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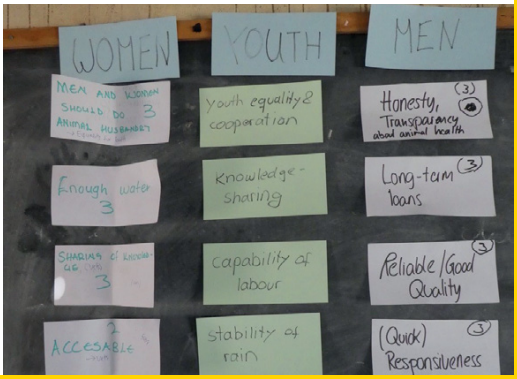
From method to action

Designing a participatory hotspot analysis to access sustainability in Zambia´s groundnut and dairy value chains

Klaus Droppelmann, Ngosa Bangwe, Joel Hähnle, Rickie Klingler, Cornelius Krüger, Johanna Kückes, Simushi Liswaniso, Leeroy Mapulanga, Cleopatra Kawanga, Namakando Namakando, Annika Reimann



2022

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Seminar für Ländliche Entwicklung | Centre for Rural Development

SLE has been offering vocational education and training for future experts and managers in the field of international development cooperation since 1962. The courses range from post-graduate studies to training courses for international experts in Berlin to solution-oriented research and consultancy for organisations and universities active in the field of development cooperation.

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SLE Postgraduate Studies on International Cooperation for Sustainable Development

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1. Workshop with farmers and dried groundnuts in Petauke, Source: Annika Reimann
2. Workshop and Zebu-type dairy animal in Livingstone, Source: Annika Reimann
3. Hot-Spot ranking; Source: Annika Reimann
4. Farmer showing groundnuts seeds, Source: Annika Reimann

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Preface

For 60 years, the Centre for Rural Development (SLE, Seminar für Ländliche Entwicklung), Humboldt-Universität zu Berlin, has trained young professionals in the field of German and international development cooperation.

Three-month empirical and solution-oriented research projects conducted on behalf of German or international development agencies form an integrated part of the one-year postgraduate course. In interdisciplinary teams and with the guidance of experienced team leaders, young professionals carry out assignments on innovative topics, providing consultancy support to the commissioning organizations while involving a diverse range of actors from household to national levels in the process. The outputs of this applied research directly contribute to solving specific development problems.

The studies are mostly linked to rural development themes and have a socio-economic focus, such as improvement of agricultural livelihoods or regimes for sustainable management of natural resources. The host countries are mainly developing or transforming countries, but also fragile states. In the latter, themes such as disaster prevention, peace building, and relief are examined. Some studies develop new methodologies, published in handbooks or guidelines. Further priorities are evaluations, impact analysis, and participatory planning. In the future, however, studies may also take place in the Global North, since the Sustainable Development Goals are a global concern.

SLE has carried out more than two hundred consulting projects in more than ninety countries and regularly publishes project results in this series. In 2021, SLE teams completed studies in Germany, Tunisia, Uganda, and Zambia.

The present study analyses the sustainability of groundnut and dairy value chains in Zambia and was conducted in cooperation with a BMZ-commissioned research project on the assessment of the sustainability of modern agricultural and food systems, NAMAGE. The report is also downloadable from www.sle-berlin.de.

We wish you a stimulating read.

Prof. Dr. Christian Ulrichs	Prof. Dr. M. Hanisch/Dr. S. Neubert
Dean	Directors
Faculty of Life Sciences	Centre for Rural Development (SLE)
Humboldt-Universität zu Berlin	Humboldt-Universität zu Berlin

Acknowledgements

The goal of this study was always to be as participatory and inclusive as possible. We wanted to listen to the perspectives and opinions of the people on the ground to understand their sustainability perceptions of their value chain. During our time in Zambia, we encountered small-scale farmers, aggregating cooperatives, big processing companies, and supporting organisations that promote value chains. The number of interesting experiences we gained is way beyond the scope of this report. However, we would like to stress that we are grateful for each encounter and thank each interview partner and focus group participant wholeheartedly.

In Zambia, we could always rely on the support and assistance of our excellent partner organisation, the Indaba Agricultural Policy Research Institute (IAPRI). We would like to thank Executive Director, Chance Kabaghe, and Research Director, Dr. Antony Chapoto, for enabling this fruitful collaboration and facilitating the planning and implementation of our research. We are especially grateful for the support by Director of Outreach, Ballard Zulu, who served as a terrific presenter at our validation workshop. Furthermore, we would like to thank Dr. Mary Lubungu for continuously giving us constructive feedback on our research and for being the discussant at the final presentation. A very special thank you goes to Stephen Kabwe, who helped and supported us in so many ways during the entire field research phase. Stephen really went the extra mile for us. Finally, we would like to thank the whole IAPRI staff for your support, constructive contributions, and hospitality. Thanks to you, we always felt welcome at your office at Middleway.

Our research could never have been started without the initiative "Nachhaltigkeit moderner Agrar- und Ernährungssysteme" (NAMAGE) and the people who wanted to explore the requirements for the promotion of sustainable food value chains in development cooperation. Therefore, we would like to thank Prof. Dr. Markus Hanisch, Christian Berg, Aicha Mechri, and Henrice Ströbesand for initiating this crucial research and for trusting us during the full project process to develop our own participatory sustainable hotspot analysis tool. We could always come to you with our questions, clarify our research objectives, and discuss theoretical concepts and methodological approaches. A special thanks goes to Carolin Müller for your support, attentive monitoring, patience, and critical and constructive feedback. We thank the BMZ for generously funding our study as part of the NAMAGE project.

Throughout the research phase, the GIZ in Zambia was very cooperative, supportive, and tremendously helpful in reaching out to dairy and groundnut cooperatives. In this way, we could schedule and organise our interviews and focus group discussions. A special thanks goes to Cynthia Mwandwe and Dr. Belindah Chilala, two experts in the field of our value chains in Zambia, who were always responsive to our questions and supported us, especially in the preparation of our field data collection phase. We would also like to thank Stefan Fett and Claudia Witkowski for showing sincere interest in our research and collaborating wherever possible.

We are grateful that we could undertake this project and fly to Zambia in the midst of the COVID19 pandemic. This would not have been possible without the efforts of Prof. Dr. Markus Hanisch and Dr. Susanne Neubert, Directors of the SLE. Furthermore, we would like to articulate our gratitude to Dr. Silke Stoeber, Margitta Minah, and Miriam Holländer who always kept their doors open for our questions and when we needed somebody to talk to. The same holds for Dirk Sprenger, whose open ears and remarkable ability to listen was a stable backup for each team member.

Last but not least, we would like to express our sincere thanks to Carmen Aspinall for doing an excellent job on making the text of this report intelligible.

Executive summary

Background and objective

The concept of sustainable food value chains (SFVC) is considered as an important element of durable food systems (FAO, 2014). However, food value chains are complex systems. So far, little attention has been paid to connecting food value chains to systemic and multi-dimensional understandings of sustainability. Existing instruments of sustainability assessments along value chains either neglect the multi-dimensional character of sustainability or are too complex and time-consuming to be broadly applicable for practitioners. This study attempts to fill the gap through the application of a systemic and participatory adapted version of the hotspot analysis, as proposed by the Wuppertal Institute (WU-HSA). Hence, we take the livelihood of small-scale farmers engaged in food value chains as a point of departure to integrate their understanding of sustainability and values into the analysis with the aim of revealing sustainability hotspots, trade-offs, synergies, as well as innovations to identify entry points in support of transformative change processes along SFVC.

The study project is part of the research project "Sustainability of modern agricultural and food systems" (NAMAGE) of the Centre for Rural Development (SLE) funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) under its special initiative "ONE WORLD - No Hunger" (SEWOH). Our aim was to develop and test a methodological tool that will identify sustainability aspects in the field to support future promotion of the food value chains facing current and future challenges. For testing and further development of a method that we borrowed from the Wuppertal Institute, we chose to analyse the dairy and groundnut value chains in Zambia. Furthermore, our interest was to assess the extent that the results from our participatory hotspot analysis correspond to agroecological principles and to find out if they, indeed, support a transformative value chain change process. The overarching goal of German development cooperation is to fight poverty and ensure food security, especially among rural smallholder communities by enabling them to face the challenges of a changing climate. Consequently, it was our key objective to enrich the hotspot analysis proposed by the Wuppertal Institute (WU-HSA) with strong participatory elements for application in a development context.

Methodology

Our adapted participatory hotspot analysis (pHSA) started off with a systemic assessment of the sustainability perceptions of smallholder farmers active in Zambia's dairy and groundnut value chains. This was done in a holistic way by emphasising system functionality as a key concept for sustainable livelihoods. Relating the basic resources required for sustaining successful dairy or groundnut production with socio-economic and ecological systems that ensure the provision of goods and services reveals the necessity of conserving specific sustainability aspects. Adaptations were made by integrating the farmers' perceptions as early as the stage of conceptualising relevant sustainability aspects, which are predetermined by experts in case of the WU-HSA. Thus, by working in this way, we could expect more farmer agency, perceived ownership, and compliance with the concept's results than the WU-HSA approach.

We assessed farmers' perception of sustainability aspects in value chains by conducting focus group discussions. We started the process by organising participants into subgroups. The subgroups were intended to capture perceptions across age and gender (HLPE, 2019). We formed three subgroups for male, female, and youth participants, each with 4 – 6 people. In total, 90 farmers in 5 focus group discussions participated in the sustainability hotspot analysis in the dairy value chain and 89 in 4 focus group discussions in the groundnut value chain. During our focus group discussions, facilitators stimulated and guided discussions by asking questions about aspects of sustainability such as physiological, safety, social, cultural, ethical, and individual resources, while taking great care not to steer the discussion into any specific direction. The process followed five steps as follows:

1. Identification of **resources** necessary for production

Participants identified basic resources required for dairy or groundnut production (for example, fodder for dairy cows) by means of free listing. These were documented on paper cards and then placed on the ground.

2. Identification of **systems** providing these resources

The systems providing those resources were identified (for example, pasture or rangelands that provide fodder for cattle), written on paper cards and, related to the basic resources. Socio-economic systems were arranged on the ground to the right of the corresponding resource cards and ecological ones to the left of them.

3. Identification of sustainability **aspects**

Having identified the systems that provide essential goods and services to meet identified needs, the sustainability aspects of each system were identified (for example, biodiversity of grass species in rangelands) and placed next to the respective system either

- as a prerequisite to access systems (socio-economic) or
- as a prerequisite to ensure self-preservation of systems (ecological)

4. Identification of **threats**

Threats are indicators of the reduced functioning of sustainability aspects (for example, the loss of grass species diversity may threaten the sustainable functioning of rangelands and their overall biodiversity and productivity). We use the term "threat" because it appears to be more intuitive than the concept of an indicator. Threats were identified within each focus group by initiating a discussion on the problems the community faces regarding the identified sustainability aspects.

5. Evaluation of threats along four criteria

Having identified the threats, their impact and significance were assessed by the participants of each subgroup who rated them 1 (low), 2 (medium), or 3 (high).

First, the impact of a threat was assessed along three criteria: 1) scope (how widespread is this threat?), 2) severity (how damaging is this threat locally?), and 3) permanence (how easily can this threat be addressed?). The sum of these three criteria gives the **impact** score. The current trend this threat shows was then assessed as decreasing (1), stable (2), or increasing (3). From this, the **significance** of the threat was calculated by adding the value for the trend to the value of the impact.

For example, the **threat** "diverse grasses dying off" is an **aspect** of biodiversity that applies to most areas of Southern Province (scope = 3). It is viewed as a very serious problem threatening dairy production (severity = 3), but the community believes it doesn't require external intervention to address it (permanence = 2). In sum, this gives the aspect "biodiversity" an **impact** rating of (3 + 3 + 2 =) 8. Because this issue is currently worsening (trend = 3), the overall **significance** is evaluated as a hotspot with the value of (8 + 3 =) 11. Threats with a value of 10 to 12 are considered a hotspot, while threats rated 9 and below are not.

To complement the data collection from the focus group discussions, we collected information using additional participatory research methodologies such as transect walks, seasonal calendars, and Venn diagrams. In our research study, we focused on the adaptation of the WU-HSA to the context of smallholder farmers

and, consequently, on the production phase. Nevertheless, to gain a comprehensive understanding of these value chains, we also engaged with stakeholders from downstream VC phases. To achieve that we applied two different methodological approaches. First, we conducted interviews with individual representatives of companies and organisations active in the input, aggregation, transport, processing, and retailing phases. These interviews were conducted in accordance with semi-structured interview guidelines customised to each VC and VC phase. We started the interviews with a review of the preliminary findings and identified hotspots from the relevant focus group discussions and asked participants to validate and build on them. Secondly, we organised a validation workshop in Lusaka. The participants of this validation workshop were recruited mainly from VC-supporting and -enabling agencies but also included some VC operators based in Lusaka. Due to their function and position in the VCs, the participants of this validation workshop were able to provide us with a bird's eye view of the entire VCs.

Findings

The pHSA methodology is grounded in a holistic food systems framework and applies a systemic approach to assess aspects of multi-dimensional sustainability along value chains. It proved to be robust, simple to apply, and adaptable to different contexts. We tested it in an animal- and a crop-based food value chain. We believe it will perform equally well in a wide range of food value chains supported by development cooperation. It is ready for field application and can probably be carried out within a 2 – 3 week field mission. The results we obtained covered aspects from all dimensions of sustainability.

In the dairy value chain, a total of 137 threats to sustainability aspects were identified in focus group discussions and key informant interviews. The social dimension comprised the most threats (61), closely followed by economic threats (56) and ecological ones (20). Out of the 61 social threats mentioned, 21 were rated as hotspots. Out of 56 mentioned economic threats, 24 were rated as hotspots. Meanwhile, the share of hotspots among threats within the ecological dimension is quite remarkable. Out of the 20 mentioned challenges to sustainability, 15 were identified as hotspots. This implies that when ecological aspects are mentioned they more frequently constitute a sustainability hotspot than concerns raised in the other dimensions.

In the groundnut value chain, a total of 88 sustainability threats were identified by stakeholders. It is interesting to note that almost half of the identified threats

(43) fall in the social dimension, confirming the importance of social and community-based approaches for value chain promotion. While social issues appeared dominant in the discussions during the morning, the evaluated hotspot threats were distributed fairly evenly across the three different dimensions. Out of 43 threats mentioned in the social dimension, only 11 were rated as hotspots, whereas roughly half the threats in the economic and ecological dimension were rated as hotspots.

The sustainability aspects and their associated hotspots identified and rated by our respondents align with agroecological principles postulated by the FAO (*see* HLPE, 2019; Gliessman, 2016). From our results, we were able to derive actionable recommendations at the incremental as well as the transformational levels of that framework. We were also able to pick up introduced innovations and potential innovations that might be scaled out in the future. Through our approach, we were able to identify important trade-offs that decision makers should carefully evaluate and accommodate when designing future support interventions.

However, our research also revealed that a participatory research approach like ours requires cross-checking against scientific evidence. Some of the sustainability aspects identified by participants, although reflecting genuine and serious concerns, were based on superficial knowledge and, at times, misconceptions about biophysical processes. Therefore, any participatory assessment must be validated by experts and cross-checked against literature before definite conclusions can be drawn as a basis for future interventions. Nevertheless, awareness on the part of development practitioners of the knowledge status and perceptions held by programme beneficiaries about sustainability aspects provides valuable information for the design of training and awareness campaigns. Furthermore, it provides a foundation for co-learning.

Recommendations

We recommend the application of the pHSA as part of the evaluation of food value chains supported by German development cooperation to identify interventions for enhancement of sustainability or assessment of the sustainability potential of food value chains that are being considered for future support. We recommend developing detailed evaluation criteria for the identification of innovations as part of the pHSA methodology. The pHSA should be conducted by a facilitation team of 4 – 6 international and national experts. Such a field mission should include the following elements:

a) Participatory hotspot analysis (pHSA) with all stakeholders of the VC through focus group discussions in the production phase (including pre- and post-production, if applicable) and key informant interviews in the other phases
b) Validation and complementation of findings from step 1 by VC experts from supporting and governing levels of the VC
c) Verification of findings from steps 1 and 2 based on available scientific evidence and development of definitive recommendations for action.

To enhance the sustainability of the groundnut and dairy value chains in Zambia, we recommend the following.

- In Southern Province, improve and secure availability and access to water resources for dairy farmers, especially for livestock drinking, fodder production, milk processing, and complementary economic activities and develop awareness and training materials on water resource management for dissemination to smallholder dairy farmers. Further, support the development and introduction of drought-resistant fodder grass and tree species. Work toward stronger integration of dairy farming with agricultural production based on agroecological principles. Support infrastructure and organisational development at milk collection centres. Finally, explore and develop complementary income sources for dairy farmers, including carbon compensation schemes.
- In Eastern Province, continue supporting the further transformation of the groundnut value chain by scaling the COMACO approach up and out through partnerships with other value chain promoters. In doing so, ensure that no virgin land is converted to production to meet organic production standards for qualification. Strengthen the capacity of farmer organisations and their apex body. Support the participatory development of improved groundnut varieties and aflatoxin control treatments in partnership with farmers, processors, seed companies, and public research institutions. Finally, support the further development and scaling out of climate crop insurances.

Outlook

In 2013 (Hachigonta et al., 2013) applied a range of biophysical and socio-economic modelling approaches to assess the likely impacts of climatic change on the southern African region, including Zambia. The authors identified key vulnerabilities and made recommendations to hedge against them. Although the scope of their analysis, covering the entire agricultural sector, was much broader than ours,

their findings and recommendations largely agree with ours. The comparison confirms that transformative change has begun in Zambia's agricultural sector (for example, the switch from input-intensive cash crops like cotton and tobacco to food crops that work well in crop rotations (maize, soya, groundnuts) and have market potential in food value chains), but more needs to be done to enhance the sustainability of Zambia's agricultural resource base, especially with regard to deforestation.

The new government elected into power in August 2021 put its immediate focus on improvements in the health and education sectors, but major changes are expected in the implementation modalities of Zambia's agricultural support programme. Future interventions will likely improve access to a wider variety of inputs than in the past and include, amongst others, financial services. Hence, it will support diversification in the smallholder agriculture sector, in line with agroecological principles.

Lastly, recent research conducted by International Institute of Tropical Agriculture and World Agroforestry Centre in partnership with COMACO showed that the application of green manure in combination with conservation agriculture produces similar yields to crops planted with mineral fertiliser with substantially reduced input costs. Recent research by Masikati et al. (2021), who simulated crop-managing and socio-economic parameters over the next 30 years comparing conventional agricultural development strategies with sustainable agriculture intensification strategies, showed that a move toward a green economy will not only have positive effects on ecosystem service delivery but is also likely to contribute to poverty alleviation in the smallholder farming community.

Zusammenfassung

Hintergrund und Ziel

Die Nachhaltigkeit von Nahrungsmittelwertschöpfungsketten gilt als wichtiges Element nachhaltiger Ernährungssysteme. Dementsprechend umfassen sie die Themenbereiche der Ernährungssicherung und Armutsbekämpfung und spielen damit eine wichtige Rolle in Entwicklungsprojekten in Ländern des globalen Südens (FAO, 2014). Der Komplexität von Nahrungsmittelwertschöpfungsketten und der übergeordneten Systeme wird jedoch selten Rechnung getragen. Es fehlt dabei häufig an einem systemischen und multidimensionalen Verständnis von Nachhaltigkeit.

Diese Studie versucht, diese Lücke durch die Anwendung einer systemischen und partizipativ angepassten Version der Hotspotanalyse (HSA), wie vom Wuppertal Institut vorgeschlagen, zu schließen. Ausgehend von der Lebensgrundlage von Kleinbäuerinnen und Kleinbauern, die in den jeweiligen Nahrungsmittelwertschöpfungsketten tätig sind, streben wir an, Nachhaltigkeits-Hotspots, Zielkonflikte, potentielle Synergien sowie Innovationen zu identifizieren und aufzuzeigen. Dabei soll insbesondere dem Verständnis von Nachhaltigkeit und Werten der Kleinbäuerinnen und Kleinbauern Beachtung geschenkt werden.

Diese Studie war Teil des Forschungsprojekts „Nachhaltigkeit moderner Agrar- und Ernährungssysteme" (NAMAGE) des Seminars für Ländliche Entwicklung (SLE), finanziert durch das Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) unter der „Sonderinitiative EINEWELT ohne Hunger" (SEWOH). Unser Ziel war es ein methodisches Instrument zu entwickeln und erproben, welches geeignet ist Nachhaltigkeitsaspekte entlang von Nahrungsmittelwertschöpfungsketten zu identifizieren, mit dem Ziel den zugrunde liegenden Herausforderungen in Zukunft besser begegnen zu können und zukünftige Förderentscheidungen zu fundieren. Um dieses Instrument in der Praxis zu testen, haben wir die Milch- und Erdnusswertschöpfungsketten in Sambia beispielhaft untersucht. Unser besonderes Interesse bestand auch darin, die Ergebnisse unserer partizipativen Hotspot-Analyse mit agrarökologischen Prinzipien abzustimmen und herauszufinden, ob letztere tatsächlich transformative Veränderungsprozesse in den Wertschöpfungsketten (WSK) unterstützen können. Eines der wichtigsten Ziele der Entwicklungszusammenarbeit ist es, zur Armutsbekämpfung beizutragen und Ernährungssicherheit zu gewährleisten, insbesondere in ländlichen kleinbäuerlichen Gemeinschaften. Daher war es unser zentrales Anliegen, die vom Wuppertal

Institut vorgeschlagene Hotspotanalyse um starke partizipative Elemente zu ergänzen, um speziell Kleinbäuerinnen und Kleinbauern einzubeziehen.

Methodik

Unsere angepasste partizipative Hotspotanalyse (pHSA) beginnt mit einer systemischen Betrachtung der Nachhaltigkeitswahrnehmung von Kleinbäuerinnen und Kleinbauern, die in den Milch- und Erdnusswertschöpfungsketten Sambias tätig sind. Dies geschieht durch die Betonung der Systemfunktionalität als Schlüsselkonzept für nachhaltige Lebensgrundlagen. Die Beziehung zwischen den grundlegenden Ressourcen, die für die Aufrechterhaltung einer erfolgreichen Milch- oder Erdnussproduktion erforderlich sind, und den sozioökonomischen und ökologischen Systemen, die die Bereitstellung von Gütern und Dienstleistungen sicherstellen, verdeutlicht die Notwendigkeit bestimmte Nachhaltigkeitsaspekte zu bewahren, bzw. zu schützen. Anders als im Falle der WU-HSA, bei der Nachhaltigkeitsaspekte von Expert:innen vorgegeben werden, werden dadurch die Wahrnehmungen der Landwirte und Landwirtinnen von Anfang an in die Analyse mit einbezogen. Somit wird in Bezug auf die Ergebnisse des Konzepts mehr Handlungsfähigkeit erworben, mehr Eigenverantwortung erzielt und mit einer größeren Wahrscheinlichkeit die Annahme von nachhaltigkeitssteigernden Innovationen erreicht.

Zur Erfassung des Nachhaltigkeitsverständnisses und -einschätzung führten wir Fokusgruppendiskussionen mit unterschiedlichen Gruppierungen durch. Eine Einteilung in Untergruppen sollte gewährleisten, dass unterschiedliche Perspektiven basierend auf Alter und Geschlecht nicht untergehen. So ließ sich vorhandenes Wissen am effektivsten bündeln und dokumentieren. Die drei Untergruppen, bestanden aus männlichen, weiblichen und jugendlichen Teilnehmer:innen, mit je 4-6 Personen. Insgesamt nahmen 90 Landwirte und Landwirtinnen in 5 Fokusgruppendiskussionen an der Nachhaltigkeits-Hotspotanalyse entlang der WSK für Milchprodukte, bzw. 89 in 4 Fokusgruppendiskussionen in der WSK für Erdnüsse, teil. Die Fokusgruppendiskussionen wurden von Moderatoren angeleitet, indem sie Fragen zu Aspekten wie physiologischen, Sicherheits-, sozialen, kulturellen, ethischen und/oder individuellen Ressourcen stellten, wobei drauf geachtet wurde, die Diskussionen nicht in eine bestimmte Richtung zu beeinflussen. Der gesamte Prozess folgte fünf Schritten:

1. Identifizierung der für die Produktion notwendigen **Ressourcen**

Grundlegende Ressourcen, die für die Erdnuss- oder Milchproduktion benötigt werden, wurden von den Teilnehmer:innen identifiziert, auf Papierkarten dokumentiert und anschließend auf den Boden gelegt.

2. Identifizierung von **Systemen**, die diese Ressourcen bereitstellen

Im nächsten Schritt wurden die Systeme identifiziert, die die Bereitstellung dieser Ressourcen sicherstellen (z. B.: Weideland, das Futter für Rinder bereitstellt), auf Papierkarten geschrieben und mit den Basisressourcen in Beziehung gesetzt. Sozio-ökonomische Systeme wurden auf der rechten Seite der Ressourcenkarten platziert und ökologische auf der linken Seite.

3. Identifizierung von Nachhaltigkeitsaspekten

Nach der Identifizierung der Systeme, die wesentliche Güter und Dienstleistungen zur Sicherung der ermittelten Bedürfnisse bereitstellen, wurden die Nachhaltigkeitsaspekte jedes Systems ermittelt (z. B. die biologische Vielfalt der Grasarten in Weidegebieten). Diese wurden anschließend entsprechend zugeordnet und kategorisiert. Entweder

- als Voraussetzung für den Zugang zu den Systemen (sozioökonomisch) oder
- als Voraussetzung für die Selbsterhaltung der Systeme (ökologisch).

4. Identifizierung von Gefährdungen/Indikatoren

Gefährdungen sind Indikatoren, die die Gesamtfunktionalität von Nachhaltigkeitsaspekten einschränken (z. B.: der Verlust von Weidefutter-grasarten kann die nachhaltige Funktion von Weideland, sowie deren Biodiversität und Produktivität, vermindern). Innerhalb jeder Fokusgruppe wurden für jeden Nachhaltigkeitsaspekt eine oder mehrere Gefährdungen identifiziert, indem ein Gespräch über die Probleme initiiert wurde, mit denen die Gemeinschaft in Bezug auf die identifizierten Nachhaltigkeitsaspekte konfrontiert war.

5. Bewertung von **Indikatoren/Gefährdungen** nach vier Kriterien

Nachdem die Gefährdungen identifiziert waren, wurden von den Teilnehmer:innen jeder Fokusgruppe ihre Wirkung und Bedeutung ermittelt, indem sie sie mit 1 (niedrig), 2 (mittel) oder 3 (hoch) bewerteten:

Zuerst wurde die Auswirkung einer Gefährdung anhand von drei Kriterien beurteilt: 1) Geltungsbereich (Wie weit verbreitet ist diese Gefährdung?), 2) Schweregrad (Wie hoch ist diese Gefährdung vor Ort?) und 3) Permanenz (Wie einfach kann dieser Gefährdung begegnet werden?). Die Summe dieser drei Kriterien ergibt die **Wirkung**. Danach wurde der aktuelle Trend dieser Gefährdung anhand folgender Fragen bewertet: Nimmt diese Gefährdung bereits ab (1), ist sie stabil (2) oder nimmt sie zu (3)? Schließlich wird die **Bedeutung** der Gefährdung berechnet, indem der Wert für den Trend zum Wert der Wirkung addiert wird.

Ein Beispiel:

Die **Gefährdung** "verschiedene Weidegrasarten sterben aus" ist ein **Nachhaltigkeitsaspekt** der Biodiversität von dem viele Gebiete in der Südprovinz betroffen sind (Geltungsbereich = 3). Weiterhin stellt der Verlust wichtiger Futtergräser eine ernsthafte Gefährdung für die Weidewirtschaft da (Schweregrad = 3). Allerdings war die kleinbäuerliche Gemeinschaft davon überzeugt, diesen Prozess ohne externe Hilfe in den Griff zu bekommen (Permanenz = 2). Somit wurde der **Wirkung** dieser Gefährdung des Nachhaltigkeitsaspekts Biodiversität, der Wert (3 + 3 + 2 =) 8 zugeordnet. Zum Zeitpunkt der Diskussion verschlechterte sich aber die Situation bezüglich dieser Gefährdung noch (Trend = 3). Daraus ergibt sich ein Gesamtwert von (8 + 3 =) 11. Werte von 10 bis 12 zeigen einen Hotspot an. Werte von 9 und geringer werden nicht als Hotspots betrachtet.

Um die Ergebnisse aus den Fokusgruppendiskussionen zu ergänzen, sammelten wir Informationen unter Verwendung zusätzlicher partizipativer Forschungsmethoden wie Transekte, saisonale Kalender und Venn-Diagramme. In unserer Studie konzentrierten wir uns darauf, die WU-HSA an die Lebenssituation von Kleinbauern und Kleinbäuerinnen in Sambias Milch- und Erdnusswert-schöpfungsketten und folglich an die Produktionsphase anzupassen. Um jedoch ein umfassendes Verständnis dieser WSK zu erlangen, haben wir uns auch mit Akteuren aus nachgelagerten Phasen der WSK beschäftigt. Um dies zu erreichen, haben wir zwei unterschiedliche methodische Ansätze angewandt. Zunächst führten wir Einzelgespräche mit Vertreter:innen von Unternehmen und Organisationen, die in der Zulieferung, der Aggregation, dem Transport, der Verarbeitung und dem Handel tätig sind. Diese Gespräche wurden in Form von Leitfadeninterviews durchgeführt, die auf jede bestimmte WSK und Wertschöpfungskettenstufe zugeschnitten waren. Wir begannen die Gespräche mit einer Vorstellung vorläufiger Ergebnisse aus den relevanten Fokusgruppen-diskussionen und stellten die dort identifizierten Hotspots zur Diskussion. Darüber hinaus organisierten wir eine Validierungstagung in Lusaka. Zu dieser Veranstaltung luden wir Repräsentant:innen von Institutionen und Organisationen ein, die unterstützende und steuernde Funktionen in den WSK einnehmen. Weiterhin luden wir auch einige Akteur:innen mit Sitz in Lusaka ein. Aufgrund ihrer Funktion sowie Position in den WSK konnten uns diese Teilnehmer:innen zu einem Gesamtüberblick verhelfen, um somit quasi die WSK aus Sicht des Ernährungssystems besser zu verstehen.

Ergebnisse

Unsere pHSA-Methodik basiert auf dem Konzept ganzheitlicher Ernährungssysteme und wendet einen systemischen Ansatz an, um Aspekte der mehrdimensionalen Nachhaltigkeit entlang von WSK zu bewerten. Die pHSA erwies sich als

robust, einfach anzuwenden und an unterschiedliche Kontexte anpassbar. Wir haben sie in einer tier- und einer pflanzenbasierten Nahrungsmittelwertschöpfungskette getestet. Wir sind davon überzeugt, dass sie in einer Vielzahl von WSK, die von der Entwicklungszusammenarbeit unterstützt werden, gleichermaßen gut anwendbar ist. Die pHSA ist praxistauglich, einsatzbereit und kann voraussichtlich innerhalb eines 2 - 3-wöchigen Feldeinsatzes durchgeführt werden. Die erzielten Ergebnisse deckten Aspekte aus allen Dimensionen der Nachhaltigkeit ab.

In der Milchwertschöpfungskette wurden in den Fokusgruppendiskussionen und Einzelgesprächen insgesamt 137 Gefährdungen von Nachhaltigkeitsaspekten identifiziert. Dabei umfasste die soziale Dimension die meisten Gefährdungen (61), dicht gefolgt von wirtschaftlichen (56) und ökologischen Gefährdungen (20). Von den 61 genannten sozialen Gefährdungen wurden 21 als Hotspots eingestuft. Von 56 genannten wirtschaftlichen Gefährdungen wurden 24 als Hotspot eingestuft. Der Anteil der Hotspots innerhalb der ökologischen Dimension ist allerdings beachtlich höher. Von den 20 genannten Gefährdungen wurden 15 als Hotspot identifiziert. Dies bedeutet, dass ökologische Aspekte häufiger einen Nachhaltigkeits-Hotspot darstellten als Gefährdungen in den anderen Dimensionen.

In der Erdnusswertschöpfungskette wurden insgesamt 88 Gefährdungen von Nachhaltigkeitsaspekten von den Akteuren identifiziert. Interessanterweise fällt fast die Hälfte der identifizierten Gefährdungen (43) in die soziale Dimension, was die Bedeutung sozialer und gemeinschaftsbasierter Ansätze für die Förderung von WSK bestätigt. Aus den 88 Gefährdungen wurden insgesamt 31 Hotspots identifiziert und bewertet. Während bei den Gefährdungen noch soziale Themen dominierten, verteilen sich die bewerteten Hotspots jedoch ziemlich gleichmäßig auf die drei unterschiedlichen Dimensionen. Von 43 Gefährdungen in der sozialen Dimension wurden nur 11 als Hotspots bewertet. Wohingegen rund die Hälfte der Gefährdungen in den ökonomischen und ökologischen Dimensionen als Hotspots eingestuft wurden.

Die von unseren Interviewpartnern identifizierten und bewerteten Gefährdungen und damit verbundenen Hotspots spiegeln die von der FAO postulierten agrarökologischen Prinzipien wieder (HLPE, 2019). Diesen durch geeignete Interventionen und Innovationen zu begegnen, ist demnach für den Transformationsprozess der Lebensmittelsysteme im Rahmen der Agrarökologie förderlich. Aus unseren Ergebnissen konnten umsetzbare Empfehlungen, sowohl auf der skalierbaren als auch auf der transformativen Ebene im Rahmen der Agrarökologie (Gliessman, 2016), abgeleitet werden. Als Teil unserer Forschung konnten wir auch potenzielle Innovationen aufnehmen, bzw. Innovationen identifizieren, die sich bereits zur

Skalierung in näherer Zukunft empfehlen. Weiterhin konnten wir durch unseren Ansatz wichtige Zielkonflikte identifizieren, die Entscheidungsträger:innen im Prozess der Gestaltung von Unterstützungsmaßnahmen sorgfältig bewerten und ausbalancieren sollten.

Unsere Forschungsergebnisse zeigen, dass ein partizipativer Forschungs-ansatz, wie wir ihn gewählt haben, einer wissenschaftlichen Überprüfung von Expert:innen bedarf. Denn einige, der in den Fokusgruppendiskussionen identifizierten, Nachhaltigkeitsaspekte und deren Gefährdungen basierten zum Teil auf subjektiven Wahrnehmungen und Erfahrungen, sowie wissenschaftlich nicht belegbaren Vorstellungen über biophysikalische Prozesse. Da es sich dabei aber dennoch um reale Herausforderungen und Ängste handelt, sollte sowohl darauf als auch auf die wissenschaftlich belegbaren Ursachen der Probleme eingegangen und in der Entwicklung von Lösungsansätzen und Interventionen berücksichtigt werden. Kenntnisse über die Wahrnehmung und den Wissenstand der Zielgruppe von Unterstützungsmaßnahmen im Rahmen der Entwicklungs-zusammenarbeit in Bezug auf Nachhaltigkeitsaspekte, liefern also wertvolle Informationen für die Gestaltung von Schulungs- und Sensibilisierungskampagnen. Daraus ergibt sich die die Grundlage für ein gemeinsames Lernen.

Empfehlungen

Wir empfehlen die Anwendung der pHSA im Rahmen des Bewertungsprozesses von Nahrungsmittelwertschöpfungsketten, die aktuell oder zukünftig durch die deutsche Entwicklungszusammenarbeit unterstützt werden. Darüber hinaus empfehlen wir, detaillierte Bewertungskriterien für die Identifizierung von Innovationen als Teil der pHSA-Methodik zu entwickeln. Die pHSA sollte von einem Moderationsteam aus 4 - 6 internationalen und nationalen Expert:innen durchgeführt werden. Die Durchführung sollte wie nachfolgend beschrieben erfolgen:

a) Partizipative Hotspotanalyse (pHSA) mit allen Akteuren der WSK durch Fokusgruppendiskussionen in der Produktionsphase (einschließlich vor- und nachgelagerter Schritte, falls zutreffend) und Einzelgesprächen in den anderen Phasen.
b) Validierung und Ergänzung der Erkenntnisse aus Schritt a) durch WSK-Expert:innen aus unterstützenden und steuernden Ebenen der WSK.
c) Verifizierung der Erkenntnisse aus Schritt a) und b) anhand vorhandener wissenschaftlicher Erkenntnisse und darauf aufbauend die Erarbeitung konkreter Handlungsempfehlungen.

Um die Nachhaltigkeit der Wertschöpfungsketten für Erdnüsse und Milchprodukte in Sambia zu verbessern, empfehlen wir Folgendes:

- In der Südprovinz, sollte die Verfügbarkeit und der Zugang zu Wasser-ressourcen für Milchbäuer:innen, insbesondere zur Viehtränkung, Futtermittelproduktion, Milchverarbeitung und ergänzende Wirtschaftstätigkeiten verbessert und gesichert werden. Diese Maßnahmen sollten von Sensibilisierungs- und Schulungsmaterialien zum Wasserressourcenmanagement für Milchbäuer:innen begleitet werden. Die Entwicklung und Einführung dürreresistenter Futtergräser und Baumarten sollte unterstützt werden. Weiterhin sollte auf eine stärkere Integration der Milchviehhaltung mit der landwirtschaftlichen und gärtnerischen Produktion auf der Grundlage agrarökologischer Prinzipien hingewirkt werden. Die Infrastruktur und organisatorische Entwicklung der Milchsammelstellen sollten unterstützt werden. Schließlich sollten ergänzende und zukünftige Einkommensquellen für Milchbäuer:innen identifiziert und entwickelt werden, einschließlich Kohlenstoffausgleichsregelungen.
- In der Ostprovinz sollte der Transformationsprozess in der Erdnuss-Wertschöpfungskette weiterverfolgt werden, indem der COMACO-Ansatz durch Partnerschaften mit anderen Förderern der Wertschöpfungskette ausgeweitet wird. Dabei muss sichergestellt werden, dass durch die Umstellung auf den ökologischen Anbau keine, bisher naturbelassene, Flächen in Ackerland umgewandelt werden. Die Kapazitäten von Bauernorganisationen und ihrer Dachverbände sollte weiterhin gestärkt werden. Die partizipative Entwicklung verbesserter Erdnusssorten und Behandlungsmethoden zur Bekämpfung von Aflatoxin sollten, in Partnerschaft mit Landwirt:innen, Verarbeiter:innen, Saatgutunternehmen und öffentlichen Forschungseinrichtungen, unterstützt werden. Schließlich sollte die weitere Entwicklung und Verbreitung von Klimaversicherungen unterstützt werden.

Ausblick

Im Jahr 2013, wendeten Hachingonta et al. (2013) eine Reihe von biophysikalischen und sozioökonomischen Modellierungsansätzen an, um die wahrscheinlichen Auswirkungen des Klimawandels auf die Region des südlichen Afrikas, einschließlich Sambia, zu bewerten. Die Autoren haben die wichtigsten Schwachstellen identifiziert und Empfehlungen zum Schutz dieser Schwachstellen gegeben. Obwohl ihre Analyse, die den gesamten Agrarsektor abdeckte, breiter angelegt war als unsere, stimmen ihre Ergebnisse und Empfehlungen im Großen und Ganzen

mit unseren überein. Der Vergleich bestätigt, dass in Sambias Agrarsektor ein Wandel begonnen hat, zum Beispiel die Umstellung von Feldfrüchten, die einen hohen Betriebsmittelaufwand bedürfen, wie Baumwolle und Tabak, auf Kulturarten, die sich gut in Fruchtfolgen einfügen (Mais, Soja, Erdnüsse) und ein Marktpotenzial in Lebensmittelwertschöpfungsketten haben. Aber es muss noch mehr getan werden, um die Nachhaltigkeit der landwirtschaftlichen Ressourcenbasis Sambias zu verbessern, insbesondere im Hinblick auf die Entwaldung.

Im August 2021 wählte die sambische Bevölkerung eine neue Regierung. Diese legte zwar unmittelbar nach dem Regierungsantritt ihren Schwerpunkt auf Verbesserungen im Gesundheits- und Bildungssektor, jedoch werden größere Änderungen bei den Durchführungsmodalitäten des sambischen Programms zur Unterstützung der Landwirtschaft in naher Zukunft erwartet. Künftige Maßnahmen werden wahrscheinlich den Zugang zu einer breiteren Palette von Betriebsmitteln verbessern als es in der Vergangenheit der Fall war und unter anderem auch Finanzdienstleistungen umfassen. Damit würde die Diversifizierung der kleinbäuerlichen Landwirtschaft im Einklang mit agrarökologischen Grundsätzen unterstützt.

Schlussendlich haben jüngste Forschungsarbeiten des International Institute of Tropical Agriculture und des World Agroforestry Centre in Zusammenarbeit mit COMACO gezeigt, dass der Einsatz von Gründüngung in Kombination mit ressourcenschonender Landwirtschaft ähnliche Erträge wie der Anbau von Pflanzen mit Mineraldünger erbringt bei deutlich geringerem Betriebs-mittelaufwand. Eine kürzlich erschienene Veröffentlichung von Masikati et al. (2021), die pflanzenbauliche und sozioökonomische Parameter für die nächsten 30 Jahre simuliert und dabei konventionelle landwirtschaftliche Entwicklungsstrategien mit Strategien zur nachhaltigen Intensivierung der Landwirtschaft vergleicht, zeigt, dass der Übergang zu einer grünen Wirtschaft nicht nur positive Auswirkungen auf die Erbringung von Ökosystemleistungen haben kann, sondern auch zur Armutsbekämpfung in der kleinbäuerlichen Bevölkerung beitragen kann. Die Ergebnisse unserer Studie zeigen auf wie der Weg dorthin beschritten werden kann.

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Abbreviations

AE	Agroecology
AI	Artificial insemination
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
COMACO	Community Markets for Conservation
DAZ	Dairy Association Zambia
FOA	Food and Agriculture Organisation of the United Nations
GIC	Green Innovation Centres for the Agriculture and Food Sector
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HLPE	High Level Panel of Experts on Food Security and Nutrition
IAPRI	Indaba Agricultural Policy Research Institute
KII	Key informant interview
MCC	Milk Collection Centre
MFL	Ministry of Fisheries and Livestock
NAIS	National Artificial Insemination Services
NAMAGE	Nachhaltigkeit moderner Agrar- und Ernährungssysteme / Sustainability of modern agricultural and food systems
pHSA	Participatory Hot Spot Analysis
SACCO	Savings and Credit Cooperative Organisation
SEWOH	ONE WORLD – No Hunger
SFVC	Sustainable food value chains
SFVCD	Sustainable Food Value Chain Development
SLE	Seminar für Ländliche Entwicklung / Centre for Rural Development
TBL	Triple bottom line
VC	Value chain
WU-HSA	Wupperal Institute – Hot Spot Analysis

1 Introduction

"We have to remember that what we observe is not nature itself, but nature exposed to our method of questioning"
Werner Heisenberg

It seems to be a complex and paradoxical dilemma: between 720 and 811 million people worldwide suffer from hunger, while 650 million are afflicted by obesity and other food-related lifestyle diseases (FAO et al., 2020; WHO, 2021). Agricultural production accounts for an estimated 43 – 57 % of human-caused greenhouse gas emissions alongside drastic biodiversity losses and land degradation while, at the same time, the agricultural sector is the largest employer in the world and ensures the livelihood of billions (ILO, 2021; UNCTAD, 2013). Clearly, the tasks for agriculture and food systems in the coming years are huge: feeding a population projected to grow to 10 billion in 2050, while significantly reducing environmental impacts and ensuring social equity worldwide (Searchinger et al., 2019). Facing these global challenges, an important question is, therefore, how do we transform our food systems to sustainable agri-food systems that nourish, provide energy, support equitable access to resources, and damage neither health nor the environment? (see TEEB, 2018a). Many initiatives have already explored the future of agriculture and there is a considerable number of recent policies (e.g., the Farm to Fork Strategy within the European Green Deal or the first United Nations Food System Summit)[1] detailing crosscutting levers of change that promote more sustainable and equitable food systems.

In the spirit of these debates, the concept of sustainable food value chains (SFVC) is considered an important element of durable food systems. As SFVC can be causally related to aspects of food security and pathways out of poverty, the concept is particularly prominent in development projects in countries of the Global South (FAO, 2014). However, food value chains are complex systems and pivot around different narratives and concepts. So far, little attention has been paid to connect food value chains to the systemic and multi-dimensional understanding of sustainability. Without this holistic perspective, critical impacts and trade-offs

[1] With the global COVID19 pandemic shining a spotlight on the vulnerabilities of food systems, the year 2021 placed a landmark on the importance of sustainable food systems; both the United Nations and the European Union have made it their top agenda point as a result.

along value chains are neglected, especially as they are usually economically invisible (TEEB, 2018b). Moreover, the concept of "multiple values", their creation, and their capture through multidimensional and context-specific lenses, has, so far, not yet been fully developed and reflected in the promotion of food value chains.

Existing instruments of sustainability assessments along value chains either ignore the multi-dimensional character of sustainability or are too complex and time consuming to be broadly applicable for practitioners, or both. This study contributes to filling this gap through the application of a systemic and participatory adapted version of the hotspot analysis, as proposed by the Wuppertal Institute (WU-HSA), thus taking the livelihood of small-scale farmers engaged in food value chains as a point of departure and integrating their understanding of sustainability and values to reveal sustainability hotspots, trade-offs, synergies as well as innovations.

1.1 Study context

The study project is part of the research project "sustainability of modern agricultural and food systems" (NAMAGE) of the Centre for Rural Development (SLE) funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) under its special initiative "ONE WORLD - No Hunger" (SEWOH). The research project seeks to find and test the design and implementation of a holistic but practical approach to assess sustainability aspects of future value chain promotion (see Figure 1 for information on the cooperation partners). The theoretical and conceptual work examines and analyses, in particular, the working and impacts of SEWOH, related projects, and their approaches to value chain promotion, with a particular focus on the work of GIZ's Green Innovation Centres for the Agriculture and Food Sector (GIC). This conceptual research work is supported through empirical findings drawn from case studies in Zambia on groundnut and dairy value chains and case studies in Uganda on the value chains of Irish potatoes and Nile perch.[2]

Zambia is not only known for the greatest curtain of falling water in the world, but for its copper wealth as well as being one of the most urbanised and peaceful countries in Africa (Taylor, 2006). But, Zambia also tops the list of countries with high levels of poverty and inequality (World Bank, 2015). The facts are glaring: more

[2] For more information on the Uganda project, refer to SLE Publications: https://edoc.hu-berlin.de/handle/18452/25033

than half of the population lives below the international poverty line,[3] with a hunger situation classified as "serious" (von Grebner et al, 2020). Being landlocked by an astounding eight countries explains Zambia's regional strategic importance on the one hand, but also its sensitivity to socio-economic disturbances on the other hand (Taylor, 2006).

Even though agriculture employs 85 % of the population, it only contributes 9.2 % to the gross domestic product while it significantly contributes to deforestation and environmental degradation in the country (FAO, 2021a). Zambia has the highest deforestation rate in Africa and fifth in the world (Jere, 2020). Due to these manifold problems and challenges in the agricultural sector, holistic and broad-based solutions are necessary. The assumption is that value chain promotion embedded in a food system approach can address multi-sectoral challenges and thus be of tremendous value in creating sustainable nutrition pathways. But existing knowledge of this complex issue has not yet translated into the development of a robust and easy-to-use methodology to assess and improve sustainability aspects of food value chains. Hence, this study aims to improve the contextual understanding of sustainability hotspots along the value chains of groundnut and dairy. Moreover, our research will contribute to the ongoing debate on suitable and practical sustainability assessment approaches in the field by its exploratory and participatory nature.

Our project partners, BMZ and NAMAGE, selected the groundnut and dairy value chains for this case study based on their nutritional qualities, potential for commercialisation, as well as contribution to rural diets through home consumption. The selection of a plant-based as well as an animal-based value chain is meant to ensure the broad applicability of our analysis tool across a wide range of value chains. Local cultivation of groundnuts may help improve the nutritional status of the rural and urban population as they are an excellent source of many macronutrients: protein, healthy fats, fibre, minerals, and vitamins. This is particularly critical in Zambia, where groundnuts are often cultivated by women and are considered a women's crop. Being that women are also tasked, culturally, with purchasing and preparing family meals, having ready access to groundnuts may mean that children may have reasonable access to a vital source of protein in the diet. This is of particular importance given that stunting rates related to calorie and protein deficiency amongst children under five years of age are notoriously high. The versatile use of

[3] The poverty line is the minimum level of income deemed adequate in a particular country. Currently, the international poverty line is estimated at $1.90 US per day (World Bank, 2021a).

groundnuts, from raw consumption to processing into powders, oils, butters, and hygiene products such as soaps, make it an excellent cash crop. Moreover, the legume crop enhances soil fertility through nitrogen-binding properties (Chikobola, 2016).

Similarly, enhanced dairy production may strengthen food security and counteract malnutrition, particularly among children (Pfeuffer & Watzl, 2018). Nutritional physiology data show that the consumption of dairy products such as milk is associated with higher bone density and a lower risk of a range of (Pfeuffer & Watzl, 2018). The FAO asserts that dairy production offers sustainable growth opportunities and poverty alleviation through employment creation in Zambia (Neven et al., 2017). However, negative impacts of dairy production, like its high demand for water resources and contribution to global greenhouse gas emissions, have to be considered.

Research collaboration and the study team

Upholding SLE's philosophies on local empowerment and inclusion in international cooperation, but also necessitated by the threat of COVID-19 travel restrictions, the study design involved Zambian research partners. Their role was particularly imperative in initiating and strengthening international research networks and thus firmly anchoring our research in the Zambian context.

To facilitate this research collaboration, the SLE entered a Memorandum of Understanding with IAPRI, one of the leading agricultural institutes for empirical research in Zambia. IAPRI has constantly expanded its mandate, outreach, and strategic network over the years, making possible the remote recruitment of an interdisciplinary team of five Zambian Masters graduates closely matching the German team's academic, employment, and research expertise. Although it was not possible to involve the Zambian team in the conceptual development phase of the study in Berlin during June and July of 2021, they provided valuable input to the research plan, the execution of the field work, the adaptation of the methodology during the field phase, and in data analysis and report writing.

Figure 1 below provides an overview of the timeline and workflow for project components carried out in Germany and Zambia, as well as team members, cooperation partners, and a pictorial representation of the approximate location of the field research areas in Zambia.

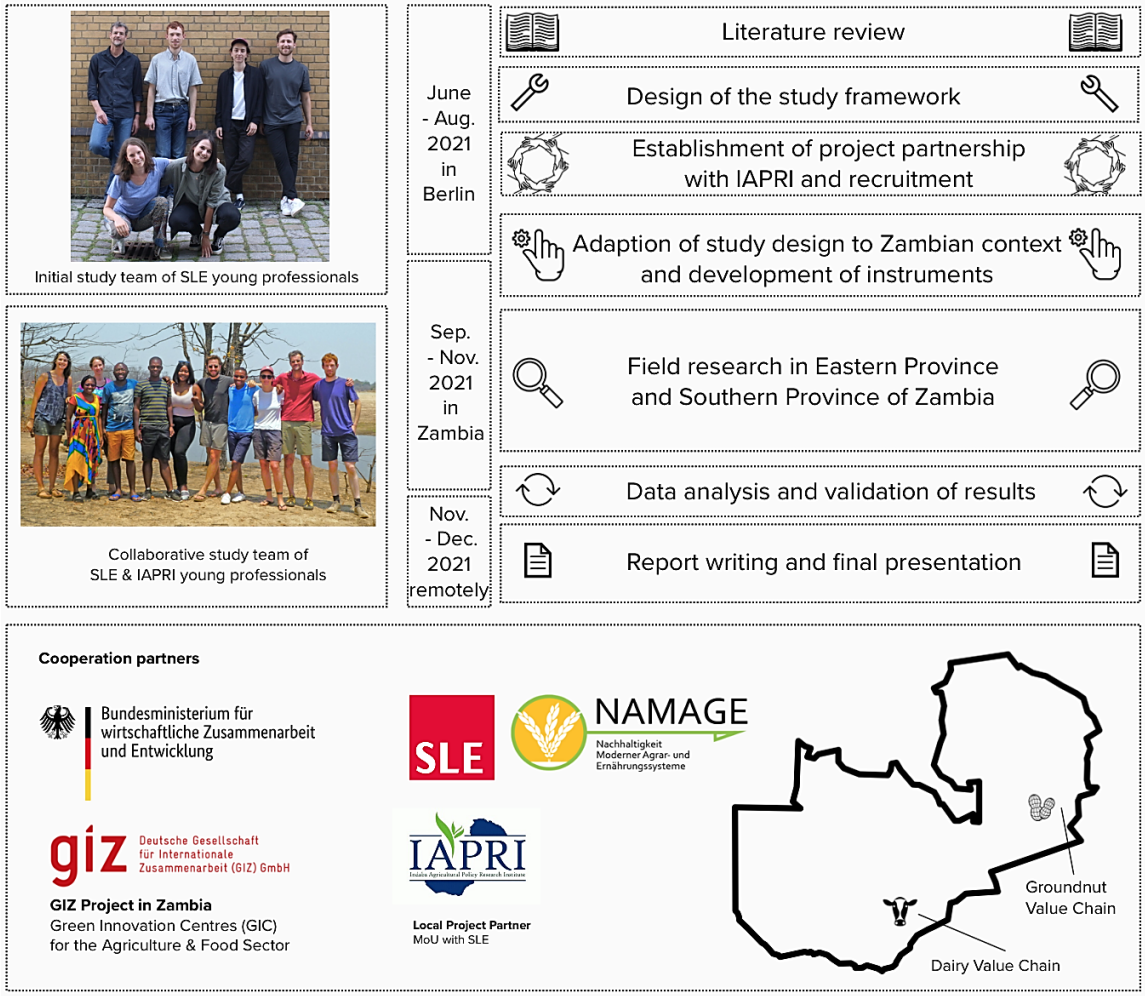

Figure 1: Cooperation partners and project workflow

Source: Carolin Müller & Annika Reimann

1.2 Study objective and guiding research questions

Coming back to the aforementioned knowledge and methodological gap, this research aimed to find, further develop, and test a participatory sustainability assessment tool suitable to identify critical areas of sustainability along the groundnut and dairy value chains in Zambia (output 1.1, see Figure 2) based on value chain (VC) actors' perceptions of multidimensional sustainability (output 1.2). Moreover, it analysed the alignment of the results with principles of agroecology and identified and discussed innovations, trade-offs, and synergies along the two VCs. Hence, the following questions guided the research:

- How can the WU-HSA be enriched with systemic and participatory elements? How does our adapted pHSA perform as a rapid and robust instrument to identify critical sustainability aspects along food value chains? And, is it possible to capture perceptions of multi-dimensional sustainability held by value chain actors through our approach?
- Are the results of the pHSA in line with agroecological principles? Do the results from our pHSA support a transformative value chain development process?
- Which trade-offs, synergies, and innovations can be identified along the groundnut and dairy VCs in Zambia?[4]

[4] We understand innovations as the transfer of solutions from similar problems to new contexts.

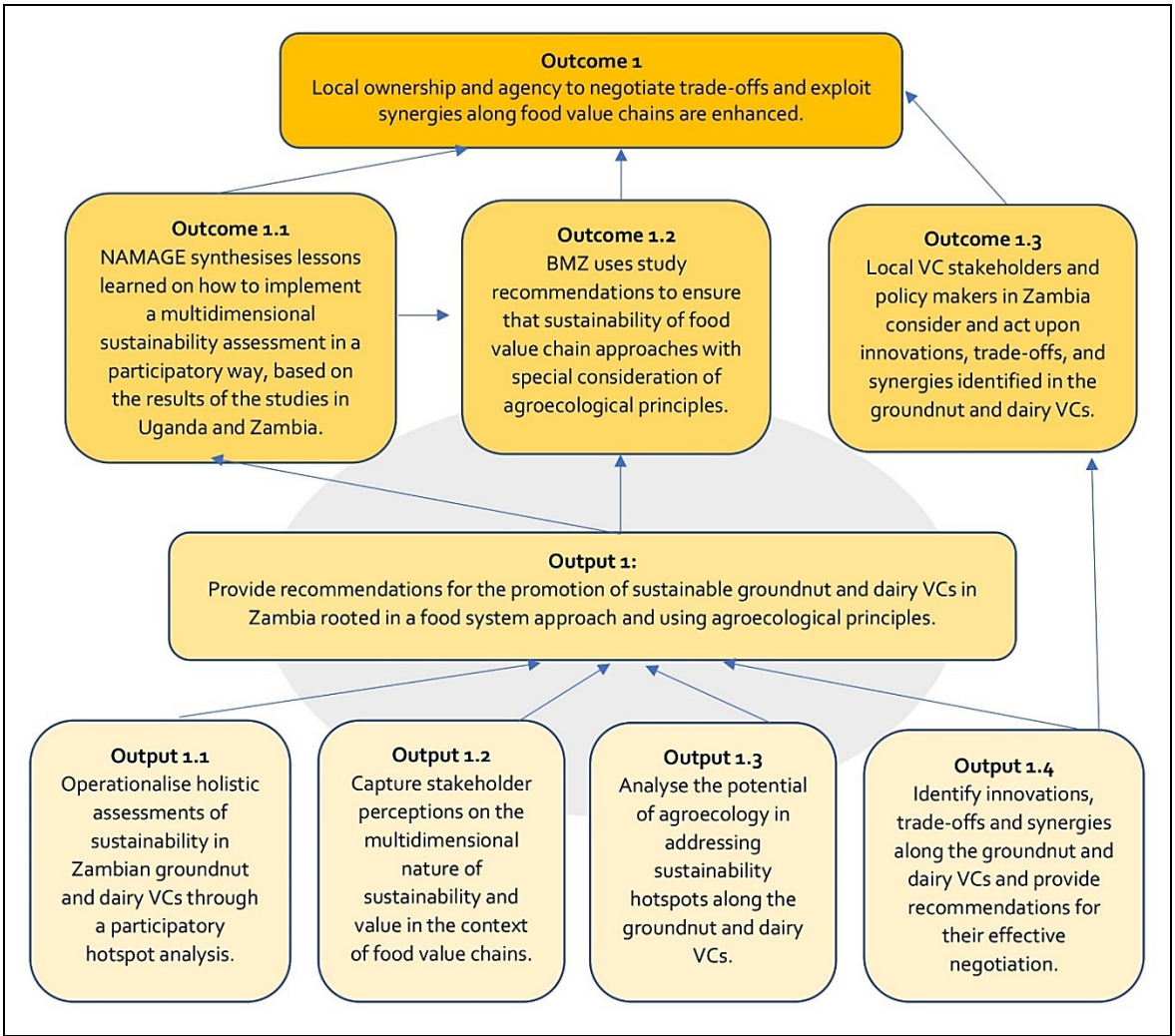

Figure 2: Study objectives

Recognising the need to improve and support future interventions in value chains, a key output was recommendations for project partners and international development organisations. Thereby, this study fed into the conceptual and methodological work of the NAMAGE research project, which will synthesise findings from its studies in Zambia (outcome 1.1) and Uganda and draw conclusions informing decision making on various levels of food systems. Going forward, these findings may enable BMZ to apply a more participatory and multidimensional understanding to current and future food VC promotion projects (outcome 1.2) and enable local stakeholders to act upon them (outcome 1.3). In the long run, this research encourages systemic and participatory approaches to identify and address sustainability hotspots, as it enhances local ownership and agency to negotiate trade-offs and exploit recommendations for improvement in food value chains (outcome 1).

2 Theoretical and conceptual background

Sustainability is a multi-faceted, complex concept that can only be understood within a specific context. Therefore, to ground our research in the theoretical debate, we will now briefly discuss value chains as part of food systems, introduce the concept of multidimensional sustainability, and elaborate transformative food system change in the context of agroecology. We conclude the chapter with an introduction of the hotspot analysis developed by the Wuppertal Institute, which serves as a conceptual starting point for the development of our methodological approach.

2.1 Value chains as part of a food system

Analysing value chains through a systems lens is a rather novel approach (IPES-Food, 2015). Our point of departure for a better understanding of sustainable food systems is based on the framework developed by Nguyen (2018; see Figure 3 below): a food system comprises all actors, processes, inputs, and (intermediary) goods that are required to provide food and nutrition security to society.

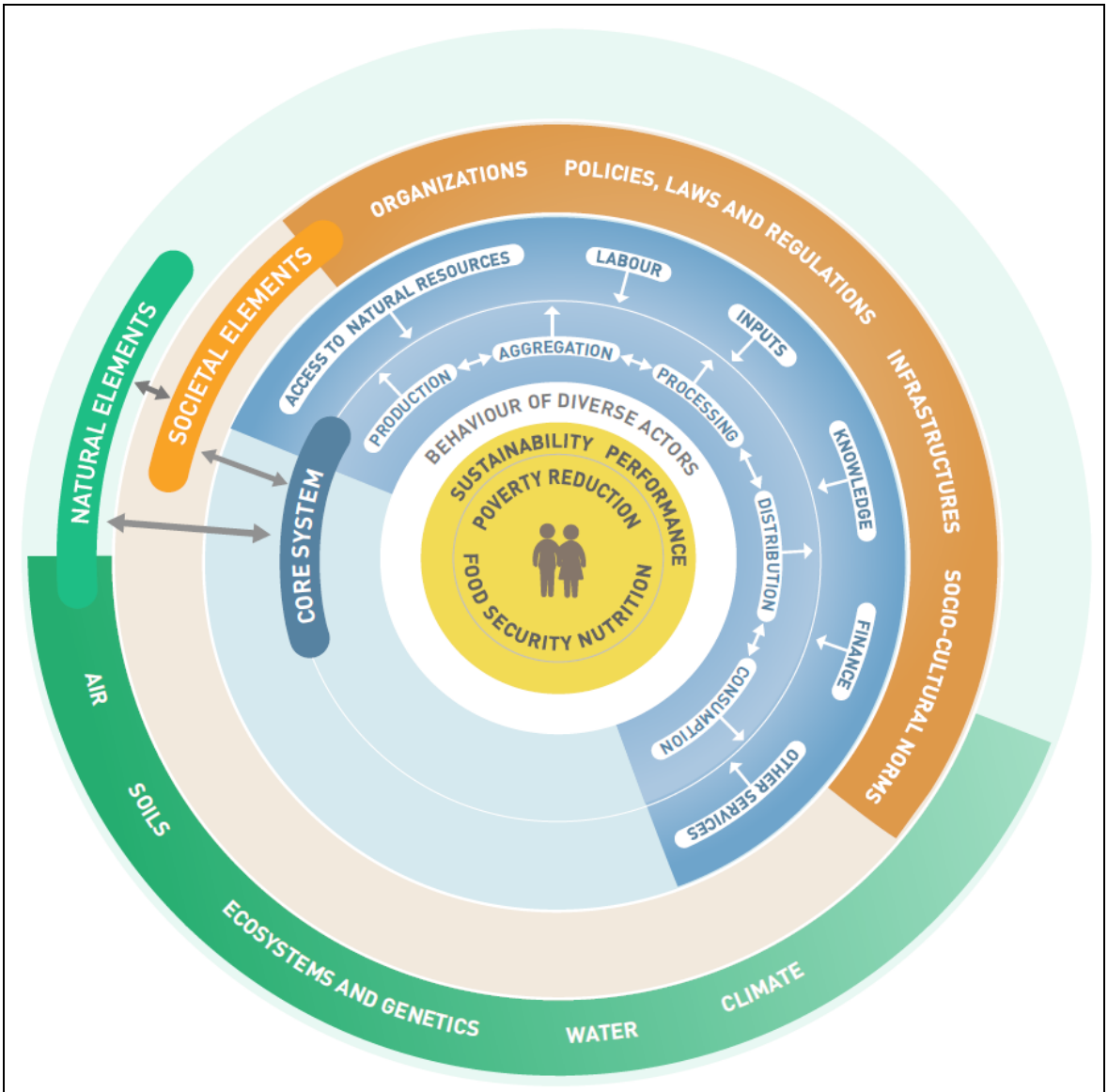

Figure 3: The food systems wheel

Source: From: *Sustainable food systems: Concept and framework* (p. 3) by Nguyen 2018, (https://www.fao.org/3/ca2079en/CA2079EN.pdf). CC BY-NC-SA 3.0.

A food system stretches along the entire food life cycle from production in agriculture, forestry, and fishery to consumption and waste disposal. In other words, all food value chains taken together are a core element of the food system and are embedded in its societal elements as norms, policies, and infrastructure. Due to its holistic orientation, this systems approach allows for identification of root causes of and solutions to complex challenges.

Food systems play an important role for overall sustainable development. Naturally, every person is part of a food system, at least as a consumer. Moreover, the

agricultural and agri-food sectors constitute the largest part of the economy in most countries of Sub-Saharan Africa and provide livelihoods and employment to many people (FAO, 2014). The food system is closely linked to the environment. Food producers depend on factors beyond their control (e.g., soils, climate); at the same time, they have a major impact on these factors through land use and agricultural biodiversity management. Bearing this systemic view in mind, our units of analysis will be the dairy and groundnut value chains in Zambia as part of the food systems. We take the value chain as defined within the Sustainable Food Value Chain Development (SFVCD) framework of the FAO (2014) as the foundation for our analysis and complement it with more multi-dimensional approaches to sustainability, such as agroecological principles.

The SFVCD framework defines a sustainable food value chain as:

> *The full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society and does not permanently deplete natural resources.*
> *(FAO, 2014, p. 6).*

However, its three intervention areas are rather narrowly focused on economic outcomes, namely 1) investments by agro-enterprises to improve the efficiency of production and food supply; 2) the creation of decent work, which partially relies on job creation outside the food system to increase affordability of food; and 3) an increase in tax revenue to expand the scope for public services.

2.2 Multidimensional sustainability

Nguyen (2018) postulated that the sustainability of a food system is generally measured along three dimensions which are causally linked and cannot be analysed independently:

- economic — a food system is profitable for all actors participating in it
- social — a food system benefits society in multiple ways
- ecological — food system processes do not harm environmental systems

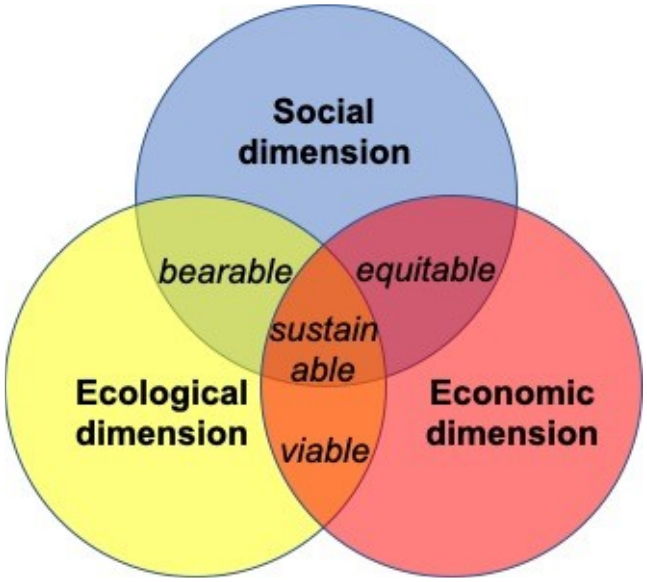

Figure 4: Visualisation of the triple bottom line of sustainability

Source: adapted from Rogers & Hudson, 2011

At its conceptual level, the triple bottom line (TBL) (Figure 4) is based on and places equal importance on each of the social, environmental, and economic dimensions (Elkington, 1997), which are frequently advocated for under the catchy phrase "people, profit, and planet". It serves as an assessment tool that has become popular in the business world because it appears to present the opportunity to measure sustainability outcomes objectively.

However, contrary to its conceptual understanding, in practice, the underlying sustainability goals are not integrated but viewed in a fragmented and additive manner, meaning that they are considered separately using a variety of indicators whose total sum are supposed to indicate "sustainability". Similar to the SFVCD, the TBL advocates that social and environmental goals will be met through trickle-down effects. Stressing the differences between the economic, social, and environmental dimensions of sustainability underscores the compartmentalisation of these goals, emphasising their coexistence rather than their interdependence which, in turn, contradicts the holistic approach in which the food system concept is actually rooted (Gibson, 2006).

Taking the more holistic approach of the food system into account, when considering the sustainability of value chains, one may conclude that the definition of SFVC falls short. It does not do justice to the complexity of the system and its interdependencies because it offers too little space to shift the focus from trade-offs and isolated solutions to trade-ins and integrated development outcomes (Mausch et al., 2020; Vågsholm et al., 2020). Hence, a concept of sustainability should be applied that emphasises interconnectedness of dimensions as a basis for planning interventions (Benton & Bailey, 2019; Hall & Dijkman, 2019). Thus, in this study we aim to enrich the sustainability concept of the SFVC with a multidimensional understanding of sustainability in line with agroecological principles and by placing special focus on participation.

2.3 Agroecology

In recent years, the notion of agroecology (AE) has gained prominence as a potential guideline for the transition to sustainable food systems and the development of new VCs (Gliessman et al., 2019; Goïta & Frison, 2020; HLPE, 2019; Willett et al., 2019). There are multiple definitions for agroecology, which can be identified in its threefold nature

- as a **transdisciplinary scientific discipline**, agroecology is underpinned by the coexistence of different scientific disciplines as well as local knowledge exchanged from farmer to farmer or among other actors along the food VC (Nicholls et al., 2016);
- as **agroecological practises**, which intend to mimic ecological processes in agricultural production to help reduce the need for external inputs; they are locally adopted and controlled and they embrace systemic management of components' interactions in the agricultural system (HLPE, 2019);
- as a **socio-political movement** initiated by smallholders in support of sustainable smallholder agriculture, with regard to practical application of agroecology and food sovereignty (Gliessman, 2016; Rosset et al., 2011).

Table 1 shows the 13 agroecological principles that were compiled by the High Level Panel of Experts (HLPE) on Food Security and Nutrition (HLPE, 2019). These 13 agroecological principles are consistent with the SFVCD approach in the sense that they span aspects of food production, processing, and consumption. They are also consistent with the operational principals of a sustainable food systems, broadly corresponding with the economic ("improve resource efficiency"), ecological ("strengthen resilience"), and social ("secure social equity/responsibility") dimensions of sustainability.

Gliessman (2015; 2016) proposes a framework for transformative food system change (see Figure 5). This framework builds on the agroecological principles by placing them on a pathway through several levels toward the final goal of sustainable food systems. These levels stretch from farmer-driven change processes to a full re-thinking of basic beliefs, values, and ethical systems at the societal and global levels (Gliessman, 2015, 2016). In this study, we built upon all of these concepts, from SFVCD to TBL to agroecology, and integrated them in the design of a methodology to assess sustainability hotspots in the context of value chain promotion as part of international cooperation and development.

Table 1: 13 agroecological principles	
Agroecological principles	**Sustainable food systems operational principles**
1. Recycling	Improve resource efficiency
2. Input reduction	
3. Soil health	Strengthen resilience
4. Animal health	
5. Biodiversity	
6. Synergy	
7. Economic diversification	
8. Co-creation of knowledge	Secure social equity/responsibility
9. Social values and diets	
10. Fairness	
11. Connectivity	
12. Land and natural resources governance	
13. Participation	
Source: Adapted from HLPE, 2019	

In line with Griffith et al. (2017), we argue that a practical approach to the assessment of sustainability along a particular value chain cannot start with mere balancing of results from single measurements. A holistic assessment of the level of sustainability should rather be based on the perceptions of stakeholders engaged in a particular value chain and should start by identifying bottlenecks and obstacles along the path to higher levels of sustainability.

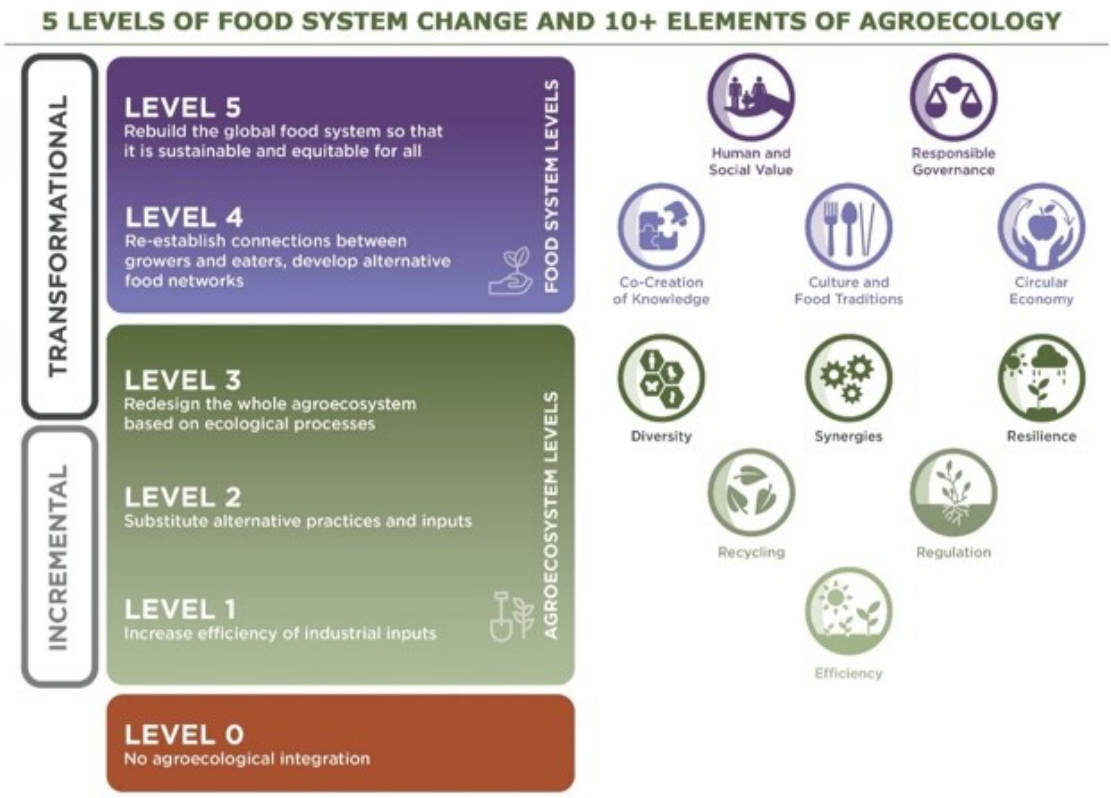

Figure 5: The five levels of food system change according to Gliessmann 2025, 2016.

Source: Biovision (https://www.agroecology-pool.org/methodology/)

2.4 The hotspot analysis of the Wuppertal Institute

While the scientific debate on sustainability frameworks is far advanced and fairly complex, it has not yet been translated into appropriate tools and instruments to operationalise frameworks for application in the real world (Griffith et al., 2017). Starting from the assumption that all value chains are, in one way or another, negatively affected by sustainability failures, the hotspot analysis provides a valuable tool for identifying underlying bottlenecks and obstacles to higher levels of sustainability along value chains. The Wuppertal Institute of Climate, Environment and Energy developed a hotspot analysis that takes a multidimensional approach to value chains assessments, encompassing socio-economic and environmental aspects of sustainability. This holistic approach targets the identification of high-priority areas throughout all value chain phases (the Wuppertal Institute uses the term "life cycle phases"), by evaluating aspects that go beyond the economic value (Bienge et al., 2009). The results of the hotspot analysis help identify impactful action points.

The analysis begins by defining value chain phases in their most basic form (for example, production, aggregation, processing, distribution, and consumption) and identifying social and environmental sustainability aspects within these value chain phases. In next steps, the relevance (criticality) of each value chain phase and then each sustainability aspect within these value chain phases is assessed from 1 (low) to 3 (high). Multiplying these numbers together gives a product and if that product is 6 or 9, it is considered a sustainability hotspot in the social and ecological categories along the entire value chain. Bienge et al. (2009) provided an example of this calculation: if the social aspect "general working conditions" may be assigned a relevance of 3 in the production phase and a relevance of 2 in the processing phase while the category "social aspects" is assigned a relevance of 3 in production but only 1 in processing, then the aspect "general working conditions" becomes a hotspot in production (3x3=9), but not in processing (2x1=2).

Although the WU-HSA takes a multidimensional approach, the identification of the sustainability aspects as well as their assessments have, up to now, been dominated by scientific data and biased by external perceptions, determining to a great extent, whether an aspect is considered a hotspot or not. Commonly, its sustainability aspects are acquired by extensive literature review or derived from international standards such as the Global Reporting Initiative and the United Nations Environmental Programme SETAC Life Cycle Initiative (Bienge et al., 2009; Brown, 2011; UNEP & SETAC, 2009). Although the developers of the method proposed consulting stakeholders and experts to review and validate results of the analysis, their methodology lacks a participatory approach that involves VC stakeholders right from the start of the research process.

3 Methodology

This chapter outlines the methodological elements and steps used in developing a holistic stakeholder-oriented and community-based approach to assess sustainability failures along value chains. We begin by explaining how we conceptualised the methodological approach to data collection in different phases of the value chain and how we planned to validate preliminary findings through consultation with experts based in Zambia. In the second sub-chapter, we report on how we implemented these approaches in the field. We conclude this chapter with an explanation of the adaptations introduced during the field phase and the observed limitations of the methodology.

In our methodological approach, we relied on a range of qualitative research methods, including

- literature review,
- focus group discussions (FGD),
- transect walks and seasonal calendars,
- semi-structured key informant interviews (KII), and
- a participatory validation workshop.

3.1 Design of a participatory hotspot analysis

In this section, we describe in detail the development of a participatory approach to the HSA. We begin with the key element of our approach which focuses on the smallholder farming community active in the production stage of the dairy and groundnut value chains. Then we briefly introduce our approach for assessing downstream phases of the value chains. Lastly, we describe how we validated the preliminary findings from the field data collection by engaging with stakeholders and experts from supporting and regulating levels of the value chains.

3.1.1 A pHSA approach for smallholder communities

To our knowledge, the WU-HSA has not yet been used to assess sustainability failures along food value chains in the context of development cooperation. A key objective of the SEWOH initiative is to contribute to the sustainable development goals of the United Nations (Federal Ministry for Economic Cooperation and Development, 2022), amongst other initiatives, supporting the development of food

value chains. In Zambia, especially in rural areas (where the livelihood of most people depends on agricultural activities), poverty levels are notoriously and persistently high (Diwakar et al., 2012). Consequently, to take the living reality of the large group of smallholder farmers into account,[5] our key objective was to enrich the WU-HSA with strong participatory elements.

Our adapted pHSA starts off with a participatory systemic assessment of the sustainability perceptions of smallholder farmers active in Zambia's dairy and groundnut value chains. In this way, we aimed to break the complex issue of sustainability in food value chains down to aspects that smallholder farmers can directly relate to in their daily lives. To achieve that, we asked participants to link basic resources required for sustaining a successful dairy or groundnut production to the socio-economic and ecological systems that ensure the provision of such resources and thus, reveal the necessity to conserve specific sustainability aspects. Adaptations were made by integrating farmers' perceptions as early as the stage of conceptualising sustainability aspects, which are predetermined by experts in the WU-HSA. Thus, we expected stakeholder participation may provide more agency, more perceived ownership, and more attained compliance to the concept's results. It may also help to design interventions and innovations in a way that enhances sustainability of smallholder agriculture along all dimensions. Additionally, such a human-centred and systems-based approach may enhance the perception of connectivity and trade-offs by the participants as well as emphasise the importance of system functionality, essential to fully grasp the holistic nature of sustainable livelihoods and the complexity of food value chains (Davidz & Nightingale, 2008).

Preliminary to the actual field work is the identification of participants in the research process from the large and diverse group of smallholder producers. Participants for this study were recruited from smallholder farmer communities engaged in the dairy and groundnut value chains and supported by the interventions of the GIC of GIZ Zambia. For the dairy value chain, the identification of producer groups to be included in the research study was handled by staff of the GIC. In the case of the groundnut value chain, this support was provided by Community Markets for Conservation (COMACO), GIC's implementation partner. Since we could not identify potential conflicts of interest, we assumed the potential risk of selection bias by applying this approach to be negligible.

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[5] In Zambia, smallholder famers are typically characterised by cultivating less than 5 ha of land, although a strict definition, specifically including dairy farmers, does not exist.

To capture the diverse living realities and perceptions of sub-groups within the smallholder community, we segregated participants by gender and age and clustered them into focus groups (each with 4 – 6 participants) of youth, women, and men. Since COVID-19 control regulations restricted meetings to a maximum of 20 people, a group size of 4 – 6 persons was a good fit for focus group discussion, as plenary sessions would not exceed 12 – 18 participants. The subgroups were intended to give different perceptions due to age and gender a voice, allowing local knowledge to be effectively clustered and documented. In total, 90 farmers participated in 5 FGDs in the dairy value chain and 89 in 4 FGDs in the groundnut value chain. More detailed information about the field data collection is provided in the annex. The methodological steps of the sustainability hotspot analysis are outlined in more detail below.

3.1.1.1 Steps of the pHSA methodology for production phase

Below we outline the individual steps of our approach, which we adapted from the Adaptive Management of Vulnerability and Risk at Conservation Sites methodology described in (Ibisch & Hobson, 2014). We divided the implementation into five steps that can be comfortably run through within a single day:

1. Identification of resources necessary for production: Participants identified basic resources required for groundnut or dairy production (for example, fodder for dairy cows) by means of free listing. These were documented on paper cards and placed on the ground.
2. Identification of systems providing these resources: The systems providing those resources were identified (for example, pasture or rangeland that provide fodder for cows), written on paper cards, and related to the basic resources. Socio-economic systems were arranged on the ground to the right of the corresponding resource cards and ecological ones to the left.
3. Identification of sustainability aspects: Having identified the systems that provide essential goods and services to meet the identified needs, the sustainability aspects of each system were identified (for example, biodiversity of grass species in rangelands) and placed next to the corresponding systems either as prerequisites to accessing systems (socio-economic) or ensuring preservation of systems (ecological).

Figure 6: Pictures from the focus group discussions.

(top left: Step 2; middle right: Step 3; bottom left: Step 5)

4. Identification of threats: Threats are indicators of the reduced overall functioning of sustainability aspects; for example, the loss of grass species may threaten the sustainable functioning of rangelands and their biodiversity. We use the term "threat" because it appears to be more intuitive than the concept of an indicator (as used in the WU-HSA). Threats were identified within each focus group through a conversation on the problems the community faces regarding the identified sustainability aspects.
5. Evaluation of threats along four criteria: The impact and significance of threats was assessed by the FGD participants as 1 (low), 2 (medium), or 3 (high). First, the impact of a threat was assessed along three criteria: a) scope (how widespread is this threat?), b) severity (how damaging is this threat?), and c) permanence (how easily can this threat be addressed?) The sum of these three criteria gives an impact score. The current trend this threat shows was then assessed as decreasing (1), stable (2), or increasing (3). From this, the significance of the threat was calculated by adding the value for the trend to the value of the impact.

We used freelisting to assess the sustainability aspects (step 1). Freelisting is a simple, rapid, and accurate method to capture mental inventories of items an individual or group thinks of within a given category, exposing cultural salience within

stakeholder groups as well as variations in individual knowledge across relatively large groups (Quinlan, 2018). The mental inventories were recorded on paper cards by a facilitator, enabling inclusion of people with diverse literacy levels. When participants omitted common items within a category, FGD facilitators prompted them with questions, taking care not to steer the discussion into preconceived directions. For example, in the category "basic resources required for groundnut or dairy production", the participants may not have explicitly stated physiological, safety, social, cultural, ethical, or individual resources, prompting the facilitator to ask if a particular aspect is relevant.

The FGD sub-groups were always moderated by two facilitators, one from the Zambian team and one from the German team, to allow participants to speak the vernacular language. The translation and documentation on cards were done in situ and agreed by the participants in so far as possible.

Figure 7 provides an example of a completed evaluation card. A final value (significance) between 4 and 6 indicates that no intervention is needed. A value between 7 and 9 indicates that this threat needs attention but no specific intervention at this point in time. A value of 10 to 12 indicates a sustainability hotspot that needs to be addressed to ensure the continued functioning of the value chain. In our example in Figure 7, the significance is rated as 11, so the aspect of biodiversity and its loss thereof due to the threat of grass species disappearing from pastures needs to be addressed to ensure the productivity of rangeland and the sustainability of smallholder dairy production. What is particularly worrying in this example is the worsening trend of the indicator (rated as 3); however, the community's sentiment that the threat is of medium permanence (value of 2) gives hope: external intervention is not needed to achieve improvements because community-level interventions (by-laws on communal pasture management and use) are thought to be sufficient.

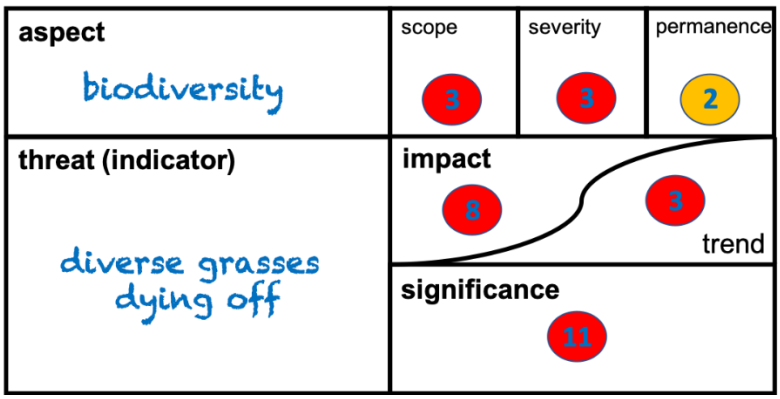

Figure 7: Evaluation card to assess impact and significance in order to determine sustainability hotspots.

The **threat** "diverse grasses dying off" is an **aspect** of biodiversity that applies to most areas of Southern Province (scope = 3). It is viewed as a very serious problem threatening dairy production (severity = 3), but the community believes it doesn't require external intervention to be reversed (permanence = 2) which, in sum, gives the aspect "biodiversity" an **impact** rating of (3+3+2=) 8. Because, currently, this issue is worsening (trend = 3), the overall **significance** is evaluated as a hotspot with the value of (8+3=) 11.

To complement the data collection from the FGDs, we collected information using participatory research methodologies including transect walks, seasonal calendars, and Venn diagrams. We formed five facilitation pairs, three of which facilitated the FGDs while the other two pairs conducted additional data collection. The objective of this additional data collection was to gain a deeper and comprehensive understanding of sustainability as perceived by the farmers. The data collection ran in parallel to the FGDs and typically involved community leaders and lead farmers, both male and female. During these exercises, focus was put on identifying and discussing conflicts over resources in the community, potential innovations, and successful or failed communal action projects. These exercises usually took 1.5 to 2 hours. Notes were transcribed as soon as possible for later analysis.

3.1.2 A pHSA approach for downstream value chain phases

We focused on adapting the WU-HSA to the context of smallholder farmers in Zambia's dairy and groundnut value chains and, consequently, on the production phase. For a comprehensive understanding of these value chains, we also engaged with stakeholders from downstream VC phases. Typically, these were individual representatives of companies and organisations active in the input, aggregation,

transport, processing, and retailing phases. Therefore, we prepared semi-structured interview guidelines customised to each VC and VC phase. The key informant interviews were conducted to verify feedback from preliminary FGD findings, identify hotspots in the VC phases that the key informants were active in using the evaluation steps described above, and collect observations of innovations and trade-offs. A sample of an interview guideline is presented in the Annex. The interviews were 1 to 1.5 hours long.

3.1.3 A pHSA approach to validate preliminary findings

After data were entered and cleaned, preliminary findings and observations were presented at a validation workshop with attendees recruited mainly from VC-supporting and -enabling agencies (see Springer-Heinze, 2018 for definition and details) and VC operators based in Lusaka.

After introducing ourselves and our research objectives, preliminary findings from both VCs were shared. We captured a large amount of feedback and input on the hotspots from the participants in a relatively short period of time via Mentimeter (see Figure 8)[6]. Following this exercise, participants discussed and identified innovations and trade-offs along the VCs in smaller working groups. At the end of the workshop, rapporteurs from the individual working groups presented results of their discussions to the plenary. This validation of our preliminary data ensured the appropriateness, robustness, and comprehensiveness of our field data collection.

[6] https://www.mentimeter.com

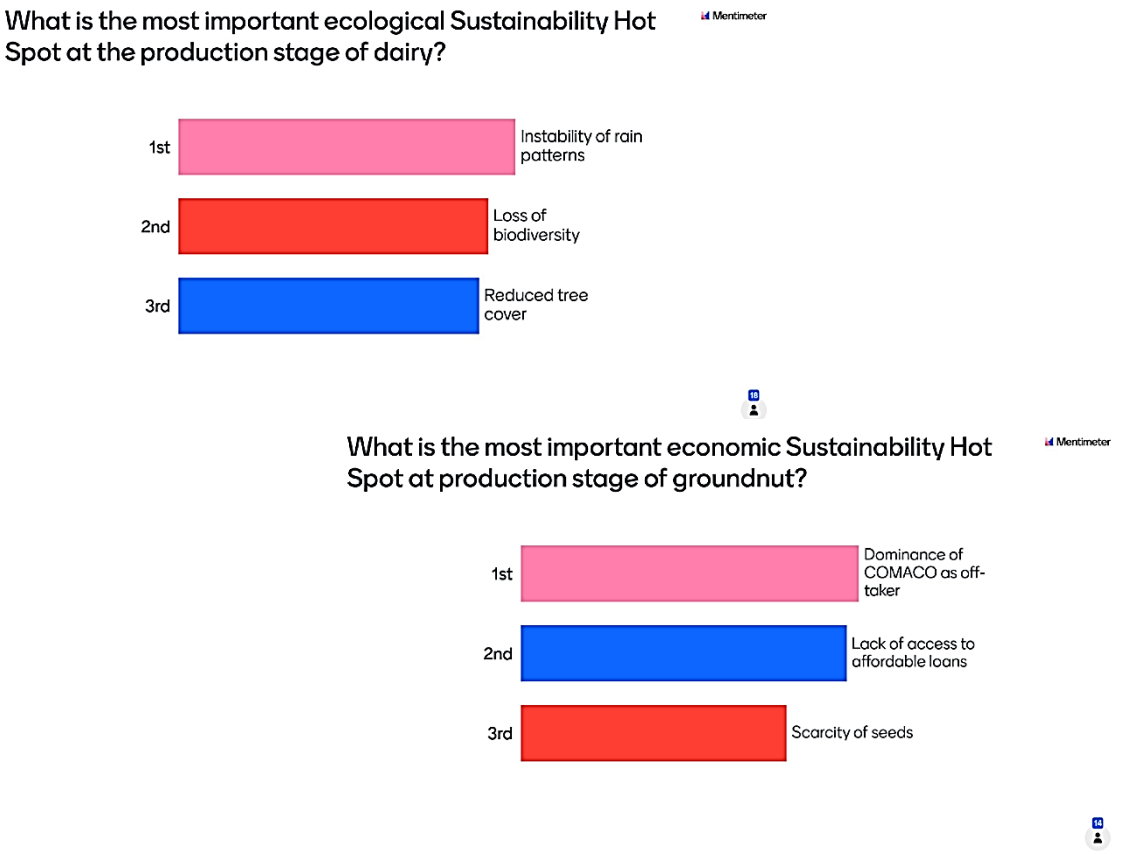

Figure 8: Example of Mentimeter summary results from validation workshop

3.2 Implementation of the methodology in the field

The empirical phase of our research study took place over approximately two months from September 4th to October 30th, 2021. During our first week in Lusaka, we reviewed our research concept and fine-tuned data collection instruments with our Zambian colleagues from IAPRI, visited partners, and made logistical arrangements for field data collection. Table 2 provides a summary information of data collection activities. More detailed information, including dates and location, are presented in the Annex.

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Table 2: Summary of data collection activities and participants

Method	**Focus Group Discussions**			**Transect Walks & Seasonal Calendar**	**Key Informant Interviews**	**Validation Workshop**
Value Chain	Women	Men	Youth			
Dairy	23	38	29	3	16	19
Total	90					
Groundnuts	31	32	26	6	19	
Total	89					

Source: own data

In Southern Province, we visited a total of five milk collection centres, four of which (Magoye, Kayuni Choma, and Simooga) were situated along the main road and rail line connecting Lusaka with Livingstone in the south. This route links landlocked Zambia to seaports in South Africa and Namibia and is one of its main development axes. The fifth milk collection centre in Namwala is in a more remote location, about 170 km north of the rail line. We purposefully oversampled the dairy value chain to allow for adaptations to our methodology based on field experiences.

In Eastern Province, we conducted four FGDs with groundnut producer groups in relative proximity to the district towns of Petauke, Katete, Chipata, and Lundazi. The road infrastructure in Eastern Province is less well developed than in Southern Province. The trunk road between Chipata and Lundazi is poorly maintained and the rural feeder road network is rudimentary. Transect walks and seasonal calendars were conducted in parallel to the FGD in the same locations to collect information on the biophysical and socio-economic environment and to explore potential innovations, synergies, and trade-offs with community leaders. Interviews with key informants took place mostly in the district towns where their offices and businesses are located.

The validation workshop took place in Lusaka at the Taj Pamodzi Hotel on the 27th of October 2021 with 19 participants representing a wide range of stakeholders from the two value chains. These included government ministries, private sector players, associations, development partners, and research organisations. Ideally, we would have welcomed participation from an even larger group, however, logistical and organisational considerations (due to COVID-19 restrictions) limited our capacity to invite more people. Unfortunately, not everybody that was invited was able to participate in the event. Nevertheless, the event generated useful information and we achieved our objective of validating our preliminary findings through a group of experts from the national level. In the Annex we provide a list of participants.

3.3 Adaptations to and limitations of the methodology

Despite careful preparation of the methodological approach during the conceptual phase in Berlin during June and July 2021 and revision of our approach with Zambian colleagues in August and September, it was still necessary to adapt certain elements in the field. We took the biggest learning step during and after the first focus group discussion at the milk collection centre in Magoye town.

It became apparent that the framing of the basic resource requirements for successful and sustained agricultural production in the initial steps of the process is critical for the entire process. The participants were prone to identify services instead of basic needs. For example, the service "training" was quickly mentioned without realising the underlying necessary resource "knowledge". It shows a tendency to immediately search for external assistance without reflecting what is actually lacking. Asking farmers to reflect on their actual knowledge gaps also bears the opportunity to realise knowledge resources internal to the community, a step that would make co-creation of knowledge possible. In a similar way, "boreholes" were mentioned as needed. However, if the water table is lower than the borehole reaches, it proves to be useless. Questioning quick assumptions like, "We need boreholes" made the participants realise what is lacking is the resource water and there are several ways other than boreholes to secure access to it. This led to the decision to include the step of "services" in the analytical process, to provide a clear logic pathway that everyone could follow. We did that by asking, "Which resource do you need?" and "Which service is able to provide that resource in a sustainable manner?"

Further adaptations were made to the organisational part of the day. The frequent report-back sessions from the sub-groups to the plenary sessions proved to

be disruptive to the work progress within the sub-group. Hence, we limited the plenary meetings to three sessions: 1) introduction at the beginning of the day, 2) before the lunch break, and 3) at the end of the day to wrap up. In the second and third plenary session, each sub-group reported their work progress back to the main group. Only clarifying questions were answered, no detailed discussion was encouraged.

To collect a manageable amount of data that would allow meaningful analysis and comparison between the two value chains, we decided to let the participants rank the sustainability aspects identified during the morning session. Only the three most important aspects from each of the ecological, social, and economic dimensions were carried forward to the afternoon session for detailed evaluation of potential sustainability hotspots. The time savings of this approach allowed for deeper discussions in the sub-groups, including the identification of innovations and trade-offs.

As an inherent challenge of the methodology, the more we pre-defined levels and formulations for the evaluation process of the hotspots, the more exploratory depth we lost. There is a clear trade-off between scientific rigor (gaining comparability and robustness) when researchers define the evaluation criteria a priori versus gaining insight into the sustainability perceptions and specific concerns of smallholder farmers (when they are invited to define the rating levels for the evaluation criteria themselves). While we focussed our approach on smallholders' perceptions, we had to be cognisant of the risk of losing out on important sustainability aspects that are beyond smallholders' concerns (e.g., carbon footprint, greenhouse gas emissions, etc.). Therefore, participatory approaches like ours that focus on a particular value chain phase should be complemented with scientific assessments addressing issues relating to the entire food system.

3.4 Data processing and analysis

The information from the evaluation cards and FGD (gender, location) were transferred to Excel. We coded the responses from the FGDs using deductive and inductive methods to ensure some degree of standardisation and thus comparability between results from different FGDs and with the AE principles. For example, we checked which AE principle covers a particular sustainability aspect identified by our participants. If that AE principle fit well, we used that term as a code for the sustainability aspect. If not, we defined a new code term for that issue. Then, the identified and evaluated sustainability threats were assigned to corresponding sustainability aspects. All aspects that received one or more threats with a score higher

than 10 were treated as a sustainability hotspot and reported on in the main text of this report. No statistical analysis was undertaken.

4 Results

In this chapter, we present the key findings from the participatory hotspot analyses in the two value chains. We begin with the dairy value chain followed by the groundnut value chain. The subchapters are organised along value chain phases and sustainability dimensions. At the start of each sub-chapter a short introduction to the value chain including the different phases is given.

4.1 Dairy value chain

Cattle rearing has a long tradition in parts of Zambia and is an important agro-economic activity. The dairy sector produced between 200 and 250 million litres of milk in 2014, of which 65 million litres passed through formal markets (Neven et al., 2017). The Zambian dairy sector is characterised by formal and informal markets throughout all value chain phases (see Figure 9)[7]. The formal market is dominated by a few processors who source milk from large-scale farmers and small-scale farmers through milk collection centres (MCCs). The informal market is comprised of traditional small-scale farmers that produce milk for home consumption and occasionally sell surplus through local channels.

During FGDs and KIIs in the Southern Province, 137 threats to sustainability aspects were identified within the production, aggregation, and processing phases of the dairy value chain. Figure 10 shows the number of threats classified as hotspots (in red) and those that were not (in blue), sorted by dimension. The social dimension includes the most threats (61 threats; i.e., 44 % of the total), closely followed by economic threats (56, 41 %) and ecological threats (20, 15 %). Out of the 61 social threats, 21 were rated as hotspots. Out of 56 economic threats, 24 were rated as hotspots. The proportion of hotspots among threats within the ecological dimension is remarkable: of the 20 sustainability challenges, 15 were identified as hotspots. This implies that when ecological aspects are mentioned, they more frequently constitute a sustainability hotspot than concerns raised in the other dimensions.

[7] The definition of the actors and value chain phases varies within the literature (see Kawambwa et al., 2014; Lubungu et al., 2021). For our analysis, we will use the value chain phases as shown in Figure 9.

	**Input** Inputs such as feed, water, equipment, drugs, and, if available, artificial insemination services are supplied by private companies or organisations like the Livestock Services Cooperative Society. Artificial insemination services are provided by the governmental National Artificial Insemination Service.
	**Production** Traditional small-scale farmers represent over 95 % of all milk producers and own 80 % of the cattle in Zambia (Neven et al., 2017). On average, they own up to 10 local breed dairy animals, each yielding 1 – 3 litres/day (Greenberg et al., 2018; Kawambwa et al., 2014; Neven et al., 2017).
	**Aggregation** MCCs are often managed by cooperatives of dairy farmers. Cooperative members supply milk to their MCCs and receive payments at the end of the month. MCCs test for freshness, water content (adulteration), and the presence of mastitis (Lubungu et al., 2021).
	**Processing** Four large-scale commercial dairy companies (Parmalat, Varun Foods & Beverages (Cream Bell), ZamMilk, and Dairy-Gold) process raw milk into yoghurt, ice cream, buttermilk, and UHT milk. During processing, the milk is subjected to further quality testing.
	**Consumption** Around 80 % of Zambian milk is produced for home consumption, leaving 20 % for the formal value chain. Processed dairy products are distributed to consumers via retailers, supermarkets, wholesalers, and traders.

Figure 9: Phases and actors in the dairy value chain

Source: Annika Reimann and Joel Hähnle

In Table 3, we summarise all sustainability aspects and their associated hotspots including their ranking results for the dairy value chain. The table demonstrates that the vast majority of concern lies in the production phase. This is partly due to our research approach which focuses on the smallholder farming community but quite a few of their concerns were echoed by actors in the other phases of the VC. It was not uncommon for these actors to state that as long as they could source sufficient quantities of milk of acceptable quality, they wouldn't see big challenges in the smallholder dairy value chain.

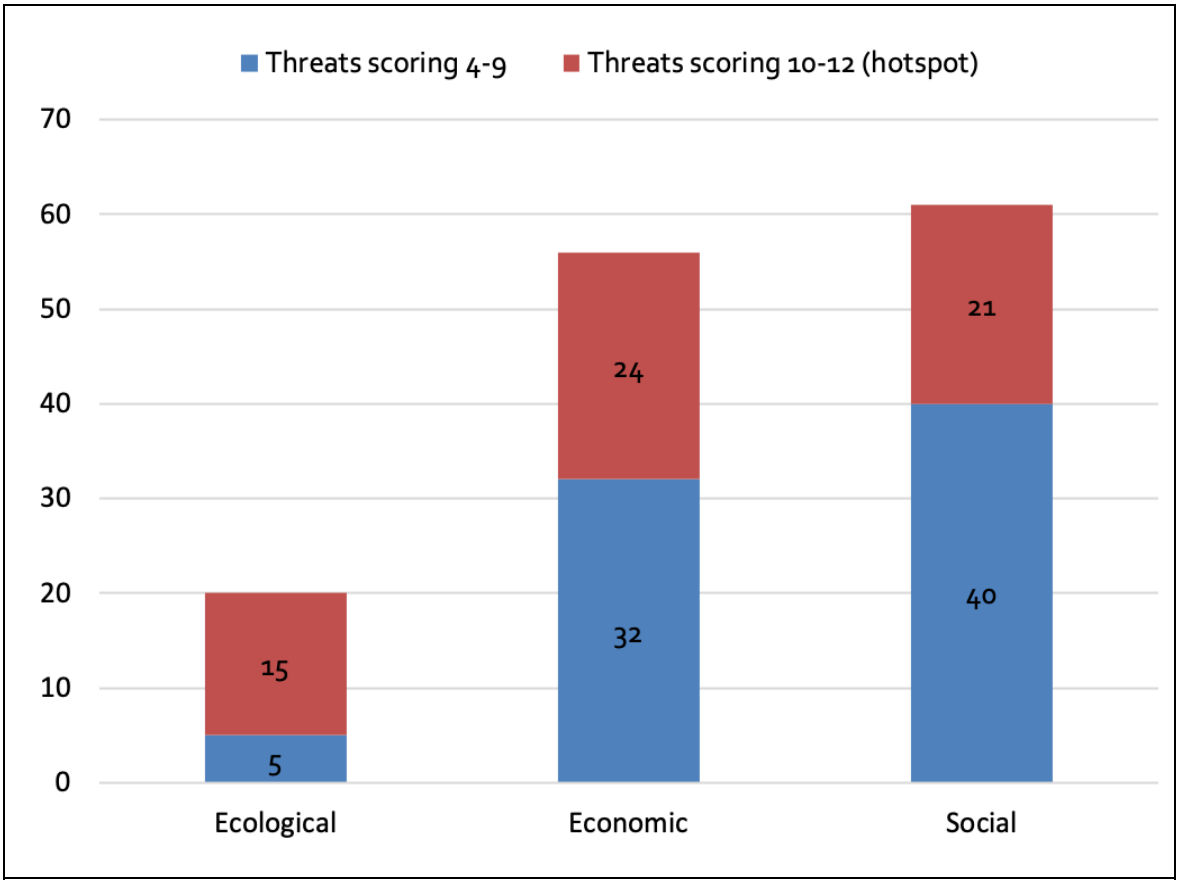


Figure 10: Identified threats to sustainability aspects of the dairy value chain by dimension

(Threats with a rating of 10 to 12 are hotspots; those with a rating of 9 or less are not hotspots)
Source: Data from FGDs and KIIs

4.1.1 Production

In total, participants of the FGDs and KIIs in Southern Province identified 53 hotspots for the production value chain phase.[8] Most of the identified hotspots at

[8] This includes hotspots that came up repeatedly as they were identified by different groups.

the production level fall into the social dimension (40 %), closely followed by economic hotspots (34 %), while ecological hotspots accounted for 26 %.

4.1.1.1 Social dimension

Government extension services

More than half of all the concerns in the social dimension related in one way or another to the role of governmental agencies, such as presence (or rather, the lack thereof) of governmental extension services in rural areas, rent-seeking behaviour, or community empowerment. In the dairy sector, official extension services are offered by the Ministry of Fisheries and Livestock (MFL) under the Department of Livestock Development. The extension services include training sessions for dairy farmers on various cattle management and milk production techniques, monitoring of animal health, milk quality assurance, and climate-smart feeding (Lubungu et al., 2021a). The MFL also organises fodder and pasture seed distribution through a project called *Enhanced Smallholder Livestock Investment Programme*. It is worth noting that all groups of small-scale farmers and extension officers identified the lack of service provision as a hotspot, although their perspectives and assessments differed. For example, a contentious issue is transport facilities for extension staff highlighted by the statement below.

> *"Usually, the funding for transportation arrives each month. However, this year it has only arrived two times so far (i.e. Sept. 2021). Therefore, farmers have to take up the responsibility of providing transport for the extension officer in order for them to receive the service." (Dairy Extension Officer, MFL, Choma)*

The youth, especially in Choma and Namwala, had a very critical opinion of the governmental extension services staff. Some of them accused extension officers of laziness while others missed the reliability of extension officers and labelled them as "dishonest". While not disagreeing with such sentiments, older FGD participants offered an explanation rooted in the political landscape: until the national elections in August 2021, Southern Province was perceived as an opposition stronghold. Therefore, some participants speculated that "vengeance of governmental authorities" (FGD Kayuni; men) may have motivated such behaviour by extension staff. The threat "political segregation" relates to this issue. More generally, participants complained about rent-seeking behaviour amongst government officials, echoing the country-wide poor state of the extension service.

Box 1: Innovation: Radio extension

Being aware of its limited outreach, the Department of Livestock Development in Choma district engaged with community radio stations and introduced radio extension programs for areas surrounding the town. Through these radio stations, farmers receive extension messages on dairy cattle management.

Table 3: Sustainability aspects, threats, and hotspot rankings in the dairy value chain				
Phase	**Dimension**	**Sustainability aspect**	**Threats to sustainability aspect (hotspot ranking)**	**n**
Production	Social	Government extension services	Vengeance by governmental authorities (11); Need to pay transport and lunch allowances (12); Distance and detachment of veterinarians (12); Lack of transport and accommodation (10); Lack of interest (11); Lack of timely delivery of services (10); Lack of honesty (10), Laziness (to transmit knowledge)/lack of serious interest (11); Poor communication (11); Lack of transport (12); Budget constraints/no regular funding (11)	12
		Gender equality	Male dominance (11); Poor education for girls and women (11); Corruption (10); Male selfishness (12)	4
		Youth empowerment	High school fees (10); Poor parenting (11); Corruption/lack of awareness (10); Underappreciation of the youth (10)	4
		Rent seeking by government authorities	Dishonesty (10); Greediness of authorities (11)	2
		Knowledge sharing	Jealousy (11)	1
		Community empowerment	Political segregation (11)	1
	Ecological	Stable rain patterns	Ignorance (11); Cutting trees/charcoal burning (12); Deforestation (11); Lack of rain (11); Deforestation (11); Deforestation (10); Disrespect of the law (10); Cutting trees/charcoal burning (12)	8
		Environmental protection (forests)	Weak chiefs/government (10); Domestic use of wood (11), Charcoal traders (12); Deforestation/charcoal burning (12); Lack of economic opportunities (10)	5
		Biodiversity	Diverse grasses dying off (11)	1
	Economic	Access to input	Changing exchange rate (10); Poor government management (10); High transport costs (11); Changing exchange rate (11), COVID19 (12); Unaffordable inputs (10); Unstable exchange rate (10)	7
		Access to capital	Free market (10); Interest rate (11); High interest rates (11); Lack of knowledge (11); High interest rates (11)	5
		Access to land	Gender relations/customs (10); High prices (12)	2
		Economic diversification	Inflation/exchange rate (10)	1

Table 3: Sustainability aspects, threats, and hotspot rankings in the dairy value chain				
Phase	**Dimension**	**Sustainability aspect**	**Threats to sustainability aspect (hotspot ranking)**	**n**
Aggregation	Social	Governance at MCC	No clear responsibility at the board (11)	1
	Economic	Milk quality	Lack of water at the MCC (10); Lack of water at the MCC (10)	2
		Transport	Lack of transport to MCC (12)	1
		Economic viability	Price fluctuations by off-takers (10)	1
Proces-sing	Economic	Milk quality	Adding water to milk (10)	1
		Participation of local value chain	Foreign products in the market (10)	1
Total social hotspots in the entire value chain				**25**
Total ecological hotspots in the entire value chain				**14**
Total economic hotspots in the entire value chain				**21**
Total hotspots in the entire value chain				**60**
Mentioned by: FGD Women FGD Men FGD Youth Key Informant Interviewee Source: data from FGDs and KIIs				

Gender equity

Gender inequality was frequently identified as a social hotspot in dairy production. Women in Kayuni stated that male dominance is a key issue in the dairy sector. According to traditional gender roles among the people of Southern Province, men are responsible for cattle herding and milking. Dairy cooperatives are characterised by low participation by women (Dairy Association of Zambia, MCCs Magoye and Kayuni). In many cases, women who actively participate in cooperatives are widows and joined cooperatives via their late husbands.

As a consequence of patriarchal norms, women often struggle to be financially independent and to start their own businesses. Since men own all of the cattle and land, women lack collateral which is crucial for access to capital. Moreover, education and trainings are particularly difficult to access for women and girls (Kayuni youth). On top of that, men tend to monopolise knowledge gained from trainings and do not pass it on to family and community members. However, it appears that this is a widespread phenomenon since "sharing of knowledge / jealousy" was identified as a general hotspot as well.

Box 2: Innovation and synergy: Women's savings groups

Customarily, male heads of households attend workshops and trainings organised by extension services, while women and youth are typically underrepresented. The Dairy Association Zambia (DAZ) addresses this issue in an innovative way. When organising meetings, DAZ approaches female savings groups in dairy farming communities to invite their members. As a result, the participation of women in extension workshops and trainings has increased, according to a DAZ representative.

Increasing female participation in dairy training can have a synergistic effect in that the newly gained knowledge is shared better among the community. In interviews with the MFL in Livingstone, the MCC in Kayuni and DAZ in Choma, several experts stated that, in their experience, women are more likely to adopt and share knowledge than men.

Youth empowerment

In many ways, women and youth face similar challenges due to their financial dependence on men. This general sentiment was corroborated by an MFL extension from Mazabuka who stated that "corruption is often threatening the inclusion of youth and women when male leaders consolidate their power". In this regard, an

observation from the youth FGD in Livingstone is noteworthy. Initially, participation in the focus group was lacklustre and its value was questioned by the young participants. It was repeatedly mentioned that "no one will listen to us anyway" and that the "older people won't share their knowledge". With a great deal of encouragement and motivation, however, it was possible to invoke a lively debate and the participants continued to discuss with each other well beyond the allocated time.

4.1.1.2 Ecological dimension

Natural resource conservation

In this discussion, we combine the presentation of the sustainability aspects of "stable rain patterns", "environmental protection", and "biodiversity", because they appear to be very closely interlinked. Throughout the FGDs, farmers stressed the importance of water availability and posed drilling boreholes as a solution. However, when the facilitators queried this quick-fix approach and pointed out longer term consequences of it, the discussions moved toward perceived root causes. It was argued that water availability has severely lessened due to climate change hastened by deforestation. According to Global Forest Watch (2022), from 2001 to 2020 Zambia lost 1.87 million ha of tree cover, equivalent to a decrease of 7.8 % tree cover and 690 MT of CO_2 emissions. Although shifting cultivation and agricultural expansion are cited as driving forces for deforestation, FGD and KII participants related deforestation to charcoal production, an important and, to some groups (like youth), the only possible source of income. Consequently, penalising illegal charcoal production, as suggested in Box 4, is likely to increase economic pressure on young men, in particular, and force them to engage in illegal profit-making activities. The effectiveness of fines may also be questionable, since "weak chiefs", "disrespect for the law", and "ignorance" were mentioned as aggravating factors for tree cutting for charcoal production.

Although the biophysical processes behind climate change are not fully or well understood, participants in all groups were aware of the link between their actions (tree cutting) and environmental consequences (reduction in water availability) and they were clearly concerned about the future viability of dairy farming given its high demand for water. A related ecological sustainability issue brought up by the manager of the MCC in Namwala was the change in grass species composition in rangelands in the Kafue Flats ("diverse grasses dying off"), a huge area traditionally used for seasonal cattle grazing. The rangeland is burnt by cattle herders to reduce the

tick load. However, the long-term effect of the frequent burning is that nutritious fodder grasses are displaced by hardier, less beneficial species.

Box 3: Innovation: Establishment of improved community rangelands

The effects of climate change have led to unavailability of fodder and pasture, especially during the dry season. The government, through the Ministry of Fisheries and Livestock, in Southern Province has embarked on establishing what they call "community rangelands". In the districts of Zimba, Monze, and Kalomo, the planting of drought-resistant, nutritious varieties of fodder and pastures grass species is being piloted (KII MFL Choma).

Box 4: Innovation: Introduction of fines

The increasing demand for charcoal spurs on deforestation. In response to this, some communities in Magoye have introduced by-laws that impose fines on charcoal production (KII MCC Magoye).

4.1.1.3 Economic dimension

Access to inputs, capital, land, and economic diversification

Although 9 of the 15 hotspot threats in the economic dimension of the production phase were identified by female focus group participants, their concerns were shared by other groups but not rated as hotspot threats. The sustainability aspects "Access to inputs" and "Access to land" were of particular concern to women. In rural communities, land falls under the customary land tenure system. Customary law is administered by chiefs and their advisors, usually all men. The chiefs also control access to grazing areas. Overstocking these rangelands has led to soil erosion and land degradation (Venn diagram, MCC Choma), making good grazing land a limited resource controlled by those in power, to the detriment of women and youth. An alternative is to acquire state land through leasehold titles (Adams, 2003), which comes with its own set of challenges. The Southern Province is patriarchal and patrilineal: men have full rights over land, wives have only cultivation rights, and men and women each have rights to half of the cultivated crop if the marriage ends (FAO, 2021b).

While customs and traditions were identified by women as threats to access to land, the threats identified under access to inputs had no gender connotation apart

from women's more general financial dependence on men. Particular to the dairy sector in this regard is the fact that most veterinary drugs are imported and, therefore, their prices fluctuate with the exchange rate of the Zambia Kwacha against other currencies, mostly US Dollar, Euro and South Africa Rand[9]. This issue was also picked up on by a male focus group that related it to the aspect of economic diversification. In locations like Namwala and Simoonga that lie off the rail line, the service delivery network by government as well as the private sector is also less accessible due to longer distances and thus higher prices for inputs.

Access to capital was perceived to be hampered by the formal financial market's high interest rates and, although not specifically mentioned as a threat, needs for collateral, which is a particular issue for women and youth. In the recent past, farmers were able to access loans through the "loan a cow initiative" of the Zambia National Commercial Bank, but, even in this case, the interest rates of 38 % were excessively high for farmers. GIZ provides smallholder dairy farmers with access to financial services through establishing and supporting saving and credit cooperatives (SACCO). Currently, there are SACCOs in Choma, Monze, and Namwala that offer loans to dairy farmers at a more favourable interest rate (GIZ, 2021). However, no preferential treatment of or conditions for women and youth were reported within these initiatives.

Experts from the MFL and GIZ in Choma as well as the National Artificial Insemination Services (NAIS) in Mazabuka stressed that many smallholder farmers lack access to productive breeds. There are limited facilities for artificial insemination (AI) in the Southern Province and many smallholder farmers cannot afford or access this service. NAIS has 15 satellite centres across the country; however, most of them struggle with access to liquid nitrogen, equipment, and trained staff. Even though NAIS conducts trainings at MCCs in AI, they do not have the capacity to follow up on these trainings and, thus, suspect that farmers trained in AI may not practise it. It is unclear if the reason for that is difficulty accessing the service or underappreciation of it. However, NAIS confirmed that suitable dual-purpose breeds are available in Zambia, but their diffusion into the smallholder community remains a challenge.

The disruption of global supply chains due to the Covid-19 pandemic also affected accessibility of inputs by smallholder dairy farmers. Consequently, products

[9] Contrary to the long-term trend, the Zambian Kwacha had appreciated drastically against all major currencies at the time of our field work, rendering this issue extremely acute and severe.

such as drugs, insecticides, fertilisers, and seeds are scarce, unavailable, or so costly that farmers are unable to purchase them.

Box 5: Innovation: Debt swap in lieu of services

The Choma cooperative which runs the MCC found an innovative way to compensate its members for delayed payments for their milk deliveries. While the farmers wait for full payment for milk sold to the MCC, they can use equipment for weeding or harvesting, such as hay balers that belong to the MCC.

4.1.2 Aggregation

In the aggregation phase, sustainability aspects were identified only in the social dimension (one sustainability aspect) and economic dimension (three aspects were perceived as threatening the sustainability of the VC).

Governance and management at MCCs

In the social dimension, management of the MCC (including embezzlement of loans by MCC boards) was identified as a hotspot. A representative of a processing company lamented that MCC boards and staff do not have clearly outlined responsibilities and hence frequently lack collective, transparent, and coherent decision-making processes. Communication channels are sometimes unclear or ignored, leading to miscommunication and confusion. Such poor oversight and lack of enforcement of guidelines invites malicious practices amongst staff members. Farmers claimed that some MCC staff did not pass on the price agreed by the processor (10 Kwacha per litre) but seemed to have taken a cut of the profits, instead paying out only 8 Kwacha per litre. There were also reports of MCC staff colluding with farmers to continue accepting their milk despite failing quality checks. Verifying such reports was beyond the mandate and capacity of the research team. Therefore, the research team cannot accept responsibility for the accuracy or truthfulness of these reports.

Box 6: Innovation: Formation of cooperative unions

With the help of cooperating partners such as GIZ, the dairy cooperatives in Southern Province are forming a cooperative union to improve advocacy in dairy production. Currently, the cooperatives do not have a united voice for lobbying for better milk prices and service delivery.

Milk quality, transport, and economic viability

Quality control for milk freshness, water content, and bacteriology is undertaken by the MCCs when they buy it from farmers (Lubungu et al., 2021) and is a great challenge. First, famers may deliver relatively small amounts of unrefrigerated milk over long distances on foot or by bicycle in inappropriate containers (plastic not stainless steel), leading to early spoiling of the milk. Second, the frequent lack of clean water at the MCC makes maintaining hygiene standards difficult.

Box 7: Innovation: Solar powered cooling tanks at MCCs

Cooling at the MCC is frequently jeopardised by power cuts, resulting in milk going sour. According to one processor, only half of all MCCs have generators as power backups and those that do face higher operating costs. Participants of the validation workshop suggested using solar power as a backup energy source to lower both fuel costs and carbon emissions.

Until last year, prices paid by processors were a serious challenge for the economic viability of MCCs. In 2020, prices were so low that some farmers preferred to sell their milk through informal distribution channels supplying the local market only. However, over the past year, milk prices paid by aggregators have since doubled, thereby increasing the income for MCCs and overcoming this challenge. When we followed up with a group of street vendors near an MCC, they told us that when the MCC pays farmers a higher price for their milk, these farmers also demand higher prices when selling milk to them. Consequently, the price for milk in local markets increases and community members' ability to access milk is affected.

4.1.3 Processing

In the processing phase, only two economic issues were identified as threatening the sustainability of the dairy VC, namely insufficient milk quality and strong market competition.

Milk quality

Basic quality control checks at MCCs are riddled with problems as reported above, but those problems are amplified when entire tanks of milk collected from several MCCs are rejected at the dairy plant because one MCC supplied contaminated or diluted milk. The processor has no alternative but to reject the entire load, penalising even compliant MCCs. Therefore, the MFL, with support from GIZ, set up a laboratory for independent milk testing. At the time of writing this report, this laboratory was not yet operational. Participants of the validation workshop lobbied for the rehabilitation of the old test laboratory in Mazabuka to help establish transparency and quality compliance in the entire VC.

Participation in the local value chain

The second concern in the processing phase involves a trade-off. A representative from the Dairy Association of Zambia explained that when the customs and excise amendment bill of 2020 came into effect on January 1 of 2021, it effectively reduced the importation of milk powder. The implication of the bill is that processors can no longer use powdered milk for reconstitution into liquid milk. In response, the processors had to stimulate milk production and milk sales in the smallholder dairy sector to cover the shortfall in supply. While dairy smallholder farmers benefitted from higher commodity prices, processors expressed concerns about the competitiveness and long-term viability of the dairy industry in Zambia (Muwowo & Hamusimbi, 2020). Also, higher producer prices may motivate smallholder farmers to sell more milk into the formal market, leaving less milk available for local markets and home consumption. Consequently, without a boost in smallholder dairy production, the bill may end up affecting the health and nutrition status of the rural population, especially of children, negatively.

4.1.4 Consumption

Data collection on consumer preferences and behaviour are only meaningful if done in the form of quantitative surveys, which is beyond the scope of our study. However, consumption is an important element of a VC and should be considered as part of a sustainability assessment. We were able to access and analyse data collected by IAPRI for the Scaling Up Nutrition Learning and Evaluation project by USAID (2021) as part of a household survey on the effect of the COVID-19 pandemic on nutrition and food security.

This survey was conducted in six rounds between September 2020 and July 2021. Our analysis of the consumption patterns of dairy products is based on the first round of the survey. After data cleaning, this round contained responses from 1,435 Zambian households, of which 101 households are in Southern Province. The survey was conducted in all provinces of Zambia, covering both urban and rural populations for each province.

Figure 11 shows self-reported patterns of dairy consumption one year before the first survey round was conducted, i.e., the baseline pre-COVID-19. Only half of Zambian households (48.4 %) consumed dairy products. Dairy consumption in urban areas (58.2 %) was significantly higher than in rural areas (39.8 %).

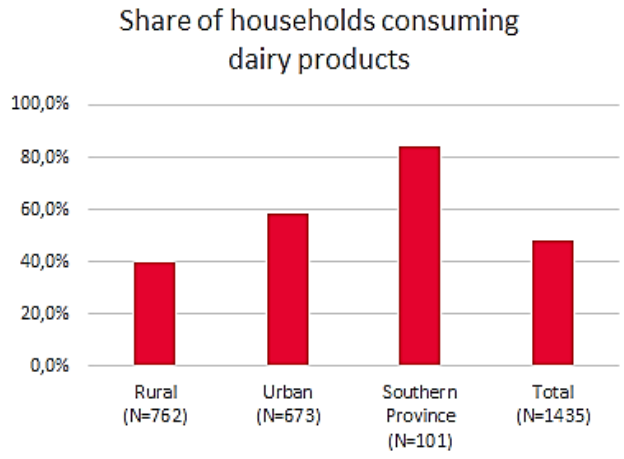


Figure 11: Proportions of households consuming dairy products pre-Covid

Source: own calculation based on USAID (2021) data

However, in Southern Province where cattle herding has a long tradition, the percentage of milk-consuming households was much higher than in urban areas (84.2 %). Accordingly, dairy products are an important component of the diet of the people in this part of Zambia. The data suggest that income (which is generally higher in urban areas) and cultural factors (such as the tradition of cattle herding) affect the choice to consume dairy products.

Looking in more detail at milk-consuming households, Table 4 confirms that own production and informal markets play a much more important role in areas where milk is produced than regions which do not typically or traditionally rear cattle. In Southern Province, 80 % of households relied on own production and informal markets for dairy products while in rural and urban areas, only 57 % and 45 % of people used these sources. Comparison of dairy consumption before and during COVID-19 showed that dairy farming households did not reduce milk consumption in response to pandemic conditions while others did, and some stopped consuming dairy altogether.

Table 4: Main sources of dairy products by consumer groups

	Rural	Urban	Southern Province
Own production	18.3 %	1.6 %	35.3 %
Informal markets	38.7 %	43.2 %	44.7 %
Grocery shops	31.7 %	28.9 %	7.1 %
Supermarkets	6.7 %	23.5 %	11.8 %
Other	4.7 %	2.8 %	1.2 %
Total number of households	**300**	**387**	**85**

Source: Own calculation, data from USAID (2021)

4.2 Groundnut value chain

Groundnut is one of Zambia´s most important crops and nearly half of the 1.4 million rural smallholders produce this legume plant (Mofya-Mukuka & Shipekesa, 2013). In Eastern Province, our groundnut study region, groundnut arrived about five centuries ago, most probably originating from West Africa (Temegne et al., 2018). The crop is enjoying increasing popularity and has replaced cotton and tobacco as a cash crop in many areas already. It is frequently grown in intercropping arrangements with soya and maize (KII Katete Extension Officer). Like the previous section, we start by introducing the structure and actors along the groundnut value chain in Figure 12. Following that, we present results from the sustainability hotspot analysis.

	**Input** Input supply is mostly provided by large enterprises such as Good Nature Agro or COMACO's seed outgrower programmes. Also, the Ministry of Agriculture is involved in the supply of seeds (Lubungu et al., 2021).
	**Production** Production is dominated by smallholders (around 75 % of the 289,000 farmers in Eastern province grow groundnut) who often intercrop groundnut with sunflower or soybean and rotate with maize (Lubungu et al., 2021). In 2019, production amounted to more than 130,000 tons on an area of around 208,000 hectares (FAOSTAT, 2019).
	**Aggregation** Aggregators include independent traders and processers such as Afriseed, Good Nature Agro, and COMACO. The latter offers to buy groundnuts from cooperating farmers for a premium conservation price. Due to high home consumption, only 45 % of farmers participate in groundnut sales (Mofya-Mukuka & Shipekesa, 2013).
	**Processing** In Eastern Province, the processing sector is dominated by COMACO, which runs a processing plant in Chipata that produces organic peanut butter, amongst other products. Most other processors, such as FreshPikt, are based in Lusaka.
	**Consumption** Around 80 % of groundnuts are produced for home consumption, leaving 20 % of the harvest for commercial sale. Processed groundnuts are sold both in retail and wholesale stores, mostly in the form of peanut butter or roasted snacks (Lubungu et al., 2021).

Figure 12: Phases and actors of the groundnut value chain

Photos: Annika Reimann & Johanna Kückes

In the Eastern Province and Lusaka, a total of 88 sustainability threats were identified in the groundnut value chain. These threats are considered important sustainability aspects of the groundnut value chain by the stakeholders from different value chain phases (Figure 13). It is interesting to note that almost half of the identified threats (43) fall in the social dimension, confirming the importance of social and community-based approaches for value chain promotion. In many discussions, groundnut was described as a "family or community crop", which refers to the labour-intensive cultivation method, especially in land preparation and weeding (Seasonal calendar Petauke).

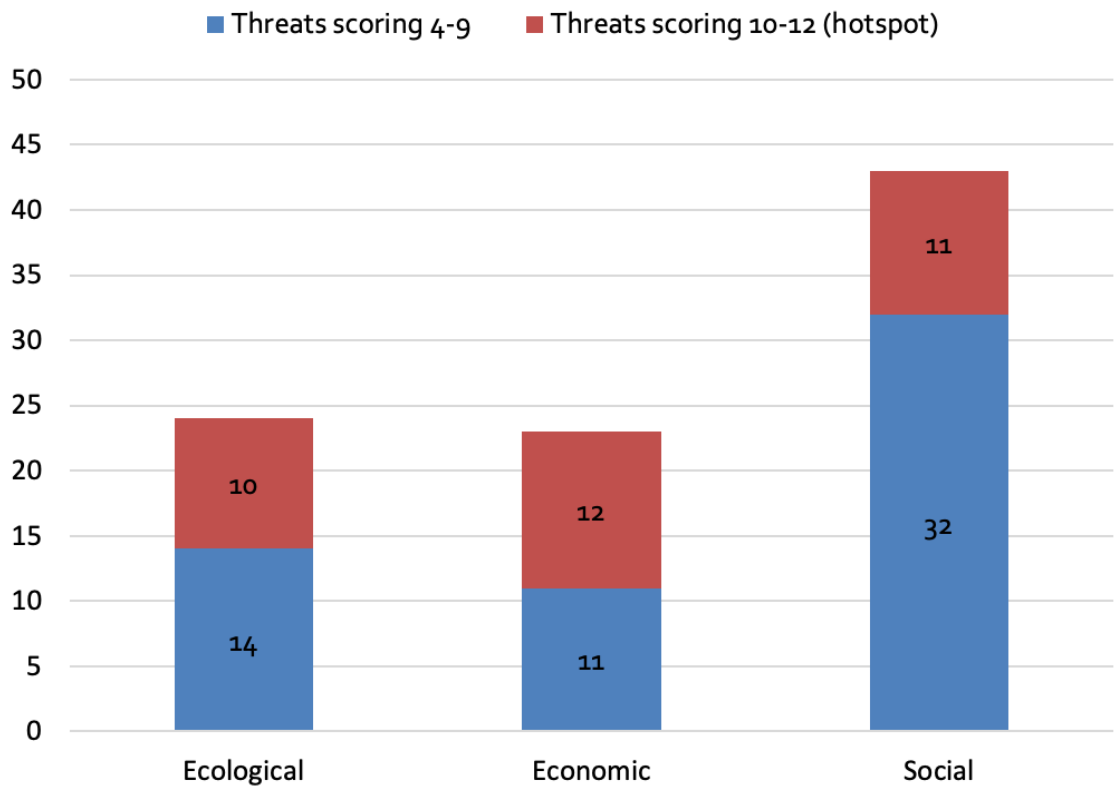


Figure 13: Identified threats to sustainability aspects of the groundnut value chain, by dimension

(Threats with a rating from 10 to 12 are considered a hotspot, while those with a rating of 9 and less are not.)

Source: data from FGDs and KIIs

A total of 88 threats to sustainability aspects were identified. Of these, 33 threats were evaluated as hotspots. While social issues were dominant among the aspects, the evaluated hotspot threats are distributed fairly evenly across the three

dimensions. Of 43 aspects mentioned in the social dimension, only 11 were selected as hotspots; whereas, roughly half the aspects in the economic and ecological dimension were rated as hotspots. Table 5: Sustainability aspects, threats, and hotspot rankings in the groundnut value chainTable 5 lists all sustainability aspects for which threats were rated as hotspots in the groundnut VC.

4.2.1 Inputs

Participants in the youth focus groups identified hotspot threats to the sustainability aspect "access to land", while input suppliers and extension officers viewed "quality seed" as a critical issue for groundnut production in the input supply phase.

4.2.1.1 Access to land

Two hotspot threats, shortage of farmland and overpopulation, contribute to this aspect and are closely related. Eastern Province is the second-most densely populated province in Zambia after Lusaka province. In 2013, the Zambian statistical office projected a near doubling of the rural population over the next 15 years (Zambia Data Portal, 2013). Although not rated as a hotspot, difficulty in accessing land for cultivation as a suspected result of chiefs' nepotism and tribalism was raised in female focus groups. The government extension officer in Lundazi confirmed the difficulty (especially for women and youth) of accessing land in Eastern Province.

4.2.1.2 Quality seed

Although seed quality is commonly treated as an economic issue, the key informants we interviewed placed it in the ecological dimension. Basically, the negative effects of the three hotspot threats, Rosette disease, lack of varieties, and unreliable seed supply/funding reinforce each other. Seed supply is perceived as unreliable because groundnut breeding is a time- and resource-intensive operation shunned by most private companies. Groundnut seeds can be recycled by farmers up to six times. Hence, the market for quality seed is a fraction of the amount of groundnut planted. Government research institutions, like the Msekera Research Institute in Lundazi, are eager to develop new varieties, but are underfunded. These two factors explain why the variety of quality seeds available on the market is limited. The third factor threatening groundnut seed quality is the Rosette virus. It is a common problem in groundnut farming throughout sub-Saharan Africa leading to severe yield reductions under dry conditions due to pod loss or smaller grain sizes

or both. While virus-resistant varieties are available, these are not as high yielding as other varieties under normal conditions.

Box 8: Innovation: Demonstration plots and smaller seed packages

Smallholder farmers are often not aware of the multiple benefits of using quality seeds from improved varieties. The high costs of purchasing standard seed packages prohibits farmers from experimenting with new varieties. Therefore, Afriseed established demonstration plots at various locations in Eastern Province and started offering seeds in smaller quantities. (Validation workshop).

Table 5: Sustainability aspects, threats, and hotspot rankings in the groundnut value chain				
Phase	**Dimension**	**Sustainability aspect**	**Threats to sustainability aspect (hotspot ranking)**	**n**
Input	Social	Access to land	Shortage of farmland (10); Overpopulation (11)	2
	Ecological	Quality seed	Rosette disease (11); Lack of varieties (11); Unreliable seed supply/underfunding (10)	3
Production	Social	Community cooperation	Disbelief (10); Jealousy (10); Alcohol consumption (12); Ignorance (12); Jealousy (12); Misunderstandings (10)	6
		Knowledge and adoption of CA	Climate change (12); Lack of knowledge/ignorance (12); Shortage of farmland (10)	3
	Environmental	Environmental protection (forests, soil, water)	Cutting of trees/charcoal burning (11); Cutting of trees/charcoal burning (12); Cutting of trees/charcoal burning (11); Cutting of trees/charcoal burning (12); Cutting of trees/charcoal burning (11)	5
		Stable rain patterns	Climate change (10); Instability of rain (10)	2
	Economic	Employment opportunities	Cutting of trees/lack of economic opportunities (11); Lack of employment opportunities (10)	2
		Demand	Monopsony of COMACO with blessing of chief (12); Low demand from COMACO (11)	2
		Access to capital	High interest rates (11)	1
Aggregation	Economic	Mobility	Weak governance/bad leadership (11); Transport/insufficient road maintenance (10)	2
		Honesty	Briefcase selling (10)	1
Processing	Economic	Quality standards	Conflicting standards with the buyers (10)	1
		Storage capacities	Lack of storage and space (10)	1

Marketing	Economic	Quality monitoring	Insufficient time efficiency/management (10)	1
		Profitability	Poor profitability for groundnut products (10)	1
Total social hotspots in value chain				11
Total ecological hotspots in value chain				10
Total economic hotspots in value chain				12
Total hotspots in entire value chain				33
Mentioned by: FGD Women FGD Men FGD Youth Key Informants Interviewee Source: data from FGDs and KIIs				

4.2.2 Production

In total, FGD participants and key informants in Eastern Province identified 23 hotspot threats in the production phase. Most of these hotspots fall into the social dimension (39 %), closely followed by economic (30 %) and ecological (30 %) dimensions.

4.2.2.1 Social dimension

Community cooperation

Although groundnut is considered a family- or community-based crop, lack of cooperation within communities was frequently discussed within the different focus groups. "Jealousy", "ignorance", "disbelief", and "misunderstandings" were identified as threats and rated as hotspots. "Alcohol consumption" and "traditional beliefs" were also viewed as contributing factors to poor cooperation among community members. Participants shared anecdotes about envious people (including headmen) who practised witchcraft to bring misfortune to successful farmers.[10]

Knowledge and adoption of conservation agriculture

Lack of knowledge and lack of knowledge sharing around conservation agriculture has been defined as a hotspot by male, female, and youth focus groups alike.[11] Conservation agriculture is a knowledge-intensive technology that requires understanding of basic principles of cultivation methods like intercropping, agro-forestry (eg. with *Gliricidia sepium*), and compost making. For that, both experimentation by the farmers and continuous guidance by extension services is needed. Experimentation is only successful in communities with a high degree of social cohesion and cooperation, otherwise technology pioneers and early adopters will likely be side-lined by other community members as explained in the paragraph above. Nevertheless, more and more farmers have become aware of conservation agriculture

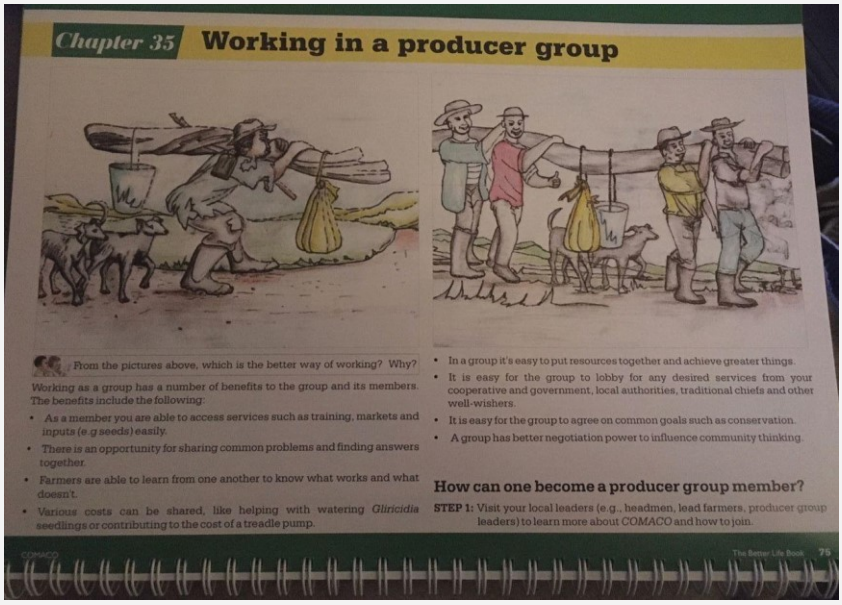
[10] A universally agreed definition of witchcraft does not exist. "Notwithstanding this, witchcraft broadly means the practice of, and belief in, magical skills and abilities that are able to be exercised by individuals and certain social groups that are intended to hurt" (Kabelenga, 2020, p. 52).

[11] FAO defines conservation agriculture as "a farming system that promotes minimum soil disturbance (i.e. no tillage), maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production" (FAO, 2022).

as a technology that helps them adapt to the effects of climatic change and reap multiple benefits from scarce farmland.

Box 9: Innovation: Producer groups

An innovation to reduce mistrust and lack of cooperation within communities is the formation of producer groups, in which conflicts may be resolved amicably and benefits are shared amongst all members. An example of this is provided in the "The Better Life Book"[12] from COMACO. It provides detailed guidance on how to become part of a producer group and what is needed for a producer group to be successful (COMACO, 2018).


Chapter 35 Working in a producer group

From the pictures above, which is the better way of working? Why?

Working as a group has a number of benefits to the group and its members. The benefits include the following:

- As a member you are able to access services such as training, markets and inputs (e.g seeds) easily.
- There is an opportunity for sharing common problems and finding answers together.
- Farmers are able to learn from one another to know what works and what doesn't.
- Various costs can be shared, like helping with watering *Gliricidia* seedlings or contributing to the cost of a treadle pump.
- In a group it's easy to put resources together and achieve greater things.
- It is easy for the group to lobby for any desired services from your cooperative and government, local authorities, traditional chiefs and other well-wishers.
- It is easy for the group to agree on common goals such as conservation.
- A group has better negotiation power to influence community thinking.

How can one become a producer group member?

STEP 1: Visit your local leaders (e.g., headmen, lead farmers, producer group leaders) to learn more about COMACO and how to join.

COMACO The Better Life Book 75

Photo: Excerpt from "The Better Life Book"

In Eastern Province, COMACO is a strong promoter of conservation agriculture. Furthermore, since 2020, COMACO has produced and exported organic peanut butter to the United States of America. Farmers that supply organically produced groundnuts to COMACO realise a premium price. However, the capacity to accommodate farmers under this scheme is currently limited. In Lundazi, for example, there are 3,750 organic COMACO farmers compared to about 18,000 conventional farmers (KII COMACO extension officer and seasonal calendar). COMACO defines

[12] The Better Life Book from COMACO (supported by GIZ) is a training handbook for farmers that can be used to teach farmers to grow different crops, protect nature, and use life skills in various areas. The book uses many visual aids and simple language. It has been made available to many farmers and is also available in public places such as schools, churches, and cooperatives.

organic farming as practising conservation agriculture in combination with agroforestry and without the application of chemical fertilisers and crop protection (see https://itswild.org/causes/sustainable-agriculture/).

Box 10: Innovation: "Farm talk" radio programme

In response to the demand for information on conservation agriculture, COMACO created a radio show, the "Farm talk". It is broadcast three times per week under the motto "Listen, Discuss and Act!". Lead farmers, supplied with solar wind-up radios, organise their producer groups to listen to the programme together, discuss the contents, and agree upon action plans (COMACO, 2018).

4.2.2.2 Ecological dimension

Environmental protection

Deforestation is, by far, the most prominent ecological issue in Zambia as a whole, so it is not surprising that it came up in all of the focus groups as a hotspot in the groundnut value chain. Decades of awareness creation obviously had an effect, but the "cutting of trees" and ensuing "charcoal burning" offers one of the few lucrative economic opportunities in rural areas. Therefore, these practices are very difficult to root out in absence of attractive economic alternatives. Nevertheless, there is a persistent assumption among FGD participants that deforestation has a direct effect on groundnut production by exacerbating the effects of climate change and causing rainfall instability (see also next paragraph).

Box 11: Innovation: Premium prices for conservation agriculture compliance

To offer economic incentives for conservation agriculture, COMACO has introduced premium prices for farmers in communities that comply with conservation practices. COMACO pays a premium price of 18 Kwacha per unshelled kilogram of groundnut to farmers in compliant chiefdoms, which is about 5 Kwacha higher than the regular market price. Based on criteria such as prevalence of bushfire, deforestation rates, and wildlife poaching trends (verified by GIS data), COMACO evaluates the performance of chiefdoms based on a traffic light system. This approach follows the principle of individual benefit through communal action.

Photo: Demonstration plot with Gliricidia sepium trees (Photo by Annika Reimann)

Stability of rain patterns

Smallholder farmers are keenly aware of seasonal changes in weather patterns, especially rainfall, since their existence depends on it, and are searching for explanations of such phenomenon. Female smallholders from Chipata suspected a connection between deforestation, climate change, and the changing rainfall patterns they experience. Consequently, they identified these threats as hotspots. In an interview with lead farmers, while drawing up a seasonal calendar in Petauke, these perceptions were corroborated. Participants explained that NGOs and COMACO have carried out a lot of awareness creation and educational work in the recent past. Nevertheless, an extension officer from Petauke pointed out that supernatural explanations are also very much prevalent, for example, that God alone is responsible for the rain.

Box 12: Innovation: Carbon compensation schemes

In 2015, COMACO entered a partnership with the World Bank to launch Zambia's first large-scale Reduced Emissions from Deforestation and Forest Degradation (REDD+) carbon project. COMACO established a monitoring system that determines how much CO_2 emissions are saved by avoiding deforestation as a result of their activities in Community Conservation Areas. Nine chiefdoms participated in the pilot initiative and COMACO aims to expand the project to another 28 chiefdoms (https://itswild.org/causes/carbon-project/).

4.2.2.3 Economic dimension

Employment opportunities

Discussing the lack of economic opportunities brought participants back to the issues of deforestation and charcoal burning. Unlike in Southern Province, these issues were put forward by senior female and male farmers, not the youth, in Eastern Province. They sympathised with youth, especially young women, because groundnut field work is performed by this group. This is regarded as family labour, hence not recognised as a form of formal employment and not remunerated. This is confirmed by statistics from the Zambian Statistics Agency (2020), showing higher unemployment rates among women and youth than men. The consequence is often that more and more people are forced to sell charcoal as a source of income to supplement their insufficient family-farm income due to the lack of jobs in the formal sector.

Demand

Although participants in our focus group discussion were recruited via COMACO and thus have a stable market for their groundnuts, both male and female farmers were concerned that not all groundnut farmers in their villages have access to COMACO. The resulting economic imbalance within the community sometimes leads to tensions. COMACO is aware of this issue but cannot work with more farmers due to their own limited capacities. In contrast to the threat of "land scarcity", some farmers in the FGD complained that their ambitions and abilities to cultivate larger areas and produce more groundnuts are slowed by COMACO's capacity restriction, especially in terms of lack of sales opportunities. Although other aggregators and processors buy groundnuts, some even from Malawi, they often offer lower prices than COMACO, do not provide support (as COMACO does), and do not penetrate remote rural areas to purchase the commodity.

Access to capital

Similar to the dairy value chain, lack of access to capital and loans was identified as a hotspot in the groundnut value chain. Female and, especially, youth felt disproportionately affected by this. The problem is that due to the lack of work in the formal sector and the fact that children and women often support farming operations informally, women and youth, especially, do not have wage statements or pay slips that could be used as collateral. Although capital may be raised elsewhere, including community members, these often attract unaffordable interest rates.

Box 13: Innovation: "Village Banking System"

To avoid prohibitive loan conditions in the formal financial sector, community members came up with a "village banking system". It consists of a group of farmers that pool funds so that individuals can take out loans from this communal fund. As collateral, farmers use their crop in the field or expected earnings from their harvest. This allows groundnut farmers to access cash funds while waiting for a better price to sell or for their contracted aggregator to collect the produce at a premium price. The "village banking system" can even include predefined and fair interest rates (COMACO, 2018). However, this system is not accessible to most women and youth who provide family labour to farming operations.

4.2.3 Aggregation

A range of aggregators such as COMACO, Good Nature Agro, and Afriseed offer an output market to groundnut farmers in rural areas. They enter contractual arrangements with farmers in the form of outgrower schemes or simply buy groundnuts available on rural markets or at the farm gate. The Zambian Ministry of Agriculture is currently developing a public–private partnership scheme to facilitate purchases between farmers and private companies through contract farming to enhance predictability for both parties.

Mobility

Stakeholders active in the aggregation phase of the VC identified the poor state of road networks resulting from insufficient road maintenance (weak governance) as a hotspot under the sustainability aspect of mobility. Poor trunk and feeder roads increase transport costs in several ways (slow speed, increased wear and tear, etc.) but also affect the quality of the collected crop because groundnut shells are more likely to break during transport.

Box 14: Innovation: Mobile money solutions

An issue that was not identified as a hotspot but poses a considerable risk to aggregators is related to conducting their business within a cash economy: the risk of being robbed while carrying cash to pay farmers for produce. To avoid this risk, COMACO is testing mobile money solutions. Similarly, the Export Trading Group (ETG) cooperates with banks that accept vouchers issued by ETG, allowing farmers to receive cash payments for their produce at the cooperating bank (COMACO provincial manager, ETG business manager).

Honesty

Briefcase- or side-selling, i.e. selling one's harvest to a third party despite having entered an agreement with another buyer, was rated as a hotspot by aggregators. A host of factors contributes to this sort of behaviour, namely the immediate need for cash on part of the farmer, unintentional late collection due to limited transport capacities on part of the aggregator, but also intentional late collection to ensure proper drying to reduce the risk of aflatoxin contamination. Side-selling is strongly correlated with the currently increasing demand for groundnuts and, thus, threatens the economic viability of aggregators and processors that provide additional services to smallholders, like input provision and extension services under preferential conditions.

4.2.4 Processing and marketing

In the processing phase, KIIs with groundnut processors revealed hotspots in conflicting quality standards, insufficient storage capacities before aggregation, and long-time requirements for quality control. In the marketing phase, KIIs with peanut butter processors and retailers revealed hotspots in low profitability of peanut butter on the Zambian market.

Quality standards

Farmers frequently soak groundnuts for easier shelling which increases the risk of aflatoxin contamination due to high moisture content. Thus, some aggregators (e.g., COMACO and Good Nature Agro) only buy unshelled groundnuts (COMACO staff; Good Nature Agro representative). Aflatoxin is a crop infection produced by fungi that is frequently associated with liver cancer (Kachapulula et al., 2017). Independent aggregators who do not consider moisture content and aflatoxin levels when purchasing groundnuts also accept shelled groundnuts, which farmers can

sell at a higher price than unshelled groundnuts (independent aggregator, Lundazi; COMACO staff).

These conflicting standards can be especially disadvantageous for selective processing enterprises. COMACO, for instance, faced a situation last year where there were no more unshelled groundnuts on the market which forced them to buy shelled nuts instead. Due to moisture and aflatoxin contamination, a relatively large percentage of the shelled nuts had to be discarded (one processor estimated a loss of 30 %), resulting in increased costs and reduced profit margins (COMACO staff; COMACO provincial manager; Share Africa representative).

Box 15: Innovation: Making use of by-products

COMACO found ways to convert rejected raw material and waste products by turning them into poultry feed and briquettes for energy production.[13] By selling low-quality nuts as chicken feed, the disposal costs for rejected raw material can be avoided. By using the energy briquettes to roast groundnuts for peanut butter production, COMACO can make costs savings and increase sustainability of its production process (COMACO staff).

Photos: Energy briquettes (left) and poultry fodder from low-quality produce (right).
Source: Annika Reimann

Storage capacities

The scarcity of storage facilities was rated as a hotspot with a worsening trend as groundnut production volumes increased (COMACO extension officer). As a consequence, bags of groundnuts were often exposed to sun and rain, reducing the

[13] This innovation is further discussed in section 5.3.

quality of the produce. Insufficient commercialisation of Aflasafe was considered a threat to aflatoxin management (Share Africa representative).[14]

Box 16: Innovation: Indigenous knowledge of aflatoxin management

Although aflatoxin contamination was not identified as a hotspot, it is obviously an important aspect in the groundnut VC. Local farmers have come up with ways to prevent fungal contamination and control other diseases. A lead farmer explained that groundnut plants are sprayed with a mixture of ash and water. Additionally, when groundnuts are stored, farmers mix *Gliricidia sepium* leaves into the bags which, they report, prevents aflatoxin formation (Transect walk, Katete). However, we could not find any evidence in the literature on the effectiveness of these practices.

Quality control

Before groundnuts are processed, samples are taken for aflatoxin level testing as they do not decrease during processing (Mofya-Mukuka & Shipekesa, 2013). The time required for testing was rated as a hotspot because it can delay processing (ETG business manager). This poses a particular challenge to small- to medium-sized processing enterprises as they process groundnuts based on wholesale orders.

Profitability

In the marketing phase, low profitability of peanut butter on the Zambian market was identified as a hotspot that became particularly severe in the past three to four years, according to one key informant (ETG business manager). Nevertheless, high demand for peanut butter created an enabling environment for innovations such as interlinking peanut butter with more profitable products (see Box 17 for details).

[14] Aflasafe is a product based on four harmless *Aspergillus* strains that infect the groundnut grain before the toxic strain can establish itself.

Box 17: Innovation: Joint sales

Despite its low profitability, companies still keep peanut butter in their product range because it is consumed by a considerable number of customers. To increase overall profitability, these companies try to promote more profitable products in conjunction with their well-established peanut butter brands. ETG, for instance, sells FreshPikt brand peanut butter jointly with FreshPikt jam to attract peanut butter consumers to their more profitable jam, using marketing strategies like "buy this product and get 10% off the price of that product".

5 From method to action: Discussion of results

In the following discussion, we relate our results from the extensive field research to our original research questions and present additional findings. The first section will address the guiding question, "*How and if the WU-HSA can be made more participatory and how does it perform in the field?*", therefore relating to outputs 1.1 and 1.2. Special focus will be placed on the strengths of the methodological approach, but also some of its inherent limitations. The second part of this chapter focuses on the question, "*Are the results of the pHSA aligned with agroecological principles?"* as formulated by the HLPE. We also discuss the extent to which the pHSA may be used as an analytical step necessary to support a transformative value chain development process (output 1.3). Finally, we address the third and fourth questions, "*Which trade-offs, synergies, and innovations can be identified along the groundnut and dairy VCs in Zambia?"* relating to outputs 1.2 and 1.4. Here, we place the focus on sustainability trade-offs in value chain development.

5.1 Methodology: A participatory approach to the HSA

Our main methodological contribution to the WU-HSA is the application of a participatory and systemic approach, especially targeted to assessing sustainability aspects at the VC's production stage. Sustainability is a very broad and multi-layered topic, intensely and controversially discussed in academic and political circles (Bruckmeier, 2022; Elkington, 2018; Tulloch & Neilson, 2014). To engage in a meaningful reflection on sustainability aspects with smallholder farmers in sub-Saharan Africa, one has to break this complex issue down to the living realities of the people concerned and start addressing real-life problems. We aimed to do that by placing emphasis on the basic resources farmers require to successfully engage in dairy or groundnut production. By taking the necessary resources as a point of departure for the sustainability assessment, farmers (i.e., our FGD participants) quickly become aware of the ecological, social, economic, and political systems that surround them and, importantly, recognise the conditions for their continued functioning. Thereby, participants gain a holistic understanding of the interdependencies between different dimensions of sustainability and their own livelihood situations.

Placing the farmer at the centre of the research process ensures and reinforces the multi-dimensional approach to sustainability assessments in food value chains in a development cooperation context. It also supports exploring alternative values, i.e. values that are culturally and socially rooted, for example the deep-rooted tradition of cattle herding among the Tonga people. Development practitioners will

probably agree that smallholder farmers frequently endorse outside perspectives and propositions in hope of gaining access to any kind of perceived benefit. In a similar vein, presenting smallholder farmers a list of sustainability aspects predetermined by academics, which is basically the WU-HSA approach, runs the risk that farmers would quickly endorse such a list without reflecting on their own actual livelihood situation. In the end, the general results may not be drastically different between these two approaches. Similarly, a comparison with available literature from Zambia (Lubungu et al., 2021; Mofya-Mukuka & Shipekesa, 2013), and East Africa (Makoni et al., 2014) confirms economic hotspots identified but these assessments do not go beyond mere economic considerations. However, nuances and details are more likely to be revealed by applying our methodology. And importantly, ownership and agency will be gained by the participants.

Staying with the notion of nuances and details, the need for distinct gender and age groups when conducting focus group discussions became apparent during our first focus group discussion. At this event, plenary sessions formed a large part of the day and we observed that elder men dominated the process of identifying sustainability aspects to be carried forward for evaluation. Hence, some of the aspects important to women and youth didn't even get to the point of being evaluated as a hotspot on that day. Based on that experience, we adapted the programme to afford the focus groups more space and used the plenary session to report back only. There was a general agreement between the groups and most of the topics raised overlapped to a considerable degree. However, gender-differentiated groups provided an open and comfortable space for participants to voice their specific concerns that otherwise may have been drowned out by culturally dominant and more vocal participants. An example is the sustainability aspect of "access to inputs, capital, and land" that was brought forward by women in the dairy VC FGDs to reflect the strong gender bias in this specific aspect: access to these resources is a general concern, but especially difficult for women and youth. Such a nuance can be critically important, especially since dairy farming may be one of the few agricultural activities available to women in a traditional cattle-herding society dominated by men. Similarly, literature often points out that groundnut production is often controlled by females in Africa (see Curtis et al., 2018; Lubungu et al., 2021; Ngoma-Kasanda & Sichilima, 2016). Therefore, it is of utmost importance to capture the position and perceptions of women when reflecting on the development process in this sector. Another example is the keen awareness youth showed in Eastern Province regarding the issue of "scarcity of land" and its connection with "overpopulation", demonstrating their particular concern for the sustainable utilisation of the

natural and agricultural resource base in the long term. In our experience, the creation of a safe space to express concerns was particularly appreciated by the youth.

Another adaptation to the WU-HSA we introduced was a set of defined criteria, i.e., scope, severity, permanence, and trend, to evaluate identified threats relating to specific sustainability aspects in order to arrive at hotspots. Instead of calculating the product of rating values for the relevance of a particular value chain phase and the sustainability aspects within this VC phase, our approach is much more detailed. And, by applying four different criteria to assess a single topic, it is easier to objectively verify the final score. We see two main advantages of our approach: a) freelisting as a first step in the process encourages open-mindedness, exploration, and creativity thus emphasising the inclusive character of this methodology and b) applying well-defined criteria for the evaluation of a potential hotspot make its assessment more transparent and allows meaningful comparison between different hotspots. Inviting participants to discuss and agree upon suitable evaluation criteria themselves boosted their awareness that they were being recognised as experts, rather than mere providers of information; this enhanced their understanding of interrelationships.

A drawback from this approach may be the very high number of threats that are identified by the participants in the study. In our study, the participants identified 137 threats to sustainability aspects in the dairy and 88 in the groundnut value chain. Compared to hotspot analyses carried out by the Wuppertal Institute and collaborators (Bienge et al., 2009; Liedtke et al., 2010; Rohn et al., 2014), our method revealed a much higher number of sustainability hotspots. The reason for this is most probably that freelisting produces a higher number of issues than more regimented forms of evaluation. This has obvious advantages and disadvantages. The main advantage lies in its contribution to a holistic assessment of sustainability from the perspective of smallholders. While the multitude of issues raised may be perceived as disadvantageous, we believe that the detailed evaluation criteria will be useful to identify issues that have a strong bearing on sustainability aspects in a subsequent scientifically based assessment round.

However, as much as this systemic and participatory approach captured the perceptions of smallholder farmers in the production life cycle, practical and logistical considerations made it unfeasible to apply it in other value chain steps. While it might be possible to gather stakeholders from all value chain phases in one place to apply our approach in each of the phases, time and budgetary limitations as well as COVID-19 regulations compelled us to choose a different route. And, in our experience, this approach is sufficient and suitable to achieve the set objectives. We

deliberately started the sustainability assessment of the value chains upstream at the production phase then worked on the downstream phases. We did this mainly for two reasons. We intentionally placed our focus on those stages of the value chains in which smallholder farmers are directly involved because the key objective of development cooperation is to contribute to poverty alleviation and food security among this target group. Therefore, to keep the interviews with actors from downstream phases short and focused, we presented them with preliminary findings from the focus group discussions. Then, we invited these stakeholders to validate and build on these results, when reflecting on additional sustainability aspects in the VC phases they are active in. Such a sequenced approach worked well in our experience. Similarly, to validate findings from all VC phases in the form of a validation workshop with stakeholders who are not actively participating in the VC but have a supporting and regulatory function, proved helpful. This way we were able to gain a comprehensive understanding of sustainability challenges along the entire VC and their implications for the entire food system within the broader context.

5.2 Aligning the pHSA with agroecological principles

As stated in the conceptual framework, agroecology is seen as a key paradigm for the transition to sustainable food systems. In the following, we discuss how the results of our bottom-up sustainability assessment correspond with the internationally agreed 13 principles of agroecology (HLPE, 2019) and how they relate to the five levels of agroecological transition proposed by Gliessman (2015, 2016). We group our discussion along the three operational principles of the sustainable food system approach and not along the sustainability dimensions that we used when presenting our results. We do this to emphasise the strong interlinkages and interdependencies between sustainability aspects and goals that follow from them in the different dimensions (Gibson, 2006). We conclude this section with a reflection on the potential contribution that addressing the identified hotspots can make to transformative value-chain development.

Improve resource efficiency

The operational principle "improve resource efficiency" of the SFS approach combines two agroecological principles, namely recycling and input reduction. At first glance it may appear that the hotspots in our study do not touch on recycling and are even in contradiction to the principle of input reduction, since smallholder farmers in both value chains complained about lack of and difficult access to production inputs. However, closer inspection allows a more differentiated analysis.

The principle "recycling" includes resource cycles of nutrients and biomass and we argue that water cycles should be considered in this regard as well. Participants in both provinces shared profound concerns for the water cycle although not all the biophysical processes involved were always fully or correctly understood. With regard to nutrient and biomass cycling, conservation agriculture has to be pointed out. Conservation agriculture is strongly promoted by COMACO, amongst others including the Ministry of Agriculture. Consequently, farmers affiliated to COMACO practise it or at least are aware of it. While conservation agriculture was frequently mentioned in discussions, it was not rated as a hotspot. This may be explained by the fact that, through COMACO's efforts, farmers perceive the issues of recycling biomass, soil health, and so on as taken care of and not threatening the sustainable functioning of their agroecosystem. In the scientific literature the impact of conservation agriculture on smallholder farming in sub-Saharan Africa is critically debated. While application of conservation agriculture on-station and on-farm clearly show benefits to the environment and farmers (Droppelmann et al., 2017; Thierfelder et al., 2017; Thierfelder & Wall, 2010), critical voices point out the low adoption rates among smallholder communities (Brown et al., 2018; Giller et al., 2015). Hence, conservation agriculture can certainly make a strong contribution to ecological sustainability of smallholder farming systems but it needs local adaptation by applying participatory extension approaches fostering co-learning to be successful.

With regard to the resource water, the situation looks completely different. Water availability for crop growth was identified as a hotspot by groundnut farmers but even more so, it was a major concern for dairy farmers in Southern Province. Water is needed for fodder production and drinking water for their animals. The sustainability hotspots "deforestation", "lack of rain", and "climate change" show that farmers are aware of the water resource cycle and view its sustainable functioning with great concern. Further down (p. 79) we will discuss the extent farmers believe these issues to be linked and what lessons we can draw from that; at this point, we would like to highlight the need for integrated solutions supporting a holistic approach for sustainability enhancement.

Findings from the (World Bank, 2021b) indicate that Southern Province will be even more affected by climatic change in future. Their data suggest a change in weather patterns (longer dry spells and more flash floods) is more likely than a dramatic change in annual rainfall amounts. In such a situation, the harnessing of surface water runoff is a feasible option. Two key interventions are possible to address water availability in a sustainable manner: farm / community dams and agrofor-

estry. While dams provide access to surface water, they also help stabilise groundwater levels. Secondly, besides providing much-needed supplemental fodder, agro-forestry has beneficial impacts on water infiltration and water retention in the soil. Runoff-irrigated agroforestry systems harness surface runoff from flash floods to provide fuelwood (Droppelmann & Berliner, 2003) and thus are a sustainable alternative to charcoal burning from indigenous forests. Ideally, interventions of this sort should be coordinated with other development projects, for example with GIZ's Sustainable Water Resources Management and Agricultural Water Use in Zambia,[15] supporting a concerted effort and holistic approach to sustainable resource management in Southern Province. Linking agroforestry interventions to carbon compensation schemes (similar to the COMACO approach, see Box 12) or emulating the approach proposed by The European Innovation Partnership on Grazing for Carbon (EIP-AGRI, 2018) may offer alternative income streams to local communities, reducing the need for illegal charcoal burning. To further enhance the transition toward sustainability, a stronger integration of dairy with other farming activities should be explored. For example, compost making in combination with high-value horticultural crops under supplemental irrigation from farm dams using treadle pumps would support the AE principle #7 "economic diversification".

Under the heading "improve resource efficiency", the AE principle #2 "input reduction" takes on a meaning that is not in contradiction with the claim for better access to production inputs by groundnut and dairy farmers. After all, the key inputs here are improved seed material and veterinary drugs. Current breeding efforts for groundnuts focus on increasing the spectrum of seed varieties suitable to a wide range of agro-climatic conditions, i.e., drought-tolerant and aflatoxin-resistant, while maintaining the ability to recycle seeds for several years. Thus, smallholder production systems would be more efficient regarding the resources land and available rainfall without causing ecological damages and without increasing the dependence on external inputs further. In this way, agricultural production becomes more resilient, which ties in with the next operational principle: "strengthening resilience". According to farmers and COMACO staff, groundnut production does not require chemical fertilisers. As mentioned earlier, groundnuts have replaced cotton and tobacco to a considerable extent in Eastern Province. When queried about that in an informal discussion, a COMACO representative explained that these cash crops are heavily dependent on high external inputs, like pesticides and chemical fertilisers. Therefore, they were not very popular among smallholder

[15] Sustainable Water Resources Management and Agricultural Water Use in Zambia; https://www.giz.de/en/worldwide/81382.html

farmers. Given the option, farmers would prefer groundnut production due to its low external input requirements.

Unfortunately, improving access to veterinary drugs for smallholder dairy farmers may not help eliminate their dependence on input markets (Govere et al., 2009), but it is likely to be beneficial to the health status of the animals (AE principle #4 "animal health"). It may be able to avoid such trade-offs by adopting management practices based on AE principles to improve animal health as suggested by Soussana et al. (2015). However, the introduction of new management practices requires a well-functioning and effective extension service delivery system.

Indeed, agricultural extension services provision was a very critical factor discussed by dairy farmers in Southern Province. Participants identified a total of 12 hotspot threats for the sustainability aspect "Presence of governmental extension services". This is corroborated in the literature by Kiwanuka & Machethe (2016), who argued that access to extension services and infrastructure is key to enabling Zambian dairy smallholders to participate in the formal value chain. In Eastern Province, among groundnut farmers, only the issue of "Knowledge and adoption of conservation agriculture" came up as a sustainability aspect but was not linked to poor extension service provision. The reason for this is likely COMACO's intense promotion of conservation agriculture and other sustainable and climate-smart practices like agroforestry among affiliated smallholder farmers. Unfortunately, COMACO is not able to make their extension services available to all farmers. Hence, COMACO farmers perceive themselves as conservation-agriculture adopters, but realise their limited numbers prevent landscape-scale benefits from materialising.

Strengthening resilience

We touched on the AE principles of "soil health" and "animal health" (see conservation agriculture and veterinary drugs) above. Although these aspects were not explicitly discussed and identified by participants as sustainability hotspots, their importance is understood and implicitly revealed through hotspots like "unaffordable inputs (e.g., vet drugs)", "Rosette disease", and "Lack of varieties (e.g., suitable groundnut seed)".

The main issue identified by smallholder farmers under "strengthening resilience" in the dairy and groundnut value chains is deforestation. Both sectors are affected by it in a similar way. Deforestation contributes to a loss of biodiversity (AE principle #6, Table 1), causes severe soil erosion, and eventually has negative effects on the entire agroecosystem, especially the water household of the affected

region. Consequently, participants in female and male FGDs placed deforestation in the ecological dimension (worded as "cutting of trees" for charcoal production under the economic dimension, which refers to economic diversification (AE principle #7,Table 1). This example highlights the strong interdependences between the dimensions of sustainability and the interlinkages between sustainability aspects. Frequently, the production and roadside sale of charcoal is the only economic activity available to large parts of the rural population in Southern and Eastern Provinces (Vinya et al., 2011), especially for the youth. To counter the negative impacts of deforestation and monocropping, COMACO promotes groundnut production in rotation with maize and soybean (as a part of conservation agriculture) along with agroforestry with *Gliricidia sepium*. Thus, agrobiodiversity at the field and landscape scale and positive ecological interactions are enhanced. However, measures that focus solely on the environmental dimension cannot solve the underlying multidimensional problem of deforestation; the socioeconomic perspective must be addressed, for example, through creation of employment opportunities or alternative income sources like carbon compensation funds.

Secure social equity/responsibility

Six of the thirteen AE principles are grouped under the operational principle "secure social equity/responsibility". This resonates with results from our research, where 44 % and 48 % of all threats identified by participants in the dairy and groundnut VCs fall in the social dimension. Although not all these threats were rated as hotspots, it points to the critical importance of the underlying aspects of sustainability. According to Gliessman (2015, 2016), it is this group of principles that contributes most to the transformational character in the food systems change process. Participants in our research assigned hotspots to all the AE principles (#8-13 in Table 1) under this grouping. The sustainability aspects "community empowerment/cooperation", "sharing of knowledge", "knowledge and adoption of conservation agriculture", and "youth empowerment" had a combined tally of 15 hotspots (Table 3 & Table 5). They strongly relate to AE principle #8 "Co-creation of knowledge".

In Southern Province, we observed an instructive example of AE principle #9 "Social values and diets". Here, the number of cattle a man owns determines his social status in the community, which appears be a strong barrier for cattle ownership among youth and women. Considered a culturally accepted economic activity for women (Mulenga & Wineman, 2014), dairy cattle farming is frequently practised by women who have inherited cattle from their deceased husbands. Then, it offers

them one of the few economic activities with which they can maintain their financial independence and provide for their families.

In Southern Province, the importance of home consumption and informal milk markets was touched upon in interviews and group discussions but was not rated as a hotspot. However, these issues did come out strongly in our analysis of consumption behaviour (section 4.1.4). People in Southern Province consume more milk than people in other provinces because they either have dairy animals on their farms or they have quick and easy access to informal milk markets. This example relates to the AE principle # 11 "Connectivity" and the related FAO element of "Circular and solidarity economy" (Barrios et al., 2020).

Moving on to the formal dairy marketing channel, participants pointed out their grievances regarding management and governance issues at MCCs as well as a lack of unified voice and collective negotiating power. To instil and improve responsible self-governance (see AE principle # 12), GIZ supports the establishment of a cooperative union in Southern Province. Similar considerations motivated stakeholders in the groundnut sector in Eastern Province to establish a cooperative association. COMACO was instrumental in setting up this association of 55 cooperatives, which had its inaugural meeting in September 2021. The objective of the association is to strengthen producer cooperatives and give them a political voice. However, since the young association is not yet financially independent from COMACO, its near-term goal is to act as a conduit for funding from development organisations, aiming to strengthen their cooperatives by establishing a robust monitoring and evaluation scheme for cooperative performance.

The AE principle #10 "Fairness" is a cross-cutting issue, which we came across in various contexts. Some participants in our research suggested they felt they were being treated unfairly or being victims of exploitative practices (for example, inflated input prices, limited access to capital, poor price transmission, etc.). While such issues would affect smallholder farmers across the board, we picked up examples of gender-based unfairness (e.g., sustainability issues "Gender equality", Youth empowerment", "Sharing of knowledge" in Table 3 and, "Employment opportunities (i.e., for young and female family members)" in Table 5).

Transformative VC development

The complexity and multi-dimensional nature of food systems necessitates the design of sustainability-enhancing support measures to food value chains to follow a holistic and systemic approach across the ecological, socio-economic, cultural,

and political dimensions. The 13 agroecological principles may have built the foundation for that and function as pathways for the 10 elements of the agroecological transition process in agricultural and entire food systems (Barrios et al., 2020). By and large, the hotspots identified by the participants in our research study can be interpreted in light of all 13 agroecological principles (see Table 1) in one way or another. Likewise, by addressing these hotspots through scaling out existing innovations and introducing new innovations, the dairy and groundnut value chains are likely to achieve a higher level of sustainability in the future. Most of the innovations that we were able to identify fall within the incremental category, mainly providing technical solutions like trainings, capacity building, and organisational support aiming at transformational change. Our approach to the participatory hotspot analysis afforded smallholder producers, active in these value chains, the opportunity to voice their intervention needs to support agroecological principles at the transformational levels 3 to 5 (see also Gliessman, 2015). Our participants even went beyond the scope of the AE principles addressing issues like rent-seeking behaviour by officials, overpopulation, and transport infrastructure. This shows that while our participatory approach is very much aligned with current approaches of the FAO, it provides an even deeper level of insight into the perceptions of sustainability held by the prime target group of development cooperation than the mere evaluation of a predetermined list of sustainability aspects drawn up by academics.

5.3 Multidimensional sustainability, trade-offs, and perceptions versus scientific evidence

Following the conceptual underpinning of sustainability outlined in Chapter 2, participants in our study identified hotspots across the social, economic, and ecological dimensions, relating to all 13 principles of agroecology across the five levels of food system transformation. These hotspots are not isolated issues that can be understood independently. Conversely, through our holistic and systemic research approach, multiple and strong interdependencies were revealed. A fair number of aspects and hotspots could be assigned to more than one dimension and their interrelationships had to be considered. A prime example is the issue of deforestation, which is only indirectly linked to the dairy and groundnut value chains but is of critical importance for the sustainable functioning of ecosystem services supporting both value chains.

Where mutual relationships and interdependencies exist, trade-offs are frequently inevitable in a food system. We understand trade-offs as causal relationships within the food system of such nature that one sustainability goal cannot be achieved without compromising another sustainability goal. An example is the informal charcoal sector. Charcoal production relies on the exploitation of natural resources, i.e., Miombo forests in Zambia. It is a source of income that is accessible even to resource-constrained people. Simply prohibiting access by whatever means to the resource natural forests may put people's livelihoods at risk. On the other hand, large-scale deforestation is likely to threaten the ecological sustainability of agricultural activities due to reduction in ecosystem service provision. In the following, we highlight some of the key identified trade-offs specific to the two VCs in more detail and suggest ways of negotiating trade-offs more effectively.

5.3.1 The dairy value chain — a socio-ecological debate

The first trade-off within the dairy value chain is between traditional cattle ownership (social dimension) and modern dairy management (economic dimension). Public extension agents, actors of the private sector, and development practitioners intend to establish a modern approach to dairy management among small-scale farmers. This particularly refers to intentions to increase productivity, while reducing the number of animals per farmer. Therefore, the MFL, several dairy processors, and GIZ cooperate in providing training to farmers. This ambition is mutually shared by smallholder farmers as expressed in FGDs. On the other hand, farmers and other experts constantly highlighted in FGDs the cultural legacy and significance of cattle herding in Zambia. In Southern Province, the Tonga, Ila, and Tokaleya communities have been practising cattle herding for generations. In many communities, owning cattle is considered a sign of privilege and social standing. Reducing the herd size in favour of fewer, more productive, and more management-intensive dairy animals, goes against these cultural values.

Box 18: Cultural significance versus productivity of cattle in Zambia

For the Tonga people of Southern Province, cattle are the currency for *lobola*, the bride price or dowry, and are crucial for many families to demonstrate wealth, negotiate power, and reinforce social standing. For example, the Tonga show respect to elders at funerals by parading cattle past the house of a deceased person according to their social standing in the community (Heeren et al., 2011). Therefore, maintaining a large herd size is socially important.

The Tonga traditionally rear Zebu-type cattle (illustrative picture below on the left) with a milk yield of 1 – 3 litres of milk per day (Neven et al., 2017). Being dual-purpose livestock, they are kept for mainly for their meat, although the Tonga people will rarely slaughter an animal for food or sale unless there is a funeral or wedding in the family. Due to their adaptability to the local environment, these traditional cattle are often crossbred with purebred beef or dairy breeds to improve their productive capacity. For example, Zebu–Taurus dairy crossbreeds commonly produce milk yields of 8 – 16 litres per day; whereas, purebred dairy animals (illustrative picture below on the right) yield 20 – 28 litres per day (Neven et al., 2017).

Photos: Zebu-type cattle (left) and purebred dairy animal (right). Source: Joel Hähnle

Nevertheless, dairy farming may offer the chance to sustain animal-based livelihood systems longer than the traditional cattle herding will be able to. In view of the expected effects on climatic change, more focus will have to be placed on the management of water resources for agricultural production. Options for that have been outlined earlier on p. 68. On that basis, the potential for sustainable intensification that dairy farming holds should be explored further, for example through a stronger integration with irrigated fodder crop farming and horticultural systems using animal manure. For example, research results from Kenya show that poverty levels among dairy farming households were lower than households primarily relying on crop farming (Valdivia et al., 2017). Since the long-term sustainability of livestock farming is questioned at the global scale and the effects of climate change on agricultural production capacity in southern Africa are not yet understood well

enough, alternative and complementary development options to dairy farming in Southern Province should be explored. If dairy farming is not supported any longer for whatever reason, what sustainable livelihood alternatives for rural communities exist in Southern Province? And, how can a shift from cattle and dairy farming to such new livelihoods be facilitated?

Projections about the direction and magnitude of the effects of climatic change are still difficult to make with certainty for a region the size of Southern Province (Arndt et al., 2019), although scientific evidence shows a clear and worrying global trend. According to data collated by the World Bank (2021b), the mean annual temperature in Southern Province increased 1.3 degrees since 1960 and rainfall amounts declined by 58 mm (6 %) from the period between 1971 and 2005 and the period between 1940 and 1970. During our validation workshop, international development actors questioned the likelihood of the success of a sustainable dairy sector in the Southern Province in view of such trends. In this context, thoughts about establishing dairy production in the Northern Province, where precipitation is expected to remain higher, were expressed as an alternative. If agro-climatic conditions in Zambia should change, the people of Southern Province will need to make informed choices about the possibility of moving their animals in search of continued livelihoods. Assuming such a scenario, experienced dairy farmers may have a better chance at success than traditional cattle herders.

The results of our research not only exposed trade-offs between sustainability dimensions but also trade-offs that introduced a temporal component.[16] We observed the dilemma between short-term and long-term decision making by analysing the issue of accessing water in the dairy sector. Throughout the entire Southern Province, small-scale farmers demanded better financial conditions and support for borehole drilling to tap groundwater resources. Over the last few years, demand for water to sustain, amongst others, the agricultural and livestock sectors has increased. Therefore, the Water Resources Management Authority, a government agency, started to oversee and regulate the drilling of boreholes to monitor groundwater resources. On the one hand, many small-scale farmers expressed their awareness of a constantly lowering groundwater level and the medium- to

[16] These temporal trade-offs have already been discussed by Jacobs (2011) in the context of policy making. He observed that policy makers are not only incentivised to appeal to voters in the short term but also have to base their decision on long-term issues that might seem uncomfortable now but need to be solved.

long-term unsustainability of borehole drilling. On the other hand, they also emphasised how crucial access to water is right now to secure the survival of their animals.

For policy makers and actors in development cooperation, the observed trade-offs provide several insights on multidimensional sustainability in the dairy sector. From an ecological perspective, the pathway toward sustainability in the dairy value chain is highly challenging, primarily due to its high demand for water and contributions to greenhouse gas emissions (methane emissions from large ruminants; *see also* IEA, 2021). Such considerations have to be carefully evaluated. Can water resources be sustainably developed in Southern Province to sustain agricultural production? Can the contribution of the dairy herd in Southern Province to global greenhouse gas emissions be effectively compensated? What is the ecological footprint, the social impact, and the economic benefit of potential alternatives?

5.3.2 The groundnut value chain — negotiating the rocky road toward sustainability

COMACO's well-intended promotion of organic groundnut production, unfortunately yielded some unintended effects. COMACO offered a premium price for organically produced groundnuts.[17] Seemingly, it is a win–win situation for participating farmers and the agro-ecosystem, in that farmers realise a higher commodity price while organic practices support ecosystem functioning and strengthen resilience. However, some farmers turned the initiative on its head when they started to convert virgin land to comply with the requirements for organic production: land certified under organic production must be left fallow for at least three years or be virgin. In the land-scarce Eastern Province, some farmers decided not to wait a full three years and hence cleared additional land if that was available. An added incentive may have been the additional income generated from the felled trees by producing charcoal. Although this doesn't constitute a trade-off in the true sense, it exemplifies the multi-dimensionality and interdependency of economic and ecological sustainability aspects.

A dilemma underlies the identified hotspot of "Scarcity of quality seed". Drought-resistant varieties, suitable to the increasingly shorter rainy seasons and water stress, are available as a result of their development and promotion by the Msekera Research Institute. But farmers fear that these early-maturing varieties

[17] COMACO's organic groundnut certification is through ECOCERT (https://www.ecocert.com/en/certification)

produce lower yields and smaller grains under normal rainfall conditions and may only save them from severe crop loss under poor rainfall conditions. Small grain size is also frequently used as an indicator for potential aflatoxin infection, dissuading processors to purchase these nuts. Hence, choosing the right seed variety has turned into a perceived gamble in absence of reliable information about the expected climatic conditions in a specific season. Consequently, farmers are compelled to accept a trade-off between securing a groundnut harvest that sustains home consumption under poor rainfall conditions and the prospect of a reasonable harvest of a marketable crop, should the season progress favourably.

Another challenge presents itself in the processing stage of groundnut. To ensure high quality standards, e.g., low aflatoxin levels in their products, COMACO has put a stringent crop-sorting procedure in place, resulting in considerable amounts of rejected groundnuts and groundnut shells. To make use of these by-products, COMACO came up with several innovations, including fire briquettes and poultry feed (see Box 15). However, it turns out that aflatoxin does not break down during processing and even accumulates in the chickens reared on aflatoxin-contaminated feed, thereby posing a health risk to people consuming those chickens (Kachapulula et al., 2017). This should not be underestimated, as reports on aflatoxin monitoring in Zambia show that traces of this toxic substance are regularly detected in peanut butter, which is subject to stricter controls and requires lower thresholds than animal feeds (Njoroge et al., 2016). This example demonstrates the importance of consulting scientific evidence before rolling out innovations.

Surprisingly, the critical issue of aflatoxin contamination was discussed by all stakeholders in the groundnut value chain but not identified as a hotspot. Although aflatoxin-producing fungi are soil borne, the most critical stages to avoid contamination are during and after harvest. Kachapulula et al. (2017) found a higher proportion of groundnut crops contaminated with unsafe aflatoxin levels in samples collected from hotter and drier agroecological zones (38 %) than cooler and wetter conditions in Zambia (8 %). However, the authors also found that subjecting safe groundnut crops to poor post-harvest conditions (i.e., >31 ⁰ Celcius and 100 % relative humidity for one week) increased aflatoxin levels by 1,000. Therefore, post-harvest handling is a critical step for ensuring crop safety since some aggregators buy groundnut crops regardless of quality and without safety checks, especially in seasons affected by limited supply. In the long run, such blatant disregard for safely standards by some players may threaten the entire industry.

6 Concluding remarks

We applied an adapted version of the WU-HSA to assess critical aspects of sustainability in the dairy and groundnuts value chains in Zambia. This adapted version was specifically designed to capture the perceptions of smallholder farmers who are active in these VCs because they are the prime target group of development cooperation interventions. Thus, we transformed the WU-HSA into a participatory hotspot analysis (pHSA). This pHSA methodology is grounded in the holistic food systems framework and applies a systemic approach to assessing aspects of multi-dimensional sustainability along value chains. It proved to be robust, simple to apply, and adaptable to different contexts. We tested it in an animal- and a crop-based value chain. We believe it will perform equally well in a wide range of food value chains supported by development cooperation. It is ready for field application and can probably be carried out within a 2 – 3-week field mission. Based on our experience, actionable recommendations can be derived at the incremental as well as the transformational levels of that framework. We were also able to pick up innovations that might be scaled out in future. Through our approach, we were able to identify important trade-offs that decision makers should carefully evaluate and balance when designing future value-chain interventions.

The results we obtained covered and went beyond aspects from all dimensions of sustainability. Taking the agroecology principles as guidelines for the design of what we called "transformative value chains" we showed how study results may be interpreted in light of these principles. Based on our experiences and results, we believe that the participatory approach of the pHSA in combination with scientific background information offers entry points for the co-creation of knowledge (AE principle #8 Table 1) for a "stakeholder community-owned" formulation of pathways for escaping current sustainability threats in the observed value chains.

The pHSA approach, specifically through focus group discussions, afforded us the opportunity to learn more about farmers knowledge and level of awareness of sustainability issues. Lessons learnt from this knowledge will help re-orient current and target future interventions in a way that puts the dairy and groundnut value chains on a more sustainable pathway. To illustrate that point, we return to some of the sustainability aspects identified by dairy VC stakeholders in Southern Province. Although farmers reflected on genuine and serious concerns in the FGD, at times, these were based on superficial knowledge and misconceptions about biophysical processes. For example, they mentioned the widespread belief that when trees get chopped down, winds get stronger and blow the rain clouds away. From

this, we can learn that farmers are aware of negative environmental consequences of deforestation on climatic change.

On page 69 we alluded to the interlinkages between the identified sustainability threats "deforestation", "charcoal burning", "lack of rain", and "climatic change". Based on our participatory assessment of perceptions held by smallholder farmers, as the main target population for sustainability-enhancing interventions, the introduction of innovations can be dovetailed with awareness campaigns and trainings. For example, Toth et al. (2017) identified general lack of knowledge as the largest constraint to the adoption of fodder tree technologies in neighbouring Malawi. Jointly exploring smallholder farmers' perceptions of biophysical processes and their level of concern for sustainability aspects may spur on the process of knowledge co-creation to fill such knowledge gaps. In their recent paper titled "Co-creation of knowledge in agroecology", Utter et al. (2021) concluded that, "As much as co-creation of knowledge illuminates the known, it also highlights the unfamiliar and areas that require further exploration and development across various settings and actors." We believe that the pHSA can make a meaningful contribution to this process. In the same vein, designing training materials in a manner that resonates with the understanding and aspirations of the very people that should benefit from the proposed interventions, is known to enhance ownership and agency and lead to sustained technology adoption.

Conceptually and methodologically, we assessed the value chains as a central element of a food system. Following this approach, we could distinguish between two categories of sustainability hotspots, which have important implications for all value-chain stakeholders, policy makers, and development actors. The first set of hotspots falls in the incremental level of the transformative food system change (see Figure 5) and plays out at the field and farm/community scale. Innovations, either introduced by government and development agencies or developed by stakeholders themselves, frequently take effect at these first two levels with limited transformational power. The advantage is that they allow a roll-out process with incremental steps suitable for traditional development cooperation interventions. The third agroecosystem level in Figure 5 already has a transformational character. Innovations and hotspots within this category work at the landscape and community scales. Here, development cooperation places more and more focus in its work. The last two food system levels are very difficult to influence by traditional development cooperation interventions that are delivered through a project or programme approach. Here, changes at the entire food system scale including changes in society and economy as well as culture and tradition have to take place. The

question now is: How can development cooperation deliver on those levels? Without providing answers to this question, our results from applications of the pHSA demonstrate the urgency with which these answers are required.

Nevertheless, the participatory element of our methodological approach contributes to transformational agendas for food systems. By engaging directly with key VC stakeholders, we not only capture their perceptions of sustainability aspects but provide an opportunity through FGDs for shaping participants' awareness of interdependencies, trade-offs, and possible synergies across the dimensions of sustainability within a food system. A testimony to this claim is a note that a lead farmer, who participated in one of the focus group discussions in Eastern Province, sent to the COMACO area coordinator. In that note, he thanked the coordinator for bringing the SLE/IAPRI research team to his community because he and his peers learnt a lot on that day and felt inspired to continue the discussion amongst themselves. Following Utter et al. (2021) farmer-to-farmer and farmer-to academic knowledge exchange is an important element of knowledge co-creation. Thus, our pHSA offers an entry point to spur and guide this process.

Lastly, what did we learn about the sustainability of the dairy and groundnut value chains? First of all, we made sense of the term "sustainability" as a holistic concept that deserves to be contextualised. Knowledge about sustainability needs to be co-created with relevant actors and interpreted. As such, it is clear by now that sustainability comparisons or statements about "relative sustainability" must remain fiction at the level of concrete project contexts. It follows that our pHSA methodology is better suited to identify the actor-perceived sustainability-aspect deficits than provide a tool to assess the relative status of sustainability. Nevertheless, we learnt a number of lessons with strong bearing on sustainability that should be taken into consideration when definite decisions on support interventions will be taken. These are:

Overarching lessons learnt

- Smallholder farmers may have an imperfect understanding of biophysical processes, but are keenly aware of and concerned about the effects of climatic change.
- More attention has to be paid to the integration of chain activities and their impacts on local economies and ecologies.
- In a smallholder setting, social cohesion is essential because communal action is required for sustainable and broad-based economic development.

- Well-functioning social organisations (like smallholder cooperatives and producer groups) and governmental institutions (like extension services and traditional leadership) play important roles in facilitating sustainable economic development and ensuring protection of the natural resource base.
- The scarcity of viable economic opportunities in rural areas threatens the functioning of the entire ecosystem because people are forced to resort to unsustainable exploitation of natural resources, for example, deforestation for charcoal production.

Lessons learnt specific to the dairy value chain

- The dairy value chain makes a significant contribution to Zambia's food system that should be expanded. Dairy plays an important role in food and nutrition security through home consumption, especially in Southern Province with its livestock-based economy and strong cultural traditions.
- The long-term sustainability of the dairy value chain in Southern Province is questionable due to its contribution to the emissions of greenhouse gas and its high demand for water resources.
- Sustainability-enhancing interventions that put the dairy value chain on a pathway to transformative change are necessary. Suitable interventions must also be able to serve as part of an exit strategy from dairy and livestock production, if future effects of climatic changes require such steps.

Lessons learnt specific to the groundnut value chain

- The shift from cash crops, like cotton and tobacco, to leguminous crops with commercial potential, like groundnuts, has helped put the smallholder economy in Eastern Province on a more sustainable trajectory.
- As modelled by COMACO's holistic approach to VC development, combining economic and social development with environmental protection puts the groundnut value chain on a firm and advanced path toward sustainability.
- A remaining challenge is to mainstream COMACO's approach through additional support structures (like alternative providers) to avoid dependence on a single player.

Challenges we encountered applying the pHSA methodology

- We relied on our partner institutions (GIZ, MFL, and COMACO) to identify and facilitate contact with our study participants on our behalf. As such, the results of our study may be biased due to the selection process of its participants. Therefore, our results may not be representative of the entirety of the dairy and groundnut value chains.
- Consumption is an important phase of any value chain that cannot be ignored in an analysis. However, the large number and diversity of consumers involved requires a quantitative survey approach, which is beyond the scope of a study like this. Therefore, secondary data from household surveys should be considered for analysis, if available.
- Thus far, the pHSA methodology only aimed at the identification of innovations. However, to make full use of the potential offered by knowledge co-creation, the methodological approach needs to be expanded to guide a detailed participatory evaluation process for identified innovations.

7 Recommendations and outlook

In this last chapter, we summarise recommendations derived from our research study. We begin with the methodology then provide detailed recommendations for the individual phases of both value chains. We recognise the fact that the differentiation between general support interventions to value chain development and those that specifically enhance sustainability aspects is difficult. Therefore, we highlight key recommendations that have a strong bearing on agroecological principles and the potential to enhance sustainability along the two value chains at the beginning of each of the subchapters (sections 7.2.1 and 7.2.2).

7.1 Methodology

We recommend the application of the pHSA as described in Chapter 3 as part of the evaluation process for food value chains supported by German development cooperation currently or in the future. Additionally, we recommend developing detailed evaluation criteria for the identification of innovations as part of the pHSA methodology. The pHSA should be conducted by a facilitation team of 4 – 6 international and national experts. The main function of the international experts is to provide the specific context of German development cooperation and conduct final cross-checks before developing recommendations. The role of the national experts is to transfer the methodology to the local context and facilitate its application in the vernacular language in partnership with international experts, depending on individual abilities. Such a field mission should include the following elements:

a) Participatory hotspot analysis (pHSA) with all stakeholders of the VC through focus group discussions in the production (including pre- and post-production if applicable) phase and key informant interviews in the other phases;
b) Validation and complementation of findings from step 1) by VC experts from supporting and governing levels of the VC;
c) Verification of findings from step 1) and 2) based on available scientific evidence and development of definitive recommendations for action.

7.2 Value chain recommendations

The following recommendations aim to provide value-chain actors, communities, national governments, development agencies, and donors involved and con-

cerned about the dairy and groundnut value chains in Zambia with actionable suggestions. They are based on inputs from project stakeholders and participants and on findings derived from our analysis. Some of these recommendations may already be in various stages of implementation by supporting agencies. In such cases, we highlight their importance and recommend scaling up and out.

7.2.1 Key recommendations to enhance sustainability in the dairy value chain

- Secure availability and access to water resources for livestock drinking, fodder production, local milk processing, and complementary agricultural or horticultural production by developing water resources at farm and community level, for example through small dams that harness surface runoff water.
- Develop awareness and training materials on water resource management in agricultural and livestock production for dissemination to farmers; examples can be drawn from the GIZ project "Sustainable Water Resources Management and Agricultural Water Use in Zambia".
- Support the development and introduction of drought-resistant fodder grass and tree species.
- Integrate dairy with agricultural and horticultural production through manure management to replace mineral fertilisers, and with agro-forestry through the introduction of fodder trees to support the water cycle.
- Explore integrating agroecology with livestock based on the five principles postulated by Soussana et al. (2015):
    1. adopting management practices that aim to improve animal health
    2. decreasing the inputs needed for production
    3. reducing emissions through improved nutrition
    4. enhancing diversity within animal production systems to strengthen their resilience
    5. preserving biodiversity by adapting management practices
- Introduce measures that effectively compensate for dairy farming's negative carbon footprint; for example, "Grazing for Carbon" (*see* EIP-AGRI, 2018), woodlots under REED+, or the COMACO approach (Box 12).

- Support infrastructure development for milk processing at the MCC level, for example through solar-power-driven cooling tanks, farm dam-water purification, etc.
- Develop and support income sources alternative to livestock-based farming systems, for example community woodlots for charcoal production, especially for marginalised groups like women and youth.

7.2.2 Key recommendations to enhance sustainability in the groundnut value chain

- Continue supporting the further transformation of the groundnut value chain in the directions pointed out in this study by scaling the COMACO approach up and out through partnerships with other groundnut value chain promoters.
- Ensure that no virgin land will be converted as a result of the promotion of organic production in the future.
- Support the organisational development of farmer organisations and their apex body in the groundnut sector.
- Support the participatory development of new seed varieties and aflatoxin-control treatments by involving farmers, processors, private-sector seed companies, and public-sector research institutions.
- Support the further development and scale out of climate crop insurance.

7.2.3 General recommendations to support transformative value chain promotion

- Support governmental extension services in developing mass-media extension messages, like interactive radio programmes or cell phone applications.
- Support the improvement of availability and accessibility of veterinary services including artificial insemination, especially in remote areas.
- Stimulate the sharing of knowledge and adoption of modern dairy management techniques by conducting trainings exclusively for women.
- Support the NAIS in the development of locally adapted dairy cows (i.e., drought-adapted and heat-tolerant) and in upgrading their technical infrastructure.

- Support the establishment and management of SACCOs in dairy communities.
- Train members and staff of MCCs in financial management so that microfinance can be channelled through MCCs to farmers in future. Also, provide training on organisational development so that farmers may acquire production and processing equipment (like veterinary drugs, steel milking cans, etc.) under preferential conditions through the MCC.
- Initiate and facilitate collaborations between MCCs and agro-dealers for cheaper bulk supplies of veterinary drugs, fodder seeds, production and processing equipment, etc.
- Initiate and facilitate collaborations between dairy processors and the government extension service to harmonise and expand extension service delivery.
- Strengthen the capacity of the governmental extension service to apply participatory extension approaches.
- Support the introduction of smaller groundnut seed packages of different seed types (for example, early-maturing and drought-resistant seeds and conventional high-yielding varieties) to encourage on-farm experimentation and learning.
- Lobby government to continue the integration of conservation agriculture into farm-input subsidy programmes.
- Explore avenues to support the establishment of "village banking systems" in all 55 groundnut cooperatives in Zambia.
- Evaluate and consider the scale out of mobile money solutions based on lessons learnt from pilot projects.
- Support infrastructure development for value addition in the groundnut VC at the farmer-cooperative level (for example, drying and storage sheds, shelling and grading equipment).
- Support research into utilisation of by-products from groundnut processing at the farmer-cooperative level (for example, poultry feed from rejected groundnuts, energy briquettes from groundnut shells, etc.).
- Promote the storage of groundnuts in domestic food reserves to ensure food and nutrition security, in particular, as a valuable source of dietary protein.

- Encourage and support consumer awareness campaigns on the value of organic food consumption.

7.3 Outlook

7.3.1 The bigger picture

In 2013, the International Food Policy Research Institute published a monograph titled "Southern African Agriculture and climate change – A comprehensive review". For their research, the authors used a range of biophysical and socio-economic modelling approaches to investigate the potential impacts of climatic change by the year 2050 (Hachigonta et al., 2013). Although about nine years old, the chapter on Zambia provides a good point of reference for conclusions and recommendations made in our report. Below, we list the key vulnerabilities that were pointed out by the authors threatening sustainability. By and large, they reflect concerns raised by participants in our study and conclusions that we drew from our analysis:

- Unsustainable land cover and land use patterns (like expansion of cultivation and settlements and charcoal burning) compromise ecosystem service delivery.
- Maize monoculture bears the risk of total crop failure; yield losses are expected for the southern part of the country due to climate change.
- Although the climate models are inconclusive about the mean annual precipitation changes (some predict increases, other decreases), they all predict mean annual temperature increases, which will lead to heat stress, higher evaporation rates, and thus reduced water recharge.
- Dramatic population increase from 14 million in 2010 to 25 – 34 million in 2050.

The conclusions and recommendations drawn from their analysis are geared to strengthen the resilience of the Zambian agricultural sector and support sustainable development. Although more general in nature, they are in line with recommendations made in our report, specifically the ones relating to research needs (e.g., drought-resistant crop varieties, water harvesting, feasibility studies on the migration of farmers to agroecological regions with better potential for agriculture) and farm-level adaptation to climate change (e.g., crop diversification, crop and livestock integration, conservation agriculture, and agroforestry). Furthermore, some

of our recommendations in the social sustainability dimension support the recommendations Hachigonta et al. (2013) put forward to the national level. While some progress has been made in Eastern Province on the trajectory toward sustainability over the past nine years, the resemblance in challenges identified by Hachigonta et al. (2013) and our team underpins the urgency for transformative food system change in Zambia.

7.3.2 Developments under Zambia's "New Dawn" government

In August 2021, the Zambian people voted in the "New Dawn" government. The newly elected president, Hakahinde Hichilema, is one of the country's largest cattle owner and pursues a pro-business policy. Therefore, enthusiasm and expectations for change were very high, especially among the dairy farmers with whom we interacted. Now nine months after Hichilema took office, one might ask, "What has changed after nine months in office?"

Concerning the agricultural policy framework, not much yet. According to analysts (Lubungu & Kabwe, 2022), the government placed its focus during the first months in office on interventions in the education and health sector. With regard to the agricultural policy landscape, it is still trying to find its feet and, for now, has retained the established agricultural and livestock policies and implementation strategies. Also, retaining the Ministry of Fisheries and Livestock is viewed as a continued commitment to the livestock sector. In fact, the Permanent Secretary of that ministry recently went on record to advocate for increased investments and private-sector participation ("Livestock sector needs," 2022), so that the sector becomes a key driver for economic diversification in Zambia.

An example of increased private-sector participation in the dairy sector is the recent dairy stakeholder forum meeting (Lubungu & Kabwe, 2022). At this meeting, the impacts of the customs and excise amendment act of 2020 were extensively but inconclusively discussed. Under the act, import duty on powered milk was raised to protect local producers. After an initial spike in producer prices and consequent positive supply response, prices have dropped again, despite the duty. Yet, some processors have reduced milk purchases from smallholders, claiming they would lose their competitiveness if they had continued do so. As a resolution, the meeting agreed that the factors driving the milk market and the impacts of the amendment act are not well understood. Hence, they expressed the need for an independent research entity to investigate the underlying mechanisms. One of the processors was even prepared to fund such a study. This bodes well for the government's plans to increase private-sector participation in the dairy sector. Similarly,

stakeholders felt that the Dairy Act of 2010 should be revised, since under the current act it was not possible to establish a functioning board that could effectively regulate the sector. However, details of what needs to be changed and to what have not yet been formulated, according to (Lubungu & Kabwe, 2022).

Regarding Zambia's farm-input subsidy programme, the government has not yet been able to transition to an e-voucher system, as promised during their election campaign. An e-voucher system would allow free purchase of inputs from retail outlets, including veterinary drugs and production equipment. According to (Lubungu & Kabwe, 2022), the government is also planning to introduce a new agriculture support programme that will go beyond simple provision of agricultural inputs, and include agricultural finance and infrastructure, among others. Such a measure would support further diversification by reducing the programme's strong focus on maize. A step toward diversification during the current 2021/22 cropping season is the support to maize, sorghum, soya, and groundnuts production by smallholders. Apparently, as part of the subsidised farm-input packages, conservation agriculture extension messages are disseminated to farmers, but analysts point out that this intervention is ineffective due to lack of extension support and adoption monitoring. Effective promotion of conservation agriculture will require a participatory extension approach (Droppelmann et al., 2017) that fosters co-learning among farmers and between extension agents and researchers, in line with agroecological principles.

7.3.3 Moving toward sustainable agriculture and a green economy

In its April 2022 newsletter, COMACO reports of a visit by the German ambassador in March 2022 (see "Madam Ambassador," 2022). The ambassador is reported to have applauded COMACO for its leadership in Zambia's emerging green economy. In the same newsletter, COMACO reports on a research partnership with the International Institute of Tropical Agriculture and World Agroforestry Centre to study the effects of green manure from *Gliricidia sepium* in combination with conservation agriculture practices on crop yields. Compared to crops planted with mineral fertilisers, yields of crops receiving green manure were less than 10 % different, while realising substantial cost savings on inputs and improved soil health. However, there are numerous reports about yield penalties for the first three to five years, when converting to conservation agriculture (Giller et al., 2009; Stevenson et al., 2014), mostly due to soil nutrient immobilisation. This is also to be expected while green-manure tree species like *Gliricidia* are still small and establishing them-

selves in the agroforestry system. In this situation, it would be helpful if future fertiliser subsidy programmes, run by the Zambian government, would support farmers converting to conservation agriculture through participatory extension approaches. Such a programme adaptation would set smallholder farming on a pathway to sustainable intensification. In a recently published research paper, Masikati et al. (2021) employed crop-managing and socio-economic modelling approaches to compare the impact of conventional agricultural development strategies based on yield increases through area expansion with sustainable agriculture intensification strategies. Their simulations, looking 30 years into the future, found that sustainable agriculture intensification will not only have positive effects on ecosystem service delivery but also on poverty reduction, especially for farms of up to 2 ha in size. Thus, a win–win solution seems possible. Our findings and recommendations point out the necessary steps on the way.

8 Bibliography

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9 Annex

Annex 1: Guideline to KII

Guideline to KII

The following notes were provided to interviewers to guide key informant interviews and focus group discussions. While no predetermined or strict script was used, the below notes were offered to interviewers to plan, resource, and guide their conversations.

Purpose

- capture life and professional experiences of participants
- Verify and extend information from FGDs, transect walks, and seasonal calendar
- Reflect on sustainability aspects identified by FGDs
- Reflect on perception of multidimensional sustainability
- Evaluate sustainability indicators (threats) in downstream value chain stages
- Identify trade-offs, innovations, synergies, and externalities
- Use as a second and flexible option to collect data from underrepresented persons from the FGD (e.g., women and youth)

Methodology

- Semi-structured interview
- Planned duration: 30 min to 1 hour
- Variety of questions
    - Perceptions of third-party stakeholders
    - Hypothetical questions
- Approach to interview
    - Keep questions simple; not too scientific; relate to daily life and surroundings
    - Ask for specific examples
    - Careful with "off the record" information; don't quote or identify person by name
- Ethical considerations, see: Kvale, S., Brinkmann, S. (2015). Interviews: Learning the craft of qualitative research interviewing. 3rd Edition. SAGE Publications, Los Angeles, United States.

Material

- Clipboard or notebook and pencil

- Translator, as necessary
- List of words in the vernacular as ice breaker
- Interview guide (printed)
- Consent form (verbal consent is sufficient but needs to be documented)

List of guiding questions:

1) Introduction of research

- Introduction of interviewers
- Introduction of the research project (expectation management)
    - Welcome and thank you for taking the time…
    - My colleague and I are …
    - "In total, we are a team of five Zambian and five German researchers and our team leader, Klaus Droppelmann…
    - We are working in collaboration with the German Development Cooperation (GIZ)."
    - We are conducting a study to identify diverse challenges for dairy/groundnut production
- Agenda: Today, we will talk about xy… we will first ask you some questions on your work experience and background, then talk with you about results from FGDs with smallholders that we conducted earlier today, …
- We expect the interview to take between 30 – 60 minutes
- Statement about confidentiality:
    - Data collected only for the purpose of research
    - Quotes will not be linked to your identity
    - Do you have any issue with being quoted by your role within the organisation (e.g. MCC employee)?
- Do you have any questions regarding today's agenda?

2) Introduction of interview partner

- Could you please introduce yourself?
- What is your name? Profession? Organisation? Age? Marital status?
    - What are the activities involved in bringing milk/groundnut from farmers to the final consumers?
    - Does your organisation aggregate/process/distribute milk/groundnut?
    - Assign value chain stage
    - Are there any other VC phases or stages that we don´t know about that you are involved in?
    - Does your organisation have other economic activities [than dairy/groundnut]?
- Do you have any questions about the interview at this point?

3) Introduction of the pHSA methodology

- Explain how the pHSA methodology (outlined in section 3.1.1) works and how it was used during the focus group discussions (using examples for each of the sustainability dimensions).
- If available present a summary of preliminary examples from the focus group discussions. Then ask if, the interviewee(s) agree(s) to all the sustainability aspects identified by smallholder farmers. In case the disagree, record in detail what exactly he/she/they disagree with and why.
- Then invite the interviewee(s) to add sustainability aspects for the production phase and run through the hotspot evaluation process together.

4) Participatory aspect identification and hotspot evaluation for the VC stage in question for this interview

- Invite the interviewee(s) to go through the pHSA steps jointly with you to identify sustainability aspects within the VC stage(s) that he/she/they are active in.

- Then identify the threats to corresponding sustainability aspects and evaluate each of them using the criteria and evaluation cards from Figure 7 in section 3.1.1. See also notes below:

Scope: How widespread is this threat?

1 = The threat is only a problem in a few villages.

2 = The threat is a problem in quite a lot of villages.

3 = The threat is a problem almost everywhere.

Severity: How serious is this threat?

1 = The consequences of this threat are not affecting our operations to much because we can employ alternative methods/resources/etc.

2 = If this threat is not dealt with, I/we may not be competitive any longer.

3 = If this threat is not dealt with, I/we will have to discontinue my/our operations.

Permanence: How long will it take to deal with this threat or what level of intervention is needed to deal with this threat?

1 = It is likely to disappears spontaneously without management interventions.

2 = It may take a few years (5 to 10 years) to contain this threat. I/we have the resources and skills to handle the consequences of this threat myself/ourselves.

3 = This threat will take a long time (10 years and longer) to deal with. I/we cannot handle the consequences myself/ourselves. I/we will require external support to deal with this threat.

- Calculate the impact: add up scope, severity, and permanence

Trend: Is the threat .....

1= ..... becoming less common than in the past?

2 = ... staying the same as in the past?

3 = ... becoming more common than in the past?

- Calculate the significance: add up impact and permanence
- Review briefly all identified hotspots before moving on.

5) Externalities, trade-offs, synergies and innovations/best practices

- Trade-offs:
    - Does the damage caused from this threat also have advantages? Or even other disadvantages?
    - What do you think motivated people to continue the practice (posing a threat)?
- Innovations:
    - How do you deal with this threat? Do you think other businesses could learn from you?
    - Have you ever come across someone who could deal with this threat very well? What did they do?
    - What is something that you would like to introduce into the VC to improve sustainability?
- Externalities:
    - Does the threat also cause problems beyond your business/organisation?
    - Does this threat also lead to benefits beyond your business/organisation?
- Synergies
    - Do any of these practices solve multiple threats?
    - Do any other players or actors solve the threats?

6) Farewell

- Explain the next steps in the research process and how the final results will be used.
- Invite the interviewee(s)to ask any questions before concluding the interview?
- Thank you very much (if appropriate and possible in local language).

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Table 6: Focus group discussions conducted in the dairy value chain

Date	District	Location	Women	Men	Youth	Total participants
13.09.2021	Mazabuka	Magoye	6	11	4	21
25.09.2021	Monze	Kayuni	6	9	5	20
17.09.2021	Namwala	Namwala	1	2	12	15
20.09.2021	Choma	Choma	6	4	2	12
22.09.2021	Livingstone	Simonga	4	12	6	22
		Total	**23**	**38**	**29**	**90**

Source: data from FGDs (n=90)

Table 7: Focus group discussions conducted in the groundnut value chain

Date	District	Location	Women	Men	Youth	Total participants
28.09.2021	Petauke	Kalindawalo	9	15	8	32
30.09.2021	Katete	Katete	5	3	11	19
04.10.2021	Lundazi	Mwasemphangwe	8	8	5	21
06.10.2021	Chipata	Chiwoko	9	6	2	17
		Total	**31**	**32**	**26**	**89**

Source: data from FGDs (n=89)

Table 8: Transect walks and Venn diagrams in the dairy value chain

Date	Location	Method	Participant
13.09.2021	Magoye	Transect walk	Small-scale farmers (female and male, > 50 yrs)
20.09.2021	Choma	Venn diagram	Small-scale farmer (female, > 50 yrs)
22.09.2021	Simoonga	Transect walk and Venn diagram	Small-scale farmer (female, < 35 yrs)

Source: Own data

Table 9: Transect walks and seasonal calendars in the groundnut value chain

Date	Location	Method	Participants
27.09.2021	Petauke	Seasonal calendar	Small-scale farmers (two female & one male farmer > 50 yrs and one female < 35 yrs)
27.09.2021	Petauke	Transect walk	Small-scale farmer (female, older than 50)
29.09.2021	Katete	Transect walk	Small-scale farmer (male, younger than 35)
04.10.2021	Lundazi	Seasonal calendar	Small-scale farmer (male, younger than 50)
04.10.2021	Lundazi	Seasonal calendar	Two small-scale farmers (female, older than 60)

Source: Own data

Table 10: Key informant interviews in the dairy value chain

Value chain phase	# of interviews
Production and aggregation	1
Aggregation	5
Aggregation and distribution (informal sector)	1
Processing	3
Supporting	6
Total	16

Source: Own data

Table 11: Key informant interviews in the groundnut value chain

Value chain phase	# of interviews
Input	1
Input, production, and supporting	1
Aggregation	2
Aggregation and distribution	1
Aggregation and distribution (informal sector)	1
Aggregation, processing, and supporting	1
Processing	2
Distribution	1
Distribution (informal market)	1
Supporting	8
Total	19

Source: Own data

Table 12: All informant interviews of the dairy value chain

Date	Location	Value chain phase	Organisation
13.09.2021	Magoye	Production and Aggregation	MCC Magoye; Gesellschaft für Internationale Zusammenarbeit
13.09.2021	Magoye	Aggregation	MCC Magoye
14.09.2021	Mazabuka	Supporting	Ministry for Fishery and Livestock
14.09.2021	Mazabuka	Supporting	National Artificial Insemination Services
15.09.2021	Kayuni	Aggregation and distribution (informal sector)	Self-employed
15.09.2021	Kayuni	Aggregation	MCC Kayuni
16.09.2021	Choma	Supporting	Dairy Association Zambia
17.09.2021	Namwala	Aggregation	MCC Namwala
20.09.2021	Choma	Supporting	Ministry for Fishery and Livestock
20.09.2021	Choma	Supporting	Gesellschaft für Internationale Zusammenarbeit
20.09.2021	Choma	Aggregation	MCC Choma
22.09.2021	Simoonga	Supporting	Ministry for Fishery and Livestock
22.09.2021	Simoonga	Aggregation	MCC Simoonga
12.10.2021	Lusaka	Processing	Parmalat
13.10.2021	Lusaka	Processing	DairyGold
19.10.2021	Lusaka	Processing	CreamBell

Source: Own data

Table 13: All key informant interviews in the groundnut value chain

Date	Location	Value chain phase	Organisation
28.09.2021	Petauke	Supporting	COMACO
30.09.2021	Katete	Supporting	COMACO
05.10.2021	Lundazi	Supporting	COMACO
05.10.2021	Lundazi	Aggregation and distribution (informal sector)	Self-employed
06.10.2021	Chipata	Supporting	COMACO
06.10.2021	Chipata	Aggregation	COMACO
07.10.2021	Chipata	Aggregation and distribution	Tsogolani Traders
07.10.2021	Chipata	Input, production, and supporting	Good Nature Agro
08.01.2021	Chipata	Aggregation	COMACO
08.01.2021	Chipata	Processing	COMACO
08.10.2021	Chipata	Supporting	Afriseed
08.10.2021	Chipata	Input	Msekera Research Station
08.10.2021	Katete	Supporting	Bamombe Cooperation, Chiteteso Association
08.01.2021	Katete	Supporting	Ministry of Agriculture
10.09.2021	Katete	Distribution	Export Trading Group
11.10.2021	Lusaka	Aggregation, Processing and Supporting	COMACO
12.10.2021	Chipata	Supporting	Gesellschaft für Internationale Zusammenarbeit
14.10.2021	Lusaka	Distribution (informal market)	Self-employed
29.10.2021	Lusaka	Processing	Export Trading Group

Source: Own data

Table 14: List of validation workshop participants

Name	Organisation	Sector	Value Chain
Midya Mrityunjoy	Dairy Gold Ltd.	Private sector	Dairy
Joan Musalu	MFL	Government	Dairy
Vincent Siimongwe	MFL	Government	Dairy
Nashon Ngalande	IAPRI	Research	Dairy/Groundnut
Sally Chanda Mufule	IAPRI	Research	Dairy/Groundnut
Eugine Kaango	IAPRI	Research	Dairy/Groundnut
Dilnawaz Mukadam	Parmalat Lactalis	Private sector	Dairy
Mary Lubungu	IAPRI	Research	Dairy/Groundnut
Yolamu Nkatata	AfriSeed	Private sector	Groundnut
Joseph Manda	MFL	Government	Dairy
Mutinta Kabeleka	DAZ	Private sector	Dairy
Cynthia Mwandwe	GIZ	Development Partner	Groundnut
Enok Siankwilimba	MUSIKA	Private sector	Dairy
Victor Ngandu	DAZ	Private sector	Dairy
Enok Zulu	DAZ	Private sector	Dairy
Raj Sheknawat	ETG	Private sector	Groundnut
Emmanuel Angomwile	Dominon Commodities	Private sector	Groundnut
Patricia Siyingwa	AfriSeed	Private sector	Groundnut
Shadrek Mwale	MoA	Government	Groundnut

10 SLE List of Publications

List of SLE publications since 2011

All studies are available for download at www.sle-berlin.de.

Mirjam Steglich, Thomas Beutler, Segbedji Geraldo Favi, Carolin Grasi, Deborah Kallee, Omotunde Idris Kasali, Saymore Ngonidzashe Kativu, Caroline Kawira, Amina Aden Maalim, Nimah F. Osho-Abdulgafar, Jonas Schaaf: *Agrarökologie und Ländliche Entwicklung, Handeln im Globalen Norden – mit dem Globalen Süden.* Berlin, 2022 — S290 D

Mirjam Steglich, Thomas Beutler, Segbedji Geraldo Favi, Carolin Grasi, Deborah Kallee, Omotunde Idris Kasali, Saymore Ngonidzashe Kativu, Caroline Kawira, Amina Aden Maalim, Nimah F. Osho-Abdulgafar, Jonas Schaaf: *Agroecology and Rural Development, Acting in the Global North – with the Global South.* Berlin, 2022 — S 290 E

Mohamed Mejed Heni, Dima Faour-Klingbeil, Gabriela Degen, Lena Gomer, Sari-Luisa Jung, Alexander Kückes, Ruth Meißner: *Eat safe, eat well! Strengthening institutional capacities and the resilience of the food safety system in Tunisia*. Berlin, 2022 — S289 E

Mohamed Mejed Heni, Dima Faour-Klingbeil, Gabriela Degen, Lena Gomer, Sari-Luisa Jung, Alexander Kückes, Ruth Meißner: *Mangeons sûr, mangeons bien! Renforcement des capacités institutionnelles et de la résilience du système de sécurité sanitaire des aliments en Tunisie*. Berlin, 2022 — S289 F

Klaus Droppelmann, Ngosa Bangwe, Joel Hähnle, Rickie Klingler, Cornelius Krüger, Johanna Kückes, Simushi Liswaniso. Leeroy Mapulanga, Cleopatra Kawanga, Namakando Namakando, Annika Reimann: *From method to action – Designing a participatory hotspot analysis to assess sustainability in Zambia's groundnut and dairy value chains*. Berlin, 2022 — S288

Hendrik Hänke, Joshua Wesana, Jasmin Christa Ahmed, Lukas Eichelter, Deous Mary Ekyaligonza, Felix Hegeler, Joanita Kataike, Eva Sophia Kirmes, Violet Kisakye, Muhangane Lauben, Flavia Marà, Stella Mbabazi, Simon Mutambo: *Sustainability Hot Spot Analysis 2.0: A participatory approach to assess the Nile perch & Irish potato value chains in Uganda.* Berlin, 2022 S287

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Nicole Paganini, Hilda Adams, Khutala Bokolo, Nomonde Buthelezi, Johanna Hansmann, Washiela Isaacs, Nomonde Kweza, Alexander Mewes, Hazel Nyaba, Vuyani Qamata, Vincent Reich, Moritz Reigl, Lara Sander, Haidee Swanby: *Agency in South Africa's food systems: A food justice perspective of food security in the Cape Flats and St. Helena Bay during the COVID-19 pandemic*. Berlin, 2021 S285

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