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Holistic Localized Performance Assessment (HOLPA) tool for collecting locally relevant and globally comparable evidence of agroecology's effects on nature and people

Sarah K. Jones,[1,*] Andrea Cecilia Sánchez,[1,2,3,**] Christine Lamanna[4], Chris Dickens[5], Matthias S. Geck[4], Chaturangi Wickramaratne[5], Veronique Alary[6,7], Peter Bolo[8], Dennis Junior Choruma[9], Somphasith Douangsavanh[10], Modou Gueye Fall[11], Gatien Falconnier[12,13,14,15], Shweta Gupta[16,17], Chris Kettle[18], Smitha Krishnan[19], Sylvia Nyawira[8], Guillermo Orjuela-Ramirez[20], Boko Michel Orounladji[21], Piedad Pareja[22], Telma Sibanda[12]

[1]Bioversity International, Parc Scientifique Agropolis II, 34370, Montpellier, France.
[2]CIRAD, UMR ABSys, F-34398 Montpellier, France
[3]ABSys, Univ Montpellier, CIHEAM-IAMM, CIRAD, INRAE, Institut Agro, Montpellier, France
[4]CIFOR-ICRAF, United Nations Avenue, Gigiri, 00100, Nairobi, Kenya
[5]International Water Management Institute (IWMI), 127, Sunil Mawatha, Pelawatte, Colombo, Sri Lanka
[6]SELMET, Univ Montpellier, CIRAD, INRAE, Institut Agro, Montpellier, France
[7]ICARDA, Tunisia
[8] International Centre for Tropical Agriculture (CIAT) c/o International Centre of Insect Physiology and Ecology (ICIPE), Duduville Campus Off Kasarani Road, Nairobi, Kenya
[9]International Water Management Institute (IWMI), 333 Grosvenor Road, Hatfield Gardens, Pretoria, South Africa.
[10] International Water Management Institute (IWMI), c/o National Agricultura and Forest Research Institute (NAFRI) P.O. Box 4199 Vientiane, Laos PDR
[11] Bioversity International, c/o Senegalese Institute of Agricultural Research (ISRA), Senegal
[12]International Maize and Wheat Improvement Centre (CIMMYT), Harare, Zimbabwe
[13]AIDA, Univ Montpellier, CIRAD, Montpellier, France
[14]CIRAD, UPR AIDA, Harare, Zimbabwe
[15]Department of Plant Production Sciences and Technologies, University of Zimbabwe, Harare, Zimbabwe
[16]International Food Policy Research Institute (IFPRI), New Delhi, India
[17]Centre for Development Research, University of Bonn, Germany
[18]Bioversity International, Rome, Italy
[19]Bioversity International, College of Horticulture, UHS Campus, GKVK Post, 560065, Bengaluru, India
[20] International Center for Tropical Agriculture (CIAT), Km 17 Recta Cali-Palmira, Valle del Cauca, Cali 763537, Colombia
[21]CIRDES, USPAE, Bobo-Dioulasso, Burkina Faso
[22]International Centre for Tropical Agriculture (CIAT) c/o International Potato Centre (CIP), 1895 La Molina Avenue, Lima, Peru

*Correspondence: s.jones@cgiar.org
**Correspondence: andrea.sanchez@cgiar.org

SCIENCE FOR SOCIETY Agroecology is an approach to managing food systems aimed at keeping them inside an environmentally safe and socially just space. It has been hailed by some as the future of farming yet criticized by others as incapable of providing food security worldwide and lifting farmers out of poverty. Yet both proponents and dissenters lack data to back up their claims. To address this gap, we developed the HOLPA tool to measure the multidimensional performance of fields, farms and landscapes at different stages of agroecological transition, using standardized and localized indicators. We introduce the HOLPA context, agroecology and performance modules and describe the process used to develop and apply HOLPA at the farm-household level in eight countries. HOLPA's simple, robust indicators and localization process could readily be adopted into national, company, and project level data collection efforts to generate globally comparable and locally meaningful evidence of agricultural sustainability.

SUMMARY

Measuring the multidimensional performance of agroecological fields, farms and landscapes provides the cross-level evidence needed to manage agricultural and food systems for multiple objectives. Most existing agroecological assessment tools are developed for specific spatial levels or production systems, provide results that are not necessarily locally meaningful nor globally comparable, and fail to capture the multifunctionality of agroecological systems [1,2]. To close this gap, we used a collaborative multi-discipline, iterative process to develop a new holistic performance assessment tool for collecting evidence on income, nutrition, biodiversity, climate, water, soil and human well-being outcomes in fields, farms, and landscapes at different stages of agroecological transition. Here we present the HOLPA tool and the methodology used to develop it. We provide the list of standardized indicators and examples of localized indicators used in HOLPA to compare performance of farm-households at varying stages of agroecological transition.

Keywords: Agroecology, sustainable food systems, assessment tools, sustainability indicators, trade-offs, synergies, survey, performance, metrics, indicators.

INTRODUCTION

Our reliance on simplified, intensively managed, food systems with excessive concentration of power and finances is failing to bring smallholder farmers out of poverty, halt the loss of biodiversity[3] or avoid catastrophic global warming[4], with environmental and health impacts costing society at least $10 trillion per year [5]. Agroecology is gaining traction as a means to shift to socially just and planet-safe agricultural and food systems [6–9]. Agroecology promotes adherence to a set of 13 principles designed to create diversified, ecologically healthy agricultural production systems in economically vibrant and socially sustainable food systems [10].

Yet concerns exist that agroecology is unprofitable, and that diversified, chemical-free production cannot feed the world [11]. These claims have been refuted by multiple sources from studies at global[12–16] and local[17–20] levels. Yet there is evidence that field-level diversification can lead to yield losses in certain regions and cropping systems [21], and that zero chemical fertilizer inputs are a poor choice in locations with low soil fertility [22]. To navigate this complexity, holistic data collection tools need to be applied to generate evidence on the benefits and limitations of agroecology across diverse contexts and identify context-adapted solutions that effectively shift agricultural and food systems to socially just and planet-safe trajectories.

Previous projects have applied many different approaches and tools to characterize agricultural practices and food systems and monitor their performance. At least 35 tools exist[2,23], with several widely used notably FAO's Tool for Agroecology Performance and Evaluation (TAPE)[24], Biovision's Agroecology Criteria Tool (ACT), Farm ACT (F-ACT) and Business ACT (B-ACT)[25], the Rural Household Multiple Indicator Survey (RHoMIS)[26] and the Indicator-based Framework for Evaluation of Natural Resource Management Systems (MESMIS)[27]. These tools have been used in multiple countries where the results are generating evidence for how to create sustainable systems, e.g. RHoMIS revealed differing strategies to increase climate smartness in Tanzania and Honduras, depending on farm size[26]. Yet existing tools have at least three limitations. One, most do not adapt to local conditions and rely solely on standardized indicators, so cannot be applied in a new context without risking that results are not meaningful to local stakeholders[1,23]. Two, while many tools capture a wide range of performance criteria, some social (notably subjective measures of agency and human wellbeing) and environmental (notably biodiversity and climate resilience) dimensions are poorly represented. Three, tools that seek to characterize practices (e.g. in terms of agroecology) tend to use in-depth methods, limiting the time that can be dedicated to collecting data on performance as part of the same survey effort.

We present a new tool for agricultural performance evaluation, that seeks to address these limitations. This Holistic Localized Performance Assessment (HOLPA) tool was developed as part of the CGIAR Transformative Agroecology Initiative, which leverages multi-stakeholder collaborations through Agroecological Living Landscapes (ALLs) to propel food systems to sustainable trajectories in landscapes within eight focal countries: Burkina Faso, India, Kenya, Laos, Peru, Senegal, Tunisia, and Zimbabwe. HOLPA was developed through a multi-disciplinary participatory process with researchers engaged in these countries, building on the strengths and learnings from existing tools and focusing on indicator simplicity, robustness, and relevance to local and global food system sustainability challenges. In this paper, we focus on three central research questions that underpin the development of HOLPA: 1) What performance themes are essential to capture the multifunctionality of agroecological systems? 2) How can we select and collect indicators that are both locally and globally relevant? 3) Using the farm-household level as a first use case, what is a minimal set of indicators needed to generate robust agroecology characterization and performance comparisons across eight countries?

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RESULTS

HOLPA framework

The HOLPA framework for assessment has three modules: **1) Context module, 2) Agroecology module, 3) Performance module**, underpinned by a **Localization process** (Figure 1).

Farm-household interviews and field surveys are HOLPA's main data collection tools, implemented using an ODK-based digital survey to facilitate data collation and timely quality checking. Additional information for the three modules can be collected through desk-work (e.g. analysing existing survey data or remotely sensed sources), focus groups (e.g. for assessment of farmer agency at the community level), and key informant interviews (e.g. to gather information on national or regional policy priorities and food system challenges).

The Context module gathers information on the socio-ecological context that may influence adherence to agroecological principles or alter performance variables. The module includes questions on socio-demographic characteristics of respondent, farm-household and landscape characteristics (e.g. field/farm/landscape size, main crop/fish/livestock systems, location, climate), and on knowledge of and attitude toward agroecology (Figure 2).

The Agroecology module is designed to collect data on the degree of agroecological adherence at the field, farm or landscape level. This section uses the HLPE 13 principles of agroecology as a basis, with at least one question relating to each principle (Figure 2). Responses are collected on a 5-point Likert scale.

The Performance module includes 18 themes spanning agricultural, economic, environmental, and social performance dimensions (

Figure 2). These themes are designed to capture the performance of the farm related to the major global challenges of our time, including achieving food and nutrition security, halting biodiversity loss, building climate resilience, and improving human wellbeing. The themes and associated indicators were selected through extensive consultation with multidisciplinary researchers and lessons from piloting with project partners in eight countries, drawing on themes and indicators included in existing tools or newly developed as part of this study. Those involved identified or developed novel indicators at the field, farm and landscape level, giving preference to readily scalable indicators. At each level, we selected at least one key performance indicator (KPI) for each theme (e.g. see Table 1). More than one indicator was selected in a few cases to capture important information that would have otherwise been missed by the KPI.

Balancing global comparability with local relevance

Given the high variability in agronomic, political, and socio-economic characteristics and priorities between regions and countries, co-creation and co-learning are central parts of agroecology. Specific places may have agronomic, environmental, social or economic objectives that are not necessarily captured in globally relevant standard themes and indicators. Each place may also use specific terminology and concepts to discuss these objectives.

To address this and ensure information collected through HOLPA is locally meaningful while still relevant to global sustainability objectives, we developed a **seven-step localization process** to carry out before implementation. This involves: 1) translating (if needed) the HOLPA survey into the local language to create a place-based version, 2) tailoring some question and response options to fit with the local context, including local concepts, terminology and sensitivities (e.g. see Table 1) 3) answering all parts of the survey to find and fix errors introduced during steps 1 and 2, and piloting the survey with at least one local researcher or practitioner familiar with the local farming and food systems, to ensure questions are correctly understood, 4) conducting a multistakeholder **local indicator selection process (LISP)** workshop where diverse stakeholders – including youth and women groups - envision a sustainable future for their landscape and select key indicators to use to monitor progress towar8ds it (see below), 5) integrating the findings from (3) and (4), to update the place-based version of HOLPA, 6) piloting the survey with at least three local farmers and addressing any issues or gaps identified to produce a final place-based version, 7) training enumerators including quality checking of initial surveys and providing feedback to ensure correct implementation.

Translation, localization, and initial piloting (Steps 1-3)

HOLPA was originally designed in English. While verbal translation of the English version of HOLPA is an option, translating HOLPA into the language that the survey will be administered prior to data collection ensures consistency across enumerators. Translation can be done through automatic translation tools (e.g. deepL) but question and response options need careful checking to ensure the original meaning is maintained. Once the survey is put into the target language, certain sections need amending to ensure their relevance for the local context (e.g. see Table 1). For example the farm-household level HOLPA includes questions on which foods the respondent consumed in the past 24 hours across 16 food groups, using questionnaires developed by the Global Diet Quality Project [28] and the list of foods to include in each food group vary by country.

Post-translation and adaptation of place-based questions, initial piloting can be completed by the HOLPA user and at least one local researcher or practitioner. The goal of this step is to ensure the survey layout and dependencies are correctly coded (e.g. ensure mandatory questions are not showing as optional), and to make sure all questions and response options are clear for respondents in the local context. The user should add explanations (or 'hints') or examples for any sections that may cause confusion or be misunderstood.

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Local Indicator Selection Process (Step 4)

A major drawback of tools that collect data in the same way everywhere is that the tool can ask questions that are inappropriate or irrelevant for the local context. They can fail to capture context variables or performance aspects that play a role in enabling or constraining an agroecology transition, or in determining food system sustainability in a specific location. Our local indicator selection process (LISP) addresses this limitation by incorporating inputs, suggestions and feedback from local stakeholders, thus ensuring the implementation of HOLPA is reviewed, contextualized and improved with a sense of ownership from stakeholders. This step guarantees locally relevant indicators form part of the assessment, and thus the evidence that is generated is useful to people where it is applied. The LISP could readily be applied to help localize any other assessment tool.

The LISP involves conducting a one-day workshop with local farmers and stakeholders, to brainstorm and prioritize a set of local indicators to include in the HOLPA tool (full details in Supplementary D1). Participants brainstorm potential indicators for each of the same dimensions as the HOLPA Performance module (agronomic, economic, social, environmental), that could be used to monitor the types of changes they want to see in their farms and landscapes. After agreeing on a set of evaluation criteria (such as importance, ease of measurement, likelihood of changing), participants evaluate the potential indicators to arrive at a set of approximately three local indicators per performance dimension to include in the localized HOLPA tool.

Updating, final piloting, and training (Steps 5-7)

Once the local indicators have been included, the HOLPA tool is ready to be piloted by the enumerators with local farmers. The enumerators are involved from step 6 onwards. The enumerator training includes three stages: survey review, piloting and feedback, and quality control. First, through an in-person workshop, each of the survey questions is reviewed. The objective is for enumerators to understand the purpose of the survey and the information required by each question, to validate the functionality of the survey on the tablet and to simulate survey implementation among enumerators. Piloting HOLPA with local farmers aims to identify difficult or unclear questions and any technological errors in the digital survey. The quality control process includes reviewing collected data and developing regular quality reports while the surveys are applied. Since the surveys are digital, it is possible to identify, from the first surveys, frequent omissions or errors.

As this survey differs from conventional agricultural surveys (focused on commercial crops), during the piloting and training, special attention should be paid to correct interpretation of questions related to social and environmental dimensions, which include perception questions and field work.

Farm-household level HOLPA

While the HOLPA framework (Figure 1) and modules (Figure 2) can be used as a basis for collecting data at field, farm and landscape level, the indicators and way they are measured may vary across applications. Here, we introduce the farm-household level HOLPA data collection methods being applied in 11 landscapes across 8 countries.

The farm-household level HOLPA application involves a ~1-2.5 hour interview with the male or female head of the household combined with ~30-60 minutes of fieldwork, ideally completed jointly with the same household head. The interview and fieldwork time estimates provided here are based on initial data collection across our 8 focal countries. Times vary across and within countries mainly depending on the production system complexity, how dispersed the fields are, and the number of local indicators added to the survey. Fieldwork is based on data collected on agricultural land at three locations on the farm, i) near to household/buildings, ii) in the farm centre ideally in a simplified system on the farm (e.g. monoculture), iii) close to natural or semi-natural vegetation and if possible in a diversified part of the farm (e.g. agroforestry) (Figure 3).

Standard HOLPA indicators

We describe the core set of indicators included in farm-household level HOLPA's context, agroecology and performance modules and the basis for their selection (i.e. existing tools, published methodologies).

Context inidcators are gathered using mainly mutiple choice questions (Table 1, Document S1). The module is used to collect data on respondent, household and farm characteristics, mainly following RHoMIS[26]. In addition, it includes a series of Likert-scale questions to gather respondent attitude towards nature and food systems, drawing on the types of value statements identified with a pro-environmental mindset which theory suggests can motivate behaviour changes towards agroecology[29]. Several additional Likert-scale questions gather information on respondent perceptions of local climate change.

Agroecology adherence is monitored using one or more questions per agroecological principle, each with likert-scale response options similar to TAPE[24] and F-ACT[25] (Table 1, Document S1). Overall adherence can be assessed by calculating the median score per principle and then taking the median across all principles.

Agronomic performance is measured using indicators for: 1) crop health, 2) animal health, 3) soil health, 4) nutrient use (Table 1, Document S1). Crop health is measured as the percentage of crop production lost or damaged in the last 12 months, with qualitative measures of crop health used as a secondary indicator[30]. Animal health is monitored based on the share of livestock and/or fish with injuries, illness or mortalities, representing a subset of indicators used in AssureWel[31] assessment protocols. Perceptions of soil fertility and soil erosion are combined to indicate soil health, to draw on often superior farmer knowledge[30], while soil organic carbon is used as a secondary indicator of soil health (in addition to use for below-ground carbon storage). Soil organic carbon content is measured in a laboratory, from a composite of soil samples collected at five points in each of the three fieldwork locations on each farm. Nutrient use is measured as the amount of chemical and/or organic fertilizer or manure applied per area of cropland.

Enviromnental performance is measured using indicators for: 1) biodiversity, 2) agrobiodiversity, 3) landscape complexity, 4) climate mitigation, 5) water use, and 6) energy use (Table 1, Document S1). Biodiversity is measured as the on-farm diversity of insects (pollinators, pests, natural enemies) and trees, using methods similar to TAPE[24]. Bird diversity is an optional additional indicator, with data collected using a mobile app to record and identify birdsongs (e.g., i-bird). Agrobiodiversity is captured in terms of the crop, livestock and fish species richness per unit area, and share of cropland under diversified farming practices, following the Agrobiodiversity Index approach[32]. The proportion of on-farm land covered by natural and semi-natural vegetation is used as an indicator of landscape complexity [33,34]. Climate mitigation is assessed by estimating the below (soil organic carbon) and above (in woody vegetation with a diameter >10cm) ground carbon storage on-farm[35]. We use a simple farm climate mitigation rating score as a secondary indicator, by assigning a score from 1 (net negative emissions) to 5 (net positive emissions) to each agricultural practice used on farm, based on its climate mitigation potential as assessed by previous meta-analyses, and then summing the scores. Our indicator for water conservation is the number of months with agricultural water stress per year, with presence of rainwater harvesing methods a secondary indicator. Energy use efficiency is measured as the number of energy-consuming agricultural activities that use renewable sources. Additional information collected in the environmental theme includes share of locally adapted crops varieties, tree species, livestock breeds, and irrigation water sources.

Economic performance is based on indicators for: 1) household income, 2) agricultural productivity, 3) labour efficiency, and 4) climate resilience (Table 1, Document S1). Household income is determined as the total household income relative to the national poverty line, with income stability and sufficiency as secondary indicators. Agricultural productivity is measured in terms of yield (e.g. t/ha, kg/head) for the main three crops, and livestock and/or fish produced on-farm (adapted from TAPE). Number of labour hours per year per hectare is used as an indicator of labour efficiency[36,37]. Climate resilience is measured using the Resilience Index Measurement and Analysis (RIMA), based on questions related to access to basic services, assets, adaptative capacity, food security, shocks and access to social networks [38]. Some additional information is collected that may provide useful economic insights, including on debt ratio (closely related to farmer stress and suicide rates[39]), credit access and credit constraints.

Social performance is measured in terms of: 1) diet quality, 2) farmer agency, 3) human well-being, 4) land-tenure security (Table 1, Document S1). Diet quality is determined by calculating the houshold diet diversity score [28]. Farmer agency is monitored using a 5-point likert scale (with open questions to allow for in-depth qualitative analysis) on perceived decision-making power and freedom for male and female members of the household [40]. Human well-being is indicated by taking the median score across a series of questions on self-perceived life satisfaction with 5-point likert scale answers, covering health, nutritional, economic and social security [41]. Land tenure security is measured as the share of land the household owns, leases or uses on which they perceive they may involuntarily lose use rights within the next five years [42].

Locally selected indicators

Local indicators prioritized in the LISP process need to be added into place-based versions of HOLPA alongside the standard indicators, prior to data collection. Evidence from HOLPA implementation in our case study landscapes shows that a wide range of local indicators were identified. For example in Tunisia in the Kef and Siliana landscape, the production systems are dominated by livestock supplying dairy or meat value chains. Locally identified indicators included the number of manure pits per farm, the quantity of fodder produced across all seasons per farm and categorized by type (quality fodder, roughage), the number of fodder storage facilities per farm, the cost of sanitary cover, the cost of fodder production, and the number of users of biodegradable packaging among others.

In Mandhra Pradesh in India, local farmers and stakeholders reported accessability to adequate quantity and quality of water as a major challenge. Specific local indicators on water were added to the HOLPA tool, capturing water footprints, water use efficiency and water quality.

In Ucayali in Peru, a large number of the prioritized indicators were already part of the HOLPA standard tool. However, several indicators were disaggregated to allow locally specific concerns to be captured, such as separating land tenure by land use (e.g. percentage of cropland owned), capturing the origin of the dietary products (e.g. proportion of each food consumed that is produced on-farm) and seed management (e.g. use of good practices for seed storage).

In Zimbabwe, farmers were interested in assessing more precisely animal health through feed diversity. This led to the implementation of specific questions on feed availability in different period of the year for cattle, goats and chicken. Keeping animals is critical for farmers of the region, especially in the case of typical 'El nino' years where cereal harvest is contraind and farmers need to sell livestock to buy food.

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This diversity in local indicators identified in our study sites highlights the importance of the LISP step for ensuring locally relevant information is captured by HOLPA and other performance assessment tools.

DISCUSSION

The value of building a holistic evidence base

Agroecology is grounded in a multidimensional set of principles that can be implemented in a multitude of ways depending on the starting point and socio-political context[7,43]. The effect of different transition options on agronomic, environmental, economic and social outcomes in specific contexts are often poorly understood, grounded in absent, partially documented or inconclusive evidence[44,45]. With powerful agrifood actors interested in maintaining the status quo[14,43], solid evidence on positive transition pathways and outcomes is vital to dispel doubts and accelerate action to achieve sustainable food systems[7,46].

Agricultural performance tends to be judged on the capacity to efficiently produce a few commodities, commonly measured in terms of productivity indicators, such as yield, income, and returns to labour[2]. These simplistic measures do not capture the social and environmental value (and costs) of agricultural systems, and our over-reliance on them is a driver of the hidden harm that simplified, intensive agricultural systems cause around the world[47]. This article presents HOLPA as a framework and tool that proposes a locally grounded approach for collecting and evaluating data on agronomic, ecological, economic and social aspects of field, farm and food systems, including a core set of indicators to allow cross-site comparisons and learning.
HOLPA proposes performance measures that recognize the multidimensional value of agriculture, and context and agroecology indicators to identify what aspects of fields, farms and landscapes drive up this value.

Many of the indicators included in HOLPA are common to other tools, such as nutrient use, soil organic carbon content, and land tenure security, enabling the integration of evidence from diverse assessment tools. Yet HOLPA is unique in including often neglected social indicators, such as subjective human-wellbeing and farmer agency, and underutilized environmental indicators such as landscape complexity and climate mitigation potential, allowing these aspects to get accounted for in evidence-based decision-making. HOLPA incorporates recently developed methodologies (e.g. Global Diet Quality project[28]) and some novel approaches (e.g. qualitative measure of climate mitigation).

In holistic tool design, compromises must be made to balance complexity with feasibility. The indicator selection criteria we applied ensures a minimum robustness, yet future developments could strengthen the tool. For example, our protocol for crop productivity involves collecting yield data for only the three main crops through farmer recall. Assessing yields based on farmer recall can be unreliable[48], and collecting data on yields for only one crop is suboptimal in multicrop systems. Direct measurement of whole system yields (i.e. weighing harvested produce from a representative sample of all crops per plot) is time-consuming but may become more feasible to include in HOLPA with the development of time-saving image-based yield calculations[49].

Responding to local needs

HOLPA is distinct from off-the-shelf performance tools in its localization process, designed to ensure the tool responds to local concerns and priorities, making the evidence it generates more relevant to local stakeholders. The LISP step promotes co-development and co-creation of knowledge which is a fundamental grounding principle of agroecology. LISP is straight-forward to implement and ensures farmers are part of the tool design, addressing a key limitation of many assessment tools[50]. Performance assessment tools looking to inform agroecological transitions need to be co-developed with the actors that could change mindsets and behaviours[29] based on the evidence collected. The participatory indicator prioritization step included in LISP is important for building consensus around the most important metrics but also for constraining the time and data intensiveness of the tool, which can create barriers to large-scale use[51].

Lessons for future action-orientated tool design

The global key performance indicators were selected in consultation with ecologists, hydrologists, agronomists, soil scientists, gender specialists, economists and geographers, in an effort to capture the complexities of agrifood systems in a single holistic tool. Due to the need for compromise to keep the list of indicators manageable, few disciplines were completely satisfied with the final KPI list. For example, agronomists on the project preferred nutrient balance as a KPI but no methods were identified for rapidly assessing this at multiple sites, leading to selection of nutrient use per unit land area as a more feasible alternative. The need for compromise reflects the complexity involved in collecting robust data on multidimensional values[52].

Being truly transdisciplinary is hard, both during tool development and implementation. Training, iterative feedback sessions, and willingness to avoid jargon and provide simple explanations to ensure understanding, are vital, especially when the team is working across languages and cultures. Yet systems approaches like this are what is needed for scientists and local stakeholders to relate to the worldviews, perceptions and concerns facing others, and be more effective at finding integrated solutions.

Potential HOLPA applications

HOLPA is a framework and tool for building a robust evidence base for the multidimensional performance of fields, farms and landscapes at various stages of transition to agroecology. Data can be used to compute agroecology and performance indicators as summarised in Table 1 and detailed in Document S1. Context variables and agroecology indicators can be analysed using cluster analysis and principal component factor analysis to identify field, farm or landscape typologies [53,54] and to understand the degree of agrological transition among contextually similar sites [55]. These data can also be used to explore which biophysical, social and economic context variables enable or prevent farmers from transitioning to agroecology, for example using multivariate regression models [56]. Such information could be used to inform investment and policy intervention decisions to lift barriers and accelerate behaviour shifts [43].

Performance indicators can be analyzed to identify the context and agroecological conditions that lead to the highest performance, for single indicators (e.g. income, climate resilience) or across multiple indicators by combining scores into an overall performance index. An index can be computed by transforming indicator scores to a standard scale and aggregating following [32] (see example in Document S1) or through participatory discussions to develop place-based performance ratings[57]. An index can assist farmers, policy and decision makers rapidly compare the performance of farms within and across landscapes and prioritise investments towards underperforming areas or typologies of farms [26,57,58].

Finally, while HOLPA implementation times are comparable to existing tools, the time required still presents a constraint to large-scale data collection. Time savings may be possible by using remotely sensed data to replace selected environmental indicators, such as tree cover and landscape complexity (e.g. [59]).

Joining the evidence dots

Ideally holistic assessment tools should be implemented at plot, farm and landscape level at each site on a repeat basis, to capture temporal and spatial interactions (e.g. time-delay between stronger adherence to agroecology and more stable income or increased farmer agency). Multi-level assessments enable connected planning across levels. In practice, internal and external factors present constraints.

Data generated from holistic tools can close knowledge gaps on how to transition to sustainable food systems. To make full use of these data, we need to provide a means for assembling and harmonizing data from diverse tools into a statistically analyzable, continuously updated evidence bank. We welcome engagement with other tool developers and users to create a collaborative space for performance data integration and interpretation, to support inclusive, rigorous and transparent evidence access for decision-making[60,61]. For such evidence to lead to positive changes in our food systems, researchers need to continue to learn with and from local farmers and other stakeholders to make sure any recommendations stay grounded in what is really best for the smallholders, communities and nature on which our food system depends.

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Further information should be directed to and will be fulfilled by the lead contact, Sarah Jones (s.jones@cgiar.org).

Materials availability

The ODK compatible version of the global farm-household level HOLPA survey described in this study has been deposited to Dataverse: https://doi.org/10.7910/DVN/EIRW1G. The Excel-based quality assurance tools are available in the same Dataverse repository.

Data and code availability

This study did not generate datasets or code.

HOLPA development process

Conceptual framework

The HOLPA framework is based on the premise that capturing the level of adherence to agroecology, the multidimensional performance of the field, farm and/or food system, and indicators to distinguish the socio-ecological context in which these systems function, are the foundation for any tool aiming to collect evidence on the outcomes of agroecology. Initial dialogue focused on who are we generating evidence for and how can we ensure it is useful to them, leading us to conclude that embedding a local visioning and indicator selection process was key.

Tool review

To develop the core set of indicators to include in HOLPA, we started by reviewing indicators proposed in existing frameworks and tools that assess i) adherence to agroecology, and/or ii) multi-objective sustainability performance of agricultural or food systems. The following tools were included in our review: ACT, F-ACT, B-ACT [25], the Committee on Sustainability Assessment indicators [62], the Commission on Sustainable Agriculture Intensification principles and metrics [63], Doughnut Unrolled [64], Evaluation and Simulation of Agroecological Systems impact indicators [65], Global Farm Metric [66], MESMIS [27], RHoMIS [26,67], SDG targets and indicators [68], TAPE [24], World Benchmarking Alliance [69] and several comprehensive indicator sets for measuring agricultural performance proposed in literature [58,70,71]. We compiled the identified indicators into long-lists of context, agroecology, and performance indicators for use in HOLPA. We removed duplicates and added placeholders for missing elements, e.g. holistic human wellbeing. The lists were then shared and iteratively discussed in a series of online meetings with up to 55 multidisciplinary researchers involved in the CGIAR Agroecology Initiative, to agree the priority context variables, agroecology adherence indicators, and performance themes and indicators to use for HOLPA, and attempt to develop new indicators to fill gaps. The researchers included 29 men and 26 women representing 9 institutes working with smallholder farmers, and included nutrition, agronomic, climate, water, soil, biodiversity, gender, equity, and value chain specialists.

Context module development

Indicators in this module were selected to capture characteristics of the respondent, farming system, and/or landscape that may affect performance or far adherence to agroecological principles. Many question and response options are taken from existing tools (particularly RHoMIS and TAPE). Novel questions added to HOLPA include those capturing personal and societal motivations to transition to agroecology.

Agroecology module development

This module focuses on measuring how closely a field, farm or landscape follows agroecological principles. The TAPE and ACT suite of tools emerged as the most up to date and comprehensive tools for place-based assessments, but both tools could require a substantial time-investment during implementation due to the number of questions included. We opted to use these two tools as a basis for developing a shorter list of questions, using simplified versions of TAPE's questions and responses where possible and aligning the questions with the HLPE 13 principles similar to ACT. We developed the module to include at least one question for each of HLPE's 13 agroecological principles and ensure simple Likert scale response options.

Performance module development

The performance module aims to collect data on the multidimensional outcomes of field, farm or landscape management decisions. Our tool review resulted in an initial long-list of 112 performance indicators. During the tool development meetings (which varied between group-wide and topic-specific small-group sessions), researchers discussed which performance themes were essential to include, agreed on an indicator selection criteria, discussed ways to capture under-reported aspects of sustainability such as farmer agency, holistic wellbeing, labour inputs, and whole system yields, and prioritised indicators and measurement methods to which they considered most important and effective at capturing performance in their area of specialism. The researchers were asked to, where possible, identify measurement methods that could be used at multiple spatial scales, i.e. field, farm and landscape level. This process resulted in the identification of 18 performance themes (33 indicators) across agronomic, environmental, social and economic domains (Figure 2).

A single researcher then reviewed every indicator and i) removed any that did not meet our inclusion criteria (see below), ii) ensured there was at least one indicator for all 18 performance themes.

Performance indicator inclusion criteria

When seeking to monitor multiple outcomes, performance indicators need to be simple enough for it to be viable to collect data across many sites, yet not so simple that they are meaningless. We used the following indicator selection criteria:

1. Measurability - there is a clearly defined method for collecting data for the indicator.
2. Resources required - the indicator can be measured quickly (hours not days).
3. Relevance - the indicator assesses progress towards sustainability objectives inclusive of agroecological principles.
4. Usefulness - the indicator can be used to guide decision-making for sustainability.
5. Robustness - the indicator is supported by peer-reviewed literature or has proven reliability.
6. Acceptability - easily understood and communicated.
7. Sensitivity to change - the indicator can detect changes in farm or food system management away from or towards agroecology principles.
8. Responsiveness – appropriate duration or delay between action and detectable response.

Piloting and iterative improvements

The HOLPA question and responses were converted to ODK format, localized, piloted with local researchers and (after improvements) with farmers in the CGIAR Agroecology initiative target countries (Burkina Faso, India, Kenya, Laos, Peru, Senegal, Tunisia, Zimbabwe) in 2023, for use at the farm-household level as a first use case. Based on feedback from the pilot and partners, including that the survey was too time-consuming, several questions were removed or merged and some response options were simplified. The order of questions was improved to facilitate implementation, e.g. to group context, agroecology and performance module questions relating to agrochemical inputs, or to animal health.

Localised indicator selection process (LISP)

To develop the LISP process, we first reviewed participatory approaches used in monitoring and evaluation as well as in agricultural development in general[72–74] [REFS]. Researchers from each of the CGIAR Agroecology Initiative target countries gave feedback on the draft workshop plan, which was then piloted with two groups of stakeholders in Kenya. A revised workshop plan and tools were then implemented in each of the other target countries, with some variations based on their specific needs and constraints. The final process guidelines were developed based on feedback from each implementation.

The number of local indicators added to HOLPA needs to be constrained to keep the survey length manageable. In our focal landscapes, between one and three locally-selected indicators were prioritised per performance dimension (agricultural, environmental, economic, social). Where a prioritized local indicator was already included in the standard HOLPA tool, no additional indicators were added unless the local indicator used a different methodology to the standard indicator (e.g. evaluating soil health using locally defined indicators).

Training HOLPA-users

We organized three online trainings for in-country survey coordinators, who then led an in-person training session with enumerators. The trainings involved practicing survey installation on a handheld device, step-by-step review of every survey question, clarifying any sources of confusion, and having each trainee complete the entire survey at least once to practice inputting survey responses.

CellPress

Administering HOLPA

The farm-household sampling strategy should be designed to respond to the research questions of interest to the HOLPA user. Selecting farms across distinct areas on agroecological or socio-ecological typology maps can help to ensure variation in sampled farm-household characteristics.

At each household, after explaining the purpose of data collection and receiving respondent consent to proceed, the interview and fieldwork surveys should be used to gather data on context, degree of agrecology integration, and all 18 performance themes (Figure 2). The farm-household HOLPA surveys can be administered through ODK-based digital survey tools (e.g. using KoboCollect or FormShare). This allows regular transfer of responses to a centralised online database, reducing loss of data. It also enables the survey coordinator to perform quality checks during data collection and iteratively improve guidance and training to enumerators to reduce errors and inconsistencies.

Data cleaning and analysis

Survey data can contain errors, some of which can be readily fixed during the data cleaning stage and others which cannot, meaning the data point should be excluded. We developed an excel-based quality assurance tool to enable rapid detection of common errors (see Materials availability). For example, the total agricultural land area may not match the sum of the agricultural land area reported as used for different purposes (e.g. cropland, pasture, other). The user should decide how to address this, e.g. rechecking the responses with the household head. Some errors could be avoided by future improvements to the survey design.

After data cleaning, users can calculate indicator scores using the scoring system described in Document S1. Additional indicators can be calculated depending on the local indicators included and user research questions.

SUPPLEMENTAL INFORMATION

Document S1. Supplementary experimental procedures. This document contains additional guidelines on HOLPA implementation, measurement protocols, computation of indicator scores, and the full HOLPA farm-household survey.

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AUTHOR CONTRIBUTIONS

Conceptualization: CL, SKJ
Methodology: AS, CD, CL, CW, SKJ, MG, with contributions from all authors
Software: AS, GO, SKJ
Validation: AS, GO, SKJ, with contributions from all authors
Writing – original draft: SKJ
Writing – review and editing: All authors
Visualization: AS, CL, SKJ

All authors read and approved the final manuscript.

DECLARATION OF INTERESTS

The authors declare no competing interests.

Figure 1. HOLPA framework

[See end of paper]

Figure 2. HOLPA modules

[See end of paper]

Table 3. HOLPA farm-household level fieldwork design

[See end of paper]

Table 1. HOLPA farm-household level indicators and localization needs

[See end of paper]

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Figure 1. HOLPA framework

HOLPA includes three modules designed to enable analysis of performance while controlling for socio-ecological context and agroecology transition stage. Before applying HOLPA, a localization process is used to pilot and validate the questions and response options (adjusting options where necessary to make them relevant for the context) and add any locally important indicators not already captured.

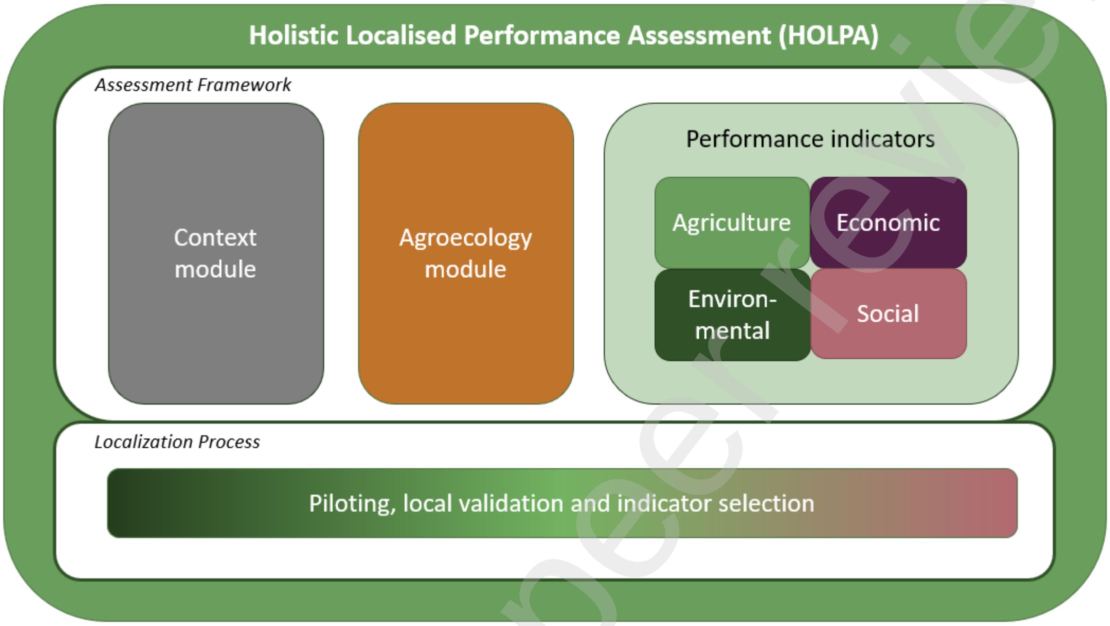


Figure 2: HOLPA modules

HOLPA's context module gathers data on the socio-ecological characteristics and respondent attitude towards agroecology. The agroecology module questions focus on assessing integration of HLPE's 13 agroecological principles. HOLPA gathers data for 18 performance themes spanning four domains (agronomic – light green, environmental – dark green, economic - purple, and social - pink). Each theme has at least one key performance indicator (for details, see Table 1). Additional data capturing context-specific characteristics and/or indicators for performance may be added through the local indicator selection process.

Figure 3: Typical field measurement locations used for the farm-household level HOLPA survey

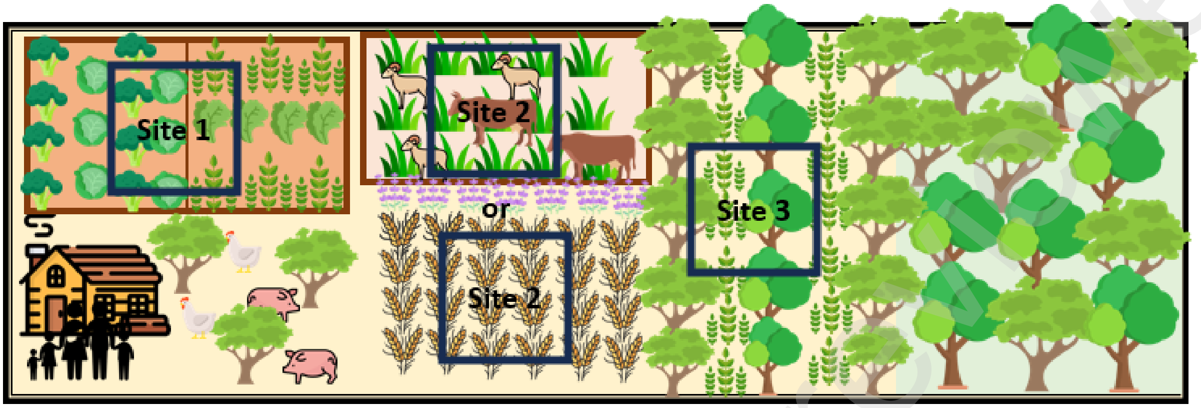


Table 1: Summary of HOLPA farm-household survey content and localization needs.

In the Performance module, only questions used to calculate Key Performance Indicators are presented. The Needs Localisation column specifies instances where question wording or response options need tailoring to local contexts prior to survey implementation.

Theme	Main questions	Response options	Response format	Needs localisation
Context module				
Location	Country / Commune / Municipality / Village / GPS point of household	E.g., Peru, Senegal, Burkina-Faso	Categorical	Yes. Insert the specific country name
Respondent characteristics	Name and Last name		Text	No
	Demographic information: year of birth / gender / ethnicity / marital status / education	E.g. Male, female, other/prefer not to say	Categorical	No
	Relationship with: the head of the household (if not the head of household); person responsible for making decisions on farm activities	E.g. Spouse, sibling, child, parent, non-relative	Categorical	No
	Number of years living in the community		Continuous	No
	Primary and secondary occupation in the last 12 months	Agricultural and/or livestock work on your own land. Permanent salaried work on other people's land. Seasonal wage labor on other people's land. Public administration. Company (landowner). Salaried (non-agricultural work). Study / education / training. Homemaker. Can't work. Prefer not to say. Other (specify)	Categorical	No
Household characteristics	Number of household members by gender and age (<18, (≥18 and ≤65, and > 65 years old		Integer	No
	Current involvement in any agricultural research or development project	Yes. No	Binary	No
Farm characteristics	Total area of land the household owns, leases from another person, and holds use right, either alone or jointly with someone else specifying amounts for male and/or female members		Continuous	Yes. Specify the locally relevant metric unit for area.
	Farmland slope	○ Steep ○ Moderately steep ○ Slightly steep ○ Flat	Categorical	No.
Production systems	On-farm generated products in the last 12 months. Amount of produce used for household consumption, livestock consumption, on-farm use, sales, gifts, wasted/lost, other uses	Crops (including perennial crops). Livestock. Fish. Trees (e.g., for wood, bark, rubber). Honey. Other (specify) None / 1-25% /26-50% / 51-75% / 76-100%.	Categorical; Likert scale	No
	Amount of chemical and non-chemical fungicides / pesticides / herbicides applied to cropland, over the last 12 months	Amount of pesticide applied. Area affected.	Continuous	Yes. Specify the locally relevant metric unit for area.
	Approaches employed to manage livestock and fish diseases over the past 12 months	Vaccination. Antibiotics. Organic treatments. Quarantine measures. Genetic selection for disease resistance. Herbal remedies or traditional medicine. No action taken. Other (specify).	Categorical	No
Climate change	Perception of temperature / rainfall change over the last 30 years	Increased No change Decreased I am not sure	Likert scale	No
	Do you perceive that the timing of rainfall has changed over the last 30 years?	Rainfall starts earlier/later Rainfall stops earlier/later Rainfall start and/or stop are no longer predictable. No change. I am not sure.	Categorical	No
	Farmland flood / drought events in the last 12 months	Yes / No	Binary	No
Motivation to transition	Understanding of the concept of agroecology	3- Clear understanding.	Likert scale	No

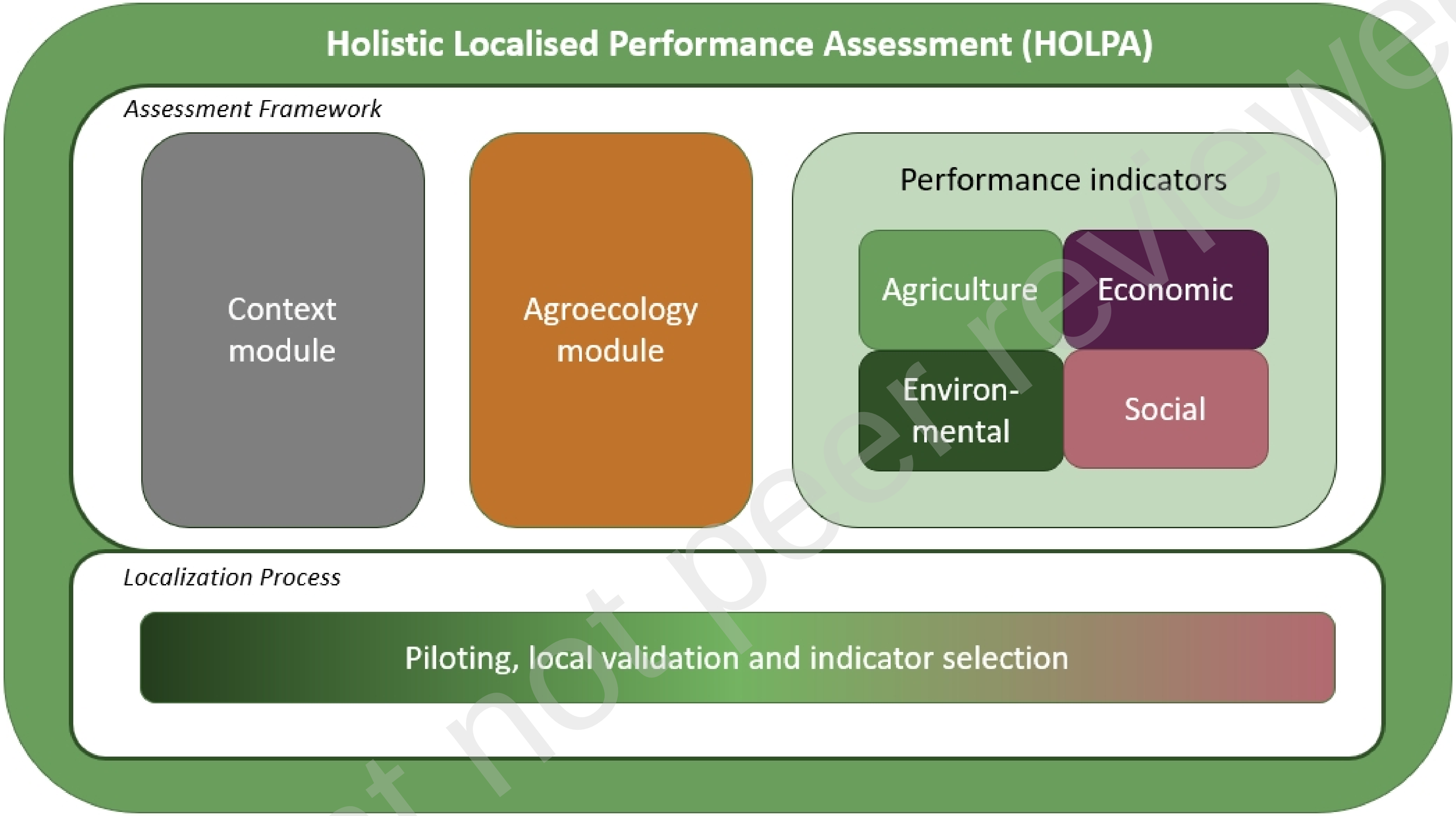
Theme	Main questions	Response options	Response format	Needs localisation
		2- Some knowledge, but willing to learn more. 1- Not familiar with the term.		
	Agreement with the following statements: - I care a lot about nature: - Being in nature benefits me: - I live in a place where most people take good care of the land and nature: - I take care of the land and nature on my farm: - I identify myself as an agroecological farmer: - I have power and freedom to change farm production practices if I want to: - If I work together with others in my community, we have power and freedom to solve problems facing farmers: - I make decisions about what food to buy based primarily on price: - I would prefer to eat food that is produced without chemical inputs. - I would prefer to eat food that is grown locally: - I would prefer that the food I buy is produced and processed in ways that provide a fair wage and good conditions for workers: - I think shifting to agroecological farming is a sensible business decision: - Most farmers think current farming systems are working well and do not need changing:	2- Completely agree. 1- Somewhat agree. 0- Neutral. -1- Somewhat disagree. -2- Completely disagree.	Likert scale	No
Agroecology module				
Recycling	Primary sources for seeds, nutrients, livestock breeds, fish seeds, fish feed, and energy	5- 100% self-produced, exchanged or managed collectively. 4- 75% self-produced or exchanged, 25% purchased from the market. 3- 50% self-produced or exchanged, 50% purchased from the market 2- 75% purchased from the market, 25% self-produced or exchanged. 1- 100% purchased from the market.	Likert scale	No
Input reduction	Approaches employed to manage soil fertility, crop pests, livestock/fish diseases in cropland over the past 12 months.	5- Only ecological practices/treatments. 4- Combination of ecological practices/treatments and organic inputs. Or only organic inputs 3- Combination of ecological practices/treatments, and chemical and organic inputs. 2- Combination of chemical and organic inputs. 1- Only chemical inputs.	Likert scale	No
	Utilization of dry feed (e.g., grains, hay) for livestock nutrition.	1- All the time 2- Often 3- Sometimes 4- Rarely 5- Never	Likert scale	No
	Main types of fish feed use in the last 12 months	5- Only natural feed used. 4- Combination of natural and prepared organic feed used. Or only organic feed used. 3- Combination of natural, prepared organic and prepared chemical feed. 4- Combination of prepared organic and chemical feed. 5- Only chemical feed.	Likert scale	No
Soil health	Number of agricultural practices employed on cropland to improve soil quality and health	5- Four or more practices used. 4- Three practices used. 3- Two practices used. 2- One practice used.	Likert scale	No

Theme	Main questions	Response options	Response format	Needs localisation
		1- No action taken.		
Animal health	Number of practices employed on farm to keep livestock / fish healthy and happy	5- Four or more practices used. 4- Three practices used. 3- Two practices used. 2- One practice used. 1- No action taken.	Likert scale	No
	Are the animals of your farm healthy and happy?	5- Animals do not suffer from stress, hunger, thirst, pain, or diseases, and are slaughtered in a way to avoid unnecessary pain. 4- Animals do not suffer from hunger, thirst or diseases but can experience stress, especially at slaughter. 3- Animals do not suffer from hunger or thirst, but suffer from stress, may be prone to diseases and can suffer from pain at slaughter. 2- Animals suffer periodically/seasonally from hunger and thirst, stress or diseases, and are slaughtered without avoiding unnecessary pain. 1- Animals suffer from hunger and thirst, stress and diseases all year long, and are slaughtered without avoiding unnecessary pain.	Likert scale	No
Biodiversity	Amount of crop / livestock / fish species per ha.	5- More than 3 species per ha. 3.67- 3 species per ha. 2.34- 2 species per ha. 1- 1 species per ha.	Likert scale	No
	Diversity of trees (or perennial woody crops) on farm	5- High diversity. 3.67- Medium diversity. 2.34- Low diversity. 1- None.	Likert scale	No
	Plant diversity in national and semi-natural vegetation on farm	5- High diversity: five or more species with different heights, woodiness, or flowering seasons 3.67- Medium: two to four species 2.34- Low: only one species 1-No natural or semi-natural vegetation on-farm	Likert scale	No
Synergies	Number of practices implemented to ensure positive relationships between animals, crops, trees, soil, and water.	5- Four or more practices. 4- Three practices. 3- Two practices. 2- One practice. 1- No action taken.	Likert scale	No
Economic diversification	Number of income sources the household has.	5- Five or more sources of income. 4- Four sources of income. 3- Three sources of income. 2- Two sources of income. 1- One source of income.	Likert scale	No
Knowledge co-creation	Number of times per year the household exchanged information with extensionists, consumers, food traders, government, NGOs, other farmers, researchers.	5- Five or more times per year. 4- Four times per year. 3- Two to three times per year. 2- One time per year. 1- Never.	Likert scale	No
Governance	Household engagement in activities and meetings related to the management community's land and natural resources.	5 - Always participates. 4 - Most of the time participates. 3 - Sometimes participates. 2 - Rarely participates. 1 - Never participates.	Likert scale	No.
	Household influence on community land and natural resources management decision-making.	5 - Contribute to all the decisions. 4 - Contribute to almost all the decisions. 3 - Contribute to some decisions. 2 - Contribute to few decisions. 1 - Did not contribute to any decision.	Likert scale	No.
	Perception of community land and natural resources management.	5- Extremely well-managed. 4- Well managed. 3- Moderately managed. 2- Poorly managed.	Likert scale	No.

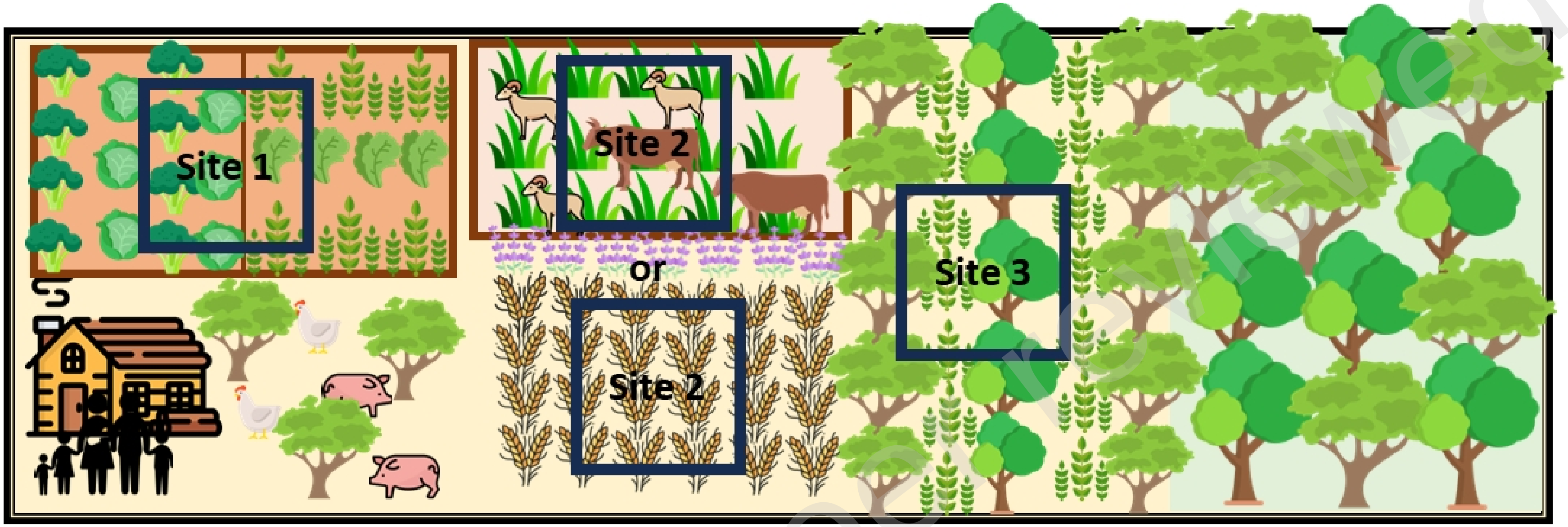
Theme	Main questions	Response options	Response format	Needs localisation
		1- Not at all well-managed.		
Social values and diets	Household access to healthy, diversified, seasonal, and/or traditional food.	5- Good access. 4- Fairly good. 3- Moderate access. 2- Limited access. 1- No access at all.	Likert scale	No.
Fairness	Is on-farm income sufficient to support household?	5- All needs are met, and savings are regular. 4- Needs for food are covered, and surplus generates cash for essentials and sporadic savings. 3- Needs for food are covered, but no surplus for savings. 2- Only needs for food are covered, no surplus for other essential needs. 1- Needs for food and other essentials are not met.	Likert scale	No.
	Does the household get fair prices when selling on-farm products?	5 – Always get a fair price. 4 - Usually, depending on the product. 3 - Occasionally, depending on the product. 2 - Rarely get a fair price. 1 - Never get a fair price.	Likert scale	No.
	How would you rate the stability of household income?	5- Income is increasing over time. 4- Income is stable over time. 3- Income varies little from year to year. 2- Income varies from year to year. 1- Income is on a decreasing trend.	Likert scale	No.
Connectivity	What are the various channels through which households may sell at least part of their on-farm produce?	5- Directly to consumers. 4- To farmers' organization / cooperative. 3- To retailers such as supermarkets, grocery stores, or restaurants. 2- To a middleman / aggregator. 1- Household does not sell on-farm produce.	Likert scale	No.
Participation	How many associations or organizations are household members part of?	4- Member of three or more organizations. 3- Member of two organizations 2- Member of one organization. 1- Not an organization member.	Likert scale	No.
	How effective are farmer associations/organizations at supporting farmers in business?	5 - Exceptional effectiveness in supporting farmers' businesses. 4 - Significant role in supporting farmers' businesses. 3 - Satisfactory support in supporting farmers' businesses. 2 - Limited support with marginal impact on farmer's overall success. 1 - No support provided. 0 - I don't know.	Likert scale	No.
Performance module				
Agricultural				
Crop health	Percentage of crop production lost or damaged last year	E.g., 10%	Continuous	No
	How would you describe crop health from a score of 1 (lowest) to 5 (highest), for each of the following indicators? • Appearance • Crop growth • Disease incidence • Insect pest incidence • Natural enemy abundance and diversity • Weed competition and pressure • Actual or potential yield • Vegetational diversity • Natural surrounding vegetation	E.g. for Appearance (and assisted by an example image of each option): 5- Healthy foliage with no signs of deficiency 4- Foliage with very minor deficiency signs 3- Foliage with some deficiency signs 2- Discolored foliage with moderate deficiency signs 1- Discolored foliage with severe deficiency signs No data-I am not sure, or the question is not applicable	Likert scale	No

Theme	Main questions	Response options	Response format	Needs localisation
	• Management system			
Animal health	Extent of injury, illness, or death of livestock and/or fish due to diseases in the last year	3- Low 2- Medium 1- High	Likert scale	No
Soil health	Saturation of soil organic matter (0-20cm)	E.g. 5%	Continuous	No
	Soil health fertility and erosion	3-highly fertile with no soil erosion 2-moderate/low fertility with some soil erosion 1-infertile and major soil erosion	Likert scale	No
Nutrient use	Amount of chemical / organic fertilizer used on cropland per hectare	E.g. 5 kg/ha or 2 L/ha	Continuous	No
Environmental				
Biodiversity	On-farm insect, bird and mammal diversity	5-High diversity: Abundant presence with a wide variety of species. 3.67-Medium diversity: Regularly seen with several species. 2.34-Low diversity: Rarely seen or limited to a few species. 1-None: no insects, arachnids, birds, or mammals observed.	Likert scale	No
	Number and diversity of trees (or perennial woody crops) on farm	5- More than 50 trees (and/or other woody perennials) per ha with at least five species with different heights, woodiness or flowering seasons 3.67- 21-50 trees (and/or other woody perennials) per ha, and/or two to four species 2.34- 1-20 trees (and/or other woody perennials) per ha and/or only one species 1- No trees or other woody perennials.	Likert scale	No
Agrobiodiversity	Crop, livestock, and fish species diversity (richness per hectare)	5: More than 3 species per ha (for each of crop, livestock and fish, unless absent on the farm) 3.67: 3 species per ha 2.34: 2 species per ha 1:1 species per ha	Likert scale	No
	Use of local adapted crop varieties / livestock breeds	5- Only or mainly locally adapted varieties (or local breeds). 4 – 75% locally adapted varieties (or local breeds), and 25% certified seeds (or exotic breeds). 3 - Mainly certified seeds and some locally adapted varieties are grown (e.g., traditional cultivars, landraces). 2 - Only or mainly certified quality seeds are grown. 1 - I don't know, or seeds are neither certified or locally adapted.	Likert scale	No.
Landscape complexity	Landscape complexity, measured as share and diversity of land covered by natural and semi-natural vegetation on land owned, rented or used by the household	Score from 1 to 5, where 5 represents a farm with more than 50% natural or semi-natural habitat with at least five species of different heights, woodiness or flowering seasons, and 1 represents absence of natural or semi-natural habitat.	Continuous	No
Climate mitigation	Net greenhouse gas emission score, based on presence/absence and emissions score (from 1 to 5) of a list of management practices pre-rated from high emitting and low carbon storage to low emitting and high carbon storage	Score from 1 to 5, where 1 represents a farm with high emission and low sequestrating practices, and 5 a farm with low emission and high sequestration practices	Continuous	Yes. Validate rating with local experts.
Water	Number of months of the year it is difficult to access enough water for agricultural needs (e.g., growing crops, drinking water for livestock) during a normal year	%	Continuous	No
Energy use	Sustainability of energy use, based on the types of energy used (renewable, non-	Sustainability of energy use with scores from 1 (Non-renewable and externally	Continuous	No

Theme	Main questions	Response options	Response format	Needs localisation
	renewable) and its source (locally produced, or not)	produced) to 5 (Renewable and self-produced)		
Economic				
Income	Total household income in the last 12 months, relative to national average	E.g. 1.2	Continuous	Yes. Specify the local currency
	Stability of the household income	5 - Income is increasing over time. 4 – Income is stable over time. 3 - Income varies little from year to year. 2 - Income varies from year to year. 1 - Income is on a decreasing trend.	Likert scale	No.
Agricultural productivity	Yield gap, calculated based on the harvested produce per unit area (or per animal) for at least the three main crops (or livestock/fish) relative to locally attainable yields	E.g. 0.6	Continuous	Yes. Specify the locally relevant area units, and obtain estimates of locally attainable yields for each crop.
Labour productivity	Number of person hours worked per year, per hectare	E.g. 50 hrs/yr/ha	Continuous	No
Climate resilience	Resilience score based on access to basic services, assets, social networks and adaptive capacity	1-5	Continuous	No
Social				
Diet quality	Household Food Group Diversity score (FGDS), calculated from 24-hr recall of consumption of foods in 16 food groups	Scores from 0 (no diversity) to 10 (high diversity)	Continuous	Yes. Use a country-specific list of foods in each food group from [28].
Farmer agency	Perceived individual level of agency in decision-making regarding food production, trade, consumption and other matters	5- Power and freedom to make all major life decisions. 4- Power and freedom to make many major life decisions. 3- Power and freedom to make some major life decisions. 2- Only a small amount of power and freedom. 1- Almost no power or freedom to make decisions.	Likert scale	No.
Human well-being	Self-perceived level of life satisfaction based on 10 criteria: standard of living; health; life achievements; personal relationships; physical safety; feeling part of the community; economical / nutritional security; amount of free time; local environment; occupation	Scores from 1 (completely dissatisfied to 5 (completely satisfied)	Continuous	No
Land tenure	Likelihood of losing access to land owned, used or rented by the household, within the next 5 years, based on respondent perception of land access security	Scores from 1 (extremely likely) to 5 (extremely unlikely)	Continuous	No
	Proportion of agricultural land used by the household that is owned by household	%	Continuous	No


Holistic Localised Performance Assessment (HOLPA)
Assessment Framework
Context module
Agroecology module
Performance indicators
Agriculture
Economic
Environ-mental
Social
Localization Process
Piloting, local validation and indicator selection

HOLPA
CONTEXT
Location
Motivation to transition
Climate change
Production systems
Farm characteristics
Household characteristics
Respondent characteristics
PERFORMANCE
Crop health
Animal health
Soil health
Nutrient use
Biodiversity
Agrobiodiversity
Climate mitigation
Landscape complexity
Water
Energy use
Income
Agricultural productivity
Labour productivity
Climate resilience
Diet quality
Farmer agency
Human well-being
Land tenure
AGROECOLOGY
Recycling
Input reduction
Soil health
Animal health
Biodiversity
Synergy
Economic diversification
Knowledge and creation
Social values
Fairness
Connectivity
Governance
Participation


Site 1
Site 2
or
Site 2
Site 3