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► To cite this version:

Vimbai Gobvu, Sharai Ncube, Venancio E. Imbayarwo-Chikosi, Robin Bourgeois, Prisca H. Mugabe, et al.. Preferred livestock interventions for small-scale livestock farmers in the Great Limpopo Transfrontier Conservation Area: a demand-driven and systemic approach. 2023. hal-04060712v2

HAL Id: hal-04060712

<https://hal.science/hal-04060712v2>

Preprint submitted on 2 May 2023

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1 **Preferred livestock interventions for small-scale livestock farmers in the Great Limpopo**
2 **Transfrontier Conservation Area: a demand-driven and systemic approach**

3
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19

20 **Abstract**

21 In southern Africa, residents of Transfrontier Conservation Areas practice small-scale farming in semi-arid
22 environments constrained by the presence of protected areas and extensive wildlife/livestock/human
23 interfaces that come with conflicts and opportunities. Under these contexts, livestock production aims at
24 supporting local livelihoods despite the harsh semi-arid environment and conflicts with wildlife. In order
25 to promote local development and the well-being of TFCA residents, prioritization of livestock
26 interventions adapted to the local context is needed. The objective of this study was to explore a
27 methodology to list demand-driven interventions for livestock production (cattle, small ruminants and
28 chicken) in a communal land in Zimbabwe. This study used the outputs of an anticipatory scenario-building
29 workshop and individual questionnaires to establish possible and desired livestock interventions by local
30 stakeholders. Results from both the co-elaborative scenario building workshops and the questionnaire
31 survey had participants preferring almost the same interventions that were: restocking herds with breeds
32 adapted to local production; training in livestock practices and production; support to marketing; feed
33 development and value addition; loan schemes to invest in livestock housing and stockfeeds; and finally,
34 animal health interventions to reduce the heavy disease burden. The individual questionnaire data specified
35 preferred interventions for each domestic species. These demand-driven interventions provide a basis for
36 future development projects in the area and avoid top-down approaches by development agencies that fail
37 to address local needs and lack appropriation by local stakeholders necessary for the sustainability of the
38 interventions.
39

40 **Keywords:** Livestock production, small-scale farming, scenario planning, participatory approach, bottom-
41 up approach, Transfrontier Conservation Area

42 **1. Introduction**

43 Mixed crop and livestock systems in southern Africa are the predominant form of agriculture and
44 source of income, and produce more than 80% of food in the region (Tui et al., 2021). Extensive
45 Livestock production systems (LPS) in sub-Saharan Africa are challenged by decreasing rangeland
46 sizes, poor-quality livestock feed, diseases and pests (Mupangwa & Thierfelder, 2014). Small-
47 scale LPS are also characterized by constrained operational environment such as limited access to
48 markets and veterinary services and negative impacts of climate such as unpredictable and variable
49 rainfall and worsening droughts (Oduniyi et al., 2020; Mogomotsi et al., 2020).

50 Livestock production interventions must be informed by the farmer needs as well as prevailing
51 state and conditions of livestock production. For instance, changes in land use patterns following
52 the land reform of the early 2000s have influenced livestock production patterns across Zimbabwe,
53 whereby the national livestock herd sizes declined by about 20% for beef, over 83% for dairy, and
54 26 and 25% for pigs and small ruminants respectively. The productivity of smallholder cattle herds
55 remains very low, with average calving rates of about 45% against a potential of 60%, and off-
56 take rates of about 6% against a recommended 20% (GoZ, 2018). The Zimbabwe National
57 Agriculture Policy Framework calls for the formulation of interventions that directly respond to
58 the local people's needs and enhance the flow of investments that are critical to sustaining the
59 growth of the agricultural sector with a decided focus on increasing agricultural productivity and
60 production (GoZ, 2018). Successful transformation of the smallholder livestock sub-sector with
61 increased output and productivity to meet the increased demand for animal protein and surplus for
62 export, requires appropriate intervention modes. Information is required on vulnerability and
63 adaptation that are context specific, while accounting for the main farming system components
64 (Tui et al., 2021).

65 Local communities have not always been consulted in social-change processes (Sandru, 2014,
66 Gobvu et al., 2021) and as a result, development partners may not be appropriately informed of
67 the community priorities. Community-based approaches have been suggested to identify and
68 prioritize problems (Khashtabeh et al., 2019). Participatory approaches to solving livestock
69 production build a strong base for the intervention in the community (Mubita et al., 2017). In

70 addition, they ensure that interventions are designed to respond to a demand-driven process and
71 not parachuted in a top-down manner, that is not embraced by final beneficiaries. LPS
72 interventions defined through a participatory approach should therefore produce interventions that
73 are locally owned, context-relevant and adapted to local constraints.

74 In Zimbabwe, agro-pastoralist communities in Transfrontier Conservation Areas (TFCA) practice
75 livestock production in the most semi-arid environments of the country characterised by rainfall
76 variability and unpredictability. TFCAs were founded on the realization that natural resources that
77 straddle international boundaries are a shared asset with the potential to meaningfully contribute
78 to the conservation of biodiversity and the welfare and socio-economic development of rural
79 communities (tfcportal.org). In TFCAs, LPS farming communities live close to protected areas
80 and experience human-wildlife conflicts including livestock predation by wild carnivores,
81 competition between livestock and wild ungulates for forage and water and infectious (potentially
82 zoonotic) disease that can be transmitted between wild and domestic animals (Matseketsa et al.,
83 2019; Caron et al., 2013). Cumming (2011) summarized some of the development constraints in
84 TFCAs as follows: weak legal frameworks and peoples' rights, land resource access rights, lack
85 of sound spatial and temporal information on biodiversity, generally poorly developed local
86 infrastructure, exclusion of those in a position to make positive contributions to TFCA
87 development, negative attitudes to the processes and weak capacity for self-organisation and
88 institution building at local levels and, stifled potential for local innovations and ownership of
89 solutions to such problems. Therefore, to deliver efficient livestock production interventions, state
90 and development agencies need to facilitate locally adapted and context relevant programmes.
91 Given the agro-ecological, institutional and socioeconomic contextual issues described above, this
92 study taking place within the context of a development project, used an inclusive and participatory
93 approach to identify demand-driven interventions for livestock production in a TFCA communal
94 area in South-east Zimbabwe.

95

96 **2. Material and methods**

97 **2.1. Study Site**

98 Sengwe Communal Area is located in the Great Limpopo TransFrontier Conservation Area
99 (GLTFCA) in the Southeast Lowveld of Chiredzi District, Zimbabwe, which lies at 21°33'S and
100 31°30'E. The specific study site, Ward 15, lies at the southern edge of Gonarezhou National Park
101 buffered by the Malipati Safari Area to the South and Malilangwe Conservancy Trust towards the
102 North. The average altitude is 392 m. Chiredzi District is in Agroecological Region V and is
103 characterised by erratic rainfall and low mean annual rainfall of around 450mm (Kupika et al.,
104 2019, Nyarumbu et al., 2019) with high interannual rainfall variation (Poshiwa et al., 2013).
105 Minimum temperatures range between 4.3 and 21.1 °C and maximum temperatures range between
106 27.8 and 37.3 °C. Major soils are eutric vertisols, chromic luvisols and eutric fluvisols.
107 *Colophospermum mopane* trees dominate in the area. Livelihoods are crop-based, non-farm based
108 and to a greater extent, cattle-based (Murungweni et al., 2016).

109 **2.2. Study context and design**

110 The Promoting Sustainable Livelihoods in TFCAs (ProSuLi) project recognised that the success
111 of development programs is rooted in positive stakeholders' interactions, recognising the
112 legitimacy and importance of their respective positions, needs and constraints and the need for
113 negotiations in order to achieve a shared common vision of a sustainable project (Caron et al.,
114 2022). ProSuLi objective was to promote sustainable livelihoods in 4 local communities living in
115 the periphery of protected areas in Zimbabwe, Mozambique and Zimbabwe within the Great
116 Limpopo TFCA and the Kavango-Zamabezi (KAZA) TFCA. This study applied two approaches
117 namely: a co-elaborative scenario-building workshop (Bourgeois et al., 2023) to support a group
118 of local stakeholders/actors in producing plausible contrasted scenarios about the futures of
119 livelihoods in the Sengwe site by 2038, followed by a planning workshop and a questionnaire-
120 based survey.

121 The co-elaborative scenario-building workshop was conducted in October 2018, with purposefully
122 selected community representatives covering community livelihoods and support sectors. They
123 were selected because they were expected to provide a range of different perspectives on
124 livelihoods in the study areas, based on their knowledge and experience. A follow up workshop
125 including other community members who were not part of the scenario building workshops helped
126 in building legitimacy to the process. A questionnaire survey was conducted in September/October

127 2019 on sampled individual households to identify their preferred livestock interventions. The
128 survey was conducted by an MSc student (the first author of this article).

129

130 **2.3. Co-elaborative scenario building towards action**

131 **2.3.1. Participatory prospective analysis and the Futures workshop**

132 The common method used for creating scenarios about alternative futures for local livelihoods in
133 the ProSuLi project was a co-elaborative scenario building approach called Participatory
134 Prospective Analysis (Bourgeois et al. 2017). In Sengwe, it was implemented through a three-day
135 Futures Workshop. It gathered 22 participants who were selected as “knowledge-broker” in order
136 to provide diverse knowledge and perspectives. Participants included farmers from crop and
137 livestock production groups, community based organisations, natural resources management
138 groups, school committees, local traditional leaders, expert participants and government officials
139 were purposively drawn from District government departments including agricultural extension
140 (AGRITEX), veterinary services, gender and community development and local non-
141 governmental organisations. Farmers engaged in the co-elaborative workshops acted on behalf of
142 the whole community, in ensuring validation of preferred interventions. The project team,
143 including researchers and students from Zimbabwe, Mozambique and France facilitated the
144 workshop. The workshop alternated plenary and group sessions taking the participants step-by-
145 step from their perception of the future to the strategic tipping points connecting the future with
146 the present. For detailed information about the methodological steps, see Bourgeois et al. (2017 &
147 2023).

148 The resulting scenarios are not predictions and do not intend to become blueprints for action. Their
149 role is to widen the perception the participants have of the present by engaging in a stimulating
150 reflection about the evolution of their environment, and what could happen to their livelihoods
151 beyond usual basic trend analysis. As such they serve to “benchmark” the future, opening horizons,
152 enabling people to think differently and becoming pro-active in TFCA management (Bourgeois et
153 al., 2023).

154 After the workshop, we applied a post-treatment of the data collected. All factors of change were
155 classified as directly, indirectly or not linked to LPS based on their definition. Factors of change

156 were also identified and distributed according to the STEEP classification (Bowman, 1998),
157 namely social, technical, economic, environmental and policy dimensions.

158

159 **2.3.2. From anticipation to action: a follow-up participatory workshop**

160 A few months after the Futures workshop, a follow-up participatory workshop was organized with
161 selected participants of the community in order to provide feedback on the outputs of the
162 workshop, validate them and organize the way forward towards the selection of activities for the
163 project. Participants were from local development trusts, local NGOs, community-based natural
164 resource programme; community childcare workers, teachers from primary and secondary schools,
165 local irrigation schemes, veterinary services, seed multiplication farmers, animal health care
166 centre, farmers, religious leaders, agriculture extension services and headmen.

167 **2.4. Questionnaire survey**

168 After the co-elaborative scenario building processes, a survey was conducted on potential livestock
169 interventions in order to consolidate the outputs of the participatory workshops. A questionnaire
170 survey was implemented using semi-structured questionnaires to collect information on preferred
171 livestock interventions. The questionnaire thematic areas were: demographic information,
172 livelihoods activities, livestock kept and preferred livestock interventions. Structured interviews
173 collected information on livestock species kept and preferred livestock interventions per species
174 of livestock. Respondents were sampled from 9 villages of Sengwe ward 15, as initially selected
175 by the ProSuLi project. This ward was chosen because of its past involvement in research and
176 development projects with the team (such as the DREAM Project on Learning Platforms) and as a
177 ward sharing a border with Gonarezhou National Park, the second largest park in Zimbabwe in the
178 South-East corner of the country. Each village had around 25 households and for the 9 villages
179 there were 225 households. It was assumed that half of the households (0.5) had livestock. The
180 confidence coefficient was assumed to be 90% giving a z-value of 1.645. A 0.05 acceptable
181 sampling error was also assumed. The sample size was calculated using the following Cochran's
182 sample size formula (Cochran, 1977).

183

$$n = \frac{p(1-p)}{\frac{e^2}{z^2} + \frac{p(1-p)}{N}}$$

184 Where p is the population proportion (50%), e is the acceptable sampling error (5%), z is the z -
185 value at reliability level of 0.90 (1.645) and N is the population size (225). The computation
186 provided for a sample size of not less than 123 households. An additional three households were
187 included from the outcome of the purposive sampling to create a final sample size of 126
188 households.

189 Sample size was calculated using the Cochran's sample size formula (Cochran, 1977), with an
190 assumption that half of the households owned livestock (ZimVac, 2017) and this gave maximum
191 variability, giving a p value of 0.5. Assuming a 90% confidence, and at least $\pm 5\%$ precision, a 90
192 % confidence level gives Z values of 1.645 (Cochran, 1977). The studied population was 225
193 households and the survey sample size was adjusted, to 126 households, with 14 households per
194 village across the 9 village in the ward. The survey purposely selected household heads for
195 respondents.

196 **2.5. Statistical Analysis**

197 Data from the household survey were analysed with the Statistical Package for Social Sciences
198 (SPSS) Version 25 (IBM Corp, 2017). Data were described using frequencies and means
199 procedures of SPSS. Exploration of livestock numbers per household was done through the median
200 because the frequency distribution of the data was skewed.

201

202 **3. Results**

203 **3.1. Co-elaborative scenario building toward action**

204 **3.1.1. The Futures workshop**

205 The workshop took place between the 22 and 24 October 2018 and was held in English, Shangaani
206 and Shona at Malipati village, ward 15, Chiredzi district. Of the stakeholders that participated in
207 the co-elaborative scenario-building workshop, 80% were male, reflecting male-domination in the
208 societal structures of the community (Gbaguidi, 2018).

209 Participants agreed to set the time horizon for this activity at 2038. Thirty-six factors of change
210 were identified and distributed according to the STEEP classification (Bowman, 1998), namely
211 social, technical, economic, environmental and policy dimensions. The participants selected five

212 driving forces of local livelihoods in the area: LPS was regrouped with farming production systems
 213 as one of the five driving forces; others were “State of food security / poverty”; “Governance
 214 capacity of the local community”; “Capacity to adapt to climate change”; “State of local culture
 215 and tradition” (Table 1).

216 **Table 1: Driving forces (n=36) and factors of change influencing directly or indirectly LPS**

Name	Definition	Dim.	Link to LPS
Capacity to adapt to climate change	The capacity of local people to adapt to climate change through actions	En	D
Quality of air	The quality of air in the area	En	
State of natural resources	Vegetation cover, excluding water and water bodies	En	D
State of water and water bodies	The quality and availability of water	En	D
State of animal health	Including domestic and wildlife	En	D
Human wildlife interactions	The nature of interactions between local people and wildlife	En	D
Governance capacity of the local community	The capacity of the local community to organize and influence decisions	P	I
Natural resources management	By whom and how are natural resources (excluding wildlife) managed	P	D
Wildlife management	By whom and how is wildlife managed	P	I
Land use policy	Who decides and how about land use at the local level	P	I
Land use allocation	By whom and what for is land use allocated	P	D
State of health infrastructure	Quality and distribution of hospitals, clinics and pharmacies	P	
Access to health services	Who has access to health services quality of the services	P	
Distribution of wealth	Who is wealthy and where are they located	Ec	I
Nature and type of investment locally	Nature and type of investment locally	Ec	I
Nature and type of development	Which economic sector is developed how, by whom	Ec	D
State of poverty	Who is poor and how is poverty distributed	Ec	D
Movement of people	Migration flows out and into the area (number of people, who move in and out of the area)	Ec	
State of transport infrastructure	Quality and distribution of transportation networks	Ec	I
Accessibility to and from the area	How easy it is to reach and leave which parts of the area	Ec	D

Access and type and quality of education	Who has access to what type of education including the quality of it	T	
State of ICT	Level of development and accessibility to information and communication technologies	T	I
State of farming knowledge and skills	Include crops and livestock	T	D
Type of livestock farming system	How livestock is managed and by whom	T	
Livestock density	Number and distribution of cattle in the area	T	D
Type of farming system	Who is farming and how (crops)	T	I
Type of energy and access	Who has access to energy and what type of energy	T	
Attitude/behaviour of people	Individual attitude and behaviour of people locally	S	I
State of local culture and traditions	The place of the local culture and traditions in the local society	S	D
Place of men and women in the society	Place of men and women in the society	S	I
General level of education	The level of literacy of the people in the area (including who and also distribution)	S	I
Nature of people relationship	The nature of the local social links between people	S	I
Density and distribution of the population	Who and how many live where	S	I
State of health of people	Who is healthy, where, who is not healthy, why	S	
State of food security / poverty	Who is food insecure, how many and where	S	I
Demographic policy	The public means used to regulate the number of people living in the area	S	I

217 *Note: in bold the 6 driving forces (both “Types of farming systems” were merge by participants as one*
218 *driving force; the “Dim.” column indicates the related STEEP dimension as follows: S=Social,*
219 *T=Technical, En=Environment, Ec=Economic, P=Political; the last column “Link to LPS” indicate the*
220 *factors of change that are directly (D) or indirectly (I) linked to LPS.*
221

222 Thirteen out of 35 (37,1%) factors of changes were directly linked to LPS and 15 (42,9%) were
223 indirectly linked to LPS which together indicated that 28 factors of change (80%) for local
224 livelihoods were directly or indirectly linked to LPS.

225 In order to identify the five driving forces to build the frame of the future scenarios, participants
226 engaged in a reflection on the interconnections between the different factors. A voting process

227 took place where each participant was allocated dots of different colours to indicate on a board the
228 factors that were the most influenced by the others and the factors that were the most influential
229 on the others. Based on this voting process, participants selected five driving forces of local
230 livelihoods in the area: LPS were regrouped with farming production systems as one of the five
231 driving forces; others were “State of poverty”; “Governance capacity of the local community”;
232 “Capacity to adapt to climate change”.

233 For each driving force, different future states were proposed and discussed in common. Future
234 states (in 2038) could be desired or not desired states. The three future states that were used for
235 the driving force LPS + farming production systems were: 1. Mixed farming prevails with irrigated
236 crop farming; new adapted breeds and varieties (for animals and crops); local farmers are
237 practising the use of adapted breeds of livestock with higher market value; 2. No more farming,
238 nor livestock systems (because of an environment and a climate incompatible with farming and
239 livestock keeping; 3. Zero grazing and livestock production systems concentrated on chicken and
240 rabbits associated with greenhouse farming.

241 In plenary and subsequent validation sessions, participants collated 5 plausible contrasted
242 scenarios based on the future states of the 5 driving forces, and code-named them as : *Selfish Pain*,
243 *The Male Power*, *Laissez-faire Kills*, *Bye Poverty!*, *A Big One for a Few Ones* (Box 1; English
244 versions chosen by the participant based on vernacular expressions). Full narratives resulted from
245 the inclusion all the remaining 30 factors of change into the synopsis. This process was that initial
246 narrative were written by the project team and later validated by local stakeholders through
247 participatory feedback and comment sessions.

248

249 **Box 1:** Full narratives

250 *Chaitemura Chavakuseva – Bye poverty!* In 2038, there is a mix of local and foreign cultures with good
251 governance, empowered local leaders and cross-cutting inclusiveness in land use allocation. Due to the
252 adoption of solar energy, there is well-adapted irrigation which promotes mixed farming using adapted
253 livestock breeds and crop varieties with high-value markets. As a result, the level of poverty has been
254 reduced to 30%. The poor and vulnerable groups (women, orphans and elders) scattered around the park.

255 *Mazvakemazvake - Laissez-faire kills:* In 2038, an individual culture prevails and people do whatever they
256 want, affecting the governance capacity of the local community and leading to infighting for leadership.
257 The power struggle deviates people from adapting to climate change. As a consequence farming has
258 collapsed. A very disturbing situation exists whereby ninety

259 *Matimba Avanuna - The male power:* In 2038, local culture and traditions are central to the society, taught
260 at school. The governance capacity of the local community is characterised by abuse of power by male-
261 dominated leaders and corruption in land allocation. People are resisting to adapt to climate change. As a
262 result there is no more farming activities and livestock! Therefore 90% of the population is living in poverty
263 throughout the whole area, except for the 10% who are either employed or have their own business.

264 *A big one for a few ones:* In 2038, the local culture and traditions are central in the local society and people's
265 lifestyles entice them to resist to adapt to climate change. A top down governance system has taken over
266 the capacity of governance of the local community and land use allocation. It is supporting agricultural
267 activities based on zero grazing at small scale with small livestock (rabbits, chicken...) and
268 greenhouse/rooftop farming. 60 % of the population remain poor, particularly women, children, elder men
269 and the unemployed. Poverty is spread across the villages.

270 *Selfish pain:* In 2038, the local culture and traditions have been erased, leading to chaotic fight for power
271 and unclear land use allocation. Ninety percent of the population has first become poor due to no more
272 farming and livestock products. This resulted in everyone abandoning the area, leaving it with no capacity
273 to adapt to climate change.

274

275 After vibrant debating the workshop participants finally concluded that they preferred the *Bye*
276 *Poverty!* narrative (Box 1; See annex 1 for the full narrative of the *Bye Poverty!* narrative) as an
277 acceptable future for 2038 that the project could take as a vision. Subsequent intra-community
278 workshops were organised by participants of the workshop to feedback the experience and outputs
279 of the workshop and validate the narrative chosen. The futures described in the five narratives are
280 not predictions and are not intended to serve as blueprints for action. Their role is to widen the
281 perception the participants have of the present by engaging in a stimulating reflection about the
282 evolution of their environment and what could happen to their livelihoods, beyond usual basic
283 trend analysis. As such they serve to “benchmark” the future, opening horizons and enabling
284 people to think differently.

285 **3.1.2. Follow-up participatory workshop**

286 A follow-up participatory workshop was held on the 12th and 13th of April 2019 to plan the way
 287 forward following the co-elaborative scenario planning. Participants included local development
 288 trusts, local NGOs, community-based natural resource programme; community childcare workers,
 289 teachers from primary and secondary schools, local irrigation schemes, veterinary services, seed
 290 multiplication farmers, animal health care centre, farmers, religious leaders, agriculture extension
 291 services and headmen. After feedback on the Futures workshop, questions about the process and
 292 discussion about the *Bye Poverty!* scenario, participants decided to create four thematic groups
 293 namely: Governance and advocacy; Livestock production Crop production; Ecotourism to identify
 294 activities to be implemented under the project

295 Each thematic group had to come up with activities to start the pathway towards the desired
 296 scenario in 20 years. Group committees were created with membership based on interests and
 297 also the need for equitable representation. During day 2 of the workshop, groups discussed and
 298 presented possible activities in a plenary session where collective decision was reached (Table 2).
 299 In addition to a list of theme and activities (Table 2), the LPS group listed also the material needed
 300 to complete these activities.

301

302 **Table 2:** Sub-themes and activities identified by the livestock production system thematic group

Objective	Sub-theme	Activities
Desired state: Mixed farming prevails with local farmers practising the use of adapted breeds of livestock with higher market value	Production	<ul style="list-style-type: none"> ● Bringing in adapted breeds of cattle, goat and chicken ● Building of a small-scale abattoir in Malipati ● Setting-up revolving fund for farmer to
	Supplementary feeding	<ul style="list-style-type: none"> ● Silage making ● Planting of pasture grasses ● Hay cutting
	Animal husbandry	<ul style="list-style-type: none"> ● Create feedlots for direct slaughter ● Create paddock to control breeding
	Animal health	<ul style="list-style-type: none"> ● Organise regular dipping for tick control

		<ul style="list-style-type: none"> ● Vaccination ● Available treatment for common diseases ● Organise regular deworming
	Empowerment	Training farmers on <ul style="list-style-type: none"> ● Animal health and production ● Livestock marketing ● Value addition, e.g., animal skin tanning ● Running an enterprise

303

304 **3.2. Questionnaire survey results**

305 **3.2.1. Socio-demographic information**

306 Females represented 57.9% of respondents. The average household size was 7.21±3.54.
 307 Respondents had an education up to primary level (49.2%) or secondary level (30.2%) while
 308 20.6% did not attend school at all. Close to 60% of the respondents were aged between 41 and 60
 309 years old, while 20% were older than 60 years and 20% younger than 31 years. The major source
 310 of income for households was livestock production (27.8%), followed by horticulture (23.8%) and
 311 minor sources of income being salary, pension or part-time work.

312 Livestock ownership across households was generally greater for small stock, with 91.2% of
 313 households owning a mean flock size of 15 chicken (and up to 36); 94.4% of households owning
 314 a mean of 15 goats (and up to 35). Cattle were owned by 78.6% of households with a mean herd
 315 size of 11 (up to 25). Only 8% of the respondents owned sheep while 37.3% had donkeys which
 316 they kept only for draught power. The main reasons for keeping cattle were social security (e.g.,
 317 in case of an unexpected need of money for burial, health issues), milk production and to a lesser
 318 extent for draught power.

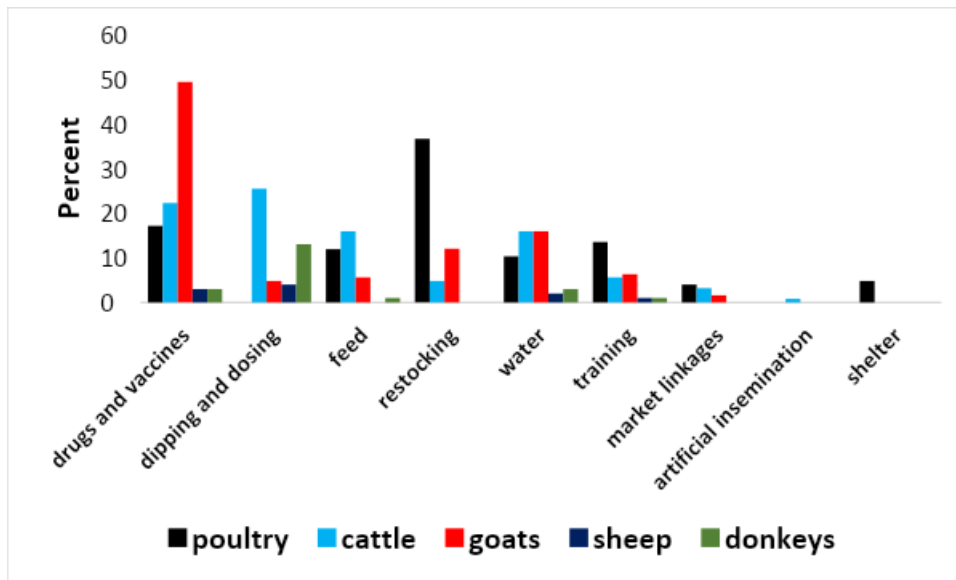
319 **3.2.2. Preferred livestock interventions**

320 The most mentioned domestic species requiring intervention were cattle (93.8%), poultry (98.1%)
 321 and goats (95.4%), with much less mentions for donkeys (21%) and sheep (10%).

322 Figure 1 presents, for each species, the most cited interventions. For cattle, the most cited
 323 interventions revolved around animal health in terms of access to drugs and vaccine as well as the

324 capacity to organise dipping and dosing against important vectors (e.g., ticks) and parasites (e.g.,
 325 gastro-intestinal parasites). The next important mentioned interventions were revolving around
 326 feeding and access to water, especially during the dry season during which both these natural
 327 resources are scarce.

328 **Figure 1:** Preferred livestock interventions per domestic species in Sengwe



329

330

331 For goat production, health issues linked with access to drugs and vaccines were largely the most
 332 cited, with issues related to restocking (with locally adapted breeds) and access to water being less
 333 cited. For chicken, restocking was the most cited intervention, followed by access to drugs and
 334 vaccines and training on chicken production systems. The most preferred intervention for sheep
 335 was dipping and dosing (4%) followed by drugs and vaccines (3%). For donkeys, the most
 336 preferred intervention was dipping and dosing (13%) followed by water access and training.

337

338 4. Discussion

339 In this study, in the context of a research-action and development project, we intended to identify
 340 activities that could promote local livelihoods in a semi-arid environment of Zimbabwe in the
 341 Great Limpopo Transfrontier Conservation Area.

342 **4.1. Relation between methodologies**

343 This study demonstrates two separate processes for community inquiry whereby the co-elaborative
344 scenario building process and the follow-up workshops used collective discussions and consensus
345 among the participants while the survey focused on the individual views of respondents. To
346 support the long-term sustainable management of GLTFCA, the co-elaborative scenario building
347 process gave room for the community to build sustainable development pathways through desired
348 pathways and futures while the survey probed deeper into the perspectives of the individuals. The
349 participatory process did not provide activities detailed to the domestic species under consideration
350 (i.e., cattle, goat, chicken, sheep and donkey) while the questionnaire survey and FGD helped
351 identifying interventions at species level. With a year between the two processes, they reflected
352 similar views on livestock health and alimentation (i.e., pasture and water) as pillars to LPS,
353 especially for cattle and goat production. The main difference between activities identified through
354 the working group and through the questionnaire was on the value chain (e.g., building abattoir,
355 create paddock) and marketing aspects (e.g., create feedlots for direct slaughter) and also more
356 technical options for supplementary feeding (e.g., silage making) of LPS. The co-elaborative
357 working group was a more diverse group of stakeholders including governmental services (e.g.,
358 veterinary services), with higher levels of education and exposure to market-oriented interventions.
359 In addition, the fact that locally, livestock markets are heavily constrained and almost non-existent
360 (beside between inter-adjacent villages) due to the difficulty to access the area (i.e., more than 100
361 kms of dirt and sometimes difficult road to join the main district town) may have limited the
362 capacity of interview respondents to project themselves into marketing. Another hypothesis could
363 be that the attendance to participatory workshops provided participants with a better capacity to
364 project themselves into the future and consider LPS in a more progressive way.

365 Multiple qualitative and quantitative methods hold distinct advantages over single method
366 evaluations but their value is not in the number of methods used, but in how each method matches
367 the evaluation questions (Odendaal et al., 2016). The anticipatory and participatory workshops
368 enabled local stakeholders to have a more multi-sectorial approach of LPS. Linking the 35 other
369 factors of change with LPS and observing that 80% of them were directly or indirectly linked to
370 LPS demonstrated the importance of LPS in local livelihoods but also that some interventions
371 could have multiple impact for local livelihoods beyond LPS (e.g., state of food security,

372 distribution of wealth, Table 1). The creation and subsequent discussion of ‘what if’ learning
373 narratives during the workshops enabled participants to consider creative and novel alternative
374 livestock interventions. The *Bye Poverty!* narrative indicated the importance of livelihood systems
375 which integrate local cultures, good governance, empowered local leaders, mixed farming with
376 integrated livestock and cropping production systems, high-value markets and poverty reduction.
377 These are all illustrated across the various LPS interventions selected by the communities. It is
378 hard to imagine farming without the tight integration of crops and livestock in smallholder
379 agriculture (Melesse et al., 2021) and the livelihood systems are complex and coupled with
380 human/natural systems (Senda et al., 2020). Overall, Tui et al., (2021) demonstrated that the
381 sustainable development scenario consistently addressed institutional failures and motivated
382 productivity-enhancing, environmentally sound technologies and inclusive development
383 approaches. Proposed interventions in our study focused on improving solidarity within the
384 livestock sector through improved planning and formal communication networks between farmers.

385 **4.2. Relevance of identified interventions**

386 The importance of managing animal health in this district has been scientifically investigated,
387 especially in the context of the wildlife/livestock interface due to the presence of protected areas
388 and the risk of pathogen spill-over between wild and domestic populations and even to humans in
389 the case of zoonoses (Caron et al, 2013; de Garine-Wichatitksy et al., 2013; Miguel et al., 2013;
390 Gadaga et al., 2015). A highly listed intervention was dipping livestock in diptanks, village
391 infrastructures that allow livestock to be immersed in a water pool in which an anti-tick chemical
392 molecule has been diluted. This helps to fight against tick infestation and tick-borne diseases (e.g.,
393 theileriosis, babesiosis, anaplasmosis), the diseases with the most impact on cattle mortality in the
394 area. Dosing is the intervention that allow to treat animals against intestinal parasites (e.g.,
395 nematodes). In the study area, during the time when research was undertaken, dipping frequency
396 was irregular due to lack of dipping chemicals (normally provided by veterinary services). There
397 was also an issue of lack of water at dipping sites due to the difficulty to access water, the distance
398 of water sources (especially during the dry season) and the quantity of water needed for each
399 dipping (several thousand litres to counteract the evapotranspiration happening in the multiple
400 thousand litres diptank). Sungirai et al., (2017) mentions that interruptions to dipping in communal
401 areas are usually due to long distances from homesteads to diptanks which makes it difficult for

402 them to present cattle frequently for dipping and also issues of drought which cause diptanks
403 become non-functional due to lack of water (Sungirai et al., 2017). In the study area, there were
404 no dipping systems for goats and sheep, but only dipping and vaccination programs for cattle.

405 Respondents mentioned issues of lack of funds to purchase dosing chemicals. Hove et al. (2008),
406 mentions that despite the prevalence of ticks on goats, as well as of the pathogens they transmit,
407 their control by the state-run veterinary services is minimal and tick control mostly targets cattle.
408 Other respondents would not mention the need for dipping and dosing goats and this may be due
409 to the mistaken perception that goats are resistant to disease (Poku, 2009). According to
410 Tavirimirwa et al., (2013), diseases and parasites are major constraints to communal cattle
411 production and are endemic in most Zimbabwe communal areas. The situation is worsened by the
412 unavailability and high cost of drugs and inadequate veterinary officials (Mutibvu et al., 2012). A
413 survey by Mlambo, (2002) showed that most of the cattle farmers have poor access to veterinary
414 extension services except for contact with the dip attendants during dipping days.

415 Competition for rangeland and access to water is also prevalent as water is distributed along the
416 main River (i.e. Mwenezi River) that delineates the border between the communal land and the
417 Gonarezhou national park. During the dry season, a few pools of water remain in the riverbed to
418 water wild and domestic ungulates and constrain livestock pasture to a few kilometres around those
419 pools Zengeya et al. (2014;2015). A report by Zimbabwe Resilience Building Fund, (2017)
420 showed that the trekking distance for water for livestock in Chiredzi district was above the normal
421 2km.

422 Drought has also been a recurrent phenomenon in the area. Masikati, (2011) mentions that seasonal
423 deficiency in feed quality and quantity particularly during the second half of the dry season is the
424 major constraint to communal livestock production. Poor management of rangelands, and
425 rangeland fires also limit the availability of fodder (Tavirimirwa et al., 2013). Livestock benefit
426 from improved feed supply through larger quantities and improved quality of crop residues (Tui
427 et al., 2021). The different importance implied in the preference for feed intervention among cattle
428 and goats could be due to the perception and observation that herbaceous grazing becomes more
429 limited for cattle compared to goats, which can forage more efficiently on the predominant woody
430 vegetation. Poultry, on the other hand rated higher in the feed intervention partly because this

431 species needs feed to be brought to them. This supports the well documented LPS constraints in
432 these contexts (Van Rooyen and Homann-Kee Tui, 2009; Chatikobo et al., 2013; Tui et al., 2021)
433 For poultry, the most preferred intervention was restocking. This could be because of the higher
434 representation of women in the survey and the fact that women are usually in charge of the
435 management of chicken compared to men who are more in charge of cattle in local livelihoods
436 (Assan, 2014; Njuki and Sanginga, 2013). Women are aware of the contribution of livestock
437 production to their livelihoods and engage in decision making and management of poultry (Senda
438 et al., 2011; Mcainsh et al., 2004). After restocking, the most listed intervention for poultry was
439 access to drugs and vaccines. This could have been because during the study, an outbreak of what
440 was suspected to have been Newcastle disease killed a lot of birds and left many homes with very
441 few to no birds (Madzinga B., personal communication, November 2019). Respondents had no
442 prior knowledge about (Newcastle) vaccination for poultry and requested interventions on training
443 on health management of poultry. Only poultry interventions had mention of shelter, presumable
444 due to their higher vulnerability to predation. In implementing their project; “Strengthening
445 resilience to enhance food security and nutrition of vulnerable rural communities to cope with
446 recurrent shocks and stressors in Chiredzi district”, the Mwenezi Development Training Centre
447 have implemented interventions on developing poultry shelter for the local communities (MDTC,
448 2022).

449 The most preferred intervention for donkeys was dipping and dosing. There were no dipping and
450 dosing practised for donkeys in the area as donkeys were viewed as animals of less importance
451 and some would say they find their own means of survival somehow. The very low economic
452 value of donkeys and their capability to withstanding poor treatment contributes to them receiving
453 poor management (Muvirimi and Ellis-jones, 1999). Donkeys are an important asset for traction
454 power and transport, have high drought tolerance compared to cattle, play a critical role in
455 providing draught power for smallholder farmers but their potential is not fully utilized (Maburutse
456 et al., 2012; Hagmann et al., 1995).

457 **4.3. Research-action for development**

458 Deployment of bottom-up studies across different types of production systems provides the
459 evidence base needed making it possible to consider the perspectives of livestock farmers first in

460 order to better inform interventions (Duckett et al., 2017). Different organisations working in the
461 Sengwe Communal Area have previously come up with livestock interventions for cattle
462 restocking programs, goats and chickens restocking using ‘improved’ exotic breeds. Most of these
463 interventions have been imposed in a top down manner and had sustainability challenges due to
464 lack of community involvement and buy-in in project selection and design (Silvius and Schipper,
465 2014). For example, a Brahman restocking programmes through pass-on schemes (World Vision,
466 Heifer International, and SEDAP) brought in Brahman breeds for restocking without much
467 consulting local community about their preferred performance traits or interventions (pers.
468 Comm., local farmers). The local community complained of the Brahman being less drought-
469 tolerant than their local breeds. The Brahman pass-on scheme also could have led to genetic
470 dilution as most participants ended up with cross breeds with more local and adapted breeds.
471 Today, the community has mostly Brahman crosses, and the loss of their hardy indigenous breeds
472 is felt. A considerable number of livestock development programs have failed and reasons for the
473 failures include limited involvement of farmers who are the final beneficiaries, in both planning
474 and implementation, leading to ineffective development programs (Duguma et al., 2010). Any
475 development endeavour needs to be aligned to the specific goals of the target communities and
476 production environments. This gives them ownership of the project and there are high chances that
477 they may continue with some project aspects even after project duration (Silvius and Schipper,
478 2014).

479 **5. Conclusion**

480 After the definition of LPS interventions in the LPS working group, the four working groups
481 gathered, discussed and negotiated about the activities that the ProSuLi project could implement
482 given the available funds. In Ward 15, it was decided to invest in two solar-powered boreholes in
483 two different villages associated with new small-scale irrigated nutrition gardens and linked to
484 diptanks in order to easily fill them with water. The boreholes would also be linked with the
485 primary and secondary schools to provide water for school consumption. Capacity building was
486 also provided on LPS as requested but also on the governance around boreholes and irrigation
487 scheme governance and the sustainability of these systems. Given the participatory approach used
488 in this project, we believe that the LPS and other interventions identified and implemented for
489 some of them will provide more appropriation by and capacity of local stakeholders to promote

490 the sustainability of these activities beyond the lifespan of the project. In addition, the local
491 stakeholders are now prepared to discuss with external interventions (development or state
492 projects) about their priorities in terms of LPS interventions.

493

494

495 **Acknowledgements**

496 This study was designed and implemented within the EU-ProSuLi project and conducted within
497 the framework of the Research Platform Production and Conservation in Partnership ([www.rp-
499 pcp.org](http://www.rp-
498 pcp.org)). We appreciate the continued support from farmers in Sengwe communal land who
500 participated in the study. We would also like to extend our sincere gratitude to veterinary and
501 extension officers for their overwhelming support. This study would not be possible without their
502 cooperation. A special mention goes to Pastor Steven Chauke who was our local site coordinator
and interpreter.

503 **Conflict of interest disclosure**

504 The authors declare that they have no conflict of interest.

505 **Data accessibility**

506 In Annex 2 & 3 attached to the publication, the database and the Futures workshop report, can
507 respectively be found.

508 **Funding**

509 This study was funded by the European Commission under the EU-ProSuLi project,
510 FED/2017394-443.

511

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665

A1 B3 C1 D1 E1 Chaitemura Chavakuseva – Bye poverty!

In 2038, there is a mix of local and foreign culture with good governance, empowered local leaders and cross-cutting inclusiveness in land use allocation. Due to the adoption of solar energy, there is well adapted irrigation which promotes mixed farming using adapted livestock breeds and crop varieties with high value markets. As a result, the level of poverty has been reduced to 30%. The poor are vulnerable groups (women, orphans and elders) scattered around the park.

667

668 The realisation of worsening land degradation has been promoted by an increased acceptance by the
669 community of letting outsider experts and ordinary people to come and live and work among the
670 community, bringing with them a lot of knowledge and expertise for natural resource management. The
671 community has however remained careful to let only positive outside influence. This openness has led to
672 people to collectively decide on adopting solar energy for household uses as well as powering irrigation
673 pumps. A bonus benefit of this has been the cleaner air which is not polluted by wood smoke. Collective
674 problem analysis by the community has made them realise that the problem of water availability has been
675 caused by extremely high demand for water by livestock, wildlife and human beings. In response to this,
676 collective action has led to wise use of water bodies by planned and mutually agreed allocation of water
677 for livestock, wildlife, and human use, without overcrowding the water bodies. This has led to marked
678 reduction in conflicts between commercial agriculture and wildlife. Before this, National Parks and the
679 local communities were always quarrelling about livestock encroachment into Gonarezhou National Park
680 in search of forage and water on one hand, and, wildlife encroaching onto the agricultural fields, devouring
681 livestock and harming the humans. In 2038, this situation has greatly declined and the only illegal poaching
682 for food is pronounced among the remaining very poor women, elders and orphans who are scattered
683 along the Parks boundaries. At least now there is not the organized criminal poaching by big cartels as
684 used to happen twenty years ago. Wildlife is managed by the GNP authorities with consultation of the
685 local leaders who adequately and effectively represent their constituencies.

686 Large livestock have almost disappeared and small livestock raised on zero grazing is in good health. This
687 has come by through leaders and ordinary people having extensive discussions about what type of
688 livestock production would be beneficial, considering the changing climate. Agriculture is a focal
689 investment area and is supported by agribusiness development. The area is generally prosperous due to
690 investment from outside through joint venture between local farmers and supply chains and remittances
691 from migrants. Value chain development is very vibrant for small livestock and small grain development
692 in areas such as animal health services, grain processing, animal products processing and marketing.
693 Wealthy people are successful farmers and local agribusiness owners and traders. The local governance
694 structures enables women and previously disadvantaged groups to negotiate and participate freely and
695 fairly in business ventures. Outmigration of young unskilled people has reduced as it is now lucrative to
696 stay locally and engage in agribusiness. The area has been connected to the national grid through public
697 investment to support agriculture and agri-business.

698 There is a good all-weather tar road that connects the production areas to the Beitbridge-Harare highway
699 from Malipati. Another one leads to the entrance of the Gonarhezou national park. These roads are
700 maintained by the government but with very strong input of ideas and even resources by the local

701 community who are well organised. Other roads under the responsibility of the local community remain
702 untarred but the community always willingly collectively organises labour and some money to fix the road
703 to make it passable during the rainy season. This is because their local business is so vibrant that they do
704 not want bad roads to compromise their livelihoods.

705 Traditional farming knowledge and skills remain among the majority of the people but due to influx of
706 experts and knowledgeable people, the farmers are capable of collectively deciding to adopt improved
707 farming skills and technologies. Due to their exposure to the outside world through education, young local
708 farmers have engaged in zero grazing and greenhouse farming after gaining technical knowledge and skills
709 elsewhere. A technical centre for advanced farming has been built in the district. Local youths who excel
710 in high school are increasingly accessing higher education outside Malipati, but many of them return to
711 live and work at home after graduation.

712 Most people have access to primary education where local culture and traditions are taught. Physical
713 access to primary schools has greatly improved with school dropouts at high school level being only ten
714 percent of what they used to be twenty years ago. Malipati village has a secondary school. Local education
715 has greatly improved due to increased access to and adoption of ICT. Literacy is aligned on an economic
716 divide between young local farmers and entrepreneurs with market-oriented technical training in
717 agriculture and agri-business and a majority of people educated in the local culture and traditions. A
718 generation of hard-working young agripreneurs has emerged while most of the people remain deeply
719 influenced by the local culture and traditions. This is actually good because the community through its
720 good local governance is quite empowered to speak out against and block negative outside influence but
721 collectively and inclusively discusses any new ideas. Chronic food insecurity is no longer very common.

722 A powerful relay antenna operating 24/7 has been built in Malipati village offering the possibility to high-
723 speed connection to those who can afford it. At least 75% of the community actually affords this high-
724 speed connectivity. There is pronounced use of internet communication mainly used for agriculture
725 business activities such as communicating with the market, organizing for marketing activities as well as
726 synchronizing local collective production with outside lucrative markets.

727 The population has remained stable and is no longer just concentrated along the tar road and the borders
728 of the park but is concentrated in many clusters of activity which are focused on agribusiness activities.
729 Demography policies are mainly very localised and focus on local visions of equity and progress. Primary
730 health services is now widely accessible everywhere in Sengwe. Malipati has a well serviced health centre
731 and people travel outside Malipati only for major medical issues.

732 Overall, the land use policy is determined at the central level of the government and implemented by the
733 local land agency of the government. Local community members are actively consulted and engaged in
734 improved land use practices. There is now synchrony between national government land use policies and
735 local community practices.

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