BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: S1b

Assessing trade-offs between ecosystem services in agroecological transitions of agrifood systems

Hosts:

	Name	Organisation	E-mail
Host:	Livia Madureira	UTAD/CETRAD (Centre for Transdisciplinary Development Studies)	lmadurei@utad.pt
Co-host(s):	Carla Ferreira Monica Dantas Mário G. Santos	UTAD/CETRAD UTAD/CETRAD UTAD/CITAB (Centre for the Research and Technology of Agro-Environmental and Biological Sciences)	carlacf@utad.pt monicadantas@utad.pt mgsantos@utad.pt

Abstract:

Agroecology and ecosystem services are closely linked, with agroecological practices promoting the sustainable management of agroecosystems. There is growing interest in agroecology, as a sustainable innovation, that plays a crucial role in the transition towards sustainable agriculture (Bilali, 2019). Agroecology also provides the scientific and methodological basis for transitioning to new paradigms of rural development, emphasising the importance of farmer-led participation and extension (Lianu et al., 2023). Thus, this transition process requires changes in practices, knowledge generation, social and economic relations, and institutional conditions (Gliessman, 2018). Therefore, specific policy frameworks are essential to support agroecology and to establish sustainable strategies in the face of climate change and development pressures. Given the multifaceted nature of agroecological transitions and the need for a holistic approach that considers social, political, economic and environmental aspects, a discussion on the trade-offs of agroecological transitions in agrifood systems is needed. Several authors emphasise the need

to understand the internal and external factors influencing the transition process and propose methodologies to assess human capital, management capacity, agroecosystem quality and transformability (Darmaun et al., 2023; Ong & Liao, 2020). In addition to these research strands there is an interesting room to explore and to assess the trade-offs between ecosystem services involved by the agroecological transitions (e.g. fire risk and non-tillage eco-functional farming practices). The choices regarding these trade-offs and co-benefits involve social-ecological systems under uncertainty and different socio-cultural perspectives.

This session welcomes abstracts for brief presentations (5 min) that will foster collective discussions on the following topics:

- Approaches, frameworks, methods, and tools for assessing socio-ecological trade-offs and co-benefits between ecosystem services in agroecological transitions.
- Metrics and indicators for assessing agroecological transitions built on the ecosystem services approach.
- Policies, strategies, and practices supporting the design of agroecological transitions as transformative changes towards more sustainable, resilient, healthy, and ethical agri-food systems.

The overall aim of the session is to strength a transdisciplinary community linking ecosystems services approach to agroecological agrifood systems transitions, including the edition of a special issue on “Trade-offs between ecosystem services in agroecological transitions of agrifood systems: Assessment and measurement approaches”.

References:

Bilali, H. (2019). Innovation-Sustainability Nexus in Agriculture Transition: Case of Agroecology. Open Agriculture, 4, 1 - 16.

Darmaun, M., Chevallier, T., Hossard, L., Lairez, J., Scopel, E., Chotte, J., Lambert-Derkimba, A., & de Tourdonnet, S. (2023). Multidimensional and multiscale assessment of agroecological transitions. A review. International Journal of Agricultural Sustainability, 21.

Gliessman, S. (2018). Defining Agroecology. Agroecology and Sustainable Food Systems, 42, 599–600.

Lianu, C., Simion, V.E., Urdes, L., Bucea-Manea-Țoniș, R., Radulescu, I.G., & Lianu, C. (2023). Agroecological Approaches in the Context of Innovation Hubs. Sustainability, 15, 4335

Ong, T.W., & Liao, W. (2020). Agroecological Transitions: A Mathematical Perspective on a Transdisciplinary Problem. Frontiers in Sustainable Food Systems, 4

Goals and objectives of the session:

This session welcomes abstracts for brief presentations (5 min) that will foster collective discussions on the following topics:

- Approaches, frameworks, methods, and tools for assessing socio-ecological trade-offs and co-benefits between ecosystem services in agroecological transitions.
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The overall aim of the session is to strength a transdisciplinary community linking ecosystems services approach to agroecological agrifood systems transitions, including the edition of a special issue on “Trade-offs between ecosystem services in agroecological transitions of agrifood systems: Assessment and measurement approaches.

Planned output / Deliverables:

The overall aim of the session is to strength a transdisciplinary community linking ecosystems services approach to agroecological agrifood systems transitions, including the edition of a special issue on “Trade-offs between ecosystem services in agroecological transitions of agrifood systems: Assessment and measurement approaches.

Session format:

1 hour: max. of 5 presentations (5 min. each) + 20 min discussion + 10 min collaborative wrap-up (including future work)

1:30 hours: max of 10 presentations (5 min. each) + 30 min discussion + 10 min collaborative wrap-up (including future work)

II. SESSION PROGRAM

Room: Expert Street 3

Date of session: 21st of November 2024
Time of session: 11:00 – 12:30 & 13:30 – 15:30

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
11:00	Lívia	Madureira	UTAD/CETRAD	Introduction to the SS
11:10	Nicole	Cecchinato		The importance of land management practices for ecosystem services evaluation in Europe: a literature review
11:20	Cian	Blaix		Agroecological interventions contribute to greater climate change mitigation and biodiversity in Europe
11:30	Youssef	Wang-Touri		Improving soil quality while preserving farmers' income: An ecosystem services-centered conceptual framework
11:40	Lívia	Madureira	UTAD/CETRAD	Integrated Assessment Framework for Socio-Ecological Trade-offs in Agroecological Transitions
12:50	Frédéric	Joly		Inferring regulating ecosystem services supplied by animal production systems from life cycle assessment
12:00	all	all		Discussion (Approaches, frameworks, methods, and tools; Metrics and indicators)
13:30	Claudio	Petucco		Coupling Agent-Based Modelling, Life Cycle Assessment, and ecosystem modelling for the sustainability assessment of agricultural systems: an application to farmer clusters
13:40	Marco	Moretti		An evaluation of the crop sequences adopted by potato growers in Flanders, Belgium

Time	First name	Surname	Organization	Title of presentation
13:50	Sylvia	Vetter		Carbon dioxide removal through Enhanced Rock Weathering: impacts on ecosystem services
14:10	Ana	Márquez-Barrenechea		Microbial diversity in tomato rhizosphere soil under varying agroecological management
14:20	Megan	Critchley		Mapping the potential for cocoa agroforestry as an NbS in Ghana: can national scale ES assessments support transformational change?
14:30	Suvangi	Rath		Spatio-temporal Dynamics and Valuation of Agricultural Ecosystem Services in Eastern India
14:40	all	all		Discussion (Metrics, indicators, Policies, strategies, and practices)
15:00				End of the session

III.ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Microbial diversity in tomato rhizosphere soil under varying agroecological management

First authors(s): Ana Márquez Barrenechea

Other author(s): Marina García-Llorente, José Antonio González

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Soil microorganisms contribute to numerous ecosystem services that are essential to the sustainable functioning of agroecosystems. They may increase crop yield, contribute to carbon and nutrient cycles, and enhance food web interactions. Cropping management leads to changes in the soil environment, giving preference or preventing the development of certain

microbial communities. Agroecological practices –such as reduced tillage or green manure– are agricultural practices aiming to produce significant amounts of food while being based on ecological processes and ecosystem services. Our study aims to explore the effects of agroecological practices on soil microbiome. During July 2024, three representative samples were collected in 15 tomato plots under varying agroecological management, placed in two plains of the SE of the Madrid region (Spain). We determined microbial abundance (DNA extraction and real-time PCR), microbial diversity (Illumina MiSeq sequencing on 16S rRNA and ITS marker regions), and soil physicochemical properties. We identified variate communities of fungi and bacteria present in tomato rhizosphere soil in all samples. The use of mineral fertilisers and pesticides affected microbial communities, resulting in significantly enhanced biological and functional diversity in plots under agroecological management. Agricultural practices such as crop rotation or organic amendments, influenced microbial communities' abundance, as they induce changes in soil organic matter quantity and quality. Overall, these findings provide empirical evidence on the positive effects of agroecological practices on microbial communities under real farming conditions, contributing to the transition towards sustainable and resilient agroecosystems.

Keywords: Agroecology, Ecosystem services, Horticulture, Microbial communities, Soil biodiversity

2. Agroecological interventions contribute to greater climate change mitigation and biodiversity in Europe

First authors(s): Cian Blaix

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Considering the impact that the agricultural sector currently has on biodiversity and the environment, alternative agricultural systems are needed. There is a need for agriculture to look beyond maximising production yields by also focusing on the public goods that it can provide. Agroecology is based on a set of principles associated with sustainable food production. Adherence to some of the principles pertinent to the field and agroecosystem scale should in theory lead to more environmentally-friendly practices and increase ecosystem service provision. A meta-analysis was conducted using data from 172 studies across Europe to test if adopting agroecological systems or practices (henceforth both are referred to as interventions)

results in an increase in biodiversity and climate change mitigation compared to conventional interventions in Europe. We found that agroecological interventions had a positive effect on biodiversity and climate change mitigation in general. For biodiversity, significant positive effects were found for all five functional groups identified except for macro-decomposers. Effects were positive for taxa abundance, richness, and diversity indices (e.g. Shannon) apart for taxa evenness. A positive effect was also found for carbon storage and for the reduction of N2O emissions. Biodiversity and climate change effects were positive in herbaceous cropping systems, perennial systems, and grasslands, but no significant effects were found in market garden systems, possibly due to the lower number of studies found which were conducted in that system type. These results demonstrate the importance of agroecology in providing ecosystem services and further effort should be made to implement sustainable food systems in a bid to tackle climate change and preserve farmland biodiversity by developing European and national policies to facilitate the scaling up of agroecology.

Keywords: meta-analysis, ecosystem service, environment, sustainable farming

3. The importance of land management practices for ecosystem services evaluation in Europe: a literature review

First authors(s): Nicole Cecchinato

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Agroecology integrates scientific disciplines, practical techniques and socio-political movements, offering a sustainable approach that enhances ecosystem services through practices (Tittonell et al., 2020; Wezel et al., 2009) aiming to reduce environmental impacts while improving biodiversity, soil health, and water quality for instance (HLPE, 2019). A systematic literature review was conducted to evaluate the importance of land management practices in agroecosystems for ecosystem services production at a European scale. Conventional practices (e.g. soil tillage, monoculture) were compared with agroecological practices (e.g. intercropping, agroforestry) based on their impacts on specific ecosystem services such as carbon sequestration, soil quality, water regulation, and biodiversity (Wezel et al., 2014; European Commission, 2021). The review analyzed 206 papers published between 2000 and 2023, categorizing 74 as qualitative and 132 as quantitative. The data were compiled in an Excel file for database creation, with quantitative assessments using R modeling and

spatial representation planned for subsequent phases of the project. Tools such as QGIS and TEEBAgri-Food Framework can be employed to quantify the benefits of agroecology, facilitating the development of an Evaluation Framework Tool (EFT) for systematic assessment.

As shown, agroecological practices present numerous positive ecological impacts across different scales by strengthening the agroecological systems and increasing resiliency towards environmental stress due to their diversified and ecologically balanced nature (Tittonell, 2014). Despite of these benefits, they also may present limitation and potential negative impacts (e.g. higher competition for nutrients), when there is an improper implementation of the agroecological practices (Pittelkow et al., 2015).

In conclusion, agroecology holds significant promise for enhancing ecosystem services, promoting agricultural sustainability, and addressing global challenges such as food security, biodiversity loss and climate change in European agroecosystems. Collaborative efforts from policymakers, researchers and stakeholders are essential to overcome barriers and facilitate the transition to more resilient agricultural systems (Smith et al., 2021).

Keywords: land management practices, ecosystem services, agroecological practices, Evaluation Framework Tool (EFT), European scale.

4. Mapping the potential for cocoa agroforestry as an NbS in Ghana: can national scale ES assessments support transformational change?

First authors(s): Megan Critchley
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Cocoa is a major cash crop in Southwest Ghana and supports the livelihoods of hundreds of thousands of smallholder farmers. Conventional practices, such as monoculture plantations, can result in low long-term yields while negatively impacting biodiversity and the surrounding environment. Current production practices further reduce the wellbeing and climate-resilience of cocoa farmers by eroding the provisioning of ecosystem services, which fundamentally underpin cocoa yields. Using an ecosystem services approach, we can identify opportunities to implement nature-based solutions (NbS) to address challenges related to farmer livelihoods, climate change and biodiversity loss at scale. This project aimed to provide data and evidence

in the form of spatial maps to support the implementation of more sustainable, climate-resilient cocoa agroforestry land use practices, that contribute towards alleviating multidimensional poverty while enhancing nature.

We modelled the potential outcomes of transitioning existing cocoa areas towards agroforestry practices across Ghana. Ecosystem services and biodiversity modelling were used to map areas where the expansion of agroforestry practices would be most beneficial. It found opportunities to increase tree coverage across nearly two million hectares of low-shade cocoa plantations. Establishing appropriately shaded and well-managed cocoa plantations in proposed areas alongside restoring forest reserves has the potential to protect at least 4,000 tonnes of sediment from erosion each year and store an additional 52 million tonnes of carbon. However, institutional and socio-economic barriers to scaling changes in agricultural systems remain. Questions remain over whether national scale modelling exercises are sufficient for catalyzing action on the ground. Although they cannot capture the full biogeographical and socioeconomic conditions in these dynamic landscapes, they can contribute towards advancing knowledge and evidence. Therefore, this presentation will also discuss the next steps required to ensure large-scale ecosystems services and NbS assessments can drive positive agroecological transitions that enhance the livelihoods of people on the ground.

Keywords: Agroforestry, Ecosystem services, Spatial planning, Agro-ecological transitions, Trade-offs

5. Inferring regulating ecosystem services supplied by animal production systems from life cycle assessment

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Life cycle assessment (LCA) and ecosystem services assessment (ESA) are often used for environmental evaluation. LCA appeared in the 1960s and it is commonly used to estimate the negative environmental impacts of human activities (e.g. CO2-eq emissions and energy consumption). It can rely on well-established databases and software. ESA originates from ecology and economy and grew popular by the 2000s; and it focuses on positive impacts. LCA established that one kg of human edible protein (HEP) generated higher impacts when it was

provided by ruminant livestock than when it was provided by monogastric animals. Here we applied both methods to a selection of twelve contrasting meat animal production systems, six ruminants (RUM) and six monogastrics (MON), including one agroecological organic pastoral system. We used the LCA inventory approach and Agribalyse database to characterize the land occupation of the systems, i.e. the list of land cover types they used (e.g. croplands and grasslands). From this list and quantification of six regulating ES according to covers, following the ES capacity matrix approach, we conducted ESA. We confirmed that ruminant systems had higher LCA impacts than monogastric systems for one kg of HEP (e.g. energy consumption was 351 vs 189 MJ for RUM and MON, respectively), and the trend was opposite for LCA impacts per m2 of land occupied (i.e. 0.71 vs 3.63 MJ for RUM and MON, respectively). We also observed a higher capacity to supply regulating ES for ruminants than monogastrics, with mean scores of 2.4 and 1.2, due to the presence of grasslands of different types in ruminant systems. We finally observed strong correlations between regulating ES and several LCA impact indicators per m2 of land occupied (R2 from 0.78 to 0.85). It suggests that LCA and related tools could be used to generate proxies of regulating ES.

Keywords: Agri-food system, pastoral system, human-edible protein, life cycle assessment, regulating ecosystem services

6. Integrated Assessment Framework for Socio-Ecological Trade-offs in Agroecological Transitions

First authors(s): Lívia Madureira

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Agroecology and ecosystem services are closely linked, with agroecological practices promoting the sustainable management of agroecosystems. There is growing interest in agroecology as a sustainable innovation, playing a crucial role in the transition towards sustainable agriculture. Agroecology also provides the scientific and methodological foundation for transformative paradigms of rural development, emphasizing community-led participation and local knowledge. Agroecological transitions require changes in practices, transdisciplinary knowledge generation, social and economic relations, and institutional innovations. Assessing trade-offs in ecosystem services, including food production, regulation, and cultural services, through trade-off analysis and data-driven scenarios submitted for community analysis and deliberative

choice, will help bridge the gap between global policies (e.g., EU Green Deal) and the transition paths desired by farmers and communities at the local level. Here, we present an integrated assessment framework aimed at evaluating the socioeconomic benefits and socio-ecological trade-offs of sustainable and resilient agriculture and agrifood systems by combining data with stakeholders' subjective evaluations. The framework is being developed within the Horizon project AgroServ (agroserv.eu). The Douro Socio-Ecological Living Lab, led by UTAD, hosts the testing and pilot implementation of this framework in the context of the ongoing agroecological transition in the Douro Mediterranean mountainous wine region in Portugal. One of the framework's steps involves outlining feasible and desirable transition paths for rural landscapes using a socio-technical transition scenarios approach, encompassing the multidimensionality of the transition, triggers, and drivers (e.g., agro-production systems, technology, regulation, policy incentives, market and consumer preferences, societal pressures).

Keywords: Agroecological transition, Assessment framework, Ecosystem Services, Socio-Ecological, Trade-off Analysis

7. Coupling Agent-Based Modelling, Life Cycle Assessment, and ecosystem modelling for the sustainability assessment of agricultural systems: an application to farmer clusters

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In the last decades, there has been an increased interest in understanding the role of ecosystem services as factors of production. In the context of the FRAMEWORK project (European Union´s Horizon 2020 research and innovation programme under grant agreement No 862731), the creation of farmer clusters is proposed as an innovate paradigm to achieve sustainability and conservation goals. For that purpose, this study analyses the dynamics and the effects that the provision of ecosystem services can have as factors of production in the environmental sustainability of agricultural systems. For this, we integrated farmer’s behaviours and cooperation, as well as market conditions and policies with ecological models that represent the contribution of natural ecosystems to agriculture. We measured relevant indicators such as the substitution rate between technological and natural capital (e.g., pesticides vs natural predation), and its relationship with the environmental sustainability of the agricultural system using Life Cycle Assessment (LCA) (e.g., EF v3.0). We modelled farmers that interact among

each other and with the market at a landscape scale. Moreover, we simulated the enhancement and conservation of ecosystem services provision in the form of public goods originated by biodiversity sensitive farmer clusters. Finally, our ambition is twofold. Firstly, we aim to explore the initial conditions that ensure the emergence, viability, and maintainability of farmer clusters. Secondly, we seek to transfer these findings to landscape actors and audience networks and decision makers to make them accessible and useful by providing simplified surrogate models through the Recodo platform.

Keywords: Biodiversity, Farmer Clusters, Landscape, Agent Based Model, Life Cycle Assessment

8. Improving soil quality while preserving farmers' income: An ecosystem services-centered conceptual framework

First authors(s): Youssef Wang-Touri
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While farmers can enhance soil quality by modifying their production management, this can lead to trade-offs with farm income, which constitute a challenge that can restrain farmers from improving soil quality. To alleviate these trade-offs, focusing on improving ecosystem services (ESs) rather than soil quality could offer the potential for improving soil quality and preserving farm income as ESs can be marketed. In this context, it is fundamental to understand the exact consequences for farmers' income and soil quality if farmers attempt to improve ESs. Several studies have approached part of the problem, however, studies that consider ESs at the center of the decision-making process are lacking, and/or are poorly addressing the problem as a whole. We developed a conceptual framework that provides a holistic qualitative understanding of the problem and a blueprint for quantitative analysis. The framework consisted of setting the objective as 'Improving ESs' while considering soil quality, production management, and farm income as influenced by this objective. From this approach, it appeared that 'Improving ESs' results in a sequence of requirements and consequences that affect farm income: (1) 'Improving ESs' requires changing production management; (2) changing production management influences soil quality; (3) 'Improving ESs' indirectly influences soil quality through production management; and (4) 'Improving ESs', production management and soil quality have a combined effect on farm income. Each relation was then described qualitatively based on literature and using 19 ESs, 50 farming practices, and 19 soil quality indicators. Finally, using the conceptual framework, the paper presents several major insights and a blueprint for

quantitative analysis that can contribute to developing sustainable (people: ESs, planet: soil quality, profit: farm income) farm business models. In particular, it becomes obvious that synergies between ESs and soil quality offer the potential to reduce the marginal costs of further improving soil quality.

Keywords: Farming practices, Ecosystem services, Soil quality, Farm income, Trade-offs

9. An evaluation of the crop sequences adopted by potato growers in Flanders, Belgium

First authors(s): Marco Moretti
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Healthy soils play a fundamental role in the provision of many ecosystem services (ES). Some of the main factors influencing soil health are the agricultural practices adopted by farmers, such as the sequence of crops grown through time in a given field. In fact, these sequences have a major impact on the soil and its ability to provide services essential to human life and the health of many ecosystems. Understanding how farmers make decisions about crop sequence is therefore essential to promote crop sequences that can positively influence the provision of ES from the soil. These sequences can range from complex crop rotations to the simple monoculture; generally, more diverse sequences are expected to have positive effects on soil health and biodiversity. Potatoes are a good example of a western European cash crop that can have a significant impact on soil health. The aim of this article is to study and evaluate the crop sequences implemented by potato growers in Limburg and in Flemish Brabant, Belgium, between 2008 and 2021. First, the number of crops in a sequence, or crop diversity, and their return times were evaluated for all the sequences. Second, this information was combined to obtain a Rotational Complexity Index (RCI), which was used to evaluate the change in complexity of these sequences between the periods 2008–2014 and 2015–2021. Third, a more detailed analysis of the evolution of the return time for potato was performed. Between the two reference periods, there was a general increase in the RCI, with sequences characterised by a greater variety of crops. The return time for potatoes has also changed, with the 4-year return time that significantly increased. The methodology of this research can be successfully applied by researchers and policy makers studying crop choice and rotation practices.

Keywords: Soil health, Crop rotations, Crop sequences, Land management, Sustainable agri-food management

10. Carbon dioxide removal through Enhanced Rock Weathering: impacts on ecosystem services

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Practices promoting the sustainable management of agroecosystems include carbon dioxide removal (CDR) technologies, which can have large impacts on helping to regulate the carbon dioxide (CO2) emitted to the atmosphere and therefore the climate. Enhanced rock weathering (ERW) as a CDR technology is used by accelerating the natural geological process CO2 removal through the application of crushed silicate rocks to agricultural soils. Besides the CO2 removal potential, the calcium and magnesium-rich rocks have co-benefits and trade-offs. The whole life cycle of using ERW from mining rocks, grinding, transportation, and application on the soil impacts several ecosystem services (e.g. soil functions, nutrient cycle, energy use, and raw materials). Large-scale implementation of ERW could remove up to net 2 Gt CO2 yr−1 via the whole supply chain. The implication of the large-scale implementation on soil parameters and agricultural production is analysed by reviewing existing studies focusing on soil impacts and yield through different rock mix applications, meta-analysis, and modelling. As the composition of silicate rocks differs, the analysis focused on the amount of chemicals that are applied to the field. Results show a relationship between the amount of silicon dioxide (SiO2) and potassium oxide (K2O) that is applied to a change in yield. The meta-analysis showed that yield increases with rock dust application up to an optimum amount (depending on soil and vegetation type) but could decrease with higher application rates. Spatial modelling shows results for Europe with differences for the regions where, based on the soil type, CDR can be maximized under an increase in yield, highlighting the co-benefits of the CDR method.

Keywords: Enhanced rock weathering, agriculture, yield, spatial modelling, carbon dioxide

11. Spatio-temporal Dynamics and Valuation of Agricultural Ecosystem Services in Eastern India

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Demographic, economic, social, and climatic changes are exerting increasing pressure on natural resources due to growing global demands for energy, food, and water. This threatens the well-being of the ecosystems we rely upon. To shift towards sustainable development, strategic decisions on natural resources need to be better valued and responsibly managed. Given that ecosystems can provide mitigation and adaptation services, the policies and local initiatives related to ecosystem management should integrate both climate change strategies and avoid trade-offs between them. Our study aims to map and study the land use land cover (LULC) dynamics of ecosystem services in the rainfed and irrigated ecosystems of Eastern India using ArcGIS and the equivalent factor valuation method. The LULC change revealed that the agricultural ecosystem did not increase over the years rather in Bungapali village, there was a decrease in the agricultural ecosystem due to conversion into built-up areas. The absolute change in the values of different ecosystem services between 2005 and 2020 was $66431/ha/year. We also estimated the monetary values of irrigated and rainfed paddy ecosystems. It was concluded that the irrigated paddy ecosystem delivered higher net ecosystem services ($4107/ha/year) than rainfed paddy ecosystems. Our study suggests that policies should mainstream the valuation and preservation of ecosystem services into national development plans, promote sustainable agricultural practices, and enhance climate resilience through ecosystem-based approaches. Incentivizing farmers through payment for ecosystem services is necessary to enhance the supply of ecosystem services to society. Further, incorporating ecosystem service valuation into economic decisions, strengthening environmental governance, and increasing public awareness are critical steps. This integration will not only support specific SDGs related to poverty, hunger, health, and climate action but also foster a holistic approach to achieving all 17 SDGs, leading to a more resilient and sustainable development of agroecosystems..

Keywords: Agriculture, Ecosystem Services, Land use/cover change, Valuation