



INITIATIVE ON
Agroecology

Agronomic assessment of co-designed agroecological technologies and trials in Zimbabwe

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Component 1 - Trial Description

Section 1.1- Co-design process

i. Participants

In Zimbabwe, the Agroecology Initiative operates in Wards 2 and 3 of Mbire District and Wards 4 and 27 of Murehwa District (Figures 3-4 and 7-8 below). Stakeholders who were involved in the co-design process included farmers (the majority), representatives of the government (Environmental Management Agency, Forestry Commission, Agricultural Extension Services, District Development Coordinator, Ministry of Women Affairs, Zim Parks, Rural District Council, and Grain Marketing Board), development partners, and local private sector (Figure 1).

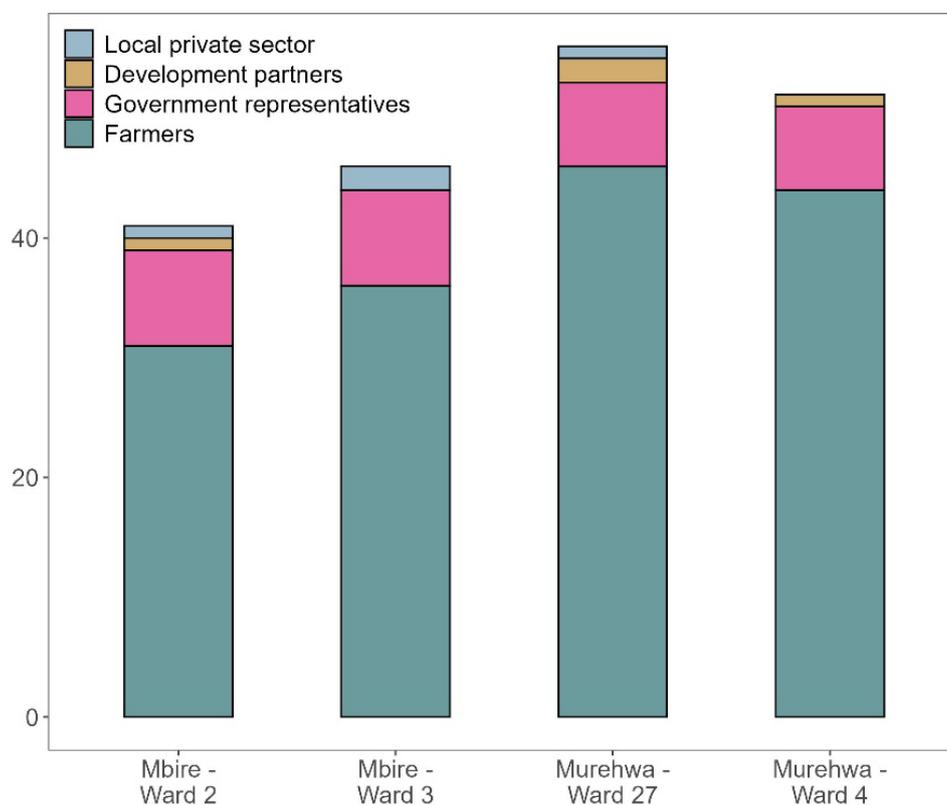


Figure 1: Agroecology Living landscape participants in Mbire and Murehwa involved in the co-design process

ii. Workshops and Activities

Table 1 below summarizes workshops and activities that took place during the co-design process.

Table 1: Description of workshops and activities conducted at National, District, Ward, and ALL level that contributed to the co-design process

Title	Scale	Date	Objective	Output/Outcome
National Consultation Meeting	National	June 2021	<ul style="list-style-type: none"> Identify potential sites for the initiative Identify challenges and opportunities for each site Map ongoing agroecology activities for each site Map potential business partners 	<ul style="list-style-type: none"> Mbire and Murehwa were selected as the project sites Priority value chains were identified Potential business partners were mapped
National Launch Meeting	National	May 2022	<ul style="list-style-type: none"> Introduce the initiative at a national level Present findings from the consultation meeting and the kick-off meetings 	<ul style="list-style-type: none"> Potential agroecological technologies and innovations identified Potential partnerships identified
Mbire Kick-off Meeting	District	May 2022	<ul style="list-style-type: none"> Introduce the initiative to the Mbire community Identify wards where the initiative could operate Identify challenges and opportunities for local food systems Validate priority value chains 	<ul style="list-style-type: none"> Initiative socialized Priority value chains validated Potential interventions identified
Murehwa Kick-off Meeting	District	May 2022	<ul style="list-style-type: none"> Introduce the initiative to the Murehwa community Identify wards where the initiative could operate in Identify challenges and opportunities for local food systems in Murehwa Validate priority value chains 	<ul style="list-style-type: none"> Initiative socialized Potential interventions identified
Participatory Stakeholder Mapping	District	September 2022	<ul style="list-style-type: none"> Participatory stakeholder mapping focusing on agriculture, natural resources management, climate change, access to markets, and social issues (gender and empowerment) 	<ul style="list-style-type: none"> Stakeholders implementing agroecological innovations/activities identified Linkages between stakeholders identified
Mapping and Diagnostics of Existing Platforms	District	October 2022	<ul style="list-style-type: none"> Map platforms related to agriculture, natural resource management, climate change, access 	<ul style="list-style-type: none"> Existing farmer groups and committees mapped

			<p>to market, and social issues (gender and empowerment)</p> <ul style="list-style-type: none"> • Document case studies on stakeholder involvement in past agroecology initiatives in Zimbabwe. • Lay the foundation for establishing ALLs. 	
Context Assessment workshop in Mbire and Murehwa	District	October 2022	<ul style="list-style-type: none"> • Assessment of the current agroecological status and understanding of the socio-economic context in Mbire and Murehwa 	<ul style="list-style-type: none"> • Challenges in Mbire and Murehwa identified • Potential opportunities and areas for synergies for the initiative identified
Mapping of Main Value Chains Workshop in Mbire and Murehwa	District	October 2022	<ul style="list-style-type: none"> • Map the relevant value chains in Mbire and Murehwa that can contribute to an agroecological transition. 	<ul style="list-style-type: none"> • Horticultural crops, poultry (indigenous chickens), livestock (cattle and goats), maize, groundnuts, and sweet potatoes identified in Murehwa • Cotton, livestock (goats and cattle), honey, sorghum, and sesame identified in Mbire.
Establishment of ALLs and Community Visioning for Mbire and Murehwa Districts	ALL	October 2022	<ul style="list-style-type: none"> • Establish four ALLs (2 each in Mbire and Murehwa) • Develop a shared community vision 	<ul style="list-style-type: none"> • ALLs established • Community vision developed
Identification of challenges and opportunities in selected value chains	ALL	November 2022	<ul style="list-style-type: none"> • Identify potential interventions for the 2022/23 season 	<ul style="list-style-type: none"> • Conservation agriculture, mechanization, push-pull, seed fairs, haymaking, and feed formulation identified as promising interventions.
Baseline survey	ALL	November 2022	<ul style="list-style-type: none"> • Gather comprehensive data on current agricultural practices, challenges, and opportunities (including commodities targeted by the value chain) 	<ul style="list-style-type: none"> • Inventory of activities being practiced in Mbire and Murehwa
Monitoring and evaluation	ALL	December 2022	<ul style="list-style-type: none"> • Assess the performance of the co-designed interventions 	<ul style="list-style-type: none"> • Evaluation and redesign of technologies being tested
Farmer feedback workshops	ALL	August 2023	<ul style="list-style-type: none"> • Gather detailed feedback from ALL members after harvesting, focusing on the performance of the tested technologies and identify areas for improvement. 	<ul style="list-style-type: none"> • Three additional treatments identified for testing during the 2023/24 season

iii. Outcomes and Challenges

The co-design process was a multi-year, iterative collaboration within Agroecological Living Landscapes (ALLs) (Figure 2). The initial phase (Year 1) led to the establishment of demonstration plots [addressing, in particular, the biocontrol of major pests, including fall armyworm (Push-Pull), and adaptation to climate change (Conservation Agriculture-CA)], seed fairs (addressing the lack of adapted planting material), and mechanization services (addressing labor constraints, often exacerbated by the adoption of agroecological practices).

In Year 2, challenges were identified for the co-designed technologies through consultation with the ALLs. These were related to production costs, biomass availability for soil mulching in the CA plot, and the need to increase livestock feed. Also, the demonstration plots progressed into a mother-baby plot design, and seed fairs expanded to seed and livestock fairs, emphasizing community-based knowledge sharing. Farmer performance reviews and feedback loops were integral to adapting strategies. This co-design approach promoted the emergence of locally tailored agroecological practices that responded directly to farmers' needs. The process effectively strengthened partnerships, knowledge exchange, and co-learning.

Challenges

The co-design process faced several notable challenges. A major issue was inconsistent representation from the local private sector and development partners across wards, which limited knowledge-sharing opportunities. Challenges identified by the community, such as inadequate infrastructure, limited access to financial services, and market barriers, often exceeded the project's scope and capacity.

The initial co-design process was conducted when community members were still developing their understanding of agroecology. This extended the community buy-in process, requiring substantial awareness-building and capacity development time.

Communication barriers also posed significant challenges, particularly in conveying scientific concepts in locally understandable terms. Translating agroecological knowledge into practical, locally relevant actions required participatory approaches and iterative dialogue, which often slowed decision-making and led to varied levels of understanding among participants. Furthermore, climate variability remained an ongoing challenge, as unpredictable weather patterns affected the testing and implementation of interventions, particularly during the second season of experimentation (2023/24).



Figure 2: Diagrammatic representation of the co-design process for 2022/23 and 2023/24 season wand related outcomes

Section 1.2- Description of practices

Control Treatment:

Name: Conventional Practice

Description:

- Maize/Sorghum¹ as sole crops
- Land preparation through animal-drawn ploughing
- Maize/Sorghum was planted in stations with an interrow spacing of 75 cm and an in-row spacing of 60 cm between them. Three seeds were planted per planting station and thinned to 2 plants after two weeks of emergence.
- 8 g Compound D² fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN³ fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- Weeds were controlled manually with hand-held hoes
- No pest control measures were applied

Agroecological Technology 1:

Name: Push-pull

Description:

- Maize/Sorghum intercropped with cowpea or dry beans under strip-cropping, with *Brachiaria* as a border crop
- Land preparation through animal-drawn ploughing
- Strip cropping of paired rows spaced 50 cm apart, with a space of 130 cm between pairs where the legume is planted. In-row spacing for planting stations of 50 cm for maize/sorghum. Three seeds were planted per planting station and thinned to 2 plants after two weeks of emergence.
- Cowpea/Dry beans planted in between the paired rows of maize/sorghum; 3 rows between pairs, with an in-row spacing of 30 cm (the distance between the last maize/sorghum row and the first cowpea/bean row being 35 cm, as well as the distance between the last cowpea/bean row and the first maize/sorghum row). Three seeds were planted per planting station and thinned to 2 plants after two weeks of emergence.
- 8 g Compound D fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- No fertilizer application to the cowpea/dry bean strips
- Weeds were controlled manually with hand-held hoes
- No pest control measures were applied

Agroecological technology 2:

Name: Conservation Agriculture (Dead Mulch)

Description:

- Maize/Sorghum as the sole crop
- The land was not tilled, but planting basins (15 cm deep and wide) were dug by hand hoes.
- 132 kgs dry grass was applied per plot, resulting in a 10t/ha application rate.

¹ Maize/Sorghum - Maize or Sorghum - Maize was planted in Murehwa and Sorghum was planted in Mbire

² Compound D fertiliser has a N:P:K ratio of 7:14:7 + 8.5% S

³ AN- Ammonium nitrate 34.5%N

- Maize/Sorghum planted in basins, with an interrow spacing of 75 cm and an in-row spacing of 60 cm between basins. Three seeds were planted per basin and thinned to 2 plants after two weeks of emergence
- 8 g Compound D fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- Weeds were controlled manually with hand-held hoes
- No pest control measures were applied

Agroecological technology 3:

Name: Conservation Agriculture (Live Mulch)

Description:

- Maize/sorghum intercropped with velvet bean under strip-cropping
- The land was not tilled, but planting basins (15 cm deep and wide) were dug by hand hoes.
- Strip cropping of paired rows spaced 50 cm apart, with a space of 130 cm between pairs where the legume is planted. In-row spacing for planting basins of 50 cm for maize/sorghum. Three seeds were planted per basin and thinned to 2 plants after two weeks of emergence.
- Velvet bean planted between the paired rows of maize/sorghum with only two rows between pairs, with an in-row spacing of 60 cm (the distance between the last maize/sorghum row and the first velvet bean row being 35 cm, as well as the distance between the last velvet bean row and the first maize/sorghum row). Three seeds were planted per planting station and thinned to 2 plants after two weeks of emergence.
- Velvet bean planting was done three weeks after maize or sorghum planting.
- 8 g Compound D fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- No fertilizer application to the cowpea/dry bean strips
- Weeds were controlled manually with hand-held hoes
- No pest control measures were applied

Agroecological Technology 4:

Name: Biochar

Description:

- Half the plot was planted with maize, and the other half sorghum
- The land was not tilled, but planting basins (15 cm deep and wide) were dug by hand hoes.
- Basins had an interrow spacing of 75 cm and an in-row spacing of 60 cm between. Three seeds of maize and sorghum were planted per planting station and thinned to 2 plants after two weeks of emergence
- 500 g biochar was applied per planting station, resulting in a rate of 11t/ha.
- 8 g Compound D fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- Weeds were controlled manually with hand-held hoes
- No pest control measures were applied

Agroecological Technology 5:

Name: Traditional

Description:

- Maize/sorghum landraces
- Land preparation through animal-drawn ploughing.
- Maize/sorghum planted in stations in a row, with an interrow spacing of 75 cm and an in-row spacing of 60 cm between planting stations. Three seeds were planted per planting station and thinned to 2 plants after two weeks of emergence.
- 8 g Compound D fertilizer was applied per planting station, resulting in a fertilizer rate of 178 kg/ha
- 5 g AN fertilizer was applied per planting station under split application, with the first application 4 weeks after planting and the second application six weeks after planting, resulting in a rate of 111 kg/ha
- Weeds were controlled manually with hand-held hoes
- Traditional/natural pest control measures (river sand, chili, *Lantana camara*, hand picking, ashes, and "blue bush-cherry" - *Maerua decumbens*) were used in the plot.

Section 1.3- Experimental setup

Location:

The District of Murehwa (17°38'57"S, 31°46'43"E, 1400 m.a.s.l.) is located in Central Zimbabwe, in Mashonaland East Province, while the district of Mbire (16°09'49"S, 30°34'40"E, 300 m.a.s.l.) is located in Northern Zimbabwe, in Mashonaland Central Province (Figures 3 and 4).

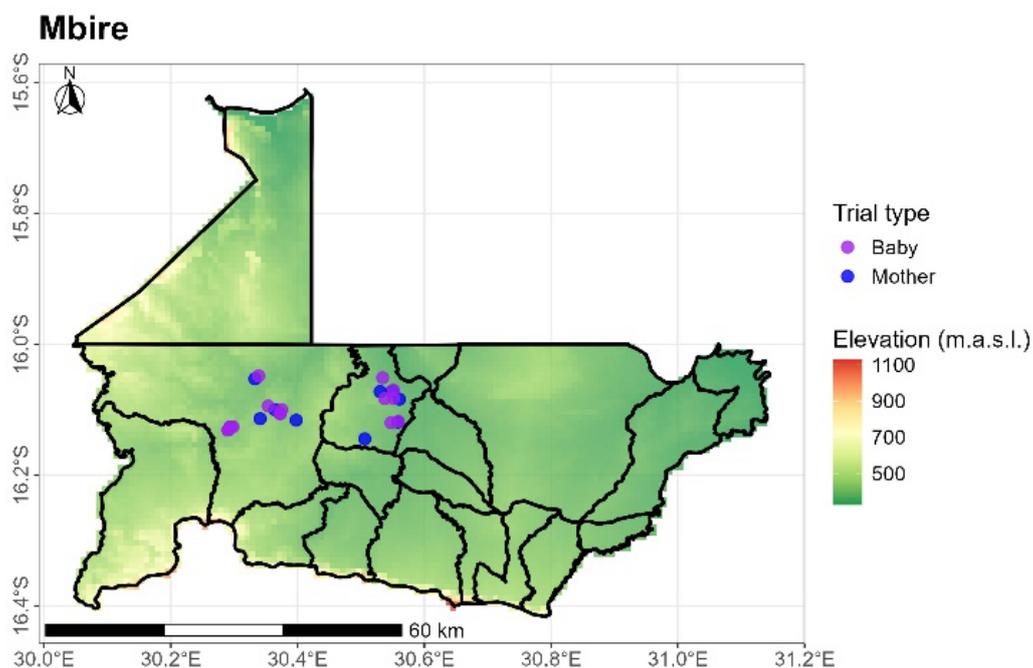


Figure 3: Elevation map of Mbire district with trial sites

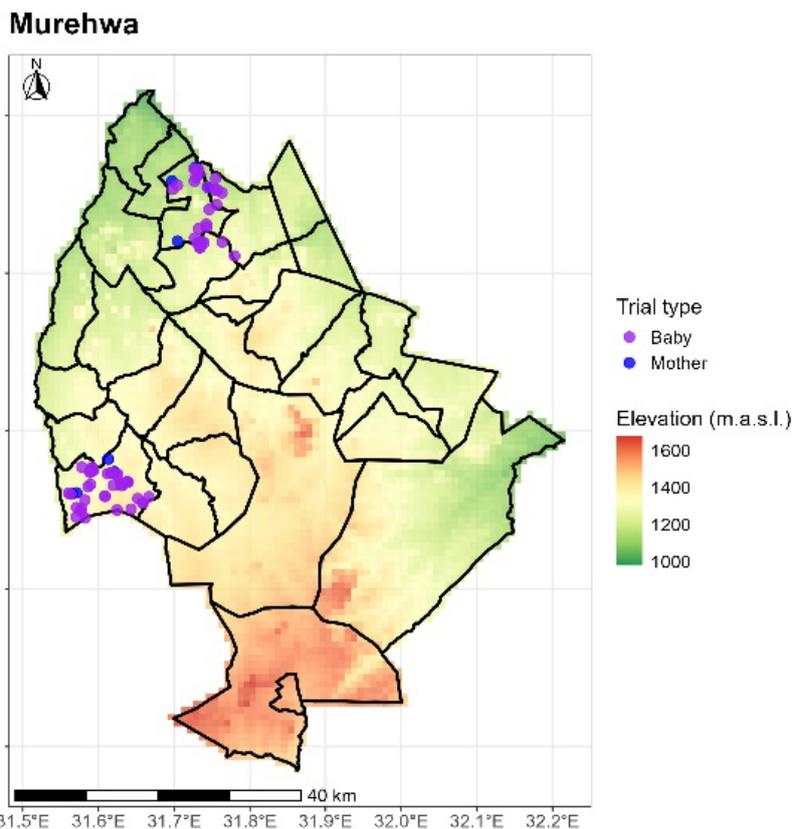


Figure 4: Elevation map of Murehwa district with trial sites

Climatic and weather conditions:

Mbire receives an average (1991-2000 average) of about 635 mm of rainfall per year, between November and March, with a mean maximum temperature (1991-2000 average) of 33°C (Figure 5). Murehwa receives an average (1991-2000 average) of about 875 mm of rainfall per year, mainly between November and March, with a mean maximum temperature (1991-2000 average) of 27°C (Figure 6).

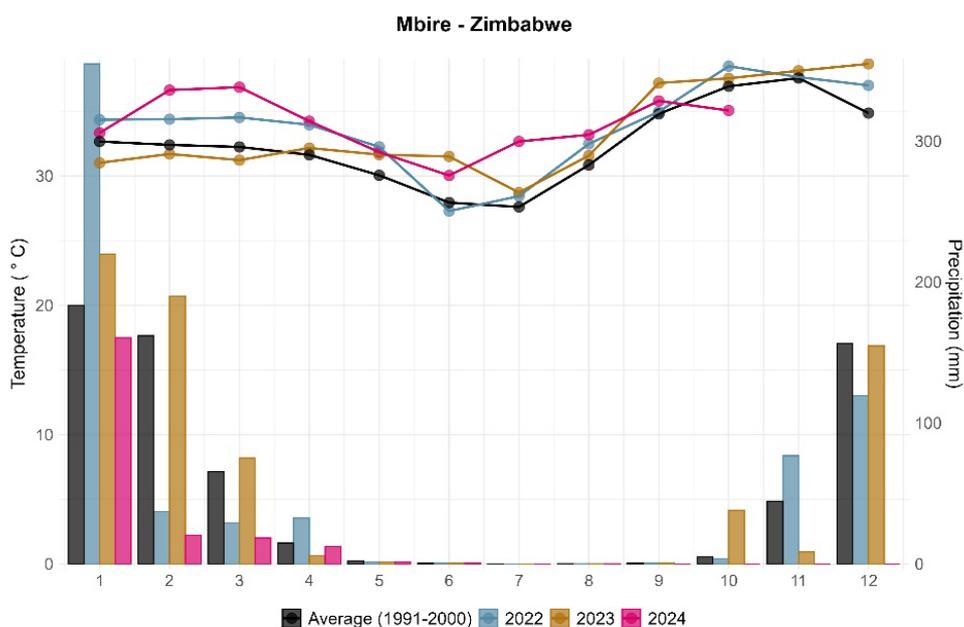


Figure 5: Climograph for the ALL of Mbire, Zimbabwe, comparing maximum temperature and monthly rainfall for 1991-2000, 2022, 2023, and 2024 (data source: <https://app.climateengine.org>).

In both Mbire and Murehwa, the 2022/23 season (first season of experimentation, with the establishment in November) was average, but the 2023/24 season was dry compared to the long-term (1990-2000) average, with in particular an unusually dry February-March period in both District (Figures 3 and 4). Maximum temperatures were also several degrees above long-term average in both districts during that period. Due to an El Niño event, this pattern has had severe implications for the performance of the trials during the second season of investigation (see below).

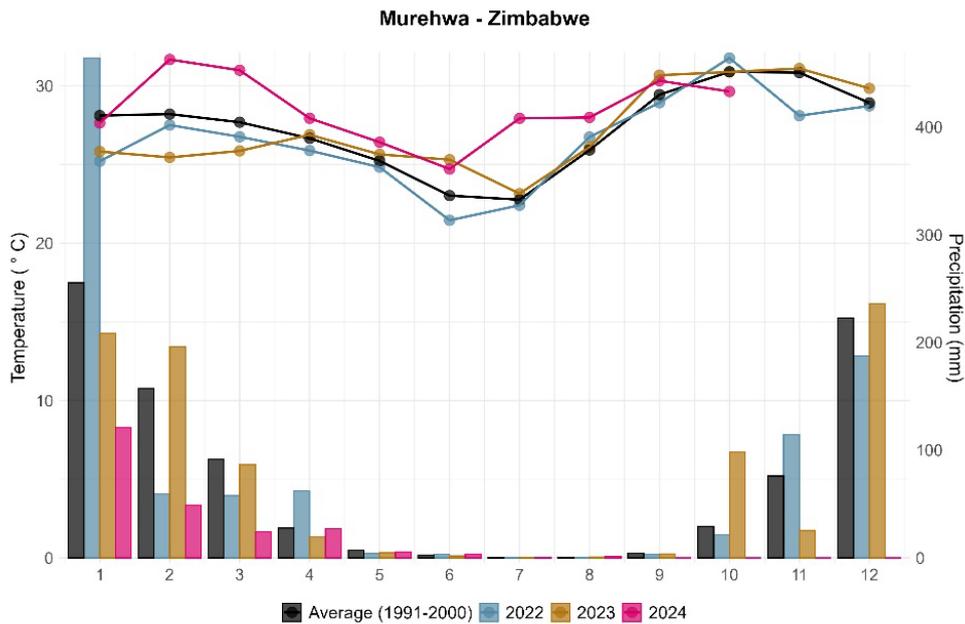


Figure 6: Climograph for the ALL of Murehwa, Zimbabwe, comparing maximum temperature and monthly rainfall for 1991-2000, 2022, 2023, and 2024 (data source: <https://app.climateengine.org>).

Landscape description

Land slope: flat(0-2%) to gentle(3-5%) in both sites (Figures 3 and 4)

Soil texture class: sandy loam and silt loam soils, with cases of loam soils in both sites (Figures 7 and 8).

Trial setup

Ten on-farm trials were established in each site, with each trial having three non-replicated treatments during the first season of experimentation (2022/23 season) and six during the second season of experimentation (2023/24). The three treatments compared during the first season were conventional practices, conservation agriculture (with "dead mulch"), and push-pull. Biochar, traditional practices, and conservation agriculture with live mulch were added in the second season. Performances were evaluated on productivity, rainwater use efficiency, and pest biocontrol. The plots were 6 m wide and 24 m long (Figures 11 and 12). Trials were established in mid-December 2022 and are planned to last until March 2025.

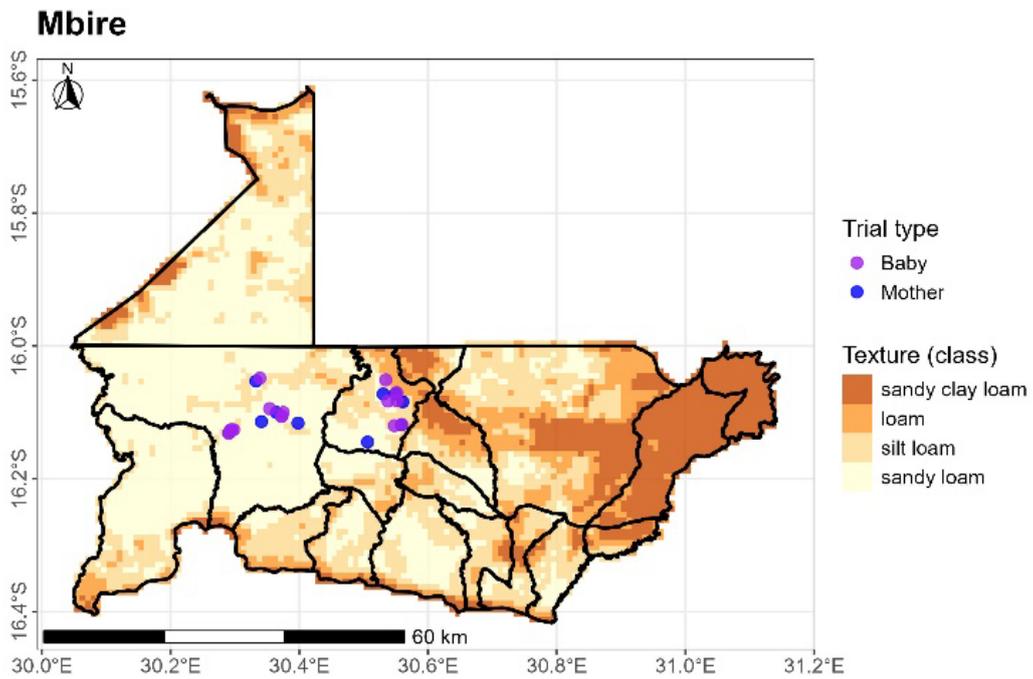


Figure 7: Soil texture class map of Mbire district with trial sites

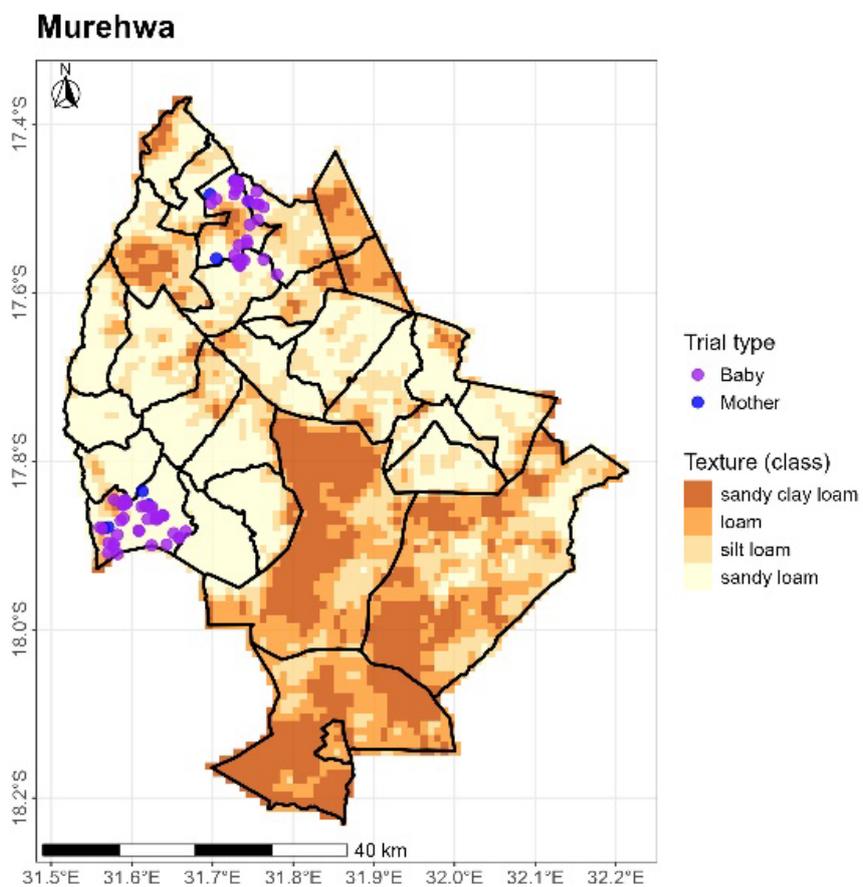


Figure 8: Soil texture class map of Murehwa district with trial sites

In 2023, following the completion of the first cycle of mother demonstration trials, 83 farmers – 64 in Murehwa and 19 in Mbire – within the ALLs selected a minimum of two treatments from the mother trials for adoption and adaptation in their baby fields. In Mbire, most farmers opted for conservation agriculture (with "dead mulch"), followed by push-pull and conventional practices (Figure 9). In Murehwa, most farmers chose conventional practices, followed by push-pull and conservation agriculture (with "dead mulch") (Figure 9). In these baby trials, farmers adhered to the original plot size and spacing used in the mother trials but were free to modify specific practices, including tillage methods, pest control strategies (Figure 10), and soil fertility management. All field activities and management practices were documented. These baby trials were established mid-December 2023 and will last until March 2025.

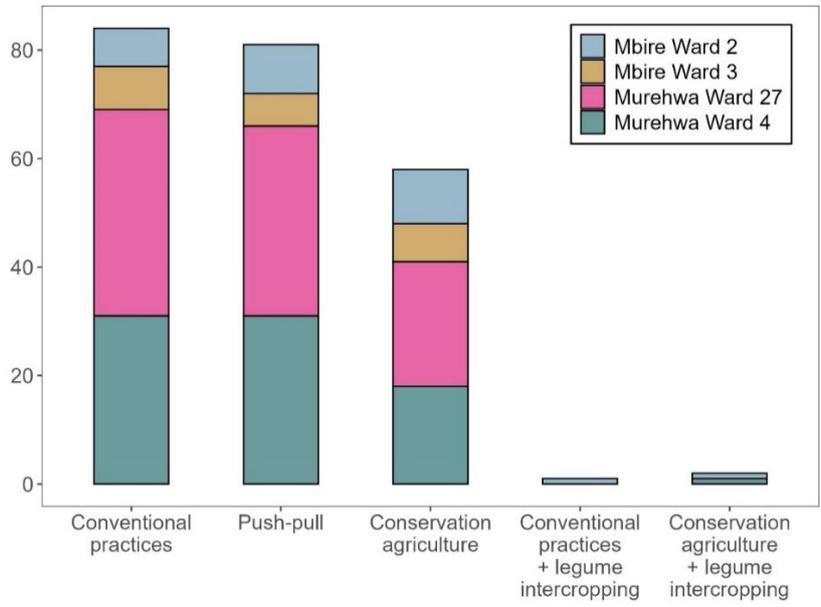


Figure 9: Treatments selected in the baby trials of the 4 ALLs in Mbire and Murehwa district (More than one treatment was selected per trial)

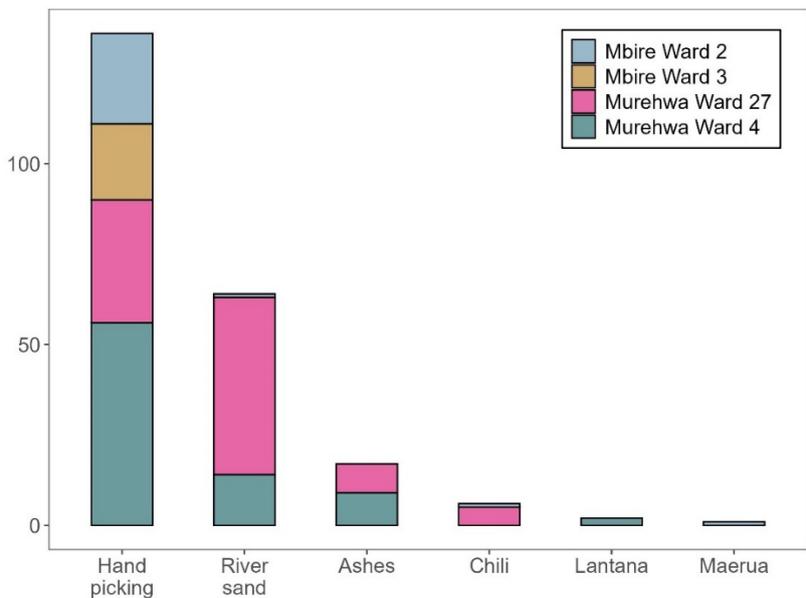


Figure 10: Pest control strategies used in the baby trials of the 4 ALLs in Mbire and Murehwa (more than one control strategy could be used in a trial, but the same strategy was used across the different treatments of the same trial)

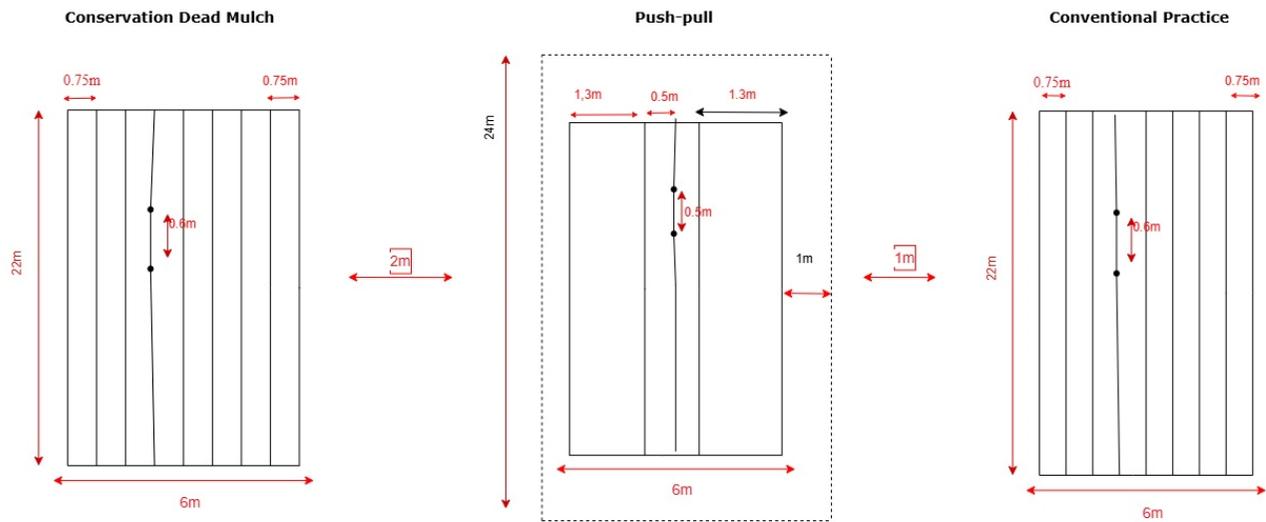


Figure 11: 2022/23 season demo trial plots layout

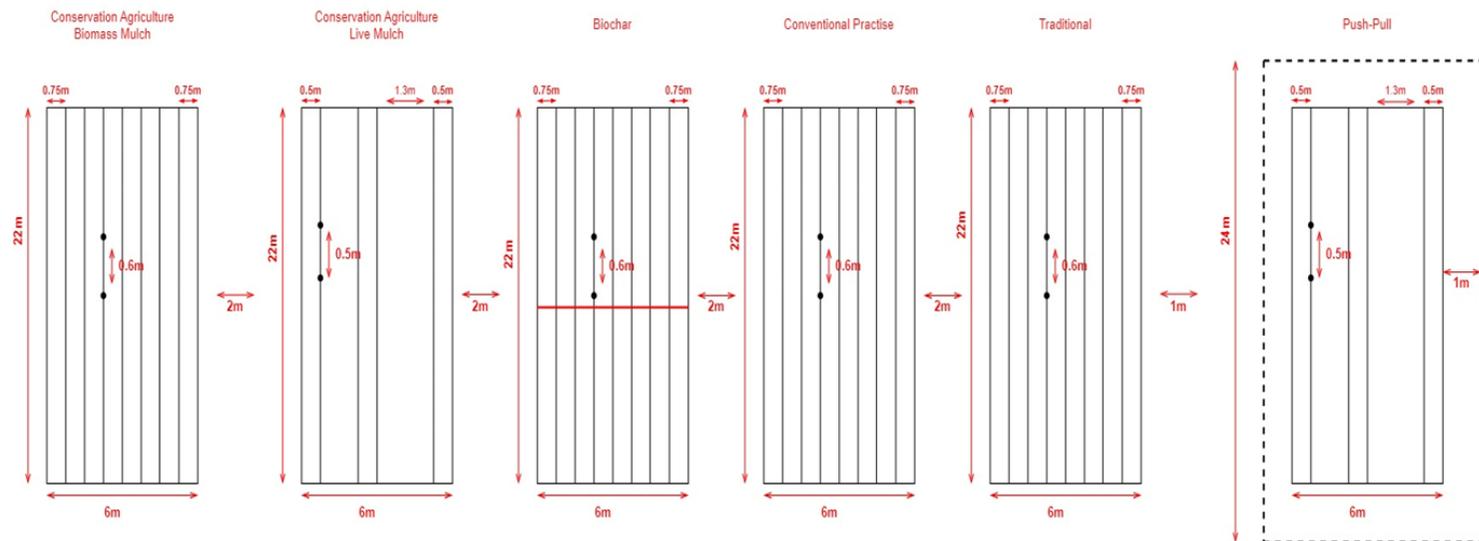


Figure 12: 2023/24 season demo trial plots layout

Table 2: Table of measurements developed during the trial

Variable	Units	Methodology	Frequency
Severity of damage due to armored cricket	Scale (1 - 9)	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were assessed for damage severity. Damage due to armored cricket was rated on a scale from 1 to 9, with 1 indicating no observable damage and 9 representing the highest degree of damage. Visual aids were used to guide and standardize severity scoring.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Prevalence of damage due to armored cricket	%	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were selected for assessment. The number of plants displaying leaf damage due to armored cricket was counted.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Severity of damage due to fall armyworm	Scale (1 - 9)	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were assessed for damage severity. Damage due to fall armyworm was rated on a scale from 1 to 9, with 1 indicating no observable damage and 9 representing the highest degree of damage. Visual aids were used to guide and standardize severity scoring.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Prevalence of damage due to fall armyworm	%	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were selected for assessment. The number of plants displaying leaf damage due to fall armyworm was counted.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Severity of damage due to maize stalk borer	Scale (1 - 9)	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were assessed for damage severity. Damage due to maize stalk borer was rated on a scale from 1 to 9, with 1 indicating no observable damage and 9 representing the highest damage. Visual aids were used to guide and standardize severity scoring.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Prevalence of damage due to maize stalk borer	%	Sampling was conducted using a W-shaped pattern, with five sampling points per plot. At each point, ten plants were selected for assessment. The number of plants displaying leaf damage due to maize stalk borer was counted.	Vegetative and flowering stages during the 2022/23 season and vegetative stage during the 2023/24 season
Rating performance of tested technologies	Scale (1 - 9)	A participatory rating was conducted, and farmers were divided into four groups based on age and gender: young males/females (18-35 years) and older males/females (36 years and above). In 2023, the evaluation focused on several key performance indicators: grain and biomass yields, input use efficiency, labor use efficiency, pest and disease biocontrol, drought resilience, and soil conservation. In 2024, three additional indicators – water use efficiency, production costs, and soil fertility – were added	During farmer field days
Ranking performance of tested technologies	Rank (1 - 6)	A participatory ranking of the technologies (from the first to the last) was conducted, and farmers were divided into four groups based on age and gender: young males/females (18-35 years) and older males/females (36 years and above). In 2023, the evaluation focused on several key performance indicators: grain and biomass yields, input use efficiency, labor use efficiency, pest and disease biocontrol, drought resilience, and soil conservation. In 2024, three additional indicators – water use efficiency, production costs, and soil fertility – were added	During farmer field days

Grain yield	t/ha	After counting the number of plants, a net plot discarding the first two rows and the last two planting stations was harvested. Both stover and grain were weighed. A randomly selected humidity sample of 10 plants was collected and oven-dried to determine moisture content. The subsample was then threshed to determine the harvest index.	At crop maturity
Stover yield	t/ha	After counting the number of plants, a net plot discarding the first two and last two rows and the first two planting stations was harvested. Both stover and grain were weighed. A randomly selected humidity sample of 10 plants was collected and oven-dried to determine moisture content. The subsample was then threshed to determine the harvest index.	At crop maturity

Component 2- Agronomic performance

In what follows, predicted values obtained from linear mixed models, rather than raw data, are presented to avoid competition with other publications prepared by the country team. Codes (and notebooks in html format) for the various analyses conducted and visualizations produced are available here: <https://github.com/FBaudron/AE-I-Agronomy-Assessment/tree/main/Zimbabwe>.

In all linear mixed models used, the farm was used as a random factor, and the district as a fixed factor. In analyses across the two seasons of observation, season was used as a fixed factor, and an interaction between season and treatment was considered. A Gaussian distribution was used when using grain and stover yields as response variables, a Poisson distribution when using pest damage severity and rating, and a binomial distribution when using pest damage prevalence.

Section 2.1 – Productivity dimension

Gross productivity:

During the two seasons under observation and during Season 1, there were no statistically significant differences in grain yield and stover yield between the control (conventional practice) and the agroecological treatments (conservation agriculture and push-pull, the only two treatments tested during both seasons) in the mother trials. Predicted grain yields are between 1.8 and 2.2 t/ha for the pooled data, and 1.7 to 1.8 t/ha for Season 1 (Figures 13). Predicted stover yields are between 3.9 and 4.4 t/ha for the pooled data and between 3.7 and 4.3 for Season 1 (Figure 14).

During Season 2, grain yield and stover yield of all agroecological treatments except conservation agriculture were statistically lower than those of the control in the mother trials (Figures 13 and 14). The predicted grain yield is 0.8 t/ha for conventional practices, 0.7 t/ha for conservation agriculture, and between 0.5 and 0.6 t/ha for all other agroecological treatments. The predicted stover yield is 3.0 t/ha for conventional practices, 2.6 t/ha for conservation agriculture, and between 0.9 and 2.2 t/ha for all other agroecological treatments.

In the baby trials, stover yields of both agroecological treatments were statistically lower than stover yield in the control (there was no grain yield in baby trials in Season 2) (Figure 15). The predicted stover yield is 2.8 t/ha for conventional practices and 1.3 t/ha for conservation agriculture and push-pull.

Codes for the analysis of the performance of the mother trials' data can be found here: <https://github.com/FBaudron/AE-I-Agronomy-Assessment/blob/main/Zimbabwe/2.%20Zimbabwe%20Mothers%20Harvest.R>, and for the baby trials data here: <https://github.com/FBaudron/AE-I-Agronomy-Assessment/blob/main/Zimbabwe/5.%20Zimbabwe%20Baby.R>.

Codes for the analysis of the performance of the baby trials can be found here: <https://github.com/FBaudron/AE-I-Agronomy-Assessment/blob/main/Zimbabwe/4.%20Zimbabwe%20Rating.R>

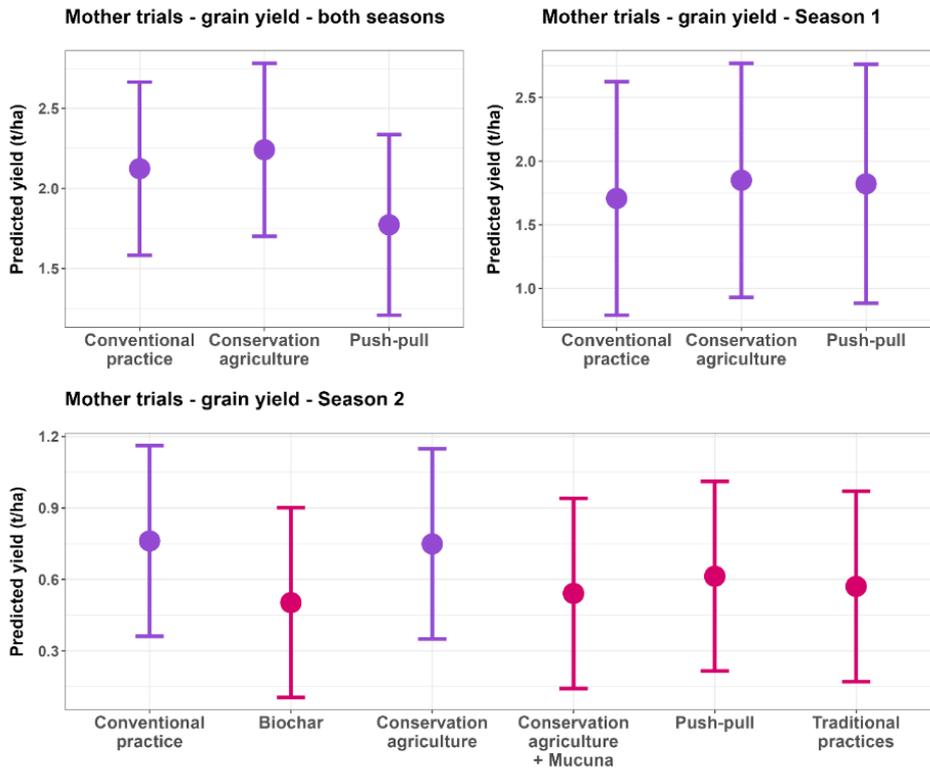


Figure 13: Predicted grain yields - from mixed models' outputs - of the different treatments tested in 'mother trials' for both seasons, Season 1 (2022/23) and Season 2 (2023/24). Dots represent predicted values, and whiskers the 95% confidence interval. The predicted value of treatment differs significantly from the predicted value of the conventional practice (control) if the corresponding dot and whiskers are colored in pink (no significant difference if colored in purple).

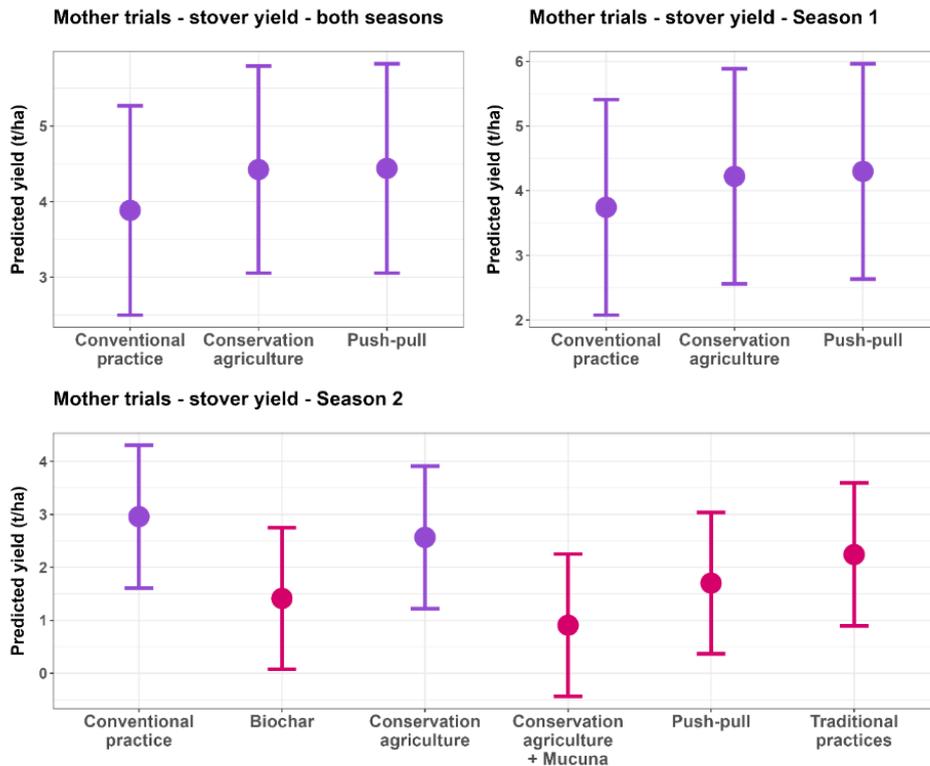


Figure 14: Predicted stover yields – from mixed models' outputs – of the different treatments tested in 'mother trials' for both seasons, Season 1 (2022/23) and Season 2 (2023/24). Dots represent predicted values, and whiskers the 95% confidence interval. The predicted value of treatment differs significantly from the predicted value of the conventional practice (control) if the corresponding dot and whiskers are colored in pink (no significant difference if colored in purple).

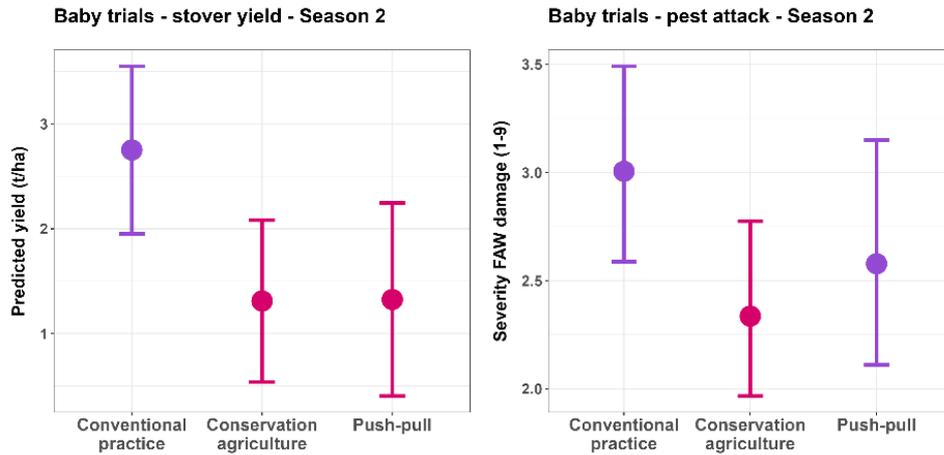


Figure 15: Predicted stover yields and severities from fall armyworm (FAW) damage – from mixed models' outputs – of the different treatments tested in 'baby trials' in Season 2 (2023/24). Dots represent predicted values, and whiskers the 95% confidence interval. The predicted treatment value differs significantly from the predicted value of the conventional practice (control) if the corresponding dot and whiskers are colored in pink (no significant difference if colored in purple).

Section 2.2 – Technical – agronomic dimension

Pest and disease pressure

During the two seasons under observation and during Season 1, the severity of damage due to fall armyworm in mother trials was significantly lower in the push-pull treatment compared to the control (Figure 16). The predicted severity for the pooled data was 2.2 for conventional practices and 1.8 for push-pull. The predicted severity during Season 1 was 2.7 for conventional practices and 2.2 for push-pull. No differences were observed between conservation agriculture and the control during the two seasons under observation and during Season 1, and between any treatments and the control during Season 2 (Figure 16).

In baby trials (during Season 2), compared to conventional practices, the severity of damage due to fall armyworm was significantly lower for conservation agriculture but not for push-pull. The predicted severity was 3.0 for conventional practices and 2.3 for conservation agriculture.

Codes for the analysis of pest damage severity in mother trials data can be found here: <https://github.com/FBaudron/AE-I-Agronomy-Assessment/blob/main/Zimbabwe/3.%20Zimbabwe%20Mother%20Pests.R>.

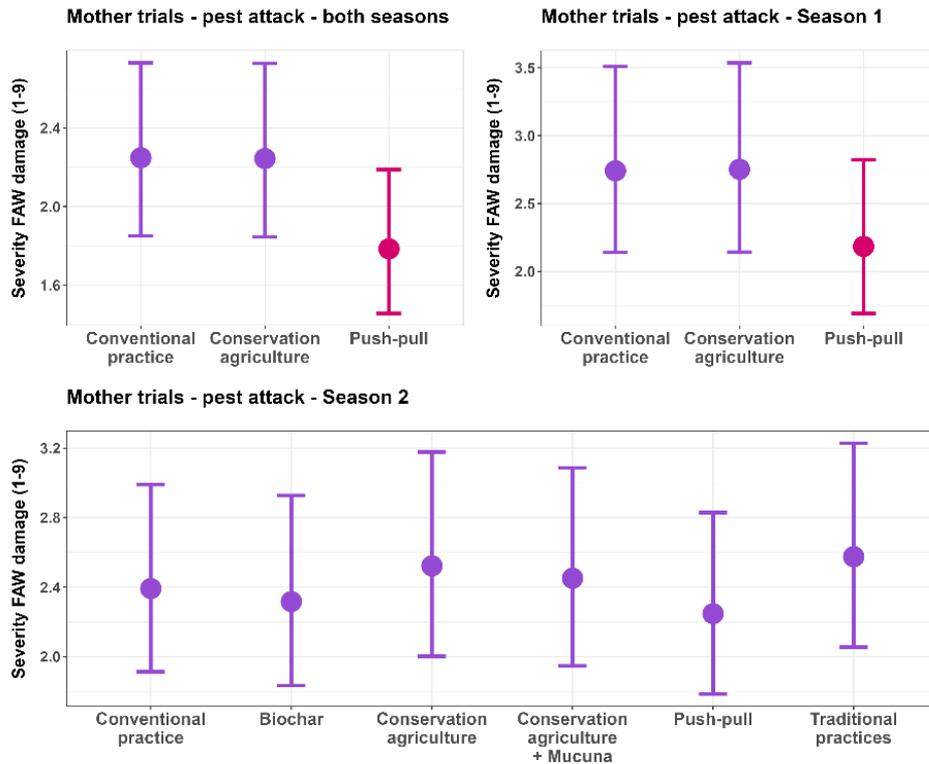


Figure 16: Predicted severities from fall armyworm (FAW) damage – from mixed models' outputs – of the different treatments tested in 'mother trials' for both seasons, Season 1 (2022/23) and Season 2 (2023/24). Dots represent predicted values, and whiskers the 95% confidence interval. The predicted value of treatment differs significantly from the predicted value of the conventional practice (control) if the corresponding dot and whiskers are colored in pink (no significant difference if colored in purple).

Section 2.3 – Rating

Compared to conventional practice, conservation agriculture was rated significantly higher than conventional practices on all dimensions except grain yield. In contrast, push-pull was rated significantly higher than conventional practices on all dimensions except grain yield, stover yield, and drought tolerance (Figure 17). There were no statistically significant differences in rating between age groups for pest and disease control, drought tolerance, and soil conservation.

However, males 35 years or older tended to rate grain yield and biomass yield lower than other age groups. Females 35 years old or older tended to rate input reduction higher than other age groups. Males 18 to 35 years old and males of 35 years old or more tended to rate labor higher than other age groups.

Component 3- Agroecology assessment

A holistic assessment of the performance of the different treatments tested in on-farm trials was conducted in both Murehwa and Mbire in November 2024, following the Tool for Agroecology Performance Evaluation (TAPE) (see <https://www.fao.org/agroecology/tools-tape/en/> for full details of the methodology) (Figures 18 and 19).

Scores (0-4) are presented in Table 3, and aggregate values – expressed in % and averaged along the 10 elements – are presented in Figures 20 and 21.

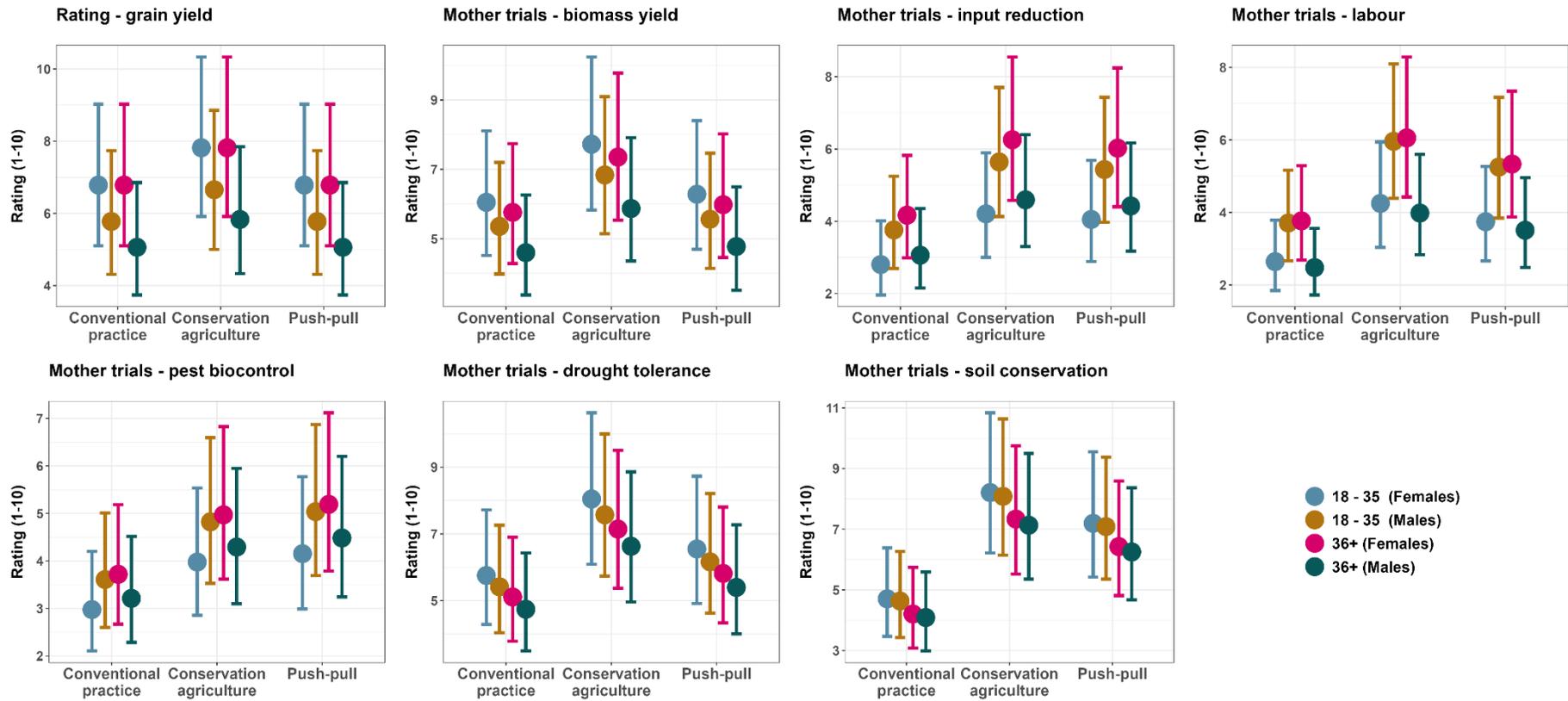


Figure 17: Rating (on a scale from 1 to 10) of three treatments tested across both seasons on seven dimensions: grain yield, biomass yield, input reduction, labor reduction, pest biocontrol, drought tolerance, and soil conservation, by females aged 18 to 35, males aged 18 to 35, females aged 36 or more and males aged 36 or more.

Table 3: Results of the TAPE assessment in Murehwa and Mbire

Element	Category	Mbire						Murehwa					
		Traditional	CA Live Mulch	Biochar	CA dead Mulch	Push-pull	Conventional	Traditional	CA Live Mulch	Biochar	CA dead Mulch	Push-pull	Conventional
Diversity	Crops	1	2	2	1	2	1	0	2	2	0	2	0
Diversity	Animals	0	0	0	0	0	0	0	0	0	0	0	0
Diversity	Trees	0	0	0	0	0	0	0	0	0	0	0	0
Diversity	Activities	0	1	1	0	1	0	0	1	1	1	2	0
Synergies	Livestock-crops-others	2	3	2	2	3	2	2	2	3	2	4	1
Synergies	Soil Management	0	0	0	1	0	0	0	3	0	3	3	0
Synergies	Trees	0	0	0	0	0	0	0	0	0	0	0	0
Synergies	Conectivity	0	2	1	1	3	0	0	2	2	2	3	0
Efficiency	External Inputs	3	0	2	1	0	0	2	0	2	1	0	0
Efficiency	Soil Fertility	3	0	2	1	2	0	0	0	1	0	0	0
Efficiency	Pest and diseases	4	3	3	3	4	3	4	3	3	3	4	3
Efficiency	Productivity	2	2	2	4	2	4	0	0	1	2	3	0
Recycling	Biomass	4	4	4	4	4	4	4	4	4	4	4	4
Recycling	Water	0	2	3	3	2	0	0	2	3	2	2	0
Recycling	Seeds and Races	4	0	0	0	0	0	4	0	0	0	0	0
Recycling	Energy	0	0	0	0	0	0	0	0	0	0	0	0
Resilience	Resilience	1	2	1	4	1	0	1	2	1	2	1	0
Resilience	Mechanism	2	2	2	2	2	2	2	2	2	2	2	2
Resilience	Environmental resilience	1	1	1	1	1	1	2	2	2	2	2	0
Culture and food traditions	Diets	2	2	2	2	2	2	2	2	2	2	2	1

Culture and food traditions	Traditions	4	3	3	3	0	0	3	2	3	2	0	2
Culture and food traditions	Local breeds and varieties	4	0	0	0	0	0	3	0	0	0	0	0
Co-creation and knowledge exchange	Horizontal exchange	4	4	4	4	4	4	3	3	3	3	3	3
Co-creation and knowledge exchange	Sharing knowledge	3	3	3	3	3	3	2	2	2	2	2	2
Co-creation and knowledge exchange	Growers participation	3	3	3	3	3	3	3	3	3	3	3	3
Human and social values	Women	3	3	3	3	3	3	3	3	3	3	3	3
Human and social values	Work	3	3	3	3	3	3	3	3	3	3	3	3
Human and social values	Migration	1	1	1	1	1	1	1	1	1	1	1	1
Human and social values	Animal welfare	0	0	0	0	0	0	0	0	0	0	0	0
Circular economy and solidarity	Local markets	3	3	3	3	3	3	2	2	2	2	2	2
Circular economy and solidarity	Networks	0	0	0	0	0	0	0	0	0	0	0	0
Circular economy and solidarity	Local food system	1	1	1	1	1	1	3	3	3	3	3	3
Responsible governance	Empowerment	0	0	0	0	0	0	0	0	0	0	0	0
Responsible governance	Organizations	0	0	0	0	0	0	0	0	0	0	0	0
Responsible governance	Growers participation	2	2	2	2	2	2	0	0	0	0	0	0



Figure 18: TAPE assessment in Mbire



Figure 19: TAPE assessment in Murehwa

In both Mbire and Murehwa, scores are generally low across all dimensions, illustrating room to further accompany local farmers in their agroecological transition through co-creation of innovations. Across sites, conventional practices scored lowest on all dimensions (except 'Culture and food' in Murehwa), demonstrating that the agroecological technologies tested are contributing to the agroecological transition of the systems considered, and are well adapted to the needs of farmers.

Traditional practices scored the highest amongst treatments in 'Recycling' and 'Culture and food' in both sites, mainly due to the use of local- self-produced - seeds. Traditional practices also scored the highest in 'Efficiency' in Mbire, due to the use of inputs - seeds, organic amendments, biopesticides - available locally. Push-pull scored the highest on 'Synergy' in both sites, as the practice is based on *Brachiaria*, which produce a high quality feed, while maize/sorghum residues and bean/cowpea residues can be used as feed as well. CA with dead mulch scored the highest on 'Resilience' in both sites, mainly due to the ability of that treatment to harvest rainwater.

Treatments received the same scores for 'Circular economy and solidarity', 'Human and social values', 'Co-creation and knowledge exchange' and 'Responsible governance'. That score is high for 'Co-creation and knowledge exchange', as the trials allow horizontal creation and transfer of knowledge and good practices and access to agroecological knowledge. The initiative (beyond the trials) also encouraged participation in producer networks and other networks.

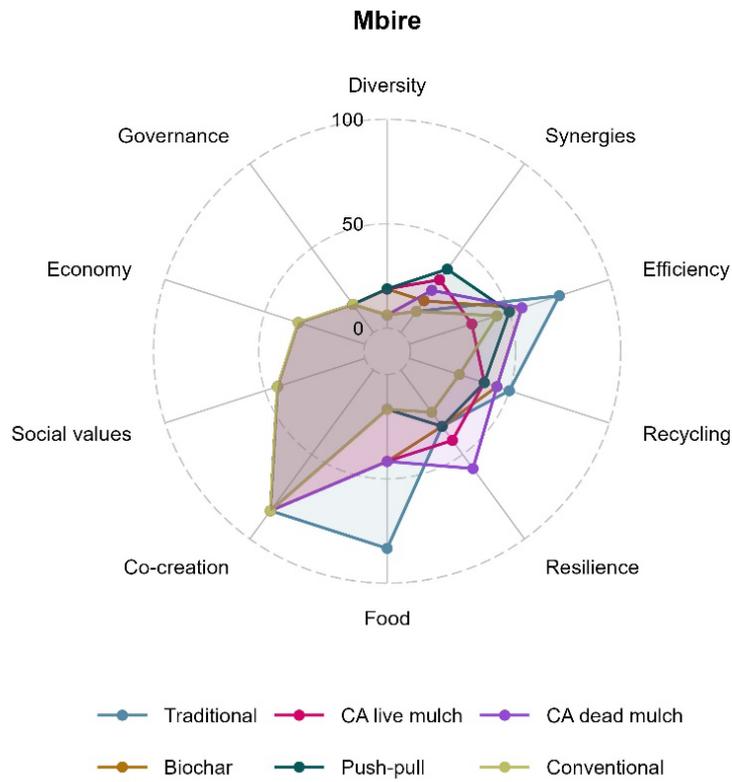


Figure 20: Comparative assessment of the six treatments in Mbire, using the Tool for Agroecology Performance Evaluation (TAPE), following Mottet et al. 2020.

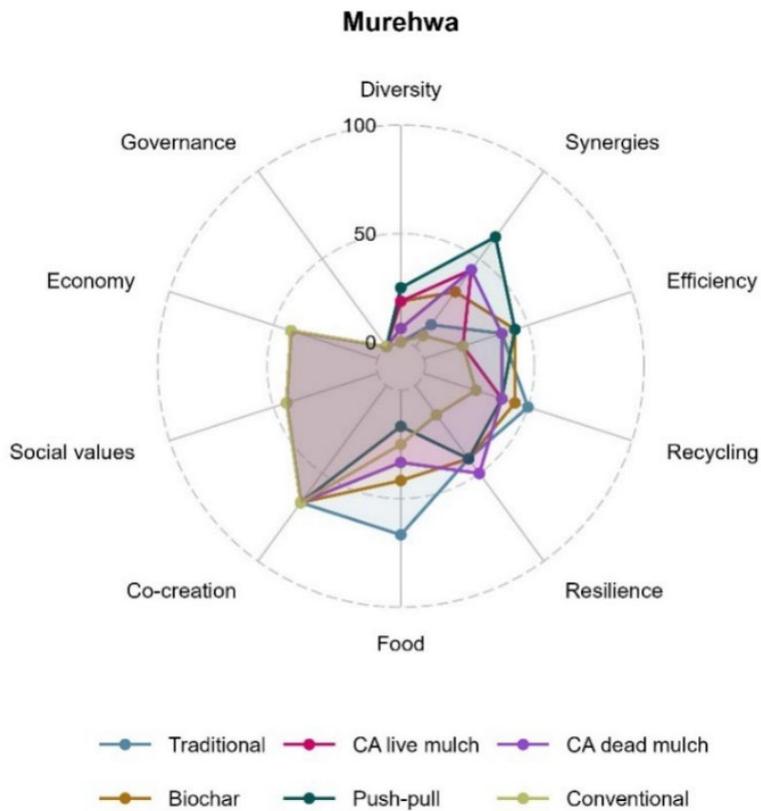


Figure 21: Comparative assessment of the six treatments in Murehwa, using the Tool for Agroecology Performance Evaluation (TAPE), following Mottet et al. 2020.

Recommendations

The tested technologies appear to make sense regarding agronomic performance (though the biochar treatment may need to be adjusted) and in terms of farmer assessment. Although none of the agroecological technologies led to higher productivity than conventional practices, their productivity was also not lower than conventional practices (at least in mother trials). This would suggest that the technologies will not result in significant yield penalties and could potentially replace conventional practices.

Push-pull appears effective in controlling fall armyworm (in mother trials and for the pooled data and Season 1).

During Season 2, which was marked by a severe drought, conservation agriculture secured yield similar to conventional practices, but yields were significantly lower for all other agroecological treatments. In crop associations (push-pull and in conservation agriculture with live mulch), competition for water is exacerbated during dry years. During such years – which can be anticipated by weather forecasts – these treatments may need to be adjusted to minimize inherent resource competition or discouraged. The team may also need to propose alternative technologies (e.g., a combination of water-harvesting technologies and drought and heat-tolerant varieties) during these seasons receiving below-average rainfall.

Conservation agriculture and push-pull performed significantly less in baby trials than in mother trials. It would be interesting to understand why that is, i.e., what adaptations in baby trials lead to lower performance. The data collected so far didn't allow us to conduct such an analysis.

Overall, we feel the team could perhaps make measurements in fewer trials but have more frequent and/or in-depth measurements. For instance, measuring pest incidence and severity more than once per season appears crucial. Tracking soil moisture in a few trials would also be very informative in order to better understand the impact of different technologies on water use efficiency (particularly during dry years). Collecting data on costs, including labor, would also be interesting in a subset of trials. From the data collected on pests, the team should concentrate on fall armyworm and drop measurements on other pests, as no pattern is emerging. The impact of biopesticide on fall armyworm is unclear from the data collected, which may warrant a specific study (which may be a lab study, perhaps through a master student; studies exist on the use of *Lantana* as a biopesticide, but none on *Maerua*, to the best of our knowledge)

We would also recommend the team be more purposive in selecting farms hosting trials to maximize the utility of the information collected. Geographic data (many open-access rasters) could be used for that. The baseline data (typology) collected by the team provides another opportunity to guide the selection of farms.

Finally, the rating of technologies conducted by the team suggests that different age and gender groups may value different performance domains, perhaps calling for different co-design processes targeting different social groups.

NB -The WP1 global team made the above recommendations to the country team

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