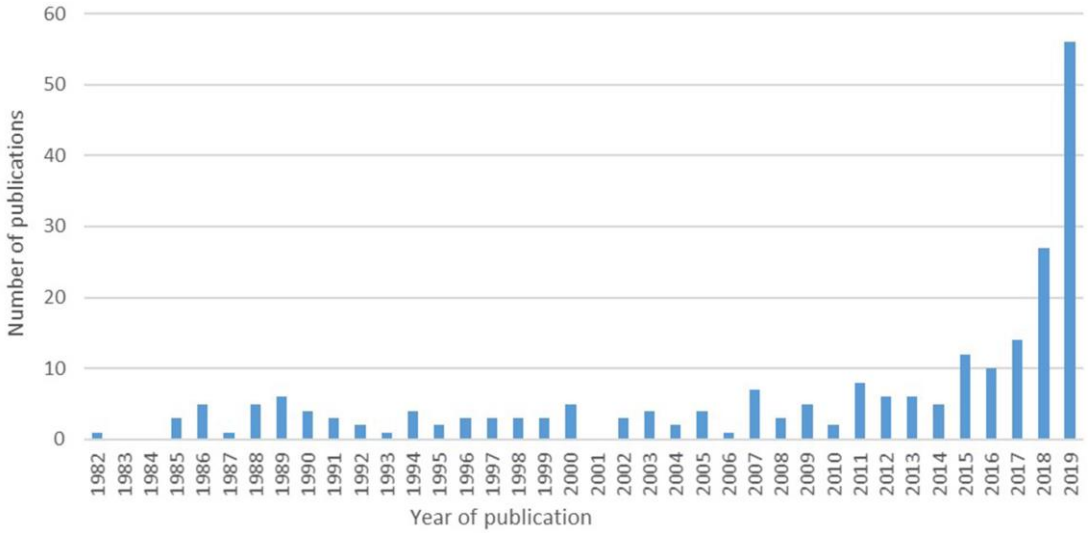
The BES Report on Regenerative Agriculture

Introduction

The term "regenerative agriculture" is gaining traction and is increasingly being used in different contexts by academics, policymakers, NGOs and land managers (see Figure 1 and similar figures in Giller *et al.*, 2021). Regenerative agriculture certification schemes are also starting to emerge, including Regenerative Organic Certified in the US and Certified Regenerative in the UK.

Figure 1. Number of research articles that use the term "regenerative agriculture"



Source: Newton et al., 2020.

However, the term "regenerative agriculture" is used with a variety of meanings by academics and practitioners, and there is no regulatory definition or definition from a well-respected international body. Two recent literature reviews have shown that a common definition does not emerge from either scientific literature or use by practitioners (see Boxes 1 and 2).

Box 1. Definition of regenerative agriculture in peer-reviewed literature

Schreefel *et al.* (2020) searched all peer-reviewed articles mentioning both the word "regenerative" and keywords related to agriculture such as "farming", "agriculture", "agronomy" and "food system" and found 279 articles. Of these, 28 peer-reviewed articles included a definition of regenerative agriculture. The authors analysed the definitions used in these 28 articles, and found four types of key objectives where the definitions converged:

- Soil health (mentioned in 17 articles), including soil biodiversity (17 articles), carbon content (13 articles) and physical quality (11 articles)
- Optimised resource management (mentioned in 13 articles), which mainly referred to nutrient cycling
- Alleviating climate change (mentioned in 8 articles)
- Improving water quality and availability (mentioned in 5 articles)

The authors found that the objectives related to human health (mentioned in 13 articles) and improvement of economic prosperity (mentioned in 12 objectives) referred to a wide range of different issues and were too vague to be operationalised.

They concluded that soil improvement is the basis of the concept of "regenerative agriculture" and therefore proposed a definition for regenerative agriculture based on soil conservation:

'*An approach to farming that uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting ecosystem services, with the objective that this will enhance not only the environmental, but also the social and economic dimensions of sustainable food production'.*

Source: Schreefel et al. (2020).

Box 2. Process vs output-based definitions

Newton *et al.* (2020)'s exhaustive review of scholar and practitioner definitions of regenerative agriculture, including 229 journal articles and 25 practitioner websites, shows that the term "regenerative agriculture" is used in the literature with a wide range of meanings, and there is not a widely accepted definition. The definitions used in the literature they reviewed were based on processes, outcomes or (more often) a combination of both. The processes that were most mentioned included:

- Reduction or avoidance of external inputs and use of on-farm inputs
- Integration of livestock
- Avoidance of synthetic fertilisers
- Reduction or avoidance of tillage
- Use of cover crops

The most mentioned outcomes were:

- Improvement of soil health
- Carbon sequestration
- Increased biodiversity
- Improvement of water resources
- Improvement of social and/or economic wellbeing

Source: Newton et al. (2020).

The lack of an agreed definition could result in a loss of credibility of the term, which could be used by companies to become more appealing to environmentally-aware consumers, with little scrutiny[1].

A robust definition and measurable assessment indicators will be needed to ensure that ecological knowledge supports the transition towards more sustainable agricultural practices. The BES would like to contribute to this debate with a policy report that will provide an ecologically-based definition for the term "regenerative agriculture", summarise the most relevant scientific evidence and thinking, discuss benefits and challenges for land managers and society as a whole, including potential trade-offs and synergies between food production and other ecosystem services, and provide policy recommendations for the transition to a more sustainable, regenerative agriculture in the UK.

The report will focus in particular on the contribution that the science of ecology can make in developing a common understanding of regenerative agriculture. It will provide a summary of the available scientific evidence on the potential impacts of regenerative agricultural practices on yields in different contexts, and will discuss changes it could bring to land use and food production in the UK. It will also examine regenerative agriculture's potential contribution to different policy agendas, from climate mitigation and adaptation to food security and biodiversity protection.

The report will examine the factors/practices that can be used to define regenerative agricultural farming and the indicators that can be used to assess its impacts, considering both process-based and output-based indicators. It will provide an overview of available methodologies and data for assessment, as well as prospective advancements in the development of new methodologies.

Objectives and scope

The report will explore the contribution of ecological sciences to the transition to more sustainable agricultural practices. It will have four main objectives:

1. To propose an ecologically-based definition of the term "regenerative agriculture" and the factors that can be used to define it.
2. To provide an overview of the available methodologies and data which can be used to provide indicators/measurements of its impacts on ecosystem functions, together with the pros and cons of different approaches and prospects on future methodologies and data availability.
3. To help understand what is needed, besides ecological knowledge, to facilitate the transition towards regenerative agriculture on the ground. This will require an analysis of potential challenges and barriers for land managers, including those relating to costs, potential decreases in yields, if any, and other risks. The report will also summarise available information on opportunities and benefits for landowners and managers, including reduced input costs, diversification of products and access to new markets.

[1] A number of organisations have raised concerns about the potential use of the term "regenerative agriculture" for green washing, due to a lack of scientific or legislative definition, see for example https://www.martin-haeusling.eu/images/GREENWASHING_AND_HIGH_TECH_-_Faking_it_un-sustainable_solutions_for_agriculture_WEB.pdf.

4. To provide policy recommendations to support farmers in the transition towards more extensive use of regenerative agricultural practices in the UK, based on scientific evidence.

Audience

The report will mainly address three categories of stakeholders in the four UK nations:

1. Policymakers designing agricultural and environmental policies, to help them to understand and support regenerative agriculture practices based on ecological knowledge, as well as to understand the benefits and challenges of different design options and the related trade-offs;
2. Land managers, to shed light on the ecological benefits and challenges of regenerative agriculture, and provide them with the ecological knowledge they need to produce both food and wider ecosystem services;
3. The wider public, to make them aware of the wide range of environmental and socio-economic outcomes of ecologically based regenerative agriculture practices.

Methodology

The report will mainly draw from the most relevant scientific evidence on the main topics addressed, which will be complemented by a few interviews with experts on the different key elements of regenerative agriculture and representatives of farming associations.

Language

The language used in the report should be accessible to non-specialists. It will aim to summarise ecological evidence to a wide range of stakeholders, including policymakers, land managers and the general public. This will require:

- Avoiding jargon as much as possible
- Explaining technical terms in boxes or footnotes
- Keeping sentences short for clarity
- Avoiding detailed discussion of scientific methodologies, and using references to allow readers to look into evidence if they are interested
- Using figures to illustrate complex concepts

The level of confidence and any uncertainty in the evidence provided should be highlighted and explained.

Geographical focus

The geographical focus of the report will be mainland UK (Overseas Territories will not be included, because of their different environmental, socio-economics and institutional characteristics). The report will include evidence from all devolved nations, in order to ensure that its analysis and policy recommendations are relevant across the entire UK, and from other countries, such as EU countries and the USA. The EU is particularly relevant not only because of the shared history, geographical

proximity, similar institutional settings and socio-economic conditions, but also because the EU is the UK's biggest trading partner.

Project management and roles

The report will be the result of a collective effort, which will involve experts at different career stages and with different roles (authors, contributors, reviewers and Steering Group members). A call for interest will be published on the BES webpage to recruit authors. The main responsibilities of these roles are summarised below.

The Steering Group will lead the drafting process and provide guidance on the scope, narrative, contents and language of the report. In addition, the Steering Group will supervise the drafting process and hold regular meetings with the authors and the Policy Team for the duration of the project, revise early drafts and sign-off on the final report, and make decisions when it is not possible to reach a consensus on a particular issue (e.g., between authors or in case of particularly contentious debates within the academic community or representatives of practitioner groups).

The Steering Group will also be responsible for decisions regarding changes to the authors working on the report in the case that progress is prevented or significantly slowed due to, e.g. lack of attendance at meetings, conduct and performance at meetings, lack of engagement with other authors and slow or substandard work. One member of the Steering Group will be assigned the role of the lead member, who will be responsible for final decisions if the group is unable to reach a consensus.

The authors will draft the report, with guidance from the project's Steering Group and the BES Policy Team. They will be selected and assigned to a chapter by the Policy Team and the Steering Group, based on their expertise on topics relevant to the report, their interests and their career stage. Authors will be responsible for sourcing the necessary information and contacting relevant experts in the field to request further information and interview them, sourcing images (including establishing copyrights where necessary) and processing reviewer comments.

Each chapter will have a lead author, who will coordinate the work of the authors of their chapter and ensure quality and consistency. They will coordinate with the other lead authors to ensure that the narrative of the report is coherent and avoids repetition. They will ensure that the reviewers' comments are properly addressed and make decisions, together with the Steering Group and the Policy Team, in case of conflicting comments. Lead authors will have regular meetings with the Steering Group and the BES Policy Team (approximately every three weeks) and will revise the draft chapters before submitting them to the Steering Group and the BES Policy Team (there will be multiple revision rounds by the Steering Group, the Policy Team and external reviewers). They will be first authors in the citation of the chapter they lead.

There may be opportunities for the Steering Group and lead authors to be involved in follow-up communications relating to the report after the end of the project, such as media-related events, workshops/webinars and meetings with policymakers. Where appropriate, guidance can be provided by the BES for such events.

Contributors will provide specific and relevant information to the authors, through semi-structured interviews, written summaries or essential references. The contributors will be selected by the authors and the Steering Group.

Reviewers will be experts who have not been involved in the drafting process. They will revise the report before its publication to ensure quality. They will represent the four UK governments, the academic community and the farming community. If there are any conflicts between reviewer opinions, the Steering Group will be responsible for making a final decision on the approach to be taken.

The BES Policy Team will work with the Steering Group to oversee the report drafting process, including ensuring the timeline is adhered to and reviewing drafts as required. They will provide the BES perspective to the project, with consideration of factors such as impartiality and quality. They will also provide guidelines about the writing style and formatting of the report. From a management point of view, they will schedule meetings between those involved in the project, help identify contributors and reviewers, organise and attend meetings with the Steering Group and lead authors, have responsibility for the final design of the report, and work with the wider BES staff to organise the launch event, press coverage and any follow-up dissemination activities.

Preliminary timeline

- **July 2022**: setting up of the Steering Group.
- **August - September 2022**: drafting of the Terms of References (ToR) and publication of the call for interest in the BES webpage.
- **September-November 2022**: Recruitment of authors, workshop with the authors, start of the drafting process
- **November 2022-March 2023**: development of the first draft.
- **March-May 2023**: revision process by the Steering Group, the Policy Team, and external reviewers, and preparation of the second draft.
- **June-July 2023**: finalisation of the report.
- **September 2023**: launch event.

This timeline may be modified during the course of the project in order to respond to potential challenges and policy windows of opportunity that may arise.

Preliminary structure of the report and questions

The report will be structured around a set of questions, which are summarised below. It will start with an executive summary, which will present the headline findings and policy recommendations to increase accessibility for policymakers. It will include a number of boxes with case-studies, definitions and scientific information, and a list of references. Each chapter will include a summary containing the key messages, of approximately a page in length.

The structure and questions detailed in this document may change during the drafting process, as a result of discussions among the Steering Group members, the Policy Team and authors, and as new information emerges.

1. Introduction (2 pages)

- What are the main environmental impacts of agriculture in the UK?

- Why do we need to transition to more sustainable agricultural practices that regenerate the soil while providing a wide range of ecosystem services?

A few figures and graphs on GHG emissions, water pollution, decrease of pollinators, soil degradation, etc.

2. Definition of regenerative agriculture (14 pages)

2.1 Definition (2 pages)

- What are the main commonalities and differences between the various definitions of regenerative agriculture found in peer-reviewed literature, reports and grey literature?
- What are the commonalities and differences between regenerative agriculture and other related terms, e.g. organic agriculture, sustainable agriculture, conservation agriculture, agroecology, carbon farming, sustainable intensification?
- What is the definition adopted in this report? What are the key principles of regenerative agriculture? And how do they relate to ecological concepts?

[Examples of principles: Lal, 2020:

- *conservation agriculture,*
- *restoration of soil health,*
- *carbon sequestration,*
- *integration of crops and trees with livestock*

Groundswell´s definition:

- *Minimise soil disturbance*
- *Keep soil covered*
- *Keep living roots in the soil*
- *Grow a diverse range of crops (broad rotation, use rotational leys and grazing cover crops)*
- *Use grazing livestock*

Box summarising how the term is used in agricultural policy in the four nations

2.2 Practices (4 pages)

- What are the essential practices for different land uses (e.g. grassland, arable land, agroforestry, paludiculture, etc.)?
  - *Minimising tillage*
  - *Reducing the use of agrochemicals*
  - *Using cover crops*
  - *Agroforestry (see for example Elevitch et al. 2018)*
  - *…?*

Maybe mention the potential, pros and cons of promising, but not yet widespread practices like perennial grains.

Important: there is no one-size-fits-all solution, and the same practice will lead to very different outcomes in different contexts. The best practices for a particular plot will depend on local agronomic, climate and socio-economic factors, and the same practice can lead to very different results in different contexts. The objective should be to empower land managers to choose the best practices for their land, balancing the specific trade-offs they face, and provide them with guidance based on scientific evidence.

Highlight the risk of greenwashing by discussing which practices farmers are currently adopting under the name of regenerative agriculture, and whether they comply with the definition of the report.

Boxes with examples of practices that fit into the definition given above in the UK and EU, and the change they bring about.

2.3 Environmental and ecological benefits (4 pages)

- What is the available evidence on the most important ecological and environmental benefits of regenerative agriculture?
- What data are available and what are the data gaps?

[see Bradford et al., 2019 for a good summary on the available scientific evidence and uncertainties about the link between soil carbon and soil health]

Summary of scientific evidence on the main benefits:

- *Carbon sequestration*
- *Reduction of soil erosion and run off, improving soil structure and aggregation, increased soil moisture*
- *Increased resilience/stability, e.g. in context of buffering climate extremes*
- *Biodiversity in soil and vegetation, and connectivity*
- *Improved nutrient cycling*
- *Improved water retention and reduced flood risks*
- *…*

[Jordon el., 2022, calculated that cover cropping and ley-arable rotations have the potential to mitigate up to a quarter of UK agricultural GHG emissions, whereas they found little change in soil carbon due to reduced tillage intensity]

2.5 Process-based and outcome-based indicators (4 pages)

- How can we define and assess regenerative agricultural practices? Shall we use process-based, outcome-based indicators, or a combination of both?
- Which are the pros and cons of process-based vs output-based indicators?

Overview of the evidence base that is available now for each type of indicators, and what evidence will likely be available in the future due to e.g.new methodological developments.

Discussion on pros and cons of process vs outcome-based indicators. Process-based indicators tend to be easier and cheaper to measure and verify, and imply a lower level of risk for farmers. However, they imply a risk for policy-makers, as regenerative agricultural practices may not always bring about the desired outcomes, as outcomes will depend on a number of agronomic, climatic and environmental factors. Measuring outcomes tend to imply higher monitoring, reporting and verification (MRV) costs (depending on the indicator used) and, if the measurement of outcomes is linked to rewards, increased upfront investment costs and potential risks for land managers, because outcomes can be influenced by factors outside their control. The advantage of outcome-based indicators are a higher degree of flexibility for land managers (they can choose their management strategies to achieve the desired outcomes) and higher certainty on the degree of achievement of environmental and climate objectives of agricultural policies.

Some outcomes are easier to measure than others. For example, detecting changes in soil carbon in time and spatial scales that are relevant for management and incentives (i.e. a short time scale and at a plot or farm level) is methodologically challenging (Bradford et al., 2019). Measuring biodiversity of species-rich grassland

using key flower species as proxy indicators is significantly easier and has a long tradition in the EU (Allen et al., 2014).

3. Potential long term consequences for food production and land use (4 pages)

- What are the potential trade-offs among ecosystem services of different land uses? Are there trade-offs among environmental objectives (e.g. biodiversity protection and climate mitigation)? Or between environmental and other societal objectives (e.g. food production?)
- What are the potential implications of regenerative agriculture on yields?
- If yields are lower than in intensive agriculture, is there a risk of reduced food security and of externalising the impact of UK food production, if food imports increase?
- If regenerative farming increases long-term sustainability of food production and resilience against climate change, will food security increase?
- Are there implications for food prices? This is important in the context of the current cost of living crisis and food poverty in the UK

Summary of available evidence on the potential impact on yields of different farming methods and different land uses, and related risk of reducing food security and externalising the impact of our food consumption if national production of food decreases. Ensuring high yields by using high levels of agrochemicals is not a sustainable option because of the consequences in terms of climate change, pollution and soil erosion, and ultimately decrease of yields in the long term. The objective should be to obtain the highest yields in the long term by maintaining/improving soil fertility, while protecting/improving biodiversity and providing a wide range of ecosystem services.

In this context, mention potential trade-offs among benefits linked to different land uses, in the context of the land-sparing vs land-sharing discussion, e.g. biodiversity benefits and ecosystem services provided by semi-natural habitats like high nature value grasslands vs. biodiversity and carbon benefits of alternative, non-agricultural land use (e.g. rewilding), and potentially trade-offs between carbon and biodiversity objectives. Maintenance of high nature value semi-natural habitats is essential to the conservation of key biodiversity in the UK (besides providing important provisioning, regulating, supporting and cultural ecosystem services), and this requires the use of pasture-fed livestock (discuss implications of different livestock densities, for biodiversity but also for food production). Also, discuss the potential benefits and impacts of using livestock, rather than agrochemicals, to manage weeds in cropland.

Brief discussion on the implication of diet change, and the overall need to reduce consumption of meat and other animal products. A transition towards regenerative agriculture will imply lower production of meat and other animal products per ha, and therefore it will be sustainable if overall consumption of animal products in the UK decreases significantly.

Also, discuss potential adverse impacts of regenerative agriculture practices from an agronomic perspective. For example, Giller et al. (2021) argue that if no external source of nutrients are used, the nitrogen content of soil and therefore yields will decline over time. What is the available scientific evidence on this point?

4. Barriers and opportunities for land managers (15 pages)

4.1 Potential impacts on farmers' income and productivity (3 pages)

- *What is the potential impact of adopting regenerative agricultural practices on farmers' income?*
- *How best to manage the ecology of farmland to maximise productivity (not necessarily production)?*

Summary of available scientific evidence on the impact of adopting regenerative agricultural practices on farmers' income, i.e. reduced costs for farmers (e.g. related to reduced or no use of agrochemicals, change in work needs, reduced fuel costs, etc.) as compared to potential changes in revenues due to modified yields and premium prices.

[See e.g. a recent report funded by RSPB on how to improve farm profitability and sustainability in marginal farm systems.

Also: Oldfield et al. (2019)'s meta-analysis shows that increase in soil organic matter improve yields of corn and wheat].

4.2 Benefits and opportunities for land managers (4 pages)

- What are the main benefits and opportunities for land managers?

Summary of available scientific evidence on benefits that land managers can obtain from regenerative agriculture besides what is covered in the previous section, e.g.:

- *Potential increase in the value of land, due to increased soil health and hence productivity.*
- *Potential diversification of products*
- *Premium prices*
- *Resilience against pests and climate change*
- *Sense of self-efficacy and wellbeing (see e.g. Brown et al., 2022)*

Boxes with examples in the UK and EU

4.3 Barriers to uptake for land managers (4 pages)

- What are the main barriers to a widespread adoption of regenerative agricultural practices? What are the main challenges and risks for farmers?
  - *Inadequate incentives from agri-environment schemes?*
  - *Risks for land managers?*
  - *Knowledge requirements and knowledge gaps?*
  - *Cultural factors, traditions, sense of identity?*
  - *…?*

This section should draw from a few semi-structured interviews with farmer organisations, besides the relevant literature.

Boxes with examples in the UK and EU

4.4 Strategies and approaches to overcome barriers (4 pages)

- What would help land managers to move towards regenerative agricultural practices or maintain them? What is needed to make regenerative farming viable and profitable in different contexts? How can a transformational adaptation process (Gosnell et al., 2019) of the farming community be encouraged?
  - *Sharing of ecological knowledge?*
  - *Incentives?*
  - *Advisory services?*
  - *Developing markets for certified products/products with a premium prices?*
  - *Exchanging good practices among farmers?*
  - *Engagement with the wider community?*
  - *…?*

- Do strategies need to include explicit references to the need for a 'just transition'? Transitions to new practices in an industry often favour businesses with access to new technology and large amounts of capital. In farming this means large agri-businesses may have the financial backing to invest in new equipment and take on the risk of transition, but small landowners and tenant farmers may not. Such a transition could therefore see the concentration of the landholdings and the exclusion of small farmers and farm labourers. How can a just transition be ensured?

This section should draw from a few semi-structured interviews with farmer organisations, besides the relevant literature.

Boxes with examples in UK and EU

5. Policy tools (13 pages)

5.1 Policy tools to support regenerative farming approaches

- Which policy tools can be used to make sure that agricultural practices becomes more sustainable, based on ecological knowledge?
- What is needed to support and empower farmers, so that they can tailor management practices to the characteristics of their land and balance trade-offs around food delivery, provision of ecosystem services and income generation?
- Which indicators can be used for each policy tool?

Overview on the policy tools that can be used to support farmers in their transition to more sustainable farming.

Discussion on how regenerative practices can be assessed for the design, implementation and assessment of different policy tools. Also, discussion on trade-offs between process-based and outcome-based indicators, and which indicators may potentially be used for which types of policy tools (e.g. agri-environment measures vs. carbon credits).

[For a discussion on pros and cons of available MRV approaches for carbon farming, and potential future methodological developments, see COWI, Ecologic Institute and IEEP (2021) and Ecologic Institute and IEEP (2022)].

- (optional) What lessons can be learned from the EU?

E.g. the Carbon Farming Initiative, the Communication on Sustainable Carbon Cycles and the upcoming Carbon Removals Certification Mechanism, the EU Nature Restoration Law, …

The following sections will discuss these questions for a number of key policy tools.

5.1.1 Agri-environment schemes (5 pages)

Environmental Land Management Schemes in England, Sustainable Farming Scheme in Wales, upcoming Agricultural Bill and proposed schemes in Scotland, upcoming new schemes in Northern Ireland

5.1.2 Certification schemes (2 pages)

5.1.3 Engaging the private sector (2 pages)

Value-chain approaches, e.g. through investments of food producers and supermarkets to increase the sustainability of their providers

5.2. The contribution of regenerative farming to the delivery of policy objectives

This section will discuss how and to what extent regenerative agriculture may potentially contribute to the delivery of key UK policies.

5.2.1 Potential contribution of regenerative agriculture to climate policies

including carbon offsetting.

5.2.1. Potential contribution of regenerative agriculture to biodiversity policy

Including:

- *Local Nature Recovery Strategies in England, and key biodiversity policies in the devolved nations*
- *Biodiversity Net Gain*

Potential contribution of regenerative agriculture to climate adaptation policies

Including resilience against draughts and floods

6. Conclusions (2 pages)

BRITISH ECOLOGICAL SOCIETY

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