

# TRANSITIONING TO AGROECOLOGICAL FOOD SYSTEMS: A review of incentives for adoption of agroecological practices and outcomes



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The **Private Sector Incentives and Investments (PSii)** project contributes to the **Agroecology TRANSITIONS** program and aims at the development of inclusive incentive structures for private and public sector stakeholders, as well as leveraging investments supporting agroecological transitions at multiple levels. A dynamic private and public sector ecosystem likely possesses some challenges but also provides new opportunities to accelerate agroecological transitions via creating incentives and mobilizing investments, transparent and holistic metrics, and capacity building to contribute to more economically efficient, socially equitable, and environmentally friendly food systems.

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The **Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT)** delivers research-based solutions that harness agricultural biodiversity and sustainably transform food systems to improve people's lives. Alliance solutions address the global crises of malnutrition, climate change, biodiversity loss, and environmental degradation.

With novel partnerships, the Alliance generates evidence and mainstreams innovations to transform food systems and landscapes so that they sustain the planet, drive prosperity, and nourish people in a climate crisis.

The Alliance is part of **CGIAR**, a global research partnership for a food-secure future.

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# Acronyms and abbreviations

<b>AVCPO</b>	Agricultural Value Chains Project in Oromia
<b>GDP</b>	Gross domestic product
<b>PES</b>	Payment for ecosystem services
<b>PPP</b>	Public-private partnerships
<b>SDGs</b>	Sustainable Development Goals
<b>SDG 2</b>	Sustainable Development Goal number 2
<b>SDG 3</b>	Sustainable Development Goal number 3
<b>SDG 12</b>	Sustainable Development Goal number 12
<b>SDG 13</b>	Sustainable Development Goal number 13
<b>SDG 15</b>	Sustainable Development Goals number 15
<b>TPP</b>	Transformative Partnership Platform on Agroecology

# Abstract

Food systems are increasingly threatened by climate change, natural resource degradation, rapid population growth, and shifting diets. Sustainable agricultural practices labeled as “agroecology” have been promoted as one of the possible solutions to current food systems challenges. Agroecological principles and/or practices have the potential to contribute to the Sustainable Development Goals of ending hunger, reducing negative environmental impacts, and achieving food and nutrition security. Although incentives for adoption of agroecological practices are critical to the transition towards sustainable food systems, there is limited in-depth reviews that provide an understanding of the existing incentive mechanisms and their relationship with adoption of agroecological practices and economic, environmental, and social outcomes. This scoping review examines incentive mechanisms in agroecology practice adoption and outcomes using a general survey of the literature and a specific case study of incentives in wheat value chains in Ethiopia. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, we review 1800 articles from three relevant databases. The review reveals that most of the incentives used are market, non-market, and regulatory, with only a few incentives focused on cross-compliance. Farmer organizations, input subsidies, price premiums, credit, technical assistance, and extension services emerged as important incentives for promoting agroecological practices and outcomes. The review shows that there is more focus on economic and environmental outcomes than on social outcomes. Yet designing incentives that target social outcomes is also critical for holistic and inclusive food system transformation. We recommend paying close attention to incentive mechanisms with fewer requirements, that increase the adoption of agroecological practices and focus on incentives that promote social outcomes.

## Key words

Incentives, investments, agroecology, transitions, sustainable food system, wheat value chains

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# 1. Introduction

Transitioning to sustainable food systems remains high on the global development agenda. Food systems face serious sustainability challenges, including deforestation, natural resource degradation, and climate change. Food systems themselves also contribute to nearly one-third of global greenhouse gas emissions and are the largest driver of biodiversity loss (Dudley & Alexander, 2017; Negra et al., 2020). Hunger, malnutrition, and poverty are also widespread in the agrifood sector, which employs a substantial share of the world's most vulnerable populations (GNR, 2021; FAO et al., 2022). Thus, there is growing interest among development practitioners, researchers, and policymakers in transitioning from current production systems toward more sustainable production models that address the adverse effects of climate change, build resilience, and promote inclusive and sustainable food systems (Pauw, 2015; Mockshell & Kamanda, 2018, Piñeiro et al., 2020). This interest is further fueled by the recently formulated global climate action agenda and the need to achieve the United Nations Sustainable Development Goals (SDGs), especially the goals of ending hunger (SDG 2), ensuring healthy lives (SDG 3), achieving sustainable consumption and production (SDG 12), combating climate change and its impacts (SDG 13), and conserving life on land (SDG 15) (Clark et al., 2018; Negra et al., 2020).

Agroecology is increasingly seen as an effective means of transitioning to sustainable food systems (DeLonge et al., 2016; Jones et al., 2022). Agroecology is defined as the application of ecological concepts and principles in farming to optimize interactions between plants, animals, humans, and the environment, while considering the social aspects needed for a sustainable and fair food system (Jones et al., 2022). It aims to increase output while minimizing the use of external inputs and maximizing the use of natural resources. There are 13 agroecological principles that include recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, knowledge co-creation, social values and diets, fairness, connectivity, land and natural resource governance, and participation (Jones et al., 2022; Wezel et al., 2020). Sustainable food systems aim to achieve environmental sustainability while enhancing, or at least maintaining farm productivity (Piñeiro et al., 2020). Sustainable food systems protect the environment by enabling more efficient use of natural resources and improving the capacity to adapt to climate change, which potentially contributes

to more resilient and productive food systems, sustainable food production, improved food security, and lower prevalence of poverty (Herrera, 2017; Piñeiro et al., 2020; Teklewold et al., 2013). Thus, the transition to more sustainable food systems is motivated by the need to transform food systems to produce food sustainably. This transition will ensure global food and nutrition security, reverse the environmental degradation that human actions have caused, restore ecosystems and achieve the SDGs.

Transitioning to more sustainable food systems will require significant capital investments and incentives to promote the adoption of sustainable agricultural or agroecological practices, such as diversification, no-till systems, and agroforestry (Piñeiro et al., 2020; Wollenberg et al., 2012). Investments from both the public and private sectors are important, especially in the Global South. However, the private sector may play a more crucial role in the transition because it can raise more capital investments for sustainable agricultural development (Augustin et al., 2021; Jones et al., 2022; Van Westen et al., 2019). Private-sector financing may also compensate for declining public funding for agricultural programs (Augustin et al., 2021; Fuglie, 2016). Incentive mechanisms, such as subsidies, technical support, tax breaks, and regulations can also play an important role in encouraging farmers to protect ecosystem services (e.g., water, soil, and forest resources). These instruments can help farmers adopt agroecological practices while also improving productivity and farm income (Cole, 2010; Piñeiro et al., 2020; Santiago et al., 2018).

Studies on the effectiveness of different types of incentives – for climate change mitigation, adoption of sustainable agricultural practices, agrobiodiversity conservation, and economic impacts – have yielded mixed results (Bryan & Crossman, 2013; Catacutan et al., 2012; Mishra et al., 2018; Pagiola et al., 2005; Ward et al., 2016; Yitayew et al., 2021). A few other studies have examined the research strategies to catalyze the transition towards more agroecological or sustainable food systems in low- and middle-income countries (Jones et al., 2022). Still others have focused on private-sector engagement in financing climate-change adaptation in developing countries (Dorkenoo, 2015; Pauw, 2015). However, there are few systematic or in-depth scoping reviews that assess the role of private-sector incentives and investments in the transition toward more agroecological or sustainable production systems. To the best of our knowledge,

only Piñeiro et al. (2020) have examined the incentives for the adoption of sustainable agricultural practices and their outcomes more generally. However, studies that examine incentives and investments for the adoption of sustainable agricultural practices with a focus on specific value chains and outcomes are limited. Moreover, although agroecology is now widely accepted by the public and private sectors, incentives and investments for transitions to agroecology are weakly implemented (Schiller et al., 2020).

In this article, we conduct a scoping review to unpack the incentives for adoption of agroecological practices. How do incentives motivate adoption? How do they drive economic, environmental, or social outcomes? We add to the limited literature on incentives for agroecological practices in two ways. First, we focus on incentives and interventions at both the farm and food system level. Second, in addition to a global review, our study adds a country- and value chain-specific case study, as agroecological transition

or sustainability issues are often landscape- and context-specific (Jones et al., 2022). The case study focuses on public- and private-sector incentives and investments in the wheat value chain in Ethiopia. Our focus on Ethiopia is important because recent efforts to increase wheat production have recognized the importance of agroecology in ensuring sustainable production (FOLU, 2020; Schmidt & Tadesse, 2019). Also, Ethiopia, like most other countries in sub-Saharan Africa, is plagued by the challenges of hunger and malnutrition, biodiversity loss, and climate change-related problems (FAO et al., 2022).

The remainder of this article is organized as follows. The next section describes the conceptual framework of the study. Section 3 then explains our scoping review methodology. The discussions of the general review and country case study results are presented in Sections 4 and 5, respectively, followed by our conclusions and policy implications in Section 6.

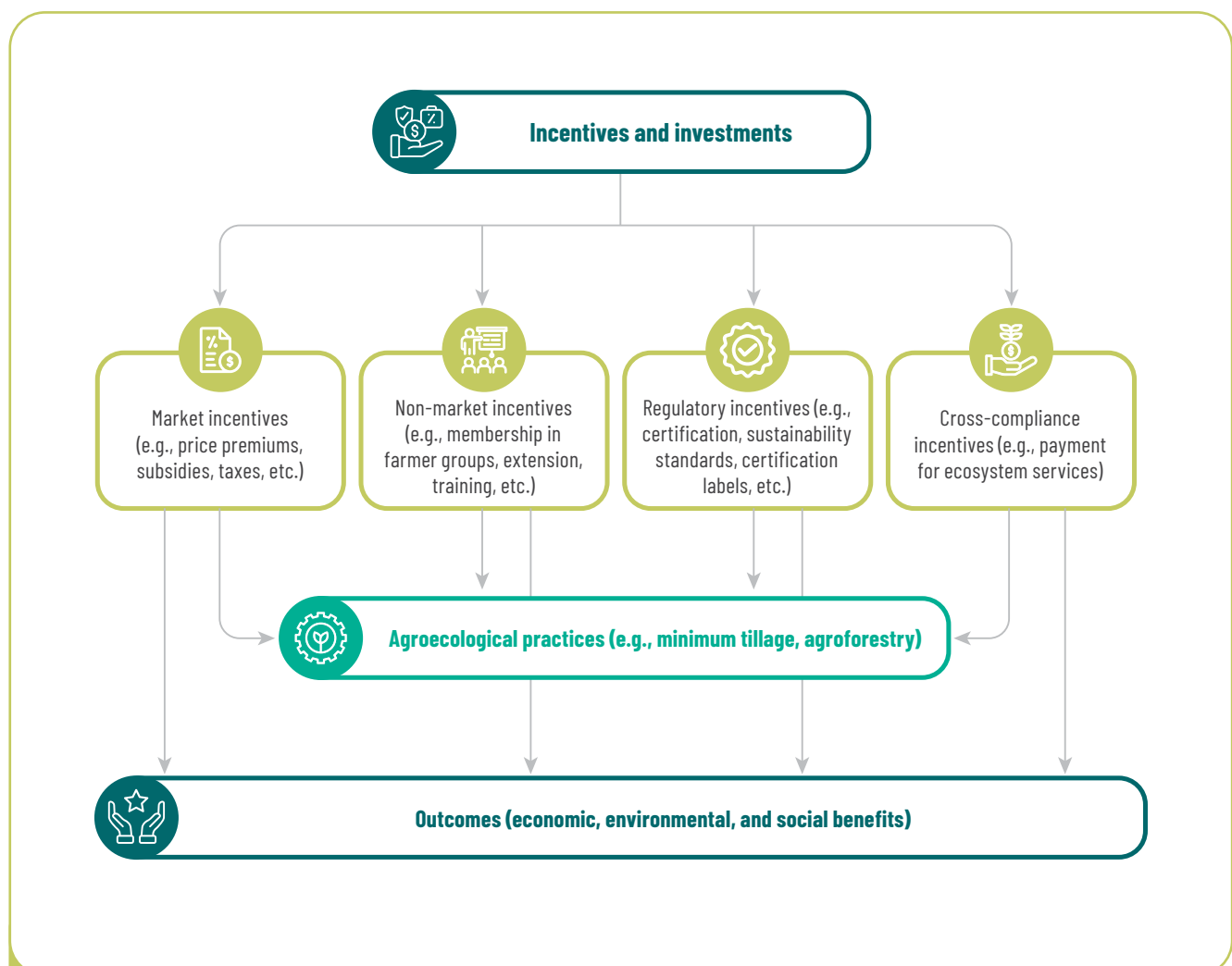


Durum wheat varieties, Ethiopia. © Bioversity International

## 2. Conceptual framework

The conceptual framework shown in Figure 1 guides this scoping review on the linkages between incentives used in food systems, adoption of agroecological practices, and economic, environmental, and social outcomes. An incentive is an instrument or mechanism that contributes to or serves as motivation to accomplish a task, which may lead to rewards (Catacutan et al., 2012). Several types of incentives are used to promote the transition towards the adoption of agroecological practices and principles. These include market, non-market, regulatory, and cross-compliance incentives. Market incentives encourage behavior change by promising economic benefits through market signals or interventions, such as prices or price premiums for inputs and outputs, subsidies, income transfers, and other cash or in-kind incentives to producers or other value chain actors (Piñeiro et al., 2020; Tscharrntke et al., 2015). Non-market incentives are broad in

scope and can include all incentives that are not market based, such as technical support, technology transfer, and fiscal measures, such as carbon pricing or applying taxes to improve environmental sustainability by discouraging emissions (Piñeiro et al., 2020). Regulatory incentives encourage behavior change through a set of rules or specific actions imposed by government agencies or private entities to promote environmental and economic outcomes through improved practices, such as environmental laws and mandatory standards (Piñeiro et al., 2020). Cross-compliance incentives encourage behavioral change by conferring payments or benefits to farmers who voluntarily comply with basic environmental standards. Examples include payments for ecosystem services (PES), or government subsidies pegged to farmers' compliance with certain environmental standards and practices.



**Figure 1** Incentive types, agroecological practices, and outcomes.

Incentives can be a form of investment because they may require some capital or financial outlay. In general, an investment is a “commitment of capital (financial, physical, intellectual, or otherwise) to something with the expectation of accumulating additional income or benefits in the future” (Fiedler et al., 2021). The public or private sector can make investments. Public investment includes government spending to increase the capital stock of the economy, while private investment includes spending or financing by non-governmental entities, such as companies, financial organizations, other investors (Ferroni & Castle, 2011; Jimenez, 1995). Public-private partnerships (PPP) – collaborative endeavors in which private actors pool their resources with public-sector organizations, such as government agencies and universities – can also be considered investments (Hermans et al., 2019). Examples of public investments in agroecology include government funding for environmental conservation practices, for research, and for extension to promote agroecological practices (DeLonge et al., 2016).<sup>1</sup> Examples of private investments include private-sector spending on sustainability standards and agroecological research (Pavageau et al., 2020). PPPs include investments in biotechnology research and value chains for high-value agricultural products (Poulton & Macartney, 2012). For instance, the Syngenta Foundation for Sustainable Agriculture project combines private-sector expertise in plant genetic profiling with public-sector strengths in field research to combat stem rust through rust-resistant wheat varieties (Ferroni & Castle, 2011).

Figure 1 shows how incentives (and investments) can either influence outcomes directly or indirectly. For instance, income gains from incentives such as income transfers can lead to direct economic and social benefits. Indirectly, incentives can lead to economic benefits (e.g., improved yields, higher profits, and higher incomes), environmental benefits (e.g., watershed protection, reduced deforestation, and reduced greenhouse gas emissions), and social benefits (e.g., increased employment opportunities, more equitable working conditions, reduced gender gaps, and women’s empowerment) through adoption of agroecological practices, such as conservation

tillage, agroforestry, and sustainability standards. Previous literature has shown that farmers are often hesitant to adopt agroecological practices without incentives, despite the potential benefits (Ward et al., 2016). Farmers perceive agroecological practices interacting in diverse ways, sometimes increasing, and sometimes reducing the benefits of other practices. Therefore, incentives and investments are needed to catalyze adoption of agroecological practices and outcomes. Farmers’ adoption of agroecological practices and principles can thus be a function of market, non-market, regulatory, or cross-compliance incentives. However, other factors beyond incentives are important. For example, an individual farmer’s education level, social capital, experience, and risk preferences may influence adoption of agroecological practices. Farm attributes, such as land size, topography, and crops, may be important, as well as policy factors, such as land tenure (Holden & Shiferaw, 1999; Kassie et al., 2009; Tesfaye et al., 2014; Ward et al., 2016). Farmers are expected to adopt agroecological practices that will either maximize their expected economic, environmental, or social outcomes, if they are risk-neutral, or maximize their expected utility of profit, if they are risk-averse, consistent with the expected utility theory (Bontemps et al., 2021).



Mustard growing among wheat. © C. Zanzanaini/Biodiversity International

<sup>1</sup> For instance, government extension programs in Ethiopia, which is our case study country, represent a significant public investment, amounting to over \$50 million dollars annually, or about 2% of agricultural GDP (Spielman et al., 2010).

### 3. Methodology

This review aims to understand how incentives motivate the adoption of agroecological practices, and ultimately, economic, environmental and social outcomes. To achieve this, we conduct a scoping review for two reasons: 1) to capture all relevant literature on the linkages between incentives, adoption of practices, and outcomes; and 2) to reduce authorial bias associated with typical narrative reviews (Piñeiro et al., 2020). We conduct the scoping review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. These guidelines and checklists detail how to conduct a scoping review to synthesize evidence and assess the scope of the literature on a topic (Page et al., 2021; Tricco et al., 2018).

To identify candidate studies or literature for inclusion in this review, we conducted a systematic scoping review using keyword searches in three relevant literature databases – Cab Abstracts, Google Scholar, and Scopus – between database inception and 15 December 2022. The keywords used include *incentives*, *investments* (“*agroecology*” OR “*agroecological*”), “*sustainable agriculture*” OR “*conservation agriculture*” OR “*climate change*” OR “*climate-smart agriculture*”, *Ethiopia* AND *wheat*. In addition, we screened the reference lists of included articles to reduce the likelihood of missing potentially relevant studies. Articles were included in the review based on the following five criteria. First, they must explicitly focus on incentives or investments for agroecological practices. Second, the articles must focus on the adoption of agroecological

practices. Third, the studies must explicitly link the adoption of agroecological practices to sustainability outcomes, such as certification, labeling, traceability, welfare effects, income, yields, profits, and others. Fourth, the articles must include clear analysis of the effects of incentives and/or investments on income, production, productivity, profits, and/or environmental sustainability. Fifth, the articles must report original qualitative or quantitative research in English from gray literature, academic dissertations or theses or peer-reviewed journal articles.

The searches yielded 1,670 articles from Google Scholar, 89 from Cab Abstracts, and 84 from Scopus, resulting in a total of 1,843 articles. After removing 28 duplicate articles, and excluding 750 inaccessible or irretrievable articles, 1,065 articles were available for title, abstract, and full-text screening by two separate reviewers to ensure that the included articles met the set inclusion criteria. Title screening resulted in the inclusion of 165 articles, of which 150 were included after abstract screening. 124 articles remained after full-text screening. Finally, after screening the reference lists of included articles to reduce the likelihood of missing potentially relevant studies, 20 articles were added to the study, leaving a total of 144 articles for full-text review. Upon completion of the selection process, relevant data on authors names, publication title, and year of publication were recorded to avoid duplication. Details of the study area, incentive type, agroecological practices, and outcomes were then extracted.



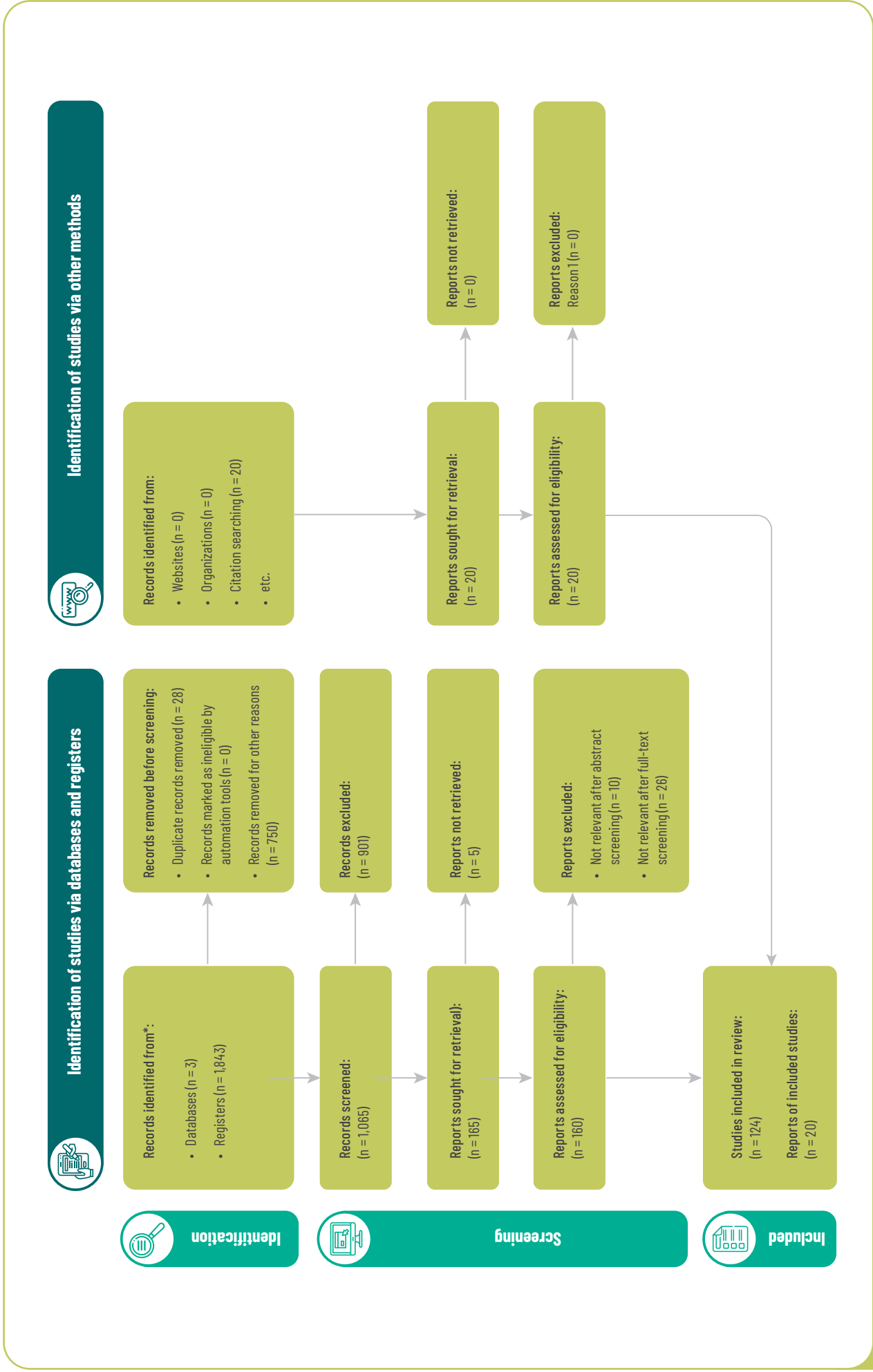


Figure 2 Scoping review flow diagram. Adapted from Page et al. (2021).

Figure 2

## 4. Results

The purpose of this scoping review is to understand the various incentives for adoption of agroecological practices, how the incentives motivate the adoption of agroecological practices, and how incentives ultimately lead to economic, environmental, and social outcomes.

### 4.1 Summary of articles reviewed

As mentioned, article screening against the inclusion and exclusion criteria took place in three phases: title screening, abstract screening, and full-text screening. This resulted in 144 articles that were evaluated for relevance in terms of connecting either incentives to adoption, adoption of agroecological practices to measurable outcomes, or both sets of links. These 144 articles facilitated a more in-depth review of the incentive types, agroecological practices adopted, and outcomes. The degree of linkages between incentives, adoption, and outcomes – as diagrammed in Figure 3 – varied amongst the 144 articles reviewed.

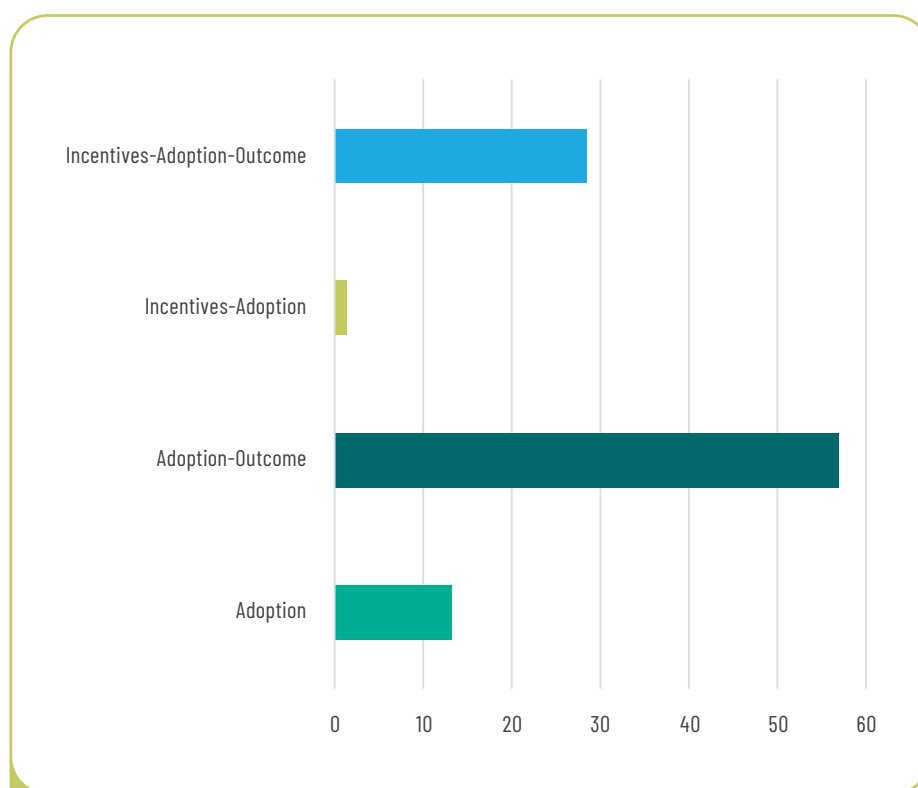


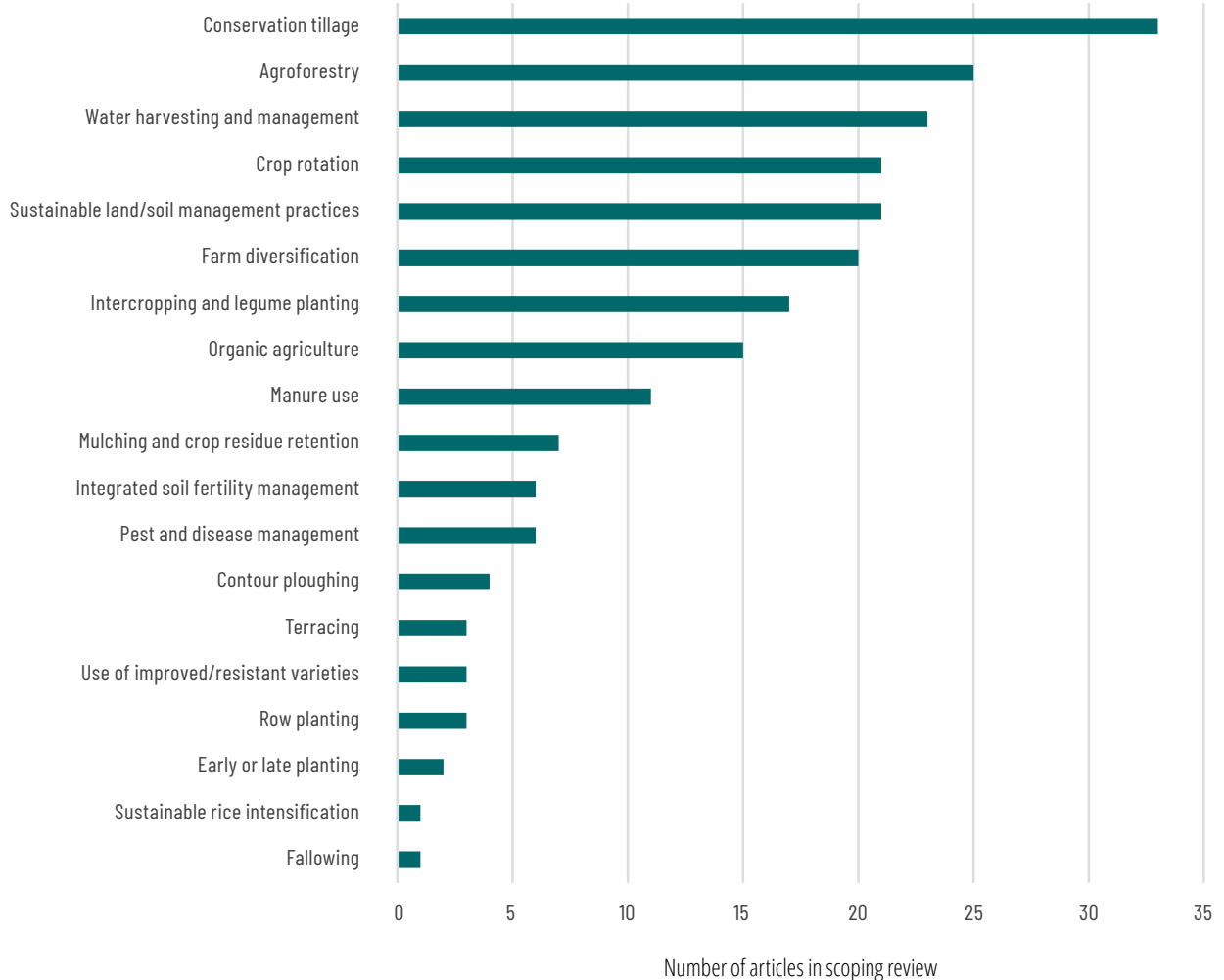
Figure 3 shows that about 14% of the articles mainly focus on the adoption of agroecological practices alone, while the largest share (59%) of the articles mainly focus on the relationship between adoption and economic, environmental, or social outcomes. About one percent of the articles link incentives to adoption of agroecological practices, while 26% explicitly link incentives to the adoption of agroecological practices and outcomes, suggesting a large gap in the literature on studies that explicitly link incentives to adoption of agroecological practices and outcomes.

**Figure 3** Summary of reviewed articles.

### 4.2 Agroecological practices

Figure 4 presents the agroecological farming practices implemented in the 144 articles reviewed. The practices include conservation tillage, agroforestry, water harvesting and management, crop rotation, farm diversification, intercropping and legume planting, sustainable land and soil management practices, organic agriculture, manure use, integrated soil fertility management, mulching and crop residue

retention, pest and disease management, contour plowing, terracing, early or late planting, sustainable rice intensification, row planting, and fallowing. The results show that conservation tillage, agroforestry, and water harvesting, and management are the most-frequently implemented/mentioned practices, while early/late planting, sustainable rice intensification and fallowing are the least-implemented practices in the articles reviewed.



**Figure 4** Summary of agroecological practices implemented in the literature review.

### 4.3 Drivers of the adoption of agroecological practices

Given the importance of understanding how incentives drive farmers' adoption behaviors and how the adoption of specific practices leads to the desired outcomes, we analyzed a subset of papers that had a complete set of links from incentive to adoption to outcome (41 articles). For each article, the incentive types were identified. The farmers' adoption behaviors and preferences, whether they adopted practices or otherwise, were recorded. The corresponding economic, environmental, or social outcomes resulting from adoption or incentives were noted.

Results revealed that incentives play an important role in influencing the adoption of agroecological practices, as farmers are reluctant or slow to adopt practices

without incentives (Ward et al., 2016). Farmers' preferences are also a function of their experience with agroecological practices, such that current farm-level practices influence their willingness to adopt newer ones. Farmers' characteristics, especially their risk attitudes, education, farm size, and environmental awareness, also affect their adoption patterns (Holden & Shiferaw, 1999; Kassie et al., 2009; Tesfaye et al., 2014). Additionally, farmers need to understand the effectiveness of the new practices before adopting them. Therefore, adoption rates are higher when supply chain actors provide technical assistance, such as training or agricultural extension. Adoption also increases when stakeholders facilitate information sharing, including awareness raising, demonstration, and farmer-to-farmer exchange programs (Kassie et al., 2009; Tesfaye et al., 2014).

#### 4.4 Incentives, adoption, and outcome linkages

As noted above, incentives can influence outcomes directly or indirectly through adoption of agroecological practices. Figure 5 depicts the direct relationship between incentives and outcomes. Consistent with previous literature (Piñeiro et al., 2020), Figure 5 shows the existence of multiple incentives and their expected outcomes. Figure 5 shows that 27% of the evaluated incentives are market-oriented, 28% are non-market, 28% are regulatory, and 17% are cross-compliance incentives. This suggests that market, non-market, and regulatory incentives are among the most-frequently used incentive mechanisms, while cross-compliance incentives are generally less prevalent among development interventions. It is plausible that market incentives are among the most-frequently used incentives because they tend to contribute to long-term and self-sustaining solutions, and are flexible, allowing farmers themselves to drive adoption decisions and changes (Kiem, 2013). However, the flexibility of

market-based incentives can also be their weakness as they can lead to economic, environmental, and social changes that are inconsistent with the intended strategic goal of the instrument. For instance, the use of subsidies may encourage the adoption of certain agroecological practices (e.g., intercropping and mulching), which may discourage the adoption of other important agroecological practices (e.g., zero tillage) (Kiem, 2013; Ward et al., 2016). The most frequently used market incentives include technology or input subsidies, credit for inputs, and price premiums. The relatively high frequency of attention to non-market incentives (Figure 5) is reasonable as they are also flexible and broad in scope. Some of the non-market incentives used to promote the adoption of agroecological practices include provision of technical support (e.g., training, extension) and collective action through farmer cooperatives or community-based memberships. These latter incentives facilitate access to information and credit, subsidizing the cost of inputs through reduced transaction costs (Manda et al., 2020; Ma et al., 2018).

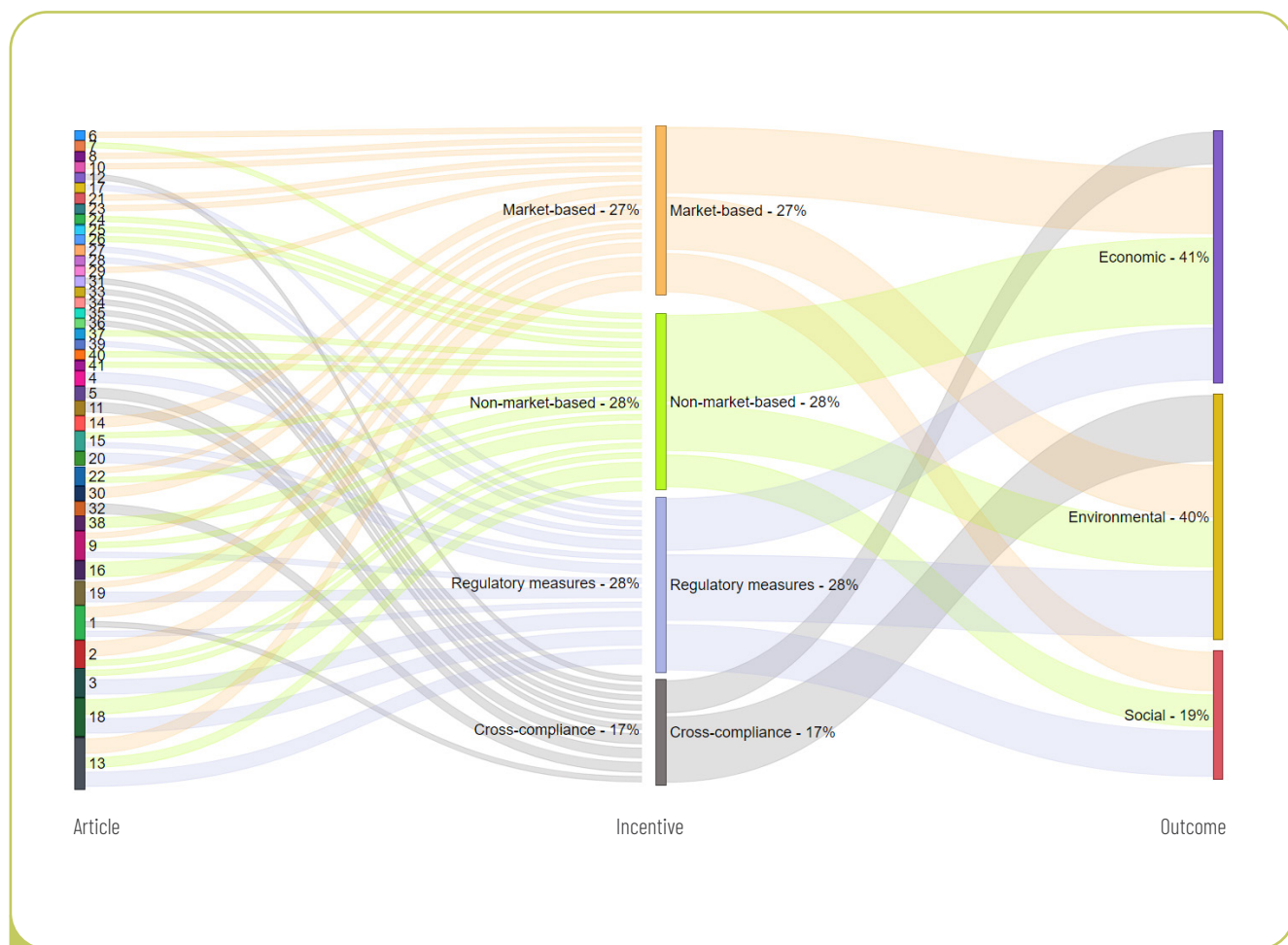


Figure 5 Incentive-outcome linkages.

Figure 5 shows that regulatory incentives are among the most frequently (28%) used incentive mechanisms. Regulatory incentives aim to promote behavioral change through a set of imposed rules, such as environmental laws and standards. Thus, they are often less preferred because they are usually mandatory and are sometimes perceived as too complex, inflexible, and long-term (e.g., legal regulations or stewardship programs), making them less attractive compared to short-term policy instruments that provide financial or material support (Schirmer et al., 2012). Third-party certification standards for organic agriculture are an example of regulatory incentives that may be less preferred by farmers because of their high entry and compliance costs, tedious paperwork, and bureaucracy (Home et al., 2017). Therefore, implementation of regulatory incentives, such as certification standards is often accompanied by technical assistance (e.g., farmer training through extension programs), information sharing to create awareness of their potential benefits, and monitoring and supervision to increase their effectiveness (Piñeiro et al., 2020). Alternatives to third-party certification schemes with lower entry costs have been developed, such as internal control systems for export markets and participatory guarantee systems for local markets (Home et al., 2017).

Cross-compliance incentives are voluntary incentives that encourage adoption by conferring payments, mainly PES, to farmers who comply with basic environmental standards or who have agreed to take certain actions to protect watersheds, conserve biodiversity, or capture carbon dioxide, for example. Most existing PES are found in developed countries. The majority of PES programs are state-run, rather than private-sector schemes (Wunder, 2005), which may explain why cross-compliance incentives receive less frequent attention (17%). PES programs allow for a direct exchange between buyers of ecosystem services and local farmers or sellers of ecosystem services (Hayes et al., 2017; Samii et al., 2014; Wunder, 2015). Due to liquidity constraints, farmers are often reluctant to adopt practices that do not result in immediate cash inflows or economic benefits (Ward et al., 2016).

Cross-compliance incentives are aimed and are often used to help overcome bottlenecks that limit the adoption of agroecological practices, such as high upfront adoption costs and liquidity constraints among farmers (Garbach et al., 2012). Indeed, previous studies in Ecuador, Ethiopia, and Uganda show that farmers are more likely to adopt practices associated

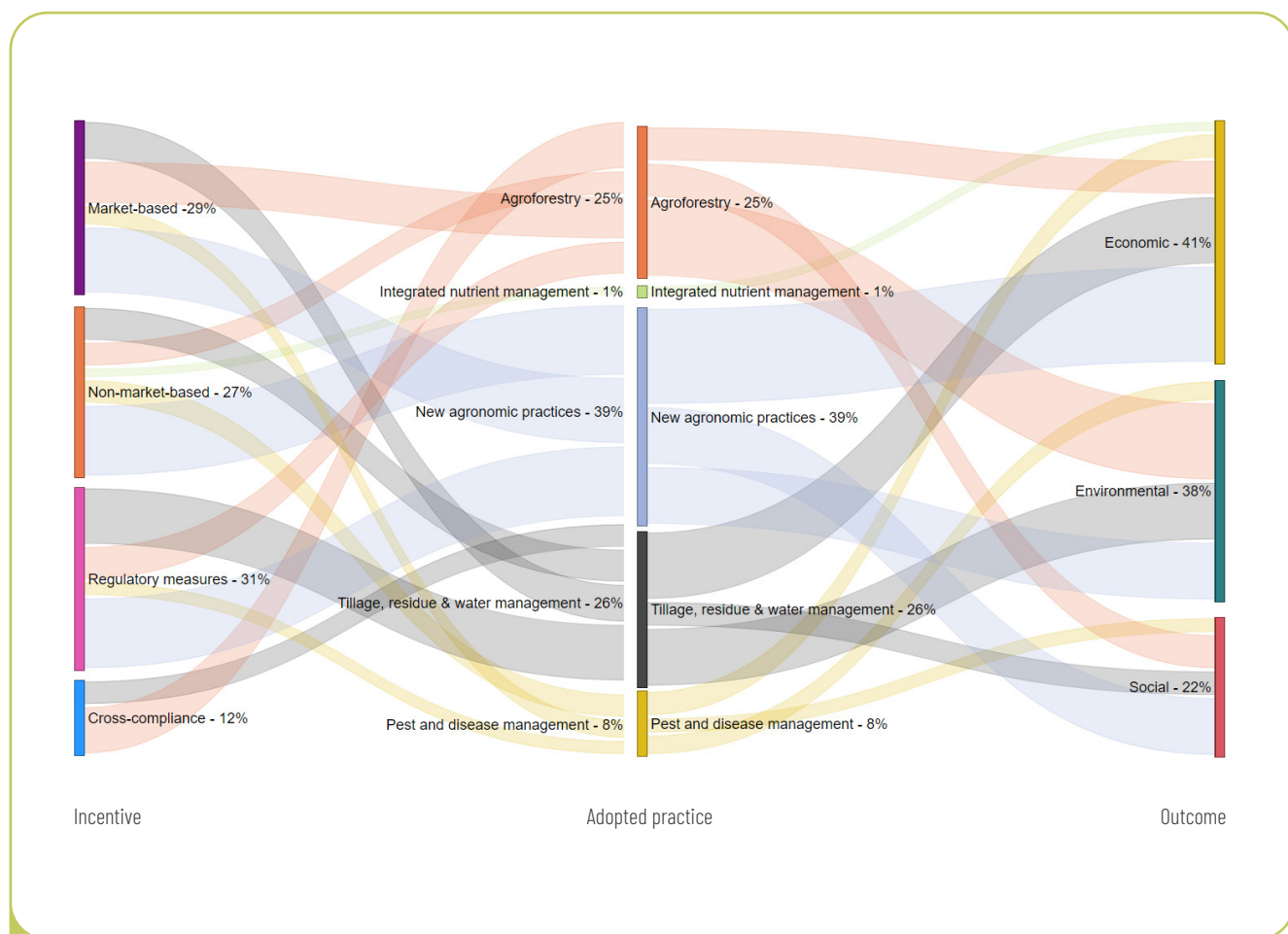


Uganda field trials. © N. Palmer/CIAT

with upfront PES (Kaczan & Swallow, 2013; Haile et al., 2019; Geussens et al., 2019). Furthermore, the studies found that farmers: a) strongly prefer food over cash as the mode of payment or compensation; b) are more likely to adopt short-term PES contracts with fewer requirements compared to longer term contracts; c) have a strong preference for PES with individual and additional in-kind rewards (e.g., labor assistance or tools) over community compensation; and d) have different preferences depending on their household characteristics, which underscores the need to tailor PES to farmers' conditions when implementing programs at large scales.

Figure 5 shows that the incentives are somewhat more related to economic outcomes (41%), such as changes in profit, income, and yields, than to environmental outcomes (40%), such as watershed protection, reduced deforestation rates, and lower greenhouse gas emissions. Social outcomes receive less attention (19%). The results suggest that incentive mechanisms support not only simple yield-enhancing objectives, but are holistic in scope, covering economic, environmental, and social outcomes. In terms of how each incentive type is specifically linked to the outcomes, Figure 5 shows that market and non-market incentives are most often associated with economic outcomes, followed by environmental and social outcomes. Regulatory incentives seem to focus more on environmental outcomes than on economic and social outcomes. Cross-compliance incentives are more associated with environmental outcomes than with economic outcomes and are not linked to social outcomes at all.

Figure 6 presents the indirect relationship between incentives and outcomes through the adoption of agroecological practices. The agroecological practices presented in Figure 4 are summarized into five categories following a modified Intergovernmental Panel on Climate Change (IPCC, 2007) categorization and are linked to the incentive categories. The five categories are agroforestry (26%), integrated nutrient management (1%), new agronomic practices (39%), tillage, residue, and water management (24%), and pest and disease management (9%). Market, non-market, and regulatory incentives seem to be more associated with new agronomic practices (crop rotation, cover crops, farm diversification, organic agriculture, etc.) than other practices, while cross-compliance incentives contribute more to agroforestry. Agroforestry is more often linked to environmental outcomes and integrated nutrient management. New agronomic practices are more frequently linked to economic outcomes. Tillage and water management contribute equally to economic and environmental outcomes, while pest and disease management practices contribute equally to all three outcomes. Consistent with the results of the direct pathway, market, non-market, and regulatory incentives are used at about the same magnitude, while cross-compliance incentives are the least prevalent. Incentives are also indirectly more associated with economic outcomes (41%) than environmental (38%) and social (21%) outcomes.



**Figure 6** Incentive-adoption-outcome linkages.

#### 4.5 Impacts of incentives on adoption and outcomes

In this subsection, we highlight the impact of incentives on adoption of agroecological practices and on farmer and consumer outcomes. Existing studies show that incentives encourage adoption of agroecological practices. For instance, Ward et al. (2016) found that

providing subsidies to farmers in Malawi increased the likelihood of adopting conservation agriculture practices. Hayes et al. (2017) found that PES reduced the number of households grazing livestock on communal land in Ecuador by 12%. Samii et al. (2014) found that PES reduced deforestation rates, while improving incomes by 4% and 14% in Mozambique and China, respectively. Garbach et al. (2012) also

found that technical assistance associated with PES had a positive effect on adoption of agroecological practices, particularly practices with private benefits, such as improving productivity. Overall, these findings underscore the importance of incentives in promoting adoption of agroecological practices.

The adoption of agroecological practices is also associated with positive effects on various outcomes, such as yield, income, food security, environmental sustainability, and other social benefits. For instance, Desta et al. (2021) found that conservation tillage significantly increased wheat yields by 20–40%, while Tanto and Laekemariam (2019) found that soil and water conservation practices increased grain yield by 72.8% in Ethiopia. The literature also shows positive effects of agroecological practices on income and farm profits. Walia et al. (2022) found that organic farming increased net profits more than conventional farming due to the premium market price (20–40% higher) paid for certified organic produce and to reduced production costs. Kassie and Zikhali (2009) also found that higher yields increased farmers' incomes and enabled them to avoid debt from buying fertilizer on credit.

Although several studies link the adoption of agroecological practices to yield and income, relatively few studies have explored the link to food security and environmental sustainability. The studies that have examined the effect of agroecological practices on food security show positive and significant effects. For example, Parachini et al. (2020) found that at least half of the articles they analyzed report positive contributions of agroecological practices to food security due to higher yields and on-farm diversity. Sileshi et al. (2019) also found that the adoption of soil and water conservation practices improved per-capita food consumption expenditures and reduced the prevalence of food insecurity in Ethiopia. In terms of environmental sustainability and resilience, previous studies have shown that agroecosystems with high biodiversity are generally more resilient to environmental stresses (Amissah & Aflakpui, 2020; Leippert et al., 2020; Zeweld et al., 2020). The adoption of agroecological practices has also been associated with social benefits, such as increased employment opportunities and reduced gender inequality (Fitzpatrick, 2015). Generally, the existing evidence is largely associational and is not based on rigorous causal analysis, highlighting the need for more rigorous evaluations.



Agricultural biodiversity in a Peruvian market. © A. Camacho/Bioversity International

## 4.6 Private-sector versus community-based incentive mechanisms

We now examine incentives commonly used by the private sector (including non-governmental organizations) and local communities. In terms of private-sector incentive mechanisms, the literature shows that sustainability standards, certification, and technical assistance are commonly used (Lambin & Thorlakson, 2018; Meemken et al., 2021; Tscharrntke et al., 2015). Sustainability standards are sets of environmental, economic, and social criteria that define best practices in production, processing, trade, and consumption. They are rules that supply chain actors can follow to demonstrate their commitment to social equity and/or environmental protection (Meemken et al., 2021; Tscharrntke et al., 2015). They are typically adopted voluntarily and are paired with compliance verification, certification, traceability, and labels (“eco-labels”) to differentiate sustainable products in the marketplace (Milder, 2013; Tscharrntke et al., 2015). Examples include certification labels, such as those developed by Fairtrade and Rainforest Alliance to promote social and environmental sustainability in supply chains. Certification programs aim to ensure that producers receive price premiums and other benefits for meeting sustainability criteria defined by a certifying entity. Technical support or capacity building in the form of agricultural extension and advisory systems that leverage local knowledge and facilitate market linkages also provide incentives to farmers to adopt agroecological practices, such as climate-smart agriculture (Côte et al., 2019; Jones et al., 2022; Khatri-Chhetri et al., 2019).

In terms of community-based incentive mechanisms, the literature shows that multi-actor innovation platforms, participatory guarantee systems, and community-supported agriculture are commonly used. Multi-actor innovation platforms, which are non-market incentive mechanisms, are arrangements set up to facilitate and undertake various activities related to identifying agricultural innovation challenges and opportunities (Loconto et al., 2016). They also bring

together different stakeholders to plan activities that promote the adoption of specific agricultural practices. Participatory guarantee systems, which are regulatory incentives, are locally focused quality assurance systems that certify producers’ farming practices based on the active participation of stakeholders. They are built on a foundation of trust, social networks, and knowledge exchange (Home et al., 2017; IFOAM, 2023). Participatory guarantee systems create a local system of production and consumption, in which multiple stakeholders experiment with sustainable agricultural practices. They collectively ensure that the practices are adopted by setting standards and verifying their compliance (IFOAM, 2023). Community-supported agriculture, which provides non-market incentives, refers to innovations that are embedded in local sociocultural contexts or specific agroecosystems and represent initiatives where community members invest in production and consumption components of the system (Bair, 2008; Loconto et al., 2016). Community-supported agriculture involves partnerships between farmers and consumers in which the responsibilities, risks, and rewards of farming are shared (Hvitsand, 2016). They aim to shorten supply chains and address increasing concerns about the lack of transparency, sustainability, and resilience of the food system. For instance, in Ecuador, La Canasta Utopía is a community-supported agriculture model that supports wider community mobilization around healthy food production and consumption and rural development (Loconto et al., 2016).



## 5. A case study on agroecological incentives for the wheat value chain in Ethiopia

We study the wheat value chain in Ethiopia because of several reasons. Ethiopia (unlike many countries) introduced a series of programs or initiatives in the wheat value chain, giving us an opportunity to examine national-level linkages between incentives, practices, and outcomes. Recent government efforts to increase wheat production have acknowledged the importance of applying agroecological principles to ensure sustainable production. Programs such as the Sustainable Land Management Program, Food and Land Use Coalition, and the Transformative Partnership Platform on Agroecology (TPP) focus on how to transition towards more agroecological wheat production systems (FOLU, 2020; Schmidt & Tadesse, 2019). Also, wheat is among the most important crops grown in Ethiopia, both as a source of food for consumers and as a source of income for farmers. Wheat and wheat products contribute about 14% of the total caloric intake in Ethiopia, making wheat the second-most important food after maize (19%) (Anteneh & Asrat, 2020; FAO, 2015). In Africa, Ethiopia is the second-largest producer of wheat after Egypt (Shikur, 2022). This case study will help us understand how incentives play out at the national level. Many incentives, especially regulatory, depend on government action at the national level. Some market processes and market incentives may also operate at the national level if there are no overwhelming import and export considerations.

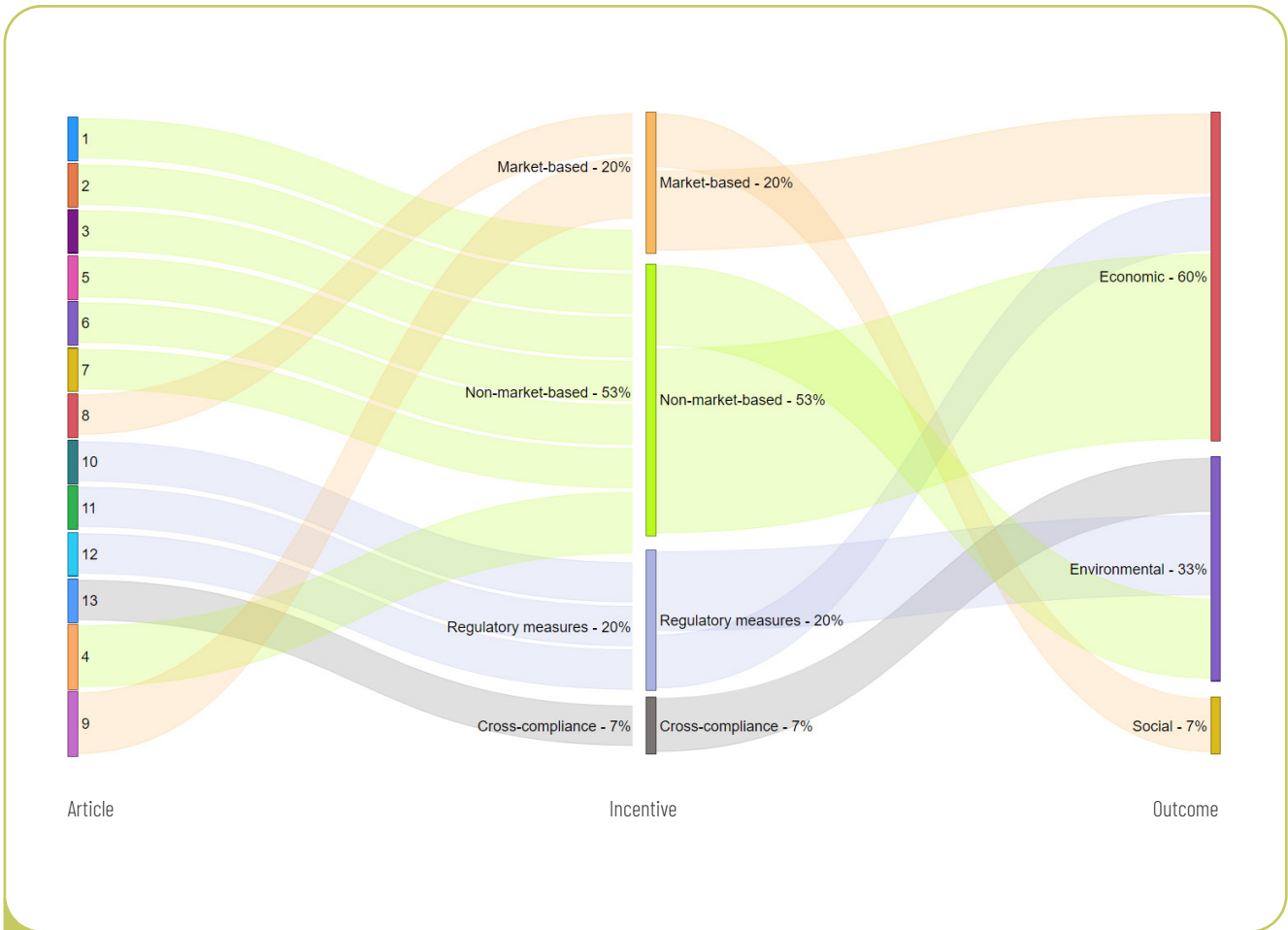
### 5.1 Agroecological wheat practices in Ethiopia

Smallholder wheat farmers in Ethiopia have adopted many agroecological practices. These include soil conservation practices (e.g., soil bunds, terraces), reduced tillage, farm or crop diversification, shifting planting or harvesting dates, crop rotation, using drought-tolerant or water-efficient varieties, using disease- or pest-resistant varieties, using short-duration or early-maturing varieties, composting

and application of farmyard manure, establishing waterways and check dams, and agroforestry (Belete et al., 2022; Desta et al., 2021; Feliciano et al., 2022; Sedebo et al., 2022; Tanto & Laekemariam, 2019). Some farmers also use organic fertilizers in combination with inorganic fertilizers to minimize the use of external inputs (Belete et al., 2022). Others use wheat varieties that are resistant to wheat diseases (e.g., stem rust, stripe rust, leaf rust) coupled with cultural practices (e.g., crop rotation and fallowing) to reduce agrochemical use and adverse environmental effects (Nigus et al., 2022). Conservation agriculture is also practiced in some parts of wheat-growing areas.

### 5.2 Incentives, adoption and outcome linkages among wheat farmers in Ethiopia

We now examine the types of incentive mechanisms and their linkages to the adoption of agroecological practices and outcomes. Figure 7 shows the direct relationship between incentives and outcomes. The four types of incentives found in our broader literature review – market, non-market, regulatory, and cross-compliance incentives – are being used to promote agroecological practices among wheat farmers in Ethiopia. However, there appears to be a small number of interventions using incentives as there are only a few articles (13) that show linkages between incentives, adoption of agroecological practices, and outcomes among wheat farmers in Ethiopia. About 20% of the incentives used in Ethiopia are market oriented, 53% are non-market, 20% are regulatory, while 7% are cross-compliance. Non-market incentives are the most-frequently used incentive mechanisms, possibly because they are flexible and broad in scope. As noted above, most cross-compliance incentives are found in developed countries (Wunder, 2005), which may explain why they have received little attention in the wheat value chain in Ethiopia.

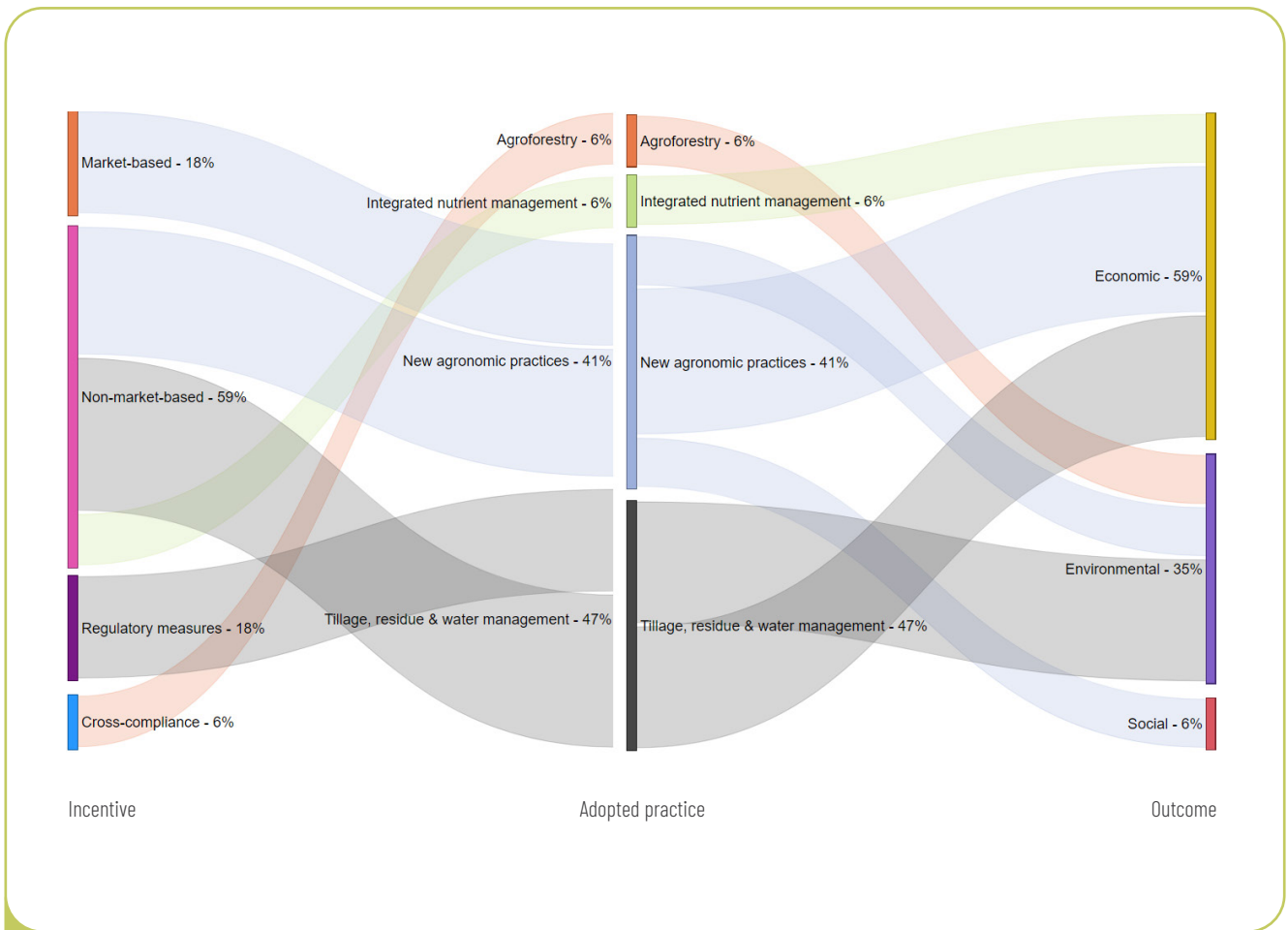


**Figure 7** Incentive-outcome linkages among wheat farmers in Ethiopia.

Figure 7 shows that, in general, incentives are more closely associated with economic outcomes (60%) than with environmental (33%) and social (7%) outcomes. Market incentives are associated with economic outcomes more than social outcomes but have no link to environmental outcomes. Non-market incentives are associated with economic outcomes more than environmental outcomes but have no link to social outcomes. Consistent with the results in Figure 5, regulatory incentives are associated with environmental outcomes more than economic and social outcomes, while cross-compliance incentives are only associated with environmental outcomes. Overall, non-market incentives seem to play a dominant role in economic and environmental outcomes. Regulatory and cross-compliance

incentives play a significant role in environmental outcomes, while market incentives play a key role in social and economic outcomes among smallholders in Ethiopia.

Figure 8 presents the indirect relationship between incentives and outcomes through the adoption pathway. Market incentives linked exclusively to new agronomic practices, such as crop rotation, cover crops, farm diversification, and organic agriculture. Non-market incentives contribute more to tillage, residue, and water management than other practices. Regulatory incentives contribute exclusively to tillage, residue, and water management, while cross-compliance incentives contribute exclusively to agroforestry.



**Figure 8** Incentive-adoption-outcome linkages among wheat farmers in Ethiopia.

In terms of the specific incentives and how they link to the adoption of agroecological practices, the literature shows that farmer cooperatives have been used to strengthen market linkages and promote principles of fairness and connectivity (Biggeri et al., 2018; Wezel et al., 2020; Zeleke et al., 2021). An example is the Agricultural Value Chains Project in Oromia (AVCPO) in the Bale zone of Ethiopia. The project helped smallholder farmers improve their livelihoods by involving them in the production of high-quality durum wheat and linking them to the pasta industry and markets through farmers’ cooperatives (Biggeri et al., 2018). Collective action harnessed through farmer cooperatives was used to improve access to markets. Smallholder farmers with limited production were able to aggregate their produce, reduce transaction costs through economies of scale, and enhance their bargaining power in contracting with buyers who require large volumes (Biggeri et al., 2018). Farmer cooperatives have also provided important incentives and avenues for technical support, such as farmer training, access to tractors and combine harvesters, and access to weather information. This support has been associated with the adoption of improved wheat

varieties and climate change adaptation practices (Sedebo et al., 2022; Zeleke et al., 2021).

Agricultural extension, improved inputs, access to credit, marketing assistance, and guaranteed markets have also been used as incentives to promote the adoption of improved farming techniques, such as lower seeding rates, row planting (a climate-smart agricultural practice), and more balanced fertilizer use (Abate et al., 2018; Gelu & Gebre, 2022; Yitayew et al., 2021). For example, training, provision of improved inputs, and marketing assistance – provided by the Agricultural Transformation Agency of Ethiopia under the Wheat Initiative – increased adoption of row planting and wheat yields among 2,000 “benchmark” farmers in 41 woredas in the four major wheat-producing regions (Amhara, Oromia, Southern Nations, Nationalities, and People’s Region) (Abate et al., 2018). Extension services were found to enhance farmers’ confidence in conservation activities and encourage them to take risks associated with adopting agroecological practices (Biratu & Asmamaw, 2016).

Land tenure certification was also found to be an important incentive because it increases land tenure security, motivating farmers to invest in land management practices on their plots (Gedefaw et al., 2020; Teshome et al., 2016). For example, the government's Land Certification Initiative improved tenure security, and contributed to increased terracing, application of manure, and crop productivity in four regions (Amhara, Oromia, Tigray and the Southern Nations, Nationalities, and People's Region) of Ethiopia (Gedefaw et al., 2020). Similarly, improved land tenure has increased investment in sustainable land management practices, such as soil bunds, composting, terracing and manure and fertilizer application, in Northwestern Ethiopian highlands (Teshome et al., 2016). To a limited extent, PES have been used as an incentive to promote reforestation. For instance, Humbo forest residents in Southwest Ethiopia have benefited from selling carbon credits through the World Bank's BioCarbon Fund (Bass et al., 2013).

Consistent with the general results presented in Section 4, this case study revealed that farmers in Ethiopia are more likely to adopt agroecological practices when the incentive mechanisms offer quick or more immediate returns, provide/include secure land tenure rights, and have access to agricultural extension and credit services (Gelu & Gebre, 2022; Holden & Shiferaw, 1999; Tesfaye & Brouwer, 2012; Yitayew et al., 2021). Land tenure security is an important incentive or driver for the adoption of longer term practices such as agroforestry and other systems that may not provide immediate returns (Beyene et al., 2019; Gessesse et al., 2016). The preference for short-term practices that offer immediate benefits may possibly be driven by the fact that land in Ethiopia is owned

by the government. This creates uncertainty that discourages long-term investments in land compared to when farmers are provided with certificates that guarantee land tenure security – the government of Ethiopia has recently issued land tenure certificates in some regions (Gedefaw et al., 2020). Apart from incentives, the adoption of agroecological practices was also driven by farmers' risk attitudes, farm sizes, liquidity constraints, and previous experiences or perceptions of the severity of potential environmental damage (Holden & Shiferaw, 1999; Kassie et al., 2009; Tesfaye et al., 2014). For instance, Holden & Shiferaw (1999) found that farmers living in the most erosion-prone areas were more likely to adopt soil conservation practices. Farmers who anticipate higher returns from new technologies or practices had positive attitudes towards them. Also, farmers who were more informed about new erosion control practices were more likely to adopt them. The net benefits or returns of the practices were also an important driver of adoption (Agegnehu & Amede, 2017).

In terms of the relationship between agroecological practices and outcomes, Figure 8 shows that agroforestry is linked to environmental outcomes. Integrated nutrient management and new agronomic practices are mostly linked to economic outcomes. Tillage and water management contribute equally to economic and environmental outcomes, consistent with the results of the direct pathway in Figure 6. Non-market incentives are the most prevalent, making up more than half of the incentives. Market and regulatory incentives equally contribute to another 36% of the incentives, while cross-compliance incentives are the least used (6%). Most of the incentives are indirectly associated with economic outcomes (59%), more than with environmental (35%) and social (6%) outcomes.



## 6. Conclusion and policy implications

The application of agroecological principles has been considered an effective means of achieving sustainable food systems (DeLonge et al., 2016; Jones et al., 2022). The transition to sustainable food systems requires significant investments and incentives to promote the adoption of sustainable agricultural or agroecological practices (Piñeiro et al., 2020; Wollenberg et al., 2012). However, only a limited number of studies have systematically examined incentives and investments for adopting sustainable agricultural practices. To the best of our knowledge, only Piñeiro et al. (2020) have examined the incentives for the adoption of sustainable agricultural practices and their outcomes, more generally. To address this gap, we conducted a scoping review to understand/explore the incentives, how incentives motivate the adoption of agroecological practices and, ultimately, the associated outcomes. We conduct a general review and add a case study focused on smallholder wheat farmers in Ethiopia.

Results from this scoping review revealed that a significant share of articles focus primarily on the association between the adoption of agroecology-related practices and outcomes. Few studies explicitly align incentives to the adoption of agroecological practices and outcomes. This was demonstrated for the wheat value chain in Ethiopia. Results also showed the existence of multiple incentive mechanisms and outcomes. Market, non-market, and regulatory incentives were generally the most common types of incentive mechanisms used to promote agroecological practices. Market and non-market incentives are relatively more flexible, allowing adoption decisions to be driven by farmers themselves rather than by external parties. They also contribute to long-term and self-sustaining solutions (Kiem, 2013). Perhaps because of this flexibility, attention to non-market incentives was strikingly higher than other incentives for the wheat value chain in Ethiopia. Regulatory



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incentives are generally perceived as too complex, which can sometimes limit their use (Schirmer et al., 2012). However, regulatory incentives were among the most used in the literature cited in this review. Cross-compliance incentives received less attention, possibly because of the significant transaction costs (search, information, contracting, and monitoring costs) involved in signing PES contracts, especially for many smallholder farmers (Pagiola et al., 2005).

The review also showed that the private sector and local communities use different incentive models. Private-sector incentive mechanisms mainly included sustainability standards, contract farming, and technical assistance. Community-based incentive mechanisms included multi-stakeholder innovation platforms that encourage participatory and inclusive innovations to address the sustainability challenges in the food system. They also included participatory guarantee systems to verify producers' compliance with certain production standards, and community-supported agriculture to shorten the supply chains and address concerns about the lack of transparency, sustainability, and resilience in the food system. Community-supported agriculture ensures that the local community has a direct connection to farmers, and that fresh and healthy farm products are delivered directly to consumers without going through intermediaries.

The review showed that farmers are often reluctant to adopt agroecological practices without incentives, despite their potential benefits (Ward et al., 2016). Farmers perceive agroecological practices interacting in diverse ways, sometimes increasing, and sometimes reducing the benefits of other practices. The adoption of agroecological practices was mainly influenced by incentives, farmers' previous experience with agroecological practices, and their risk attitudes. Education, farm size, and environmental awareness also played a role. Agricultural extension, technical assistance, and information sharing were found to be important incentives or drivers for the adoption of agroecological practices. Farmers need to understand the effectiveness and potential benefits of promoted

agroecological practices before they will adopt them (Tesfaye et al., 2014). Farmers were more likely to adopt practices associated with upfront payments and short-term contracts. They prefer individual over community compensation, and practices with additional in-kind rewards. Farmers' preferences for agroecological practices varied by household characteristics, highlighting the need to tailor incentives to farmers' conditions when implementing programs to promote large-scale adoption (Geussens et al., 2019; Haile et al., 2019; Kaczan & Swallow, 2013).

In terms of the outcomes, the review revealed that the incentives used not only support simple productivity-enhancing approaches, but are comprehensive, covering economic, environmental, and social outcomes. In general, the incentives were more associated with economic outcomes, followed by environmental and social outcomes. In the Ethiopian case study, non-market incentives were more associated with economic and environmental outcomes. Regulatory and cross-compliance incentives were more associated with environmental outcomes. Market incentives played a key role in social outcomes. In terms of the outcomes, existing studies show that incentives encourage the adoption of agroecological practices, which are subsequently associated with higher yields and incomes, food security, environmental sustainability, and social benefits. However, the existing evidence is largely associational and is not based on rigorous causal analysis. Future studies should rely on more rigorous evaluations.

Overall, the review shows that incentives are critical to the adoption of agroecological practices and to achieving a holistic and inclusive food system transformation. As farmers' decisions are aimed at maximizing certain outcomes, we recommend paying close attention to incentive mechanisms with fewer requirements, that increase the adoption of agroecological practices and focus on incentives that promote social outcomes.

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