.g. government) for education and infrastructure development (Fig. 2). In terms of ES sellers/ providers, over half of the reviewed studies (56%) reported individual farmers or landowners, 24% of studies reported the community as the ES provider, and the rest 20% reported Indigenous peoples. Regarding funding, 54% of total studies reported government investment, 17% private–public, and 29% as private investment. Only 38% of papers mentioned equity aspects of PES in general whereas one dedicated article (Calvet-Mir et al., 2015) explored the equity implications of PES from a global perspective, pointing to an intertwined relationship between efficiency and equity emphasising equity as a key feature in the design process of PES schemes.

3.2. PES programmes in Australia

Out of the 62 reviewed studies, 11 were specifically selected for analysis to understand what kind of PES schemes operate in Australia, and how the mechanism works including the type of funders, ES providers and buyers, etc. Our analysis revealed six main schemes that focus on incentivising land and water management activities, including as discussed following: conservation agreements with private land owners;

water buyback for environmental flows; reef credits; carbon farming initiatives under the Emission Reduction Fund (now called Australian Carbon Credit Unit (ACCU) scheme); Land Restoration Fund (Table 2); and similar incentivised Indigenous programmes (discussed in the next section).

3.2.1. Conservation agreements

Conservation on private land has been the earliest and ongoing PES financial instrument in Australia which commenced in the early 2000s (Table 2). This includes protecting and restoring land with high conservation values by establishing a voluntary agreement between private landowners/managers and state government authorities (Bubb, 2019; Fitzsimons, 2015; Rolfe et al., 2017). Under this arrangement private landholders may receive fixed payments per hectare for managing their land to protect threatened ecosystems and habitats of importance for native plants and animals. The tenure of the agreement can be 5–15 years or perpetual, depending upon land managers' performance and willingness, and the availability of funds. The land management activities include setting aside a parcel of land for conservation, fencing, weed and pest control, none or limited grazing, etc., that improve the habitat for wildlife. The amount of payment is determined after a preliminary assessment and approval of the area pertinent for conservation by an authorised (government) organisation, followed by the land manager's offer of a bid to manage the area which is usually negotiable with the authority. From a PES perspective, the government is the ES buyer and funder, and land managers are the ES suppliers often supporting more than one ES. However, these agreements are not contingent on a set list of ES indicators for monitoring and measuring outcomes that are normally required under a PES scheme. Sometimes land managers themselves may monitor and record the outcomes of their efforts for future funding opportunities. Depending on the availability of funds, these conservation schemes operate under different names in different Australian States and Territories (Table 2). The government is the single buyer of this scheme, although some philanthropic and private businesses have recently been involved. The value of this conservation market is estimated at $291 million to date (in 2022 $ values; Table 2), including private and Non-Government Organisations' (NGOs) investment.

Apart from the Conservation Agreements, a new market-based biodiversity credit scheme — NaturePlus™ — is in preparation by a private company, GreenCollar, for the first time to deliver biodiversity and nature-positive outcomes in Australia. Compared to input-oriented mechanisms as applied in the Conservation Agreement, this scheme considers the outputs of land management in terms of restored habitat or species and improved environmental conditions over the period, on an incremental basis. Under the terms of the agreement, the restored environmental condition is verified, measured and certified following scientific protocols (i.e. the Accounting for Nature [AfN]), to award credits to the landowners for their land stewardship. The landowners/managers receive one NaturePlus credit for restoring one hectare of land for native habitats, species, or conservation over one year. The intermediary organisation, GreenCollar, initially partners with a land manager interested in improving their land management practices, followed by approval for eligible sites to develop a project. Most projects are currently in the developing phase.

3.2.2. Water buyback for Environment benefits

Since 2008, the Australian Government has purchased water from farmers in the Murray-Darling Basin to manage water scarcity and support the recovery of environmental water flows in the Murray-Darling Rivers, which meander through four states and a territory. The Murray-Darling water trading scheme became a key mechanism in 2008 after realising the impacts of drought on farmers and river water flows in the late 2000s. In this water buyback scheme, mainly the government buys a proportion or entire water entitlement to an individual farm/landholder (water rights) through a voluntary agreement with the farmer (who is willing to participate) for returning the flow of environmental water. Several programmes run by the Australian and State Governments contribute to diverting water from solely consumptive to environmental uses to maintain the river ecosystem or habitats for animals and plants. To date, this mechanism has been a significant part of the government's Basin Plan for water recovery. It has led to a cost-effective market approach rather than merely subsidising the improvement of irrigation infrastructure efficiency. The water purchase also aligns with the government's strategic plan for achieving sustainable diversion limits, i.e. the amount of water that can be used without affecting the rivers and environmental health.

The estimated market value of the water buyback programme for environmental purposes was $2.6 billion during 2008–2017 (Australian Government, 2021). The Commonwealth Environmental Water Holder (on behalf of the Government) purchased water entitlements equivalent to 2,889 GL of water recovered for environmental uses. This water recovery approach contributes to stream flow in the rivers which leads to improvements in the breeding habitat for fish spawning and waterbirds, recovery of native wetland and riverbank plants, and reconnecting the rivers in the Basin. Conversely, farmers benefit from selling their water entitlements to repay debt or reinvest in their farms. In addition, the Australian Government is investing $40 million to maintain cultural flows on *Country* (an Indigenous term used to reflect Indigenous people's traditional connections with their clan land) for the spiritual, economic, and cultural values, and the well-being of Indigenous peoples in the catchment.

3.2.3. Reef Credit scheme

The Reef Credit scheme offers a market-based solution for improving the quality of water that flows from the catchments abutting the Great Barrier Reef to the ocean (Eco-Markets Australia, 2021). Interested farmers, graziers and land managers or landholders can obtain reef credits by changing their land management practices, including improved nutrient management or cropping practices to reduce the amount of Dissolved Inorganic Nitrogen and soil sediments flowing into waterways. These comprise remediation measures such as reshaping, revegetating, implementing engineering control structures, managing grazing, etc., that deliver a quantifiable result for measuring improved water quality and reduced nutrient or sediment flow into the reef. One reef credit equates to one tonne of soil sediment or 538 kg of Dissolved Inorganic N prevented from entering the reef. A voluntary market and a public–private partnership approach allow farmers to sell their credits to several purchasers, including businesses, investment banks, philanthropists and governments interested in achieving their water quality targets or corporate sustainability outcomes.

In 2021, the estimated value of reef credits sold by five crane farmers to a global bank, HSBC, was $1 million. Eco-Markets Australia reported 44,512 credits issued to farmers under 11 projects for future market potential, which are estimated to generate $2.5 million (Eco-Markets Australia, 2023). To develop this scheme, the QLD State Government has supported a consortium consisting of GreenCollar, Terrain Natural Resource Management, and NQ Dry Tropics. This approach offers a win–win solution for farmers to sell their credits by improving water flows to the reef and receiving income for any forgone productivity and/or extra land management costs.

3.2.4. Carbon Farming (Australian Carbon Credit Unit (ACCU) scheme)

In Australia, carbon markets started under the Carbon Farming Initiative Act (2011) which includes a number of activities that reduce GHG emissions, avoidance or sequestration of carbon, where each tonne of CO_2-e abated/sequestered earns one ACCU. To support this scheme, the Emission Reduction Fund (ERF) was initially established in 2012 with funding of $2.5 billion, later supplemented with another $2 billion in 2019. The ERF follows a blind reverse auction approach to purchase ACCUs from land managers. Land managers, businesses or communities can develop ERF projects ranging from mitigating GHG emissions

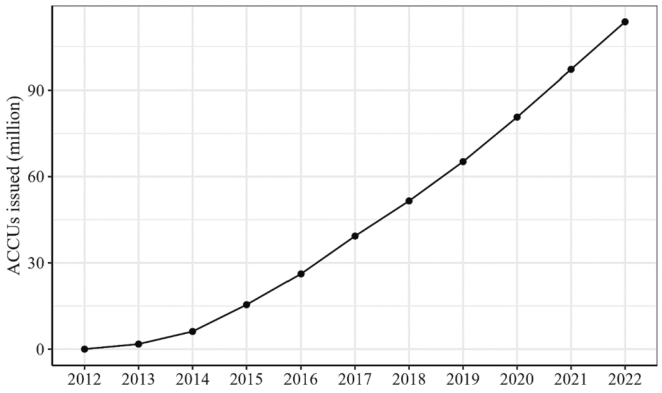

Fig. 3. Trend of ACCUs issued in Australia since 2012 with the onset of the Carbon Farming Initiative Act 2011 (cumulative ACCUs) (The Clean Energy Regulator, 2023a).

Table 3
Four main carbon abatement methods that collectively share over 90% of the registered projects under ERF as of June 2023 (The Clean Energy Regulator, 2023b).

Major carbon abatement methods	Numbers of registered projects (contracted)	ACCUs issued (millions)	Estimated value AU$ (using average price of 1 ACCU=$17 as per the Government's April 2023 auction price)
Vegetation management (controlled grazing to aid natural regrowth, avoiding tree clearing on farms, reforestation, etc.)	738 (323)	71.02	1.207 billion
Savanna fire management (emissions avoidance mainly)	81 (35)	11.54	196.18 million
Agriculture (changing the intensity of stocking and grazing)	495 (17)	1.98	33.66 millon
Landfill gas and waste	175 (33)	39.29	667.93 millon

through fire management, sequestering carbon in vegetation and soil, or mitigating GHG emissions using new techniques. More than 30 methods are registered, covering a wide range of activities related to vegetation management (avoided clearing of native regrowth, farm and plantation forestry, reforestation, etc.), agriculture (beef herd management, managing fertiliser application, soil organic carbon, etc.), landfill (alternative waste treatment, gas combustion, etc.), savanna fires (emissions avoidance 2018, sequestration and emissions avoidance), and others such as transport, mining, and energy efficiency. Each of the methods under this scheme has its specific verification methods (see https://www.dcceew.gov.au/climate-change/emissions-reduction/emissions-reduction-fund/methods#toc_0). Major ERF-funded projects include activities like afforestation, revegetation, improving agriculture/soil and fire management. Since 2012, issued ACCUs have increased substantially, showing a positive trend with 1,564 projects abating 127 million tonnes of GHG emissions as of June 2023 (Fig. 3).

To administer the application of various carbon farming and GHG emissions abatement methodologies and projects, the Clean Energy Regulator (commonly called the Regulator), an independent statutory agency, was established to monitor projects and issue ACCUs. The Regulator conducts auctions approximately twice a year. Currently, the Government is the main buyer (with some voluntary demand from companies and investors) of ACCUs. The total market value of all issued ACCUs across available methods is estimated at ~$2.22 billion to date (using the latest carbon auction price of $17/ACCU). Of this estimated value, projects on vegetation management, savanna fire management, agriculture, landfill gas and waste methods account for ~$2.10 billion, with the number of projects exponentially increasing since the scheme was implemented (Table 3). Vegetation management methods alone cover 46% of total registered projects and generate over half of issued total ACCUs. Savanna fire management, with 81 projects, has yielded 11.5 million ACCUs to date (as of June 2023), and offers great opportunities for many Indigenous communities living in fire-prone regions of remote northern Australia.

The ERF scheme is voluntary for the proponents (landholders, businesses/industries and communities) to register their project or revoke, but there is a particular permanence obligation for carbon sequestration activities. For carbon sequestration projects, the permanence period is 25 or 100 years for the proponents to dedicate their land to maintain carbon in vegetation or soils against issued ACCUs. Savanna fire management projects require 25 years, avoided deforestation projects 15 years, and all other emission reduction projects 7 years under this scheme. In any carbon abatement contract, the successful proponent requires a schedule of delivering the issued ACCUs at an agreed price with the Regulator.

3.2.5. *Land Restoration Fund*

The Land Restoration Fund (LRF) is a Queensland (QLD) State Government initiative offering a voluntary agreement opportunity for landholders to generate carbon credits by sequestering carbon or reducing GHG emissions on their lands along with additional environmental, socio-economic and Indigenous co-benefits. During 2019–2022, the scheme invested over $100 million in 23 projects related to carbon farming and related activities that afford co-benefit (additional to carbon) outcomes such as protecting native vegetation and regrowth, improving soil health, water quality, threatened ecosystems and species, employment, and the participation of Indigenous people (Queensland Government, 2023a). The projects follow approved methods of ERF schemes for carbon emissions avoidance or sequestration through vegetation, e.g. regeneration of native vegetation, reforestation and afforestation, savanna fire management, livestock management and soil organic carbon sequestration.

By undertaking LRF projects, landholders receive payments in addition to ACCUs for generating social, cultural and environmental co-benefits. The scheme specifically encourages projects undertaken by Indigenous (Aboriginal) participants. Co-benefits can be verified using methods certified by AfN, and the Core Benefits Verification Framework developed by the Aboriginal Carbon Foundation. The projects have contributed an additional income stream to an estimated 1.8 million ACCUs earned for carbon mitigation projects.

3.3. *Caring-for-Country and related schemes*

Indigenous Australians have been managing their Country (e.g. estates) at a fine (e.g. clan) spatial scale, over millennia, delivering a number of ecosystem services (e.g. protection of biodiversity, regulation of water and climate, etc.) to local, on-site as well as off-site populations. Recognising Indigenous knowledge and skills in natural resource management, broadly described as '*looking after Country*', the Australian Government has funded several schemes over the last few years such as 'Caring for Country' or Indigenous Protected Areas (discussed below) aimed at managing and enhancing cultural and biodiversity values. Although these schemes may not perfectly fit the PES definition for lack of targets or verification, the overall approach is similar for ensuring the supply of ES for public benefit. From an Indigenous perspective, we prefer to call these schemes as 'Incentivised Caring for Country (ICC)'

rather than PES given that Indigenous peoples are the stewards of their Country; 'incentivising' is a more appropriate and respectful term than 'payments'.

In 2007, the Australian Government commenced the "Working on Country" (now broadly called "Caring for Country (CforC)") program supporting Indigenous peoples' approaches to land and sea management. This program is based on a voluntary partnership between Indigenous peoples and the Australian Government whereby the government funds Indigenous Ranger Groups (IRGs) for the conservation of Indigenous lands and seas (AIATSIS, 2011). However, under the program typically there are no well-defined or targeted ES to achieve against a set of key performance indicators (e.g. specific fire and weed management activities, fencing requirements). The Australian Government, with an investment of $43 million/year, is the largest funder in addition to private, philanthropic and Indigenous organisations that also support IRGs for various land and sea management activities. Indigenous Rangers contribute a wide range of services by undertaking activities such as border protection and quarantine, fire management, weed and feral animal control, biodiversity conservation, fisheries management, wetland restoration, and water and land resource management (Hill et al., 2013; Kerins, 2012).

Along with this programme, Indigenous peoples also have the opportunity to voluntarily agree to develop Protected Areas on their land under the 'Indigenous Protected Areas (IPA)' program. There are currently 82 IPAs as of June 2023, comprising 50% of Australia's National Reserve System and spanning 87 million hectares. To support the IPAs, the Australian Government is investing $231.5 million per year from July 2023 to June 2028 (Australian Government, 2023c). IPA-related activities, such as conserving representative areas of biodiversity, and controlling weeds, feral animals and fire, are highly cost-effective, affording a win–win situation for Indigenous peoples and government (Commonwealth of Australia, 2022; Sangha and Russell-Smith, 2017).

4. Discussion

We analysed 62 research articles on Payments for Ecosystem Services, including 11 articles/reports focusing on Australia, to understand the variety of PES arrangements, types of ES, ES beneficiaries/buyers and providers/sellers, the funders and intermediary actors, and operational models of different PES schemes. This review provides a timely assessment of fast-emerging PES opportunities and broader NbS focused on Australia.

4.1. PES from a global context

Contemporary global PES projects are critically reliant on decisions concerning appropriate funding and the duration of payments with respect to opportunity costs (i.e. forgone benefits). The security, stability and credibility of revenues from PES schemes are important aspects for ES providers (Naeem et al., 2015; Suhardiman et al., 2013). One-off payments are less attractive to motivate ES providers for their forgone benefits to commence a PES scheme as a result of new land management and conservation practices (Akers and Yasué, 2019; Kumar et al., 2014; Salzman et al., 2018). Both ES buyers and sellers are at the risk of opportunity costs being too high for the buyers or the ES revenues being too low for the ES sellers (Báliková and Šálka, 2022). The sustainability of the payment scheme is thus important and requires buyers (users) to ensure long-term adequate payments to providers.

Until recently, PES programmes have largely been funded by public sources through government allocations rather than private and philanthropic funding (Deutz et al., 2020; Galaz and Collste, 2022). However, a detailed review specifically focused on PES by Salzman et al. (2018), reported that the number of PES projects supported by governments comprise roughly 50% of the 550 total globally, with the majority focused on watersheds and carbon in forest systems due to a strong global focus on mitigating climate change. In the future, the private sector is expected to play an increasingly important role and is anticipated to embrace broader nature and biodiversity, under pressure from state and national governments as well as various international organisations including United Nations agencies such as IPBES, UNEP and others (Deutz et al., 2020; UNEP, 2021).

Typically, PES schemes focus on fixing one or more environmental problems rather than supporting land stewardship practices such as those undertaken by many IPLCs across the globe. Many IPLCs are significantly economically disadvantaged addressing customary management responsibilities for their lands and seas (WWF et al., 2021), with little access to outside resources and economic opportunities (IWGIA, 2019). Appropriately developed PES schemes can afford viable economic opportunities, enhance people's well-being, and protect biodiversity by enabling them to sustainably manage their lands while delivering ES to ES buyers (Dawson et al., 2021). Such practice also contributes to addressing seven of 17 UN-led SDGs (no poverty, no hunger, good health and well-being, climate action, life on land, life below water, and decent work and economic growth (Sangha et al., 2022).

An analysis of global PES studies suggests that current PES programmes often focus on achieving cost-effective environmental outcomes rather than equally important societal equity and just outcomes (Calvet-Mir et al., 2015). For instance, a company may like to support a PES scheme on a large tract of land managed by a single entity for achieving targeted ES outcomes with limited transactional costs (e.g. monitoring, accounting, reporting), rather than supporting a diverse group comprised of small landholding managers. This kind of 'cost-minimising' approach can contribute to perpetuating inequalities among local communities, and create tradeoffs between environmental and socio-economic outcomes. However, if equity and justice outcomes are considered equally important for PES, then investing in collections of small landholdings can deliver a diverse range of socio-economic and environmental outcomes contributing to achieving wider SDGs (Chan et al., 2017). For this, new monitoring and evaluation tools and a framework for PES arrangements need to be developed to deliver multi-purpose, effective PES schemes.

Creating an enabling legal environment with appropriate institutional support is vital for the successful implementation and operation of PES schemes. Some PES schemes operate on a one-on-one basis where ES buyers and ES sellers agree and sign the contract, without any independent institutional or legislative support from the state. This may work with stakeholders who have experience in dealing with the private sector and are well-informed and understand business complexities and uncertainties. But, such arrangements can compromise public interests to holistically protect natural ecosystems for the present and future generations, especially of the poor and disadvantaged/minority groups such as IPLCs (Costanza et al., 2021). For many IPLCs and small landholdings with limited experience in dealing with corporate actors such an undertaking can be challenging. In this instance, states and legislative institutions must play a vital role particularly to protect the interests of IPLCs and small landholders. For example, Costanza et al. (2021) propose utilising a Common Asset Trust where a state can act as a trustee to raise funds from private parties (ES users/buyers) to provide economic incentives to various ES providers. In Costa Rica, the state has offered legislative support to create certainty and established a national fund (The National Forestry Fund) resulting in a nationwide PES scheme (Pagiola, 2008; Porras et al., 2013). Such institutional arrangements are essential in developing countries where often the ES providers (land managers) are largely unaware of PES opportunities, and typically where their property rights are unclear. Streamlining some of the processes such as the time required to operationalise PES including government approval and negotiations between sellers, buyers, and intermediaries are core challenges for PES programmes in developing countries (Greiber, 2011; Suhardiman et al., 2013; Suich et al., 2016).

4.2. PES in Australia

Regarding PES (or PES-kind) programmes in Australia, we found two broad issues related to funding mechanisms and management goals as discussed below.

4.2.1. Public funding and a lack of institutional and policy support

Like the global scenario, existing PES programmes are largely funded by governments in Australia to date, financing 97% of the total ES market, at an estimated value of $5.2 billion. The dominance of the Government is reflective of its role as a main buyer in two large markets - carbon credits and water buyback for the environment programme, to meet government goals for emissions reduction and protecting river systems in the Murray Darling Basin, respectively.

For all six major contemporary PES schemes, governments (federal or state/territory) have both directly and indirectly financed carbon, reef, conservation agreements, land restoration, CforC & IPAs, and water credits schemes, mainly on behalf of the public. For example, the Emissions Reduction Fund is publicly funded rather than paid for by the polluters themselves (Macintosh et al., 2022). Similarly, the Murray-Darling Basin water buyback scheme is supported by public funds to buy back water entitlements from growers for maintaining environmental river flows. This approach has generally contributed to focused government expenditure for climate mitigation and environmental protection, with an expectation that private and philanthropic enterprises will additionally support the market. For instance, the Australian Government has allocated over $2 billion for biodiversity and environmental protection, and restoration of degraded ecosystems, over the next 30 years (PricewaterhouseCoopers [PwC], 2022). Additional investment from the private sector is critical for developing such markets/systems, as well as to support sustainable, responsible, and ethical businesses and reduce uncertainty (Australian Conservation Foundation, 2022).

To manage the growing private interest, especially from landholders' perspectives (Biodiversity Conservation Trust [BCT], 2022; PwC, 2022) and the long-term viability and equity of these opportunities, there is an evident need to establish an umbrella institution or organisation to take stock of supply and demand of ES and the funds available through nature-based markets at state/territory and national levels—somewhat equivalent to Clean Energy Regulator (with clear regulations and no conflict of interests). For example, currently there is more supply of Australian carbon credits than demand from the market, with government remaining the major buyer (The Clean Energy Regulator, 2023c). Mechanisms are also required to support private–public collaborations that can help raise public–private investment to minimise the current financing gaps, supplement government allocation, and make a secure investment commitment for achieving positive outcomes over the long term.

4.2.2. Nature of the ES market— Input vs. Output-based approaches

As with global examples, in almost all Conservation Agreement-related Australian PES cases, payments reflect more input-based activities rather than performance or targeted ES outcomes. For example, the cost of restoring native vegetation, reforestation, and biodiversity protection is often used as a payment measure to support activities required for establishing conservation projects (Baumber et al., 2019). Some positive aspects of such activity-oriented PES include allowing for flexibility of biodiversity outcomes, lowering the burden of monitoring, and minimising the risk to landholders from external factors such as fire, climate change and drought (Costanza et al., 2021). Short-term (less than ten years) biodiversity and carbon farming scheme projects also offer landholders an opportunity to negotiate with ES buyers for significant unforeseen risks (e.g. drought, floods, cyclones, wildfires) by adjusting or buffering payments (Higgins et al., 2012). Due to the input-based approach, these projects do not directly ensure the flow of ES from the ES provider nor ensure the outcomes achieved (Archibald et al., 2021).

In contrast, an outcome-based approach can highlight outcomes achieved, hence likely be more attractive for the private market. The current GHG emissions abatement, biodiversity and reef credit schemes provide opportunities for performance-based outcomes. Carbon Farming schemes generate tangible carbon credits (t.CO_2-e) which are directly sold in the market. Similarly, Reef Credits are a tradeable unit based on a measured amount of nutrients or sediments removed from flowing to the Great Barrier Reef. Under Queensland's Land Restoration Fund, some GHG emissions abatement projects also provide for additional biodiversity outcomes, hence providing higher funding dividends, but often lacking robustly measured outcomes (Frontier Economics, 2020). Despite an often narrow focus on a small number of targeted ES, outcome-based approaches have proven highly popular with private investors, developers and NGOs.

4.3. Challenges for Indigenous-led PES in Australia

Carbon farming activities (largely GHG emissions abatement) supporting Indigenous fire management is the first market-based PES scheme with clear outcomes, but funded largely by the government to date. The Carbon Farming Initiative (CFI) scheme was introduced in response to international pressure to reduce GHG emissions once Australia signed the Kyoto Protocol in 2008. Commencing as an emissions trading scheme, with the change of government in 2013 the scheme morphed into the publicly funded ERF with erratic funding—two major public investments of $2.5 billion at the start in 2012 and $2 billion in 2019. The private carbon market is yet small, only ~ $150 million in 2021, mainly driven by compliance obligations and volunteer commitments. However, this is projected to change significantly under the national government's 'Safeguard Mechanism', requiring Australia's high GHG emitting facilities to progressively limit their emissions below a baseline or purchase compensatory carbon credits from the market (https://www.cleanenergyregulator.gov.au/NGER/The-Safeguard-Mechanism).

Caring for Country (CforC), commencing in 2007, is another PES-like programme supported by the Australian Government where government and Indigenous stakeholders (landowners/Native Title holders) enter into voluntary agreements, with government providing basic economic support for agreed cultural and natural resource management activities. To date, however, CforC funding still depends on precarious political goodwill, and lacks diversified sources that can sustainably support the scheme in the long run (Altman et al., 2011; Russell-Smith et al., 2019a). In Australia, accessing sustainable and reliable finance, in line with Indigenous aspirations and needs, remains a major concern for remote communities.

Lack of local, culturally-based governance is often a major limitation for Indigenous communities to realise emerging ES opportunities (Russell-Smith et al., 2019b). Local governance is vital to ensure the proper design and implementation of projects as per cultural norms and considerations. Due to colonisation, Indigenous communities have suffered a significant loss of connection with their *Country* along with associated disruption to customary governance structures and processes (Archer et al., 2019; Ritchie, 2009; Russell-Smith et al., 2022). For the success of ES markets, local empowerment, capacity building, and governance are essential elements (Hartwig et al., 2023), as amply illustrated by recently emergent inclusive community-based governance arrangements operating in some Indigenous fire management and carbon market initiatives (e.g. Ansell et al., 2020).

In addition, and as affecting disempowered local communities globally, land tenure access and related issues can critically affect opportunities for Indigenous peoples to participate in PES arrangements. In Australia, despite rapidly growing return of Indigenous lands under freehold and shared ('Native Title') title arrangements (Fig. 4; Dore et al., 2014), Indigenous land enterprise (including PES) opportunities are confronted by inconsistent and unclear property rights operative at

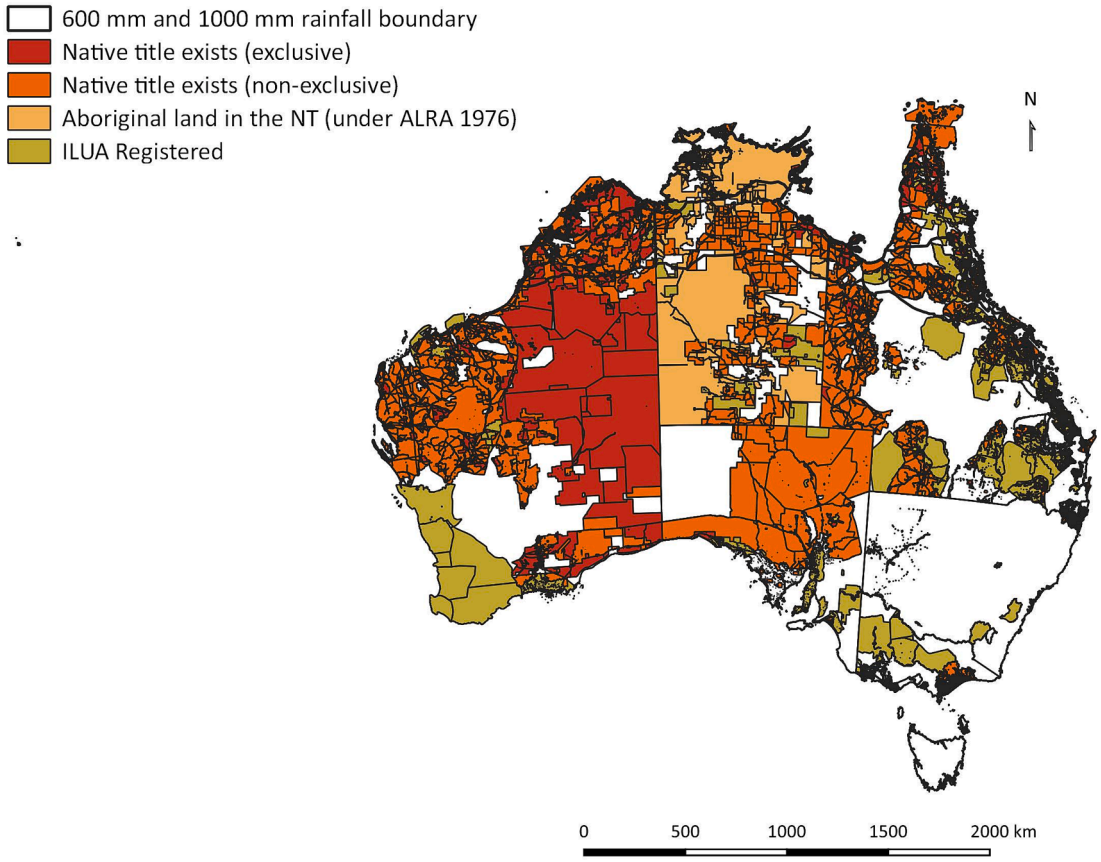

Fig. 4. Indigenous land rights (Native Title – exclusive and non-exclusive), Aboriginal land under ALRA in the NT (1976), and Indigenous Land Use Agreements (ILUA) across Australia using land rights data represented as small black dots from the National Native Title Tribunal (https://www.nntt.gov.au/Pages/Home-Page.aspx) and the Indigenous population census data from the ABS (https://www.abs.gov.au/census/find-census-data/geopackages?release = 2021&geography = AUST&table = G01&gda = GDA2020).

both national and State/Territory jurisdictional scales (Barber et al., 2016; Russell-Smith et al., 2019b; Winer et al., 2012) (Table 2). Emerging PES systems can offer significant economic benefits for both Indigenous Native Title and shared title holders (e.g. pastoral leases) across Australia, where adequate, transparent, collaborative and equitable benefit-sharing mechanisms can be developed (Russell-Smith et al., 2019a; Sangha et al., 2021).

5. Conclusions

In Australia and worldwide, >80% of existing PES and nature-based schemes rely on government funding, indicating that significant investment opportunities exist for further developing private and private–public sector partnerships. The majority of PES schemes consider addressing environmental problems using market instruments but typically don't support incentivising stewardship activities or applying holistic approaches to empower local Indigenous communities to manage their lands. Innovative NbS and PES systems need to be developed in collaboration with IPLCs, beyond the market-based approach. To date, IPLCs across the globe have had little involvement in designing or leading PES opportunities. Co-designing PES/Incentivising Caring for Country (ICC) mechanisms with IPLCs is the first critical step required for the success of such programmes.

Additionally, future PES programmes must consider both socio-economic and environmental outcomes, especially where IPLCs are involved. An integrated approach reporting both SDGs and environmental outcomes could be equally useful for investors. Empowering IPLCs, recognising and supporting their skills-base and knowledges, ensuring equitable and just distribution of funds, developing appropriate government policies and instruments, and providing sustainable and reliable incentives are essential for the success of these fast-emerging NbS to protect biodiversity and prevent further decline of our natural systems.

CRediT authorship contribution statement

Kamaljit K Sangha: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Ronju Ahammad:** Formal analysis, Investigation, Methodology, Resources, Writing – original draft. **Jeremy Russell-Smith:** Supervision, Writing – original draft, Writing – review & editing. **Robert Costanza:** Conceptualization, Supervision, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix

Appendix 1: A list of PES schemes in Australia (Aboriginal Carbon Foundation, 2019; AIATSIS, 2011; Australian Government, 2023a; Australian Government, 2023b; Banerjee and Bark, 2013; Government of South Australia, 2023; Higgins et al., 2012; Iftekhar et al., 2014; National Trust of Australia, 2023; Queensland Government, 2023b; Queensland Government, 2023c; Winer et al., 2012).

PES schemes	Location (state/ territory)	Scale of implementation	Actors/Involved parties	Salient features
Private Protected Area Programmes (2007-ongoing)	QLD	Local	Department of Environment and Science, Queensland Government, and Private landholders	• Partnerships between government and landholders to support sustainable land management goals through the establishment of private protected areas. • A voluntary conservation agreement between a landholder and the government to conserve the significant natural and cultural values of privately managed land through financial assistance. • Nature refuges are compatible with, and often complement alternate income streams for landholders such as beef/crop production, carbon farming, and ecotourism. • Since 2007, the Nature Assist program provided $16.3 million to 130 projects for landholders to carry out practical land management projects that support long-term conservation objectives across QLD.
Conservation Covenant Programmes (2003-ongoing)	WA	Local	Department of Biodiversity, Conservation and Attractions, Department of Primary Industries and Regional Development, The National Trust of Western Australia and private landowners	• Conservation Covenant is a voluntary, legally binding document that has provisions restricting activities that might threaten conservation values. • The covenant runs on land in perpetuity but the term of agreement may vary. Every conservation covenant is individually negotiated between the Department and landowner, and aims to maintain the conservation values of the bushland whilst allowing for flexibility to reflect the landowner's wishes for the land. • The National Trust's Conservation Covenant and Stewardship Program has registered 189 covenants protecting more than 18,000 hectares- of bushland in Western Australia. • The program offers financial incentives for initial independent legal advice, and tax concession.
Conservation Agreement on private land and Biodiversity Stewardship Agreement Programmes in NSW (2012-on going)	NSW	Local	Biodiversity Conservation Trust of NSW	• 2,261 Private land conservation agreements with landholders across more than 2.258 million hectares. Since 2017, 424 landholders are in the process of conservation agreements extending to 251,000 hectares new private land. Overall, 70 per cent of agreements are in perpetuity and 30 per cent term based (minimum 15 years). Landholders with funded agreements are typically paid between $ 5 and $ 433 per hectare, per annum. • BioBanking is a voluntary market scheme for private landowners to develop biodiversity credits by conserving their lands, protecting threatened species and their habitats. The buyers of the biodiversity credits allow them to offset the loss of biodiversity on an approved development site. The BioBanking Scheme was replaced by the Biodiversity Offsets Scheme (BOS) under the Biodiversity Conservation Act 2016 (BC Act) which commenced on 25 August 2017. The BOS is also a market-based scheme, somewhat

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PES schemes	Location (state/ territory)	Scale of implementation	Actors/Involved parties	Salient features
				similar to BioBanking, but there have been a number of changes including a stewardship agreement.
Private conservation (Heritage agreement) (1980- ongoing)	SA	Local	Department for Environment and Water, Native Vegetation Council and Private landholders	• Private landowners voluntarily agree with government to undertake conservation activities on their lands that have native vegetations, provide wildlife corridor and refuge for special animals and plants required protection. Funded by government as grant to landholders, the estimated market value of conservation agreement was $1 million in the year of 2021.
Private Land Conservation Program in Tasmania (2006-ongoing); Non-Forest Vegetation Project (2004-2009); Forest Conservation Fund (2006-2009); Private Forest Reserves Programme (1997-2006)	TAS	Local	Department of Natural Resources and Environment, Tasmania	• A voluntary agreement of private landowners with the conservation covenant to manage defined areas specifically for nature conservation with priority given to areas of land with significant natural values such as threatened species. • As of 2021, 908 conservation covenants on 109,570 hectares of private land and 715 garden for wildlife covering 3,077 hectares. • Minimum landholding size of 10 hectares is required for a covenant.
Conservation Covenant Program (1972-Ongoing); BushTender/EcoTender (2001-2021)	VIC	Local	Trust For Nature (Victoria), Victorian Government	• A voluntary and legally binding conservation covenant between landowners and the Trust for Nature. It can cost upwards of $ 30,000 in legal fees and ongoing stewardship. The Trust covers these costs through the support of state and federal government grants and philanthropy. • BushTender and EcoTender adopt auction-based approaches where landowners are invited to submit proposal and bid for improved management of native vegetation on their property that can generate multiple benefits, e.g. salinity and erosion control, maintenance of water quality, carbon among others. Landholders receive periodic payments for management activities under a five year agreement with the Victorian Government.
Territory Conservation Agreements (2011- to Ongoing)	NT	Local	Territory NRM, government, Landowners	• A voluntary agreement of landowners with Territory NRM for 10 years to undertake land management practices to support production and ecological values of defined sites. • The programme comprises both direct payment for management cost and in-kind contributions of landowners. • Funded by the federal government through Territory NRM.
Water Buyback for Environment	Various states/ territories (VIC, SA, QLD and NSW)	Catchment/ Basin, Regional	Farmers/ Irrigators, Investors, Indigenous communities, Environmental Water Holders (Federal and State Government and Non Government), Urban, Industrial and Recreational Users	• Commonwealth government purchases water entitlements (buy back) from farmers (with their specific allocation) to afford extra water for environmental flows. • A voluntary partnership with farmers who sell their water allocations to government (commonwealth) for environmental flows or buy from the markets for their farm irrigation. • It is one of the earlier water trade program for environmental outcomes in Australia, currently worth AU$ 2 billion.
Reef Credits	QLD	Catchment	Farmers, Businesses, Investment banks, QLD State Government	• A market-mechanism to incentivise farmers/land managers for water quality improvements across catchments of the Great Barrier Reef • Landholders undertake projects by changing land management to improve water quality. They receive reef credits for the unit of nutrients and sediments prevented from flowing to the catchment of the reef.

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PES schemes	Location (state/ territory)	Scale of implementation	Actors/Involved parties	Salient features
Carbon Farming Methods under Emission Reduction Fund	All states/ territories	National	Landholders, Business, , Indigenous people, local council, government	• A voluntary carbon offset scheme allowing land managers to generate carbon credits by changing land management practices and reducing greenhouse gas emissions. • The Emissions Reduction Fund offers landholders, communities and businesses the opportunity to run projects in Australia that avoid the release of greenhouse gas emissions or remove and sequester carbon from the atmosphere.
Land Restoration Fund	QLD	Local, Regional	Landholders, Farmers, Indigenous communities, Government	• Landholders generate carbon credits by undertaking various land management including protection of native vegetation, plantings to sequester C and avoid emissions. • The credits offer additional payment options upon verified delivery of environmental, socio-economic and First Nations co-benefits.
Caring for Country/Working on Country Programme	Various states/ territories	Local, Regional	Indigenous communities, local council, government	• Funded by the federal government for natural resources management including IPA on Indigenous estate.
Caring for our Country(2008-2018)	All states/ territories	Local, Regional	Community based organisations, regional NRM council, Catchment authority, NGOs, Industries, government	• Funded by the federal government to support sustainable environment (e.g. community programmes) and sustainable agriculture (under policy initiatives such as C farming, National Flood Plan, Drought Policy Reform, etc.). • During 2013-2014, the market for sustainable environment and agriculture practices was $463 million in the form of government grant for Caring for Country programme.

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