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Closing the knowledge gap between research, policy and practice

Circular knowledge exchange on African indigenous vegetables for improved food and nutrition security in Kenya and Tanzania

Emil Gevorgyan, Elena Ammel, Rebekka Goeke, Julia Legelli, Sönke Marahrens, Florian Neubauer, Colleen O'Connor

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SLE Postgraduate Studies on International Cooperation for Sustainable Development

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Study commissioned by HORTINLEA Project – Horticultural Innovation and Learning for Improved Livelihoods in East Africa

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Preface

For more than 55 years, the Centre for Rural Development at the Humboldt-Universität zu Berlin has trained 20 post graduates annually to become professionals equipped with excellent knowledge and skills in the field of German and international development cooperation.

Three-month empirical research projects conducted in cooperation with German or international development agencies form an integral part of this one-year course. Participants work in interdisciplinary teams supervised by experienced team leaders and carry out innovative, future-oriented research on development problems that prevail on the ground on a local or national scale. This strengthens global knowledge and provides partner organisations in the host country with strategies and tools. Here, it is vital to involve a wide range of actors in a process which includes surveys and consultations at the household, expert and policy levels.

Most studies are linked to rural (or urban) development themes and have a socio-economic focus, such as the enhancement of agricultural livelihoods or the design of regimes to manage natural resources sustainably. Up to now our partner countries have either been developing or transformation countries, and occasionally fragile states. In the future, however, studies will also be conducted in the global north, since the Sustainable Development Goals (SDGs) are a global concern. New methodologies have been introduced in some studies, e.g., production of handbooks or guidelines. Further priorities are evaluations, impact analysis and participatory planning. In these cases, the respective host country serves as a test region.

Throughout the years, SLE has carried out more than 200 cooperation projects in over 90 countries. The results are published in this series.

The present study on circular knowledge exchange for food and nutrition security was carried out in cooperation with the Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa (HORTINLEA) project.

We wish you a stimulating read.

Yours sincerely,

Prof Dr Bernhard Grimm
Dean of the Faculty of Life Sciences
Humboldt-Universität zu Berlin

Dr Susanne Neubert
Director of the Centre for
Rural Development (SLE)

Acknowledgements

The Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa – HORTINLEA project, funded by the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry for Economic Cooperation and Development (BMZ), not only set the framework for our study, it also provided us with an insight into cross-border transdisciplinary research. We would like to thank Prof Wolfgang Bokelmann, director of HORTINLEA, and Dr Susanne Neubert, the director of the SLE. We would like to express our sincere gratitude to all those who supported us in conducting this study, who helped us grow during the course of this project and who supported us during challenging times. We are also very grateful to all HORTINLEA scientists at their respective universities and research centres who provided detailed information on their project work. In particular we would like to thank those institutions that hosted members of the SLE research team during the "HORTINLEA days" in Karlsruhe, Freiburg, Hannover, Großbeeren and Berlin.

We wish to thank the staff of the World Vegetable Center in Arusha who warmly welcomed the team, offering us every possible support and who provided us with invaluable insights for our study. Further thanks are in order to our partners from Trans-SEC project, who offered us invaluable support in executing a workshop and who especially provided the background for our research on innovation processes in Tanzania.

With regard to our Kenyan partners, we would like to express our sincere gratitude to Prof Mary Abukutsa, Deputy Vice Chancellor Research Production and Extension of JKUAT, for her valuable advice and support. She inspired all of us with her friendly attitude, her passion and her impressive knowledge of African Indigenous Vegetables (AIVs). Our counterpart Prof Turoop Losenge deserves our heartfelt thanks for always being there when we needed him. No matter what occurred, he was there and greatly supported us in all phases of our project. We truly appreciate his engagement in accompanying the SLE research team in Kenya, Tanzania, and Germany. Our thanks also go out to the entire JKUAT and AICAD staff, who provided us with office space, equipment and logistical support in central Kenya.

Furthermore, we would like to thank all farmers in Tanzania and Kenya who participated in interviews and focus group discussions. This study would not have been possible without their trust and openness, as well as the support of representatives from local and national government, research and education

organisations, NGOs, the private sector, and other local and international experts. We would also like to thank our student associates, who supported our field work in numerous communities, who hosted us and who ensured our well-being in Kenya and Tanzania.

Finally, we would like to thank the SLE staff for their strong support in preparing and implementing this study, especially Anja Kühn.

Executive Summary

Study Context

With a focus on representatives from research, practice and policy, this study takes a holistic perspective on learning, dissemination and knowledge exchange among multiple Kenyan, Tanzanian and German stakeholders. Entitled "Closing the Knowledge Gap between Research, Policy and Practice: Circular Knowledge Exchange on African Indigenous Vegetables for Improved Food and Nutrition Security in Kenya and Tanzania", this study outlines major steps for ensuring that the research results of the Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa – HORTINLEA project will reach multiple stakeholders and benefit them in the future. These stakeholders may include policymakers, farmers and other actors along the African Indigenous Vegetable (AIV) value chain (from producers to consumers).

How can research results be better disseminated into practice and how can innovations be better adapted to local conditions?

What are the appropriate target-group-specific dissemination and knowledge exchange mechanisms?

Who are the key actors in this exchange and how can these multiple actors – with varying interests and power relations – be effectively involved in a circular and continuous learning and knowledge exchange process so that HORTINLEA research results reach end users sustainably?

Taking these questions as a starting point, three research objectives were defined:

- analyse local innovation processes and adoption criteria
- develop target-group-specific dissemination instruments
- conceptualise an AIV knowledge and innovation network.

The study was conducted in cooperation with HORTINLEA – an interdisciplinary research project addressing food and nutrition security challenges in East Africa, particularly in Kenya. The study was conducted in close cooperation with HORTINLEA partners in Kenya and Tanzania in order to gain a deeper and holistic

understanding of innovation and dissemination processes. It provides the relevant background for the development of target-group-oriented dissemination instruments, especially during the current and next phases of HORTINLEA. Furthermore, the findings and recommendations are expected to be a useful source for the project and its partners as well as a means by which other relevant stakeholders can establish and maintain a long-term innovation and knowledge exchange network on AIV promotion in Kenya and Tanzania, and in comparable contexts.

Concepts and Methods

The study can be categorised under the theoretical strand of the Integrated Agricultural Research for Development (IAR4D) approach. The problem-focused Innovation Systems Perspective (ISP) of Gevorgyan et al. (2015) was refined and applied. This approach takes a comprehensive view of all AIV value chain actors (e.g. farmers, traders, consumers) as well as researchers and policymakers whose interactions can lead to successful innovation. Innovation is defined here as a process that encompasses the components of generation, dissemination, adaptation and adoption of new knowledge or putting to use (adopting) existing knowledge in a new context (Gevorgyan et al. 2015). A broad definition of innovations was used, encompassing technological, social and institutional innovations. The Innovation Systems Perspective captures the whole innovation system of AIVs – framework conditions, actor groups, and their interactions. The focus of this study is on the needs of and interactions between researchers, political decision makers and small-scale farmers. The study examines how their involvement and cooperation within the innovation and dissemination process can be continuously improved.

Insufficient knowledge exchange decreases the likelihood of scientific solutions – understood as potential innovations – having a positive impact on development.

Based on this assumption, the knowledge gap triangle, i.e. the different knowledge gaps between research, practice and policy, was conceptualised. Furthermore, the study addresses sustainability as a cross-cutting issue throughout the study and in the methodology. Three dimensions of sustainability – ecological, economic and social – were introduced and defined.

Given the inductive nature of this study, the research adopted an exploratory approach characterised by the adaptation of methods and the specification of the research objectives obtained from the ongoing data collection. Data were collected mainly in rural and urban regions of Kenya and Tanzania where HORTINLEA and its partners are operating, but also in Germany.

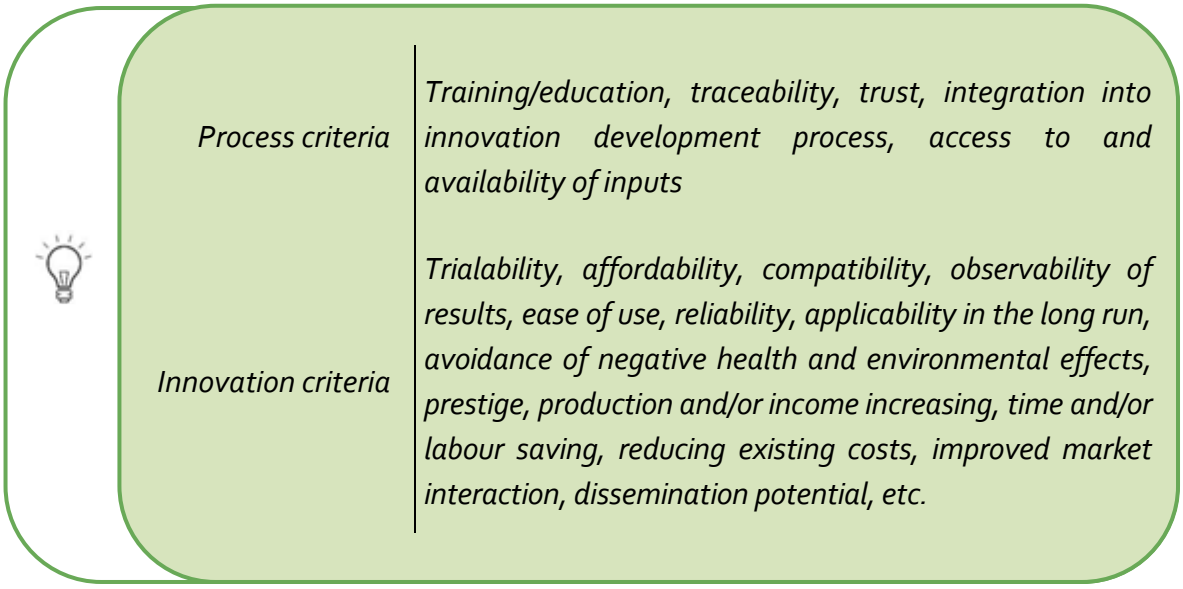
Both qualitative and quantitative methods were used for data collection, comprising 114 semi-structured individual interviews with researchers, 60 questionnaires and 15 focus group discussions with farmers and extension officers, four multi-stakeholder workshops, several meetings with relevant experts and secondary data analysis. Farmers, researchers and further AIV experts were the main interview partners and participants in workshops and focus group discussions. Moreover, 25 criteria most relevant for the farmers' decision to adopt or reject an innovation were identified. In addition, a case study on how farmers perceive the importance of certain criteria with reference to two specific innovations was conducted.

Main Findings

The Knowledge Gap between Research and Practice

Analysis of local innovation processes and farmers' adoption criteria for innovations: The most important claim from farmers seems to be that they need to be involved in the development of innovations from the beginning onwards. While doing so, farmers value being accompanied by external actors and innovation brokers, such as extension officers and researchers. It should be noted, however, that these external actors have an ambiguous reputation among farmers – some are trusted, others are suspected of having a *hidden agenda*, which will be further explained in the study.

Another important finding is that knowledge exchange and innovation dissemination among farmers (farmer to farmer exchange) play an important role when it comes to the adoption of innovations. Different criteria are taken into account by each farmer individually when making a decision on the adoption or rejection of innovations. Criteria collected in this study can be divided into two main categories: criteria that are related to the dissemination process of an innovation (process criteria), and criteria that refer to the characteristics or assumed benefits of an innovation (innovation criteria).



Several criteria are decisive for farmers whether they adopt or reject an innovation. Among these, "training" is the most important criterion. For training, extension services play a crucial role in the introduction phase. Furthermore, the availability and accessibility of training increases the probability of sustainably adopting an innovation. Various additional innovation criteria described in this study are of great importance for farmers in order to decide whether to adopt an innovation or not. It is important to involve farmers in the development process of an innovation as well as in the follow-up. The specific needs of the farmers have to be integrated into the innovation. If an innovation is not of interest for the farmer, for example because of a lack of compatibility or trialability, the innovation process is likely to fail. Hence, including the farmers' perspective early on during the research and development process of the innovation is a necessity.

The Knowledge Gap between Research and Practice as well as Research and Policy

Development of target-group-specific dissemination instruments: A comprehensive needs assessment underlines the need to develop target-group-specific dissemination instruments focusing particularly on linking actors – extension officers and literate lead farmers – as well as policymakers for sustainably disseminating HORTINLEA research results. One way to do this is to develop practical training manuals considering the whole AIV value chain. As part of the study, a concept for developing one training manual was designed focusing on

production and marketing, and another on the consumption of AIVs, including nutrition and health aspects.

In addition, a participatory approach for creating policy briefs was developed. A holistic perspective was chosen to combine scientific solutions into innovation clusters, each gathering together research results that tackle problems in the same area. Five major topics for prospective policy briefs were defined:

- health and nutrition,
- ecology, environment and climate,
- technology and economic development,
- institutions, markets and common action and
- social development, gender, culture and education.

Following these considerations, a structured collection of research results from different HORTINLEA sub-projects was compiled and complemented with local knowledge. In addition to this study, a policy brief on the health and nutrition aspects of AIVs and drafts of both training manuals were partially developed. The whole approach of developing the dissemination instruments is documented in detail.

The Knowledge Gap between Research, Practice and Policy

Conceptualisation of a sustainable knowledge and innovation network: closely modelled on the World Bank's approach "The Art of Knowledge Exchange" (2015) and adapted to the HORTINLEA context, a strategy for establishing a Knowledge and Innovation Network for AIVs (KIN) was developed. Three major steps in this plan were conducted within the frame of the study:

- setting the goals of the network,
- defining the participants of the network and
- collecting ideas regarding the design of the network.

The results of these three steps show that the KIN should be a problem-based network seeking to ensure learning, sustainable knowledge exchange and dissemination processes among multiple stakeholders. Farmers accompanied by innovation brokers should become a key participatory group in the network and knowledge dissemination a key element of its future activities. To reach the defined goals, it is recommended to build the Knowledge and Innovation Network on existing HORTINLEA structures. Additionally, the focus should be on creating

inclusive and participatory mechanisms such as thematic working groups or regular physical meetings combined with innovative digital communication tools. Finally, some permanent staff and administrative structures for the KIN should be put in place in the region.

Based on these empirical outcomes, a list of future steps for the KIN was created. First and foremost, a core group that takes responsibility for the implementation of the network must be defined. Here, HORTINLEA consortium members might take the lead. Next, it is crucial to establish a sound financial basis for the network's maintenance and activities. For instance, this can be achieved by gaining external funding or by establishing alternative mechanisms such as membership fees. Finally, it is essential to maintain participants' commitment in the long term.

Conclusion and Recommendations

Building on the results of an earlier SLE study from 2015, this study recommends a paradigm shift from the rather top-down approach of many development and research interventions to a more participatory and inclusive approach, in which farmers are integrated and empowered in the research and innovation process. The integration of farmers' perspectives into the entire innovation process is key and it should provide information for the formulation of future research questions. Moreover, the farmers' criteria identified for the adoption or rejection of an innovation can serve as a starting point for future comparative studies. Analysing the criteria in different contexts and for different innovations promises valuable insights into their local and innovation-specific importance as well as into their generalisability.

Applying a participatory and transdisciplinary approach, a toolkit on how to create and further develop HORTINLEA dissemination instruments was developed. The detailed documentation of this approach and lessons learned during the process may serve as a basis for effectively involving researchers, farmers and political decision makers alike, for increasing the probability that research results are "translated" into a target-group-specific language. Ultimately, this is a crucial condition for research to have a positive long-term impact on development.

The conceptualisation of the AIV Knowledge and Innovation Network can serve as a strategy with which temporally-restricted and externally-funded research for development projects such as HORTINLEA can develop further long-term programmes and next phase activities. The creation of a network can help to increase the sustainability of such projects. By supporting ongoing circular

knowledge exchange beyond the end of the project and by creating a feeling of shared ownership, it is easier to achieve independence from external actors (especially when it comes to funding) and continue working collaboratively on joint issues.

In general, the main message of this study is as follows:

Understanding local innovation processes and using target-group-specific dissemination instruments embedded in the wider context of a Knowledge and Innovation Network can contribute to closing the knowledge gap between research, policy and practice. This is a prerequisite for research to have a positive and sustainable impact on development.

Zusammenfassung

Kontext der Studie

Die vorliegende Studie analysiert die Wissensverbreitungs- und Austauschmechanismen zwischen diversen Akteuren im Sektor der Afrikanischen Indigenen Blattgemüse (AIV). Es wird eine holistische Perspektive eingenommen, wobei Akteure aus Forschung, Praxis und Politik im Mittelpunkt stehen.

Unter dem Titel *„Closing the knowledge gap between research, policy and practice: circular knowledge exchange on African indigenous vegetables for improved food and nutrition security in Kenya and Tanzania"*, umreißt diese Studie die wichtigsten Schritte, um sicherzustellen, dass in der Zukunft möglichst viele Akteure des AIV-Innovationssystems von den im Rahmen des Forschungsprojekts HORTINLEA (*Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa*) entstandenen Forschungsergebnissen profitieren. Wobei diese Akteure die politischen Entscheidungsträger*innen, die Bäuerinnen und Bauern sowie andere Akteure entlang der AIV-Wertschöpfungskette (vom Produzenten bis zum Konsumenten) sein können.

Wie können der Transfer von Forschungsergebnissen in die Praxis verbessert und die Innovationen an die lokalen Gegebenheiten besser angepasst werden?

Welche sind die angemessene zielgruppenspezifische Wissensverbreitungs- und Austauschmechanismen?

Wer sind die wichtigsten Akteure in diesem Austauschprozess und wie können die Vielzahl von Akteuren, mit unterschiedlichen Interessen und Machtverhältnissen, in zirkulären und kontinuierlichen Lern- und Wissensaustauschprozessen effektiv involviert werden, so dass die HORTINLEA-Forschungsergebnisse die Endverbraucher nachhaltig erreichen?

Vor dem Hintergrund dieser Fragen werden drei zentrale Forschungsziele formuliert:

- Analyse lokaler Innovationsprozesse und bäuerlicher Adaptionskriterien für Innovationen
- Entwicklung von zielgruppenspezifischen Wissensverbreitungsinstrumenten
- Konzeptualisierung eines AIV-Wissens- und Innovationsnetzwerks.

Die Studie wurde durchgeführt in Zusammenarbeit mit HORTINLEA – einem interdisziplinären Forschungsprojekt, das sich mit Fragen rund um Ernährungssicherheit in Ostafrika, insbesondere in Kenia, befasst. Die Arbeit wurde in enger Kooperation mit HORTINLEA-Partnern in Kenia und Tansania umgesetzt, um ein tiefgreifendes und ganzheitliches Verständnis über Wissensverbreitungs- und Innovationsprozesse zu gewinnen. Die Studie liefert für die aktuelle und nächste Phase des HORTINLEA-Projekts die erforderlichen Hintergrundinformationen für die Entwicklung von zielgruppengerechten Wissensverbreitungsinstrumenten. Außerdem wird erwartet, dass die Ergebnisse und Empfehlungen dieser Studie als nützliche Ideenquelle für den Aufbau und die Pflege von dauerhaften Wissens- und Innovationsnetzwerken von dem oben genannten Projekt und dessen Partnern sowie anderen Akteuren in vergleichbarem Kontext genutzt werden.

Konzept und Methodologie

Die Studie kann den Ansätzen der sogenannten integrierten landwirtschaftlichen Forschung und Entwicklung (*Integrated Agricultural Research for Development – IAR4D)* zugeordnet werden. Aufbauend auf einer vorangegangenen SLE-Studie zu AIVs (Gevorgyan et al. 2015), wird eine überarbeitete Version der problemfokussierten *Innovation Systems Perspective* (ISP) weiterentwickelt und angewandt. Durch eine umfassende Sicht auf alle Akteure der AIV-Wertschöpfungskette berücksichtigt die *Innovation Systems Perspective* die Sichtweisen von Bäuerinnen und Bauern, Forschern, politischen Entscheidungsträgern und allen weiteren Akteuren, deren Interaktionen zu erfolgreichen Innovationen führen können. Innovation wird hier als ein Prozess der Generierung, Verbreitung und Umsetzung von neuen Lösungen bzw. der Nutzung bereits vorhandenen Wissens in einem anderen Kontext gesehen (Gevorgyan et al. 2015). Dabei wird eine breite Definition von Innovationen angewandt, die neben technologischen Innovationen auch soziale und institutionelle Innovationen umfasst. Die *Innovation Systems Perspective* bildet das gesamte Innovationssystem im Bereich der AIVs ab – Rahmenbedingungen und Akteursgruppen sowie deren Interaktionen. Der Schwerpunkt dieser Studie liegt auf den Bedürfnissen von und den Interaktionen zwischen Kleinbäuerinnen und -Bauern, Forscher*innen und politischen Entscheidungsträger*innen. Es wird untersucht, wie sie bisher in den Innovationsprozess involviert sind, wie sie miteinander kooperieren und wie diese Kooperation in Zukunft verbessert werden kann.

Ein unzureichender Wissensaustausch verringert die Wahrscheinlichkeit, dass Forschungsergebnisse – verstanden als potenzielle Innovationen – einen positiven Einfluss auf Entwicklung haben können.

Abgeleitet von dieser Annahme, werden die sogenannten Lücken im Wissensdreieck zwischen Forschung, Praxis und Politik konzeptualisiert. Darüber hinaus wird der 3D-Nachhaltigkeitsansatz als Querschnittsthema der Studie vorgestellt. Dabei werden drei Dimensionen der Nachhaltigkeit – ökologische, ökonomische und soziale – eingeführt und dargestellt.

Die Forschungsregionen befanden sich in Kenia, Tansania und Deutschland und umfassen ländliche, ebenso wie urbane Regionen. Auf Grund der induktiven Vorgehensweise wurde für die Untersuchung ein explorativer Ansatz gewählt. Dieser ermöglichte es, die Methoden während der Datenerhebung anzupassen und die Untersuchungsbereiche zu spezifizieren. Es wurden sowohl quantitative als auch qualitative Methoden eingesetzt und insgesamt 114 halbstrukturierte Experteninterviews mit Schlüsselpersonen aus der Forschung, 60 Fragebögen und 15 Gruppendiskussionen mit Kleinbäuerinnen/-bauern und landwirtschaftlichen Berater*innen sowie vier *Multi-Stakeholder-Workshops* und zahlreiche Treffen mit relevanten Expert*innen durchgeführt. Bäuerinnen und Bauern, Forscher*innen sowie weitere AIV-Expert*innen waren Hauptinterviewpartner*innen und Teilnehmer*innen dieser Workshops und Fokusgruppendiskussionen. Darüber hinaus wurden 25 bäuerliche Adaptionskriterien erfasst und analysiert, die maßgeblich sind, um eine Innovation anzunehmen oder abzulehnen. Eine Fallstudie zur Relevanz bestimmter Kriterien für spezifische Innovationen rundet die empirische Analyse ab.

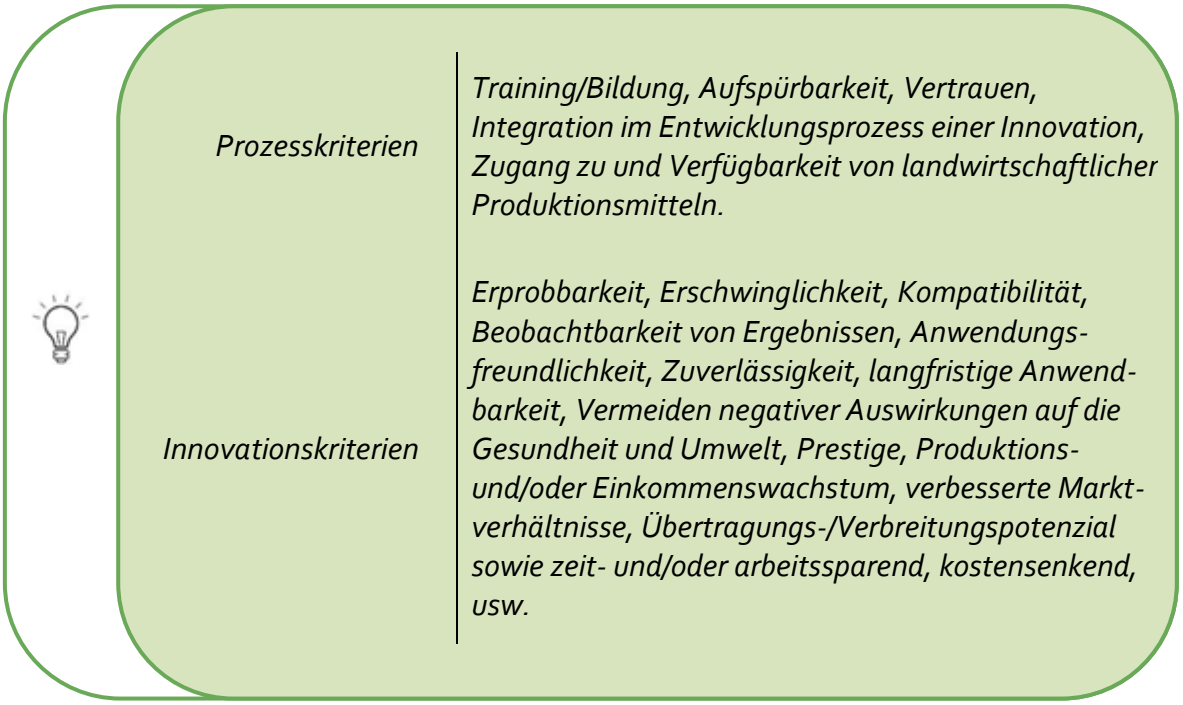
Empirische Forschungsergebnisse

Die Wissenslücke zwischen Forschung und Praxis

Die Analyse der lokalen Innovationsprozesse und der bäuerlichen Adaptionskriterien für Innovationen: Eine der wichtigsten Ansprüche der Bäuerinnen und Bauern war, dass sie in die Entwicklung von Innovationen von Anfang an einbezogen werden möchten. Außerdem legen sie besonders großen Wert darauf, von externen Akteuren (*innovation brokers*), z.B. landwirtschaftlichen Berater*innen und Forscher*innen, während des gesamten Innovationsprozesses begleitet zu

werden. Allerdings zeigt sich auch, dass externe Akteure einen ambivalenten Ruf haben – einigen wird vertraut, andere stehen im Verdacht, eine sogenannte geheime Agenda zu haben, d.h. vorrangig auf ihren eigenen Vorteil bedacht zu sein (diese wird in der Studie weiter präzisiert). Des Weiteren spielt der Wissensaustausch unter den Bäuerinnen und Bauern eine wichtige Rolle bei der Adaption von Innovationen. Unterschiedliche Kriterien wurden identifiziert, die Bäuerinnen und Bauern bei der Entscheidung, eine Innovation anzunehmen oder abzulehnen, abwägen. Aufbauend auf dieser Sammlung der Kriterien wird eine binäre Typologie entwickelt: *Prozesskriterien* beschreiben die Art und Weise, wie eine Innovation einer Bäuerin oder einem Bauern vorgestellt wird.

Innovationskriterien hingegen beziehen sich auf innovationsspezifische Charakteristika und (angenommene) Vorteile, die eine Innovation mit sich bringt.



Die erhobenen Daten zeigen, dass eine ganze Reihe von Kriterien für die Bäuerinnen und Bauern entscheidend sind, um eine Innovation anzunehmen oder abzulehnen. Das Training scheint das wichtigste Kriterium zu sein. Dabei spielen die landwirtschaftlichen Beratungsdienste (sowie *innovation brokers*) eine entscheidende Rolle. Darüber hinaus erhöhen die Verfügbarkeit sowie die Zugänglichkeit einer Innovation die Wahrscheinlichkeit, dass diese nachhaltig genutzt wird. Zahlreiche weitere Innovationskriterien, beschrieben in dieser Studie, sind für die Bäuerinnen und Bauern bei der Adaption von Innovationen von großer Bedeutung. Die spezifischen Bedürfnisse von Bäuerinnen und Bauern müssen in

den Entwicklungsprozess einer Innovation integriert werden. Daher es ist wichtig, sie in den Entwicklungsprozess einer Innovation einzubeziehen.

Die Wissenslücke zwischen Forschung und Politik sowie Forschung und Praxis

Entwicklung zielgruppenspezifischer Wissensverbreitungsinstrumente: Die Ergebnisse einer umfassenden Bedarfsanalyse bestätigen die Notwendigkeit der Entwicklung zielgruppenspezifischer Wissensverbreitungsinstrumente, insbesondere für die landwirtschaftlichen Berater*innen und federführenden gebildeten Bäuerinnen und Bauern sowie politischen Entscheidungsträgern, um die Forschungsergebnisse des HORTINLEA Projekts nachhaltig zu verbreiten. Eine Möglichkeit ist die Entwicklung eines praktischen Training-Handbuchs. Dabei soll ein holistischer Ansatz gewählt werden, der die gesamte AIV-Wertschöpfungskette einbezieht. Im Rahmen dieser Studie wurde ein Konzept zur Erstellung eines praktischen Handbuchs zu den Produktions- und Marketingaspekten von AIVs konzentriert, ein weiteres nimmt den Konsum von AIVs in den Fokus, einschließlich Ernährungs- und Gesundheitsaspekten. Darüber hinaus, um politische Entscheidungsträger zur Schaffung von günstigen Rahmenbedingungen für die AIV-Produktion und das Konsum zu motivieren, wurden politische Dossiers (*policy briefs*) entwickelt. Dafür wurden die Forschungsergebnisse verschiedener HORTINLEA-Teilprojekte zu sogenannten Innovationsclustern zusammengefasst. Ein Cluster umfasst jeweils die Ergebnisse, die zur Lösung von Herausforderungen im gleichen Bereich beitragen können. Fünf Themenbereiche (Innovationscluster) wurden definiert; in jedem Bereich soll ein politisches Dossier entstehen:

- Gesundheit und Ernährung
- Ökologie, Umwelt und Klima
- Technologie und wirtschaftliche Entwicklung
- Institutionen, Märkte und gemeinsames Handeln (collective action) und
- soziale Entwicklung, Gender, Kultur und Bildung.

Eine strukturierte Sammlung von HORTINLEA-Forschungsergebnissen wurde zusammengestellt und mit lokalem Wissen ergänzt. Darauf aufbauend wurde ein erstes politisches Dossier zu Gesundheit und Ernährung sowie Entwürfe beider Training-Handbücher erstellt. Der gesamte Entwicklungsprozess der Wissensverbreitungsinstrumente wurde detailliert dokumentiert.

Die Wissenslücke zwischen Forschung, Politik und Praxis

Konzeptualisierung eines nachhaltigen Wissens- und Innovationsnetzwerks: In enger Anlehnung an den von der Weltbank entwickelten Ansatz „*The Art of Knowlegde Exchange*" (World Bank 2015) und unter Einbeziehung des HORTINLEA-Kontexts, wurde ein Konzept für ein Wissens- und Innovationsnetzwerk für AIVs entwickelt. Drei Hauptschritte dieses Konzeptes wurden im Rahmen der vorliegenden Studie durchgeführt:

- Die Festlegung der Ziele des Netzwerks
- die Bestimmung der Teilnehmenden und
- die Sammlung von Ideen zum Design des Netzwerks.

Die Ergebnisse dieser drei Schritte zeigen, dass das Ziel dieses problemorientierten Netzwerks ist, für ein stärkeres Bewusstsein zu sorgen, dass AIVs einen Beitrag zur Nahrungs- und Ernährungssicherheit in Kenia und Tansania leisten kann. Darüber hinaus soll das Netzwerk einen nachhaltigen Wissensaustausch zwischen den verschiedenen Akteuren entlang der AIV-Wertschöpfungskette sowie im gesamten AIV-Innovationssystem sicherstellen. Bäuerinnen und Bauern sollen dabei zentrale Akteure sein und Wissensverbreitung eine Kernaufgabe des Netzwerks. Um diese Ziele zu erreichen, wird empfohlen, auf existierenden HORTINLEA-Strukturen aufzubauen. Weiterhin sollen inklusive und partizipative Mechanismen etabliert werden, etwa thematische Arbeitsgruppen und regelmäßige physische Treffen, kombiniert mit dem Einsatz innovativer digitaler Kommunikationstechnologien. Nicht zuletzt ist es ratsam, in der Region ein gewisses Stammpersonal sowie administrative Strukturen für das Netzwerk zu unterhalten.

Basierend auf diesen empirischen Ergebnissen, wurde eine Liste mit weiteren zentralen Schritten für die Verwirklichung eines Wissens- und Innovationsnetzwerks vorgestellt: Wichtig ist es zunächst, eine Kerngruppe zu definieren, die die Verantwortung für die Implementierung des Netzwerks übernimmt. Hier könnten Mitglieder des HORTINLEA-Konsortiums eine wichtige Rolle spielen. Als zweites soll sichergestellt werden, dass eine solide finanzielle Basis für die Aufrechterhaltung und die Aktivitäten des Netzwerks besteht. Möglichkeiten wären hier z.B. die Einwerbung externer Mittel, aber auch die Etablierung alternativer Mechanismen, etwa der Zahlung von Mitgliedsbeiträgen. Als drittes schließlich ist es essentiell, die Einsatzbereitschaft und Motivation der Teilnehmenden auch langfristig aufrechtzuerhalten.

Zusammenfassung und Empfehlungen

Die Einbeziehung der Sicht und Perspektive von Bäuerinnen und Bauern in den gesamten Innovationsprozess ist zentral und sollte bei der Formulierung zukünftiger Forschungsfragen in Betracht gezogen werden. Darüber hinaus bilden die identifizierten Kriterien zur Annahme oder Ablehnung einer Innovation mögliche Ausgangspunkte für künftige Vergleichsstudien. Die Analyse dieser Kriterien in anderen Kontexten und in Bezug auf andere Innovationen verspricht Einblicke in die lokal- und innovationsspezifische Relevanz einzelner Kriterien und über deren Generalisierbarkeit.

Die detaillierte Dokumentation des Entwicklungsprozesses der HORTINLEA-Training-Handbücher und politischer Dossiers, kombiniert mit den aus diesem Prozess gewonnenen Erkenntnissen, dient als Basis für die Erstellung eines Toolkits für die Entwicklung weiterer Wissensverbreitungsinstrumente. Die Anwendung eines partizipativen und transdisziplinären Ansatzes, die Einbeziehung von Forscher*innen, Bäuerinnen und Bauern ebenso wie von politischen Entscheidungsträger*innen, wird die Wahrscheinlichkeit erhöhen, dass Forschungsergebnisse in eine „zielgruppengerechte Sprache" übersetzt werden. Das wiederum ist eine wichtige Voraussetzung dafür, dass Forschung einen positiven und nachhaltigen Einfluss auf Entwicklung haben kann.

Die Konzeptualisierung des Wissens- und Innovationsnetzwerks ist eine Beispielstrategie für zeitlich begrenzte und extern finanzierte Projekte aus Forschung und Entwicklungszusammenarbeit wie HORTINLEA, um eine nächste Projektphase oder weitere langfristige Vorhaben zu entwickeln. So eine Strategie kann dabei helfen, die Nachhaltigkeit von HORTINLEA und ähnlichen Projekten zu verbessern. Die Unterstützung eines kontinuierlichen und zirkulären Wissensaustauschs, auch nach Projektende, und die Schaffung eines gemeinsamen Beteiligungsgefühls, kann mehr Unabhängigkeit von externen Akteuren ermöglichen (insbesondere in finanzieller Hinsicht).

Abschließend lassen sich die Ergebnisse der vorliegenden Studie wie folgt zusammenfassen:

Ein besseres Verständnis von lokalen Innovationsprozessen, der Einsatz von zielgruppenspezifischen Wissensverbreitungsinstrumenten und die Einbettung dieser Aktivitäten in ein Wissens- und Innovationsnetzwerk können dazu beitragen, die Wissenslücke zwischen Forschung, Praxis und Politik nachhaltig zu schließen. Das ist eine wichtige Bedingung dafür, dass Forschung einen positiven und nachhaltigen Einfluss auf Entwicklung hat.

Table of Contents

List of Figures

List of Info Boxes

List of Case Studies

Abbreviations

AIRCA	Association of International Research and Development Centers for Agriculture
AIV	African Indigenous Vegetable
EAFF	East Africa Farmers Federation
EAGC	Eastern African Grain Council
FGD	Focus Group Discussion
GlobE	Funding initiative "Securing the Global Food Supply" (Globale Ernährungssicherung)
HAK	Horticultural Association of Kenya
HORTINLEA	Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa
icipe	International Centre of Insect Physiology and Ecology
ICT	Information and Communication Technology
ILRI	International Livestock Research Institute
ISP	Innovation System Perspective
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research Organization
KENAFF	Kenya National Farmers' Federation
KENRIK	Kenya Resource Centre for Indigenous Knowledge
KIN	Knowledge and Innovation Network
NGO	Non-Governmental Organisation
PAEPARD	Platform for an Africa-Europe Partnership for Agricultural Research for Development
PELUM	Participatory Ecological Land Use Management Association
SDGs	Sustainable Development Goals
SLE	Seminar für Ländliche Entwicklung / Center for Rural Development
SP	sub-project
TAHA	Tanzania Horticultural Association
Trans-SEC	Innovating Strategies to safeguard Food Security using Technology and Knowledge Transfer
WorldVeg	The World Vegetable Center Eastern and Southern Africa

1 Introduction

Purpose of the Study

Food and nutrition insecurity and especially *hidden hunger* are pressing challenges Kenya and Tanzania are currently facing. Both rural and (peri-)urban populations are affected but in different ways. Agricultural research and the dissemination of research results into practice provide one way to address these challenges, for example by developing new or improving existing local agricultural practices. However, results from agricultural research are often not disseminated to or used by farmers and policymakers efficiently. Closing this knowledge gap between research, practice and policy is the focus of this study.

HORTINLEA (Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa) is an interdisciplinary research project addressing food and nutrition security challenges in East Africa, particularly in Kenya. The research project is scheduled to run between 2013 and 2018 and focuses on the promotion of African Indigenous Vegetables (AIVs). Over 19 universities and research institutions in Germany, Kenya and Tanzania collaboratively conduct research on AIVs in order to promote the production and consumption of AIVs. HORTINLEA is embedded in the funding initiative "Securing the Global Food Supply – GlobE" of the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Economic Cooperation and Development (BMZ). By developing and implementing innovations along the value chain of AIVs, HORTINLEA aims at improving the livelihoods of people in rural and urban areas. Addressing natural-scientific as well as ecological, institutional and socio-economic topics, HORTINLEA is comprised of 14 sub-projects (SP). This study is embedded in SP 13, which deals with the dissemination of the HORTINLEA consortium's research findings.

HORTINLEA and especially SP 13 should be viewed in the context of the approaches of (agricultural) research and development (R&D) and integrated agricultural research for development (IAR4D). Both concepts evolved out of a paradigm shift from the rather top-down approach of many development and research interventions to a more participatory and inclusive approach, in which farmers are integrated and empowered in the research and innovation process. Building on this approach, an earlier SLE study from 2015 that was also embedded in SP 13 focused on the identification of relevant actors in the AIV innovation system in Kenya. By analysing the institutional environment and contextual factors for innovations in small-scale AIV production, the research identified key

actors for the promotion of AIV innovations, their interlinkages and described the innovation ecology. Building on this previous research, the current study focuses on creating sustainable mechanisms for circular knowledge exchange and dissemination for AIVs.

Objectives of the Study

The study aims at contributing to closing the knowledge gap between research, policy and practice. The main research objectives of the study are:

- Analyse local innovation processes; identify and rank innovation adoption criteria for farmers
- Develop target group-specific dissemination instruments (training manuals and policy briefs)
- Conceptualise a Knowledge and Innovation Network (KIN) for African Indigenous Vegetables.

The study's main assumption is that insufficient knowledge exchange decreases the probability that research results, understood as potential innovations, have a positive impact on development.

Outline of the Study

Following this introduction, Chapter 2 provides some brief background information on food and nutrition security, agricultural production and AIVs in Kenya and Tanzania. The study's conceptual framework is outlined in Chapter 3, focusing on the Innovation System Perspective (ISP) and on the knowledge gap triangle between research, practice and policy, which together provide the overall framework for this study. Sustainability, the overarching issue of the study, is outlined conceptually. Chapter 4 describes the methods applied. Addressing the different parts of the knowledge gap triangle, the empirical analysis is divided into three main parts. Chapter 5.1 analyses local innovation processes, identifies and weighs farmers' criteria for adopting or rejecting innovations, and analyses specific innovations within a case study. Chapter 5.2 focuses on dissemination instruments. Following a comprehensive needs assessment, it describes the development of drafts of two instruments, namely policy briefs and training manuals. Chapter 5.3 describes a concept for an AIV knowledge and innovation network, identifying the network's goals, definition and design. The chapter ends with recommendations for further steps to kick-start the future network. Chapter 6 draws conclusions and recommendations for research, practice and policy. A critical reflection on the research is provided in Chapter 7.

2 Overall Context

Food and Nutrition Security in Kenya and Tanzania

Kenya and Tanzania are both characterised by high economic dependency on the agricultural sector. In 2016, horticulture and agriculture contributed around 35 % of Kenya's GDP with Kenya's agricultural sector employing more than 40 % of the total population and more than 70 % of Kenya's rural population (World Bank 2017a, FAO 2017c).

Info Box 1: Kenya

Kenya became independent from the British colonial administration in 1963. Since then, Kenya's system of governance has been a presidential democracy. However, ethnically charged politics, politically motivated violence and corruption remain major political challenges. Transparency International ranks Kenya 146 of 176 in the 2016 Corruption Perceptions Index (TI 2016).

According to the World Bank's indicator for governance, political stability and the absence of violence have decreased in Kenya since 2006 (World Bank 2017b). Access to, ownership of and the distribution of land, which were major challenges during colonial times, remain a political and ethnic challenge.

Currently, with a rate of growth of 5.85 % and a gross domestic product (GDP) of 55.4 billion US dollars in 2016 (World Bank 2017a), Kenya is the strongest economy in East Africa. According to the Food and Agricultural Organisation of the United Nations [FAO], however, 46 % of its population lives on less than one US dollar per day (2017c). Kenya's population has increased significantly over the past decades – from 11.3 million in 1970 to 48.5 million in 2016. At the current rate of growth, the population will almost double within the next 23 years, reaching 81 million in 2039 (FAO 2017c). 73.5 % of Kenya's population lives in rural areas (FAO 2017a).

The agricultural sector provides the livelihood for more than 80 % of the Kenyan population (FAO 2017c). Small-scale agriculture still plays an essential role, since 75 % of the farmers in Kenya cultivate less than five hectares of land

(MAFAP 2013). Within the agricultural sector, horticulture is an important subsector (Velte and Dannenberg 2014).

Kenya's most important export goods (tea, coffee, flowers, fruits and vegetables) come from the agricultural and horticultural sector (World Bank 2017a).

Info Box 2: Tanzania

Tanzania received its independence from the British colonial administration in 1961. Since then, Tanzania's system of governance has been a presidential democratic republic. According to the World Bank`s indicator for governance, political stability and the absence of violence have decreased since 2006, but remain generally higher than in Kenya (World Bank 2017b). With a rate of growth of 6.96 % and a GDP of 46.7 billion US dollars in 2016 (World Bank 2017a), Tanzania is the second strongest economy in East Africa. Despite economic growth, poverty remains high in Tanzania. 67.9 % of the population live on less than 1.25 US dollars per day (UNICEF 2017b). Tanzania's population has also increased significantly over the past decades – from 13.6 million in 1970 to 55.6 million in 2016 (World Bank 2017a). 67.5 % of Tanzania's population lives in rural areas (FAO 2017a).

Tanzania's agriculture accounted for 31.1 % of its 2016 GDP (World Bank 2017a). In 2014, around 68 % of the country's workforce worked in the agricultural sector (World Bank 2017a). The sector provides the livelihood of more than 75 % of the Tanzanian population (TFCG 2014) – mostly small-scale farmers. Agricultural products account for around 15 % of Tanzania's exports (TFCG 2014).

Hidden hunger, the chronic deficiency of essential vitamins and minerals (micronutrients), remains a challenge in East Africa (Nyaura, Sila, and Owino 2014), with food insecurity[1] and malnutrition "highly prevalent in Kenya's arid and semi-arid lands" (FAO 2017b, 1). In the first quarter of 2017, 2.7 million people were severely food insecure in Kenya (FAO 2017b). Three consecutive years of a

1 *Food security* "exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active an healthy life" (1996 World Food Summit, Paragraph 1). Following this definition, food security consists of four pillars: *food availability*, *food access*, *food utilisation* and *food stability* (FAO 2006).

lack of regular rainfall "have led to diminished food production and exhausted people's coping capacities particularly in the north-eastern, eastern and coastal areas of Kenya" (FAO 2017b, 1). According to the FAO, 36.5 % of Kenya's population is food insecure and 35 % of the children under the age of five are chronically malnourished (FAO 2017c). Around 19.1 % of Kenya's population[2] is undernourished (FAO 2017a). The Hidden Hunger Index, for instance, ranks Kenya as second highest among the 149 countries the index measures on (hidden) hunger. Even people who are overweight (25.5 % of Kenya's adult population) or obese (7 % of Kenya's adult population) can suffer from *hidden hunger* (Development Initiatives 2017) since they may not get enough micronutrients, despite a high daily caloric intake.

In Tanzania in 2015, more than 2.7 million children under the age of five were estimated to be stunted and more than 600,000 were suffering from acute malnutrition, of which 100,000 were severe cases (UNICEF 2017a). Around 32.3 % of Tanzania's population is estimated to be undernourished (FAO 2017a)[3]. According to the Global Nutrition Report (2017), 23.5 % of Tanzania's adult population is overweight and 7 % is classified as obese.

Figure 1: Focus of HORTINLEA Research Project – African Indigenous Vegetables: Amaranth, Ethiopian Kale, African Nightshade, Spider Plant

Source: HORTINLEA Proposal

Both countries face this double burden of malnutrition, the chronic deficiency of essential vitamins and minerals. Promoting the production and consumption of African Indigenous Vegetables (AIVs) is an important instrument for effectively addressing food and nutrition security challenges in East Africa. AIVs contribute to

2 Based on a 3-year average between 2014-2016.

3 Based on a 3-year average between 2014-2016.

income generation and to sustainably improving food and nutrition security (Gogo et al. 2016; Kamga et al. 2013; Ngugi, Gitau, and Nyoro 2007). However, their potential has only been rediscovered in recent years after decades of stigmatisation as a poor man's food (Stöber, Chepkoech et al. 2017). Due to their high content in micronutrients – AIVs contain up to ten times more micronutrients than exotic vegetables (Abukutsa 2010) – AIVs can prevent the negative effects of *hidden hunger*. With agriculture, being the main driver of land-use change in Tanzania and Kenya (Maitima et al. 2009), the planning and direction of agricultural development has major ecological implications as well. AIVs contribute to crop diversity and are usually cultivated in extensive small-scale farming systems (Kebede and Bokelmann 2016; Abukutsa 2010, 15). Agricultural schemes with high crop diversity can contribute to the preservation of biological diversity (Maitima et al. 2009). In addition, AIVs are rather resilient and adaptable to changing weather and climate conditions (Stöber, Chepkoech et al. 2017). This factor is gaining importance, with climate change increasing drought stress and jeopardizing crop productivity (IPCC 2014).

Study Context

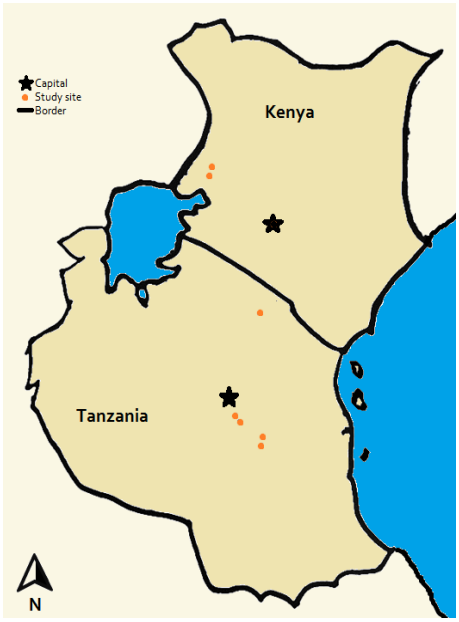


Figure 2: Overview of the study sites in Kenya and Tanzania

Source: Own illustration

The main study regions in which research on local innovation processes and the ranking of criteria were conducted are the project sites of Trans-SEC in Tanzania. Both regions, Dodoma and Morogoro, are characterised by rainfed crop-livestock orientation, having at least one local marketplace surrounded by two to three villages. Within the two regions, four villages were chosen: Ilolo and Idifu in the Chamwino district in Dodoma region and Changarawe and Ilakala in the Kilosa district in Morogoro region.

The most important differences between the districts are in climate and the prevalence of poverty[4]. The Chamwino district is characterised by a semi-arid climate with an average annual rainfall of 500 mm and a rainy

4 For further characteristics of the study regions see Annex 4.7: Characteristics of the Study Regions.

season with short rains from December until March. The Kilosa district in contrast is characterised by a semi-humid climate with an average annual rainfall of 800 to 1,400 mm and a rainy season with short rains from October until December and long rains from February until May. Among the different regions in Tanzania, the poverty rate is highest in the drier central zone, including the Chamwino district. The stunting rate for children under the age of five years is 80 % compared to 60 % in the Kilosa district. Within the Chamwino district, the village of Ilolo is better located in terms of market access than Idifu, which is further away from the main marketplace in Mvumi Mission (Sieber and Graef 2012).

Regional cross-validation of the criteria ranking took place in Western Kenya, in the predominantly rural counties of Kakamega and Vihiga. Located at an altitude of 1300-1800 m above sea level, the region is characterised by a tropical climate with an average annual rainfall of 1900 mm in Vihiga to 2100 mm in Kakamega county and temperatures around 23°C (Kenya National Bureau of Statistics 2015). Precipitation is highest in May and lowest in January (World Weather Online 2017; climate-data.org 2017). Despite the favourable weather conditions, agricultural activities are limited by poor soils that require careful soil fertility management and erosion control, as well as input of organic matter (NAAIAP and KARI 2014). AIVs are traditionally grown in this region.

Kakamega County has a poverty incidence of 45.2 % (Kenya National Bureau of Statistics 2015), and 28.4 % of the children under five are stunted in growth (Kenya National Bureau of Statistics et al. 2015). Rapid population growth has led to a relatively high population density of 544 people per km^2 (Commission on Revenue Allocation 2011).

The reproduction rates in Vihiga county are even higher, resulting in one of the highest population densities in Kenya, with 1,045 people living per km^2 (IEA 2011). This leads to average farm sizes of 0.4 hectares for small scale farming (Republic of Kenya 2013). Poverty is lower than in Kakamega, and with a rate of 23.5 % chronic malnutrition is slightly lower among children under five (Kenya National Bureau of Statistics et al. 2015). However, poverty statistics range between 39 % (Kenya National Bureau of Statistics 2015) and 62 % (IEA 2011).

3 Conceptual Framework

The following section provides the analytical background for the empirical analysis of local innovation processes, participatory development of dissemination instruments, and the conceptualisation of a sustainable learning, knowledge and innovation network for AIVs. Conceptually, these objectives are examined from the *Innovation Systems Perspective* (ISP) as developed by Gevorgyan et al. on the topic of AIVs (2015). This approach was further refined for the goals of this study.

3.1 Identifying the Knowledge Gap between Research, Policy and Practice

3.1.1 Innovation

Innovation is defined as a process that encompasses the components of generation, dissemination, adaptation and adoption of new knowledge or putting to use (adopting) existing knowledge in a new context (Gevorgyan et al. 2015). Based on current research on agricultural innovation systems (IICA 2010; OECD 2013), innovations can be classified into three major types:

- *Technical/technological innovations (product/production)* are changes in agricultural inputs, farming techniques or equipment on a micro-level. For instance, the use of new seed varieties or the application of new harvesting methods constitutes technical/technological innovations.
- *Process innovations* are understood as changes in (social) processes or the introduction of new procedures along the whole AIV value chain on a meso-level. This includes, for example, the application of new marketing strategies for AIVs in supermarkets or the identification of additional distribution channels for agricultural products by farmers.
- *Institutional/organisational innovations* refer to changes in the institutional context, for instance the introduction of new rules or regulations. These innovations mostly refer to the meso- and/or macro-levels and often have a strong link to the dynamics of county or national governance.

This threefold categorisation is important in order to understand the focus of this study regarding production innovations. Nevertheless, all three types of innovations are often closely intertwined and therefore relevant for understanding innovation processes.

3.1.2 Innovation Systems Perspective

As a major theoretical framework, the study adopts the *Innovation Systems Perspective* (ISP). This analytical framework should be regarded as a systemic approach, providing researchers with a holistic perspective on innovation processes by considering all actors involved in the innovation process. In this way, unlike most other theoretical approaches to agricultural research for development, the ISP makes it possible to thoroughly analyse the interconnections between different actor groups involved in innovation processes.

Actor Groups and Interlinkages

In general, the actors in an innovation system can be individuals or organisations; the defining feature is their role or function regarding the innovation process. The ISP is understood as a people and problem-focused perspective, taking the needs of potential innovation users as the starting point of any innovation process. As shown in Figure 2, prominent among the relevant actors are typical value chain actors such as input suppliers, producers (farmers), traders (middlemen), vendors and consumers. In addition to value chain actors, researchers, policymakers and actors from other fields (e.g. the education system, intervention landscape, linking/intermediary actors, private sector) are integral constituents of the innovation system, as interactions between them shape the innovation process.

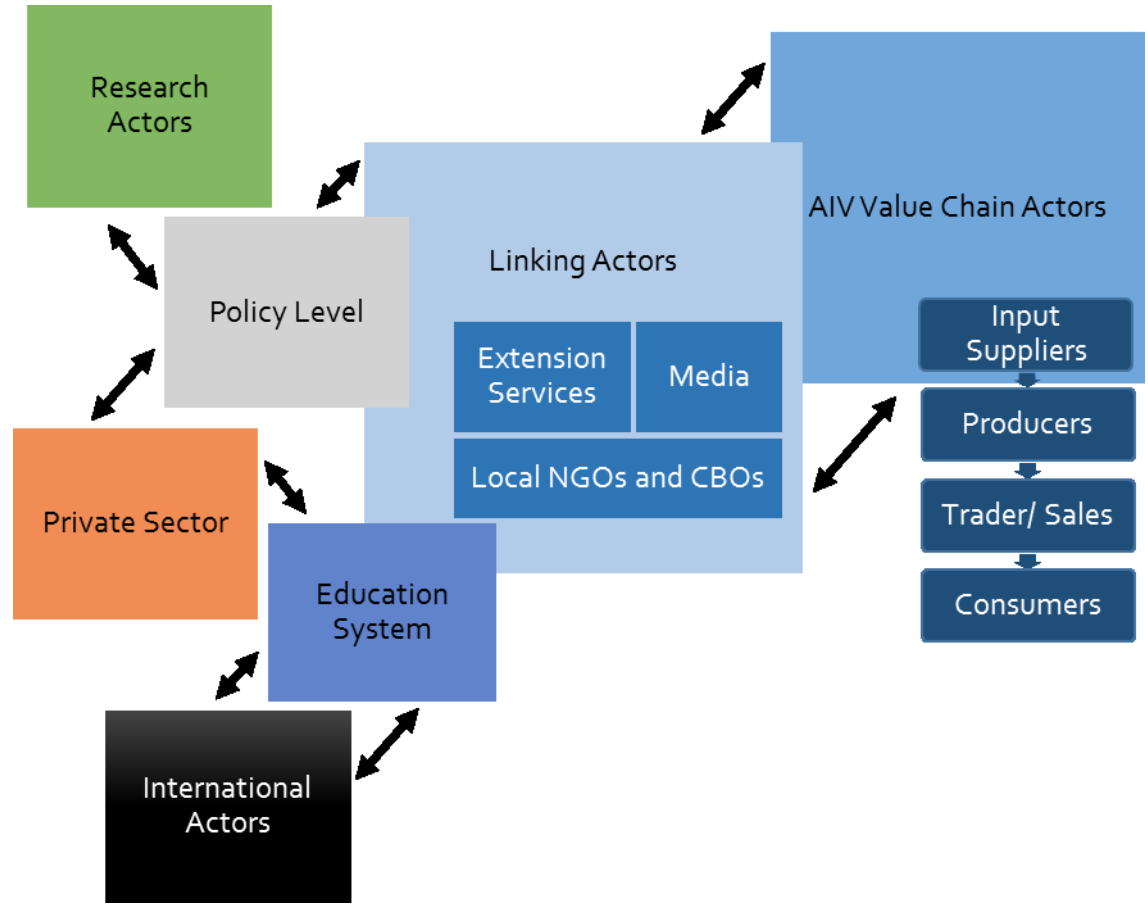


Figure 3: AIV Innovation System

Source: Own illustration adapted from Gevorgyan et al. (2015)

However, it must be noted that the ISP depicts an ideal division of actors, and not all actors actually fall neatly into only one actor group. Thus, overlaps in competencies or working areas are inherent. In the Info Box 3, each actor group will be briefly characterised.

Info Box 3: Actor Groups in the AIV Innovation System

AIV Value Chain Actors: This group includes input suppliers, (small-scale) farmers, distributors and vendors, and consumers related to AIV production and processes. It includes all actors along the value chain of indigenous vegetables who are relevant for innovation processes and dissemination strategies. Here some overlaps with other actor groups need to be noted, especially actors from the private sector.

Policy Level: This includes all actors relevant for AIV and horticulture-related policymaking or advocacy. Actors range from the national decision-making level (ministerial level), to sub-national governance (county level), and even local policy. Moreover, the policy arena includes actors engaged in lobby and advocacy work at various levels.

Research Actors: This actor group includes all those who are professionally affiliated with research or who are part of a research organisation. It includes all HORTINLEA consortium members from universities in Germany, Kenya, and Tanzania and international research institutes. Moreover, it encompasses independent researchers and cross-cutting initiatives in the area of academic research and development work. In addition, the parastatal Kenya Agricultural and Livestock Research Organisation (KALRO – formerly KARI, the Kenya Agricultural Research Institute) is responsible for research activities related to agriculture and livestock as well as the education of government extension officers.

International Actors: The intervention landscape describes the international setting of donor organisations and implementing agencies active in Kenya and Tanzania. Moreover, it includes international non-governmental organisations (NGOs) that carry out large-scale interventions in the target areas, often cooperating closely with local NGOs.

Private Sector: Actors from the private sector relevant for horticultural issues and innovations in Kenya and Tanzania include a diverse set of actors along the value chain; farmers (small-scale and large-scale commercial), seed companies and traders, as well as (social) businesses engaged in this sector by promoting technology, or working in trade or finance.

Education System: Actors from the education sector mostly include governmental education services, such as schools, universities and education centres for training extension and nutrition personnel. Non-governmental initiatives involved in education and cross-cutting issues such as consumption, production, or marketing are included in this category.

Linking Actors: Linking actors are all actor groups that have an impact on the research field and target groups, but do not neatly fit into any of the other groups. They include local NGOs and CBOs, private or independent extension services, and media actors.

Having characterised all actor groups of importance within the ISP, one can now take a closer look at AIV innovation processes. This study initially adapts a broader perspective to examine a number of these actors and actor groups in more detail. These are the actor groups of research, practice (focusing on linking actors and practitioners in the AIV value chain), and actors from the policy level. Although in reality these actor groups overlap in many aspects, a rather strict focus is set on which exact actors were examined for each of these groups. For practitioners, a clear focus was put on small-scale farmers. Researchers were examined by looking at university or research organisations. The policy level was integrated by interviewing representatives on a local and national level.

3.1.3 A Closer Look: Identifying the Knowledge Gap

As described by Gevorgyan et al. there is a particular need to integrate policymakers into the development process of horticultural innovations in Kenya. The authors argue that policymakers are of crucial importance due to their agenda-shaping power and their economic capital (Gevorgyan et al. 2015). Moreover, based on HORTINLEA project work and ongoing academic research, it is argued that there is a lack of communication between researchers and practitioners (Stöber 2017). This mismatch manifests itself in incongruent development aspirations and a lack of dialogue. Hence, it is claimed that development projects or research for development could benefit from improved transdisciplinary research and stakeholder dialogue (Stöber 2017). Based on these findings, the main problem this study seeks to address is the gap in knowledge exchange between research, practice, and policy.

This gap is illustrated in Figure 4. It shows the three actor groups and the assumed gaps in their interlinkages. Each of the three interlinkages – between research and practice, practice and policy, and policy and research – is examined in this study. It addresses how these gaps can be closed in the context of the AIV value chain in Kenya and Tanzania.

The innovation process is perceived as non-linear, multi-directional or circular in nature (van de Fliert and Braun 2002). Rather, each knowledge gap can be addressed by both actor groups, for instance between research and practice it is not only important that research results be communicated to the farmers, but also that the farmers' needs and ideas be integrated into innovation processes.

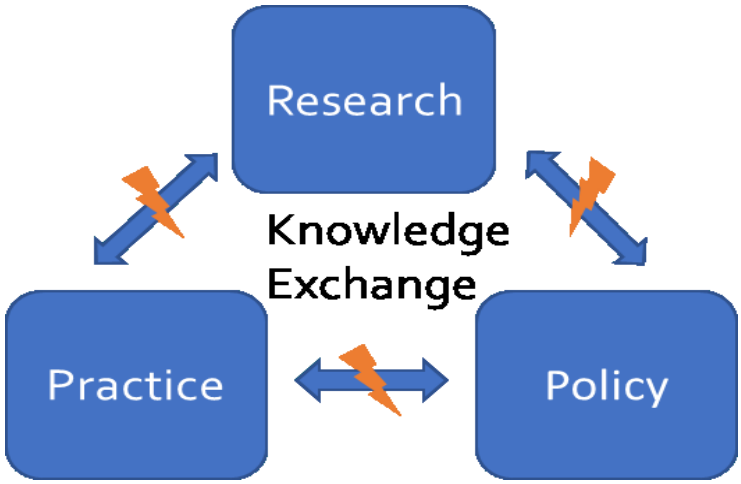


Figure 4: Knowledge Gap between Research, Policy and Practice

Source: Own illustration

The first objective of this study focuses on the knowledge gap between research and practice (Figure 4). It aims to analyse local innovation processes and identify criteria from the farmers' perspective for the adoption or rejection of potential innovations. The second objective focuses on the knowledge gaps between research and practice and between research and policy. It examines how target-group-specific dissemination instruments such as training manuals and policy briefs can be compiled. The third objective focuses on the knowledge gaps between research and policy, between research and practice, and between policy and practice. It examines how knowledge exchange between all three levels can be implemented in a sustainable way, namely by exploring the opportunities and mechanisms necessary for establishing a Knowledge and Innovation Network for AIVs.

3.1.4 Knowledge

Knowledge, understood as "information, facts, data, know-how, and experience" (Nonaka 1994; World Bank 2013, 7), is an essential part of conceptualising knowledge exchange. However, there are different types of knowledge that are important when striving for the creation of formal knowledge exchange mechanisms.

Generally, one can distinguish between *explicit knowledge* and *tacit knowledge*. Explicit knowledge describes written and codified knowledge – such as in manuals or books – that is conveyed in a unidirectional way from the source to the reader. Tacit knowledge, on the other hand, represents non-codified knowledge and knowledge based on experience, intuition or insight, often not even articulated. It is shared mostly in multidirectional ways and creates the main substance for a knowledge exchange mechanism (World Bank 2013). For this study, both kinds of knowledge and transfer mechanisms are relevant. The spread of tacit knowledge often includes the generation and diffusion of *local knowledge* within certain social contexts.

Info Box 4: Local Knowledge

Local knowledge refers to people's knowledge on their immediate environment, including "beliefs and perceptions that people hold about the world around them" (FAO 2005, 7). Furthermore, local knowledge includes specific forms of knowledge, which develop in isolation from other knowledge systems (*traditional knowledge*) or are closely linked to a certain cultural or political group of people (*indigenous knowledge*) (FAO 2005).

Being aware of distinctions between different kinds of knowledge is important for the framework of this study, which draws heavily, but not exclusively, on the broader concept of tacit knowledge.

This becomes especially relevant for the development of dissemination instruments such as training manuals. Lastly, it is of crucial importance to recognize the dynamic character of all forms of knowledge and the fact that knowledge systems are always "inextricably linked with the social, political and agro-ecological context in which they arise" (Warburton and Martin 1999, 3).

3.1.5 Knowledge Exchange Mechanisms

Knowledge exchange mechanisms are important for disseminating tacit as well as explicit knowledge. Due to the multidirectional character of this type of knowledge, learning processes become circular between different actors and through iteration over time. Ideally, stakeholders in knowledge exchange processes engage in a (continuous) dialogue that generates ideas and information. Furthermore, a knowledge exchange process should provide deliberation and discussion, and it should eventually integrate insights into the knowledge of individual actors.

Within the framework of knowledge exchange that aims to share and foster knowledge on a certain topic (such as AIVs), processes of exchange and discussion need to be conducted in a structured way that allows stakeholders to engage in the determination and investigation of relevant issues (Mefalopulos 2008).

3.2 Sustainability

Sustainability is a cross-cutting issue in the overall study design at different levels of this study. Within the framework of the Sustainable Development Goals (SDGs), sustainable development is defined as "ending poverty, protecting the planet, and ensuring prosperity for all" (UN 2015e). Preserving or improving productivity allows AIV growers to make a decent living on their own land. Long-term productivity, however, requires considering aspects that go beyond horticultural activity, such as health. Environmental boundaries set the context for human development (Steffen et al. 2015), which includes economic activities (Davíðsdóttir 2017).

Sustainability is a recurring theme that is applied in all areas of this study. Figure 5 shows that the three dimensions of sustainability are embedded in one another, with environment setting the overall context and economy being an integral part of society.

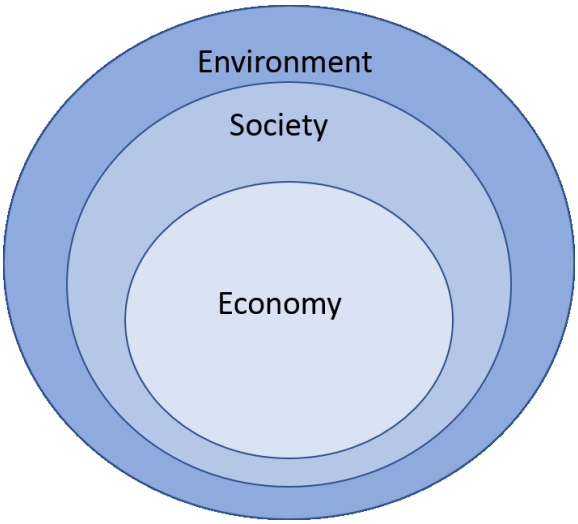


Figure 5: The Three Dimensions of Sustainability

Source: Davíðsdóttir (2017)

Ecological Sustainability

Many natural resources are finite or can be depleted through overexploitation. Soil preservation, for example, is very relevant in agriculture; more than half of the land used for agriculture worldwide is moderately to severely affected by soil degradation, especially threatening the poor (UN 2015c). Good agricultural practices (GAPs) help to preserve soil health (NAAIAP and KARI 2014). In addition, avoiding pollution caused by toxic compounds, such as pesticides and sewage, preserves the environment and human health.

This study included the relevance of ecological sustainability for farmers when they try a new agricultural practice and put it into routine use. AIV-specific GAPs that help farmers to preserve soil quality and reduce pollution and water use were collected for the development of dissemination instruments in the frame of this study. These practices are aimed at increasing yields while reducing chemical inputs, ultimately increasing farmers' resilience.

Aside from land degradation, climate change also poses a challenge for Kenya (IPCC 2014). Kenyan farmers are aware of the threats and impacts of climate change on the current agricultural system (Stöber, Moraza, et al. 2018). Producing AIVs often represents a step towards more resilient agricultural practices, as many AIVs can thrive in changing environmental conditions, in contrast to their exotic counterparts (Abukutsa 2010). Water use efficiency, for example, is often higher in AIVs than in exotic vegetables. To pinpoint further aspects that may be relevant

for ecological sustainability within their field of action, all experts included in the circular knowledge exchange process were asked to reflect on this topic.

Economic Sustainability

"Leave no one behind" is the slogan of the SDGs (UN 2015a). This holds true for all dimensions of sustainability, but economic equality is an especially important condition for societal development and equality. Kenya, among the strongest economies in Africa, is experiencing increasing levels of economic inequality (Gakuru and Mathenge 2012) and thus reduced overall economic growth (Saad-Filho 2010). One million young Kenyans entering the job market annually depend on sustainable growth to provide decent jobs (Ronneberg and Chatterjee 2017). The agricultural sector provides subsistence to the majority of rural Kenyan communities and is connected to land inequality (Gakuru and Mathenge 2012). AIVs are particularly produced by smallholder farmers, and therefore have the potential to promote inclusive growth and especially benefit the poor (Kebede and Bokelmann 2016). This study took into consideration the importance of the economic benefits of AIV innovations for farmers, and compiled good practices in AIV production in order to prepare dissemination instruments that can be applied by smallholders.

Financial sustainability is equally important within the context of economic sustainability. The third objective of this study concerns the role of long-term funding of the HORTINLEA research projects. In addition, the economic implications of maintaining a network over an extended period of time were addressed through expert interviews. Another relevant issue for economic sustainability was funding networks and research projects over the long term in such a way that ensures their results reach farmers.

Social Sustainability

Sustainability also has a major social dimension. This encompasses social inclusion or taking vulnerable societal groups into account, including but not limited to: migrants and refugees, people with disabilities, women, children and young people, elderly people, religious or ethnic minorities, and people of non-binary gender identity or non-hetero sexual orientation. SDG 16 stresses the importance of promoting "peaceful and inclusive societies for sustainable development" (UN 2015d).

Women are often especially hit by malnutrition, a problem addressed by SDG 2, which aims to provide "healthy food for all" (UN 2015b). However, women play a key role in AIV production and in poverty reduction in Kenya. They are mainly

responsible for the cultivation of staple crops (Kingiri 2010) and they make a large contribution to the food and nutrition security of the average Kenyan household. The dissemination instrument developed in the frame of this study puts a special focus on human health and nutrition. Moreover, women can play a key role in innovation networks and processes and need to be addressed as innovation brokers, entrepreneurs and as users of AIV innovations. However, research indicates that technological innovations are not gender neutral and tend to benefit men more, by lessening their workload, while increasing the workload of women, especially among the poor (ibid). In order to include women in innovation processes, measures are required that will ensure women better access to complementary inputs such as land, labour and extension services (Doss 2001). This study addresses gender inequalities by explicitly including them in the research process.

Social sustainability is not limited to the individual level. Cultural diversity and political liberty are also aspects of social sustainability. This study also analysed the importance of an agricultural innovation's cultural appropriateness. The notion of cultural appropriateness can refer to regional differences among cultures, but also to differences among social or gender groups. Since social inclusion was an important goal, vulnerable social groups received special attention when making recommendations for the design of the AIV network. Moreover, traditional knowledge about AIV production was systematically included in the assessment of GAPs.

The political dimension is also covered by SDG 16, aiming at "effective, accountable institutions at all levels" (UN 2015d). The importance of political sustainability was assessed within the scope of the network analysis. It is crucial to achieve ownership, equality and a socially sensitive network design. This study included ways of achieving a high participation rate and equality among stakeholders.

4 Methodology

This section introduces in more detail the HORTINLEA and Trans-SEC approaches and the analytical frameworks used for the different research objectives: first, local innovation processes and the theoretical description of adoption criteria; second, the conceptual approaches for developing dissemination tools; third, a Knowledge and Innovation Network; and fourth, some theoretical approaches to sustainability. In addition, this section outlines the empirical methods applied.

4.1 Analysing Inter- and Transdisciplinary Knowledge Exchange and Innovation Processes

As described in the conceptual framework, the innovation process is defined as the entire phase from setting a research goal until the end user (farmer) puts a research result into routine use. The innovation process should be achieved through circular knowledge exchange. It is hereby important to assure that the needs and knowledge of the farmers are reflected in the research.

HORTINLEA and Trans-SEC have different approaches to how and when to disseminate research results to farmers. Trans-SEC is an action-oriented research project and involved transdisciplinary knowledge exchange activities in a very early stage of the project. Research results were put into practice in an early stage of development and adapted during the period of practical use. The farmers who were selected to test the innovations in the field were clustered in innovation groups and trained in how to use the innovations. In contrast, HORTINLEA is an interdisciplinary research-focused project and concentrated on the scientific research phase of innovation development. Research results were mostly put into practice during the last phase of the project (to which this study contributes).

By analysing the approach of Trans-SEC, recommendations for HORTINLEA can be drawn, since both projects focus on horticultural innovations for small-scale farmers in East Africa. Therefore, the results of the analysis of the local innovation process (in general and Trans-SEC-specific) as well as of the adaption criteria can inform and promote the dissemination of HORTINLEA research results.

Objective 1: Analyse Local Innovation Processes and Adoption Criteria

The term *innovation process* describes the process from setting a research goal until the application of the research result into practice. However, the process

does not end when an innovation has been adopted by the users; it continues with the integration of changes, i.e. adapting the innovation. The innovation process includes the whole process of experiencing a problem, trying to solve the problem by developing a new tool or technology and putting that tool or technology to routine use (Rogers 1986).

One of the most important aspects of the *local innovation process* is the moment the potential innovation reaches the end user. This dissemination[5] phase includes the process of communicating an innovation through certain channels over time among the members of a social system (Feder, Just, and Zilberman 1985). Since one of the main characteristics of this process is the uncertainty and perceived risk for the potential user of the innovation, the decision to participate in this process is complex (Ghadim and Panell 1999).

As shown in Figure 6, communication is an essential part of the innovation-decision process. This applies not only to the dissemination of the potential innovation from experts to users but also to the feedback from users to researchers.

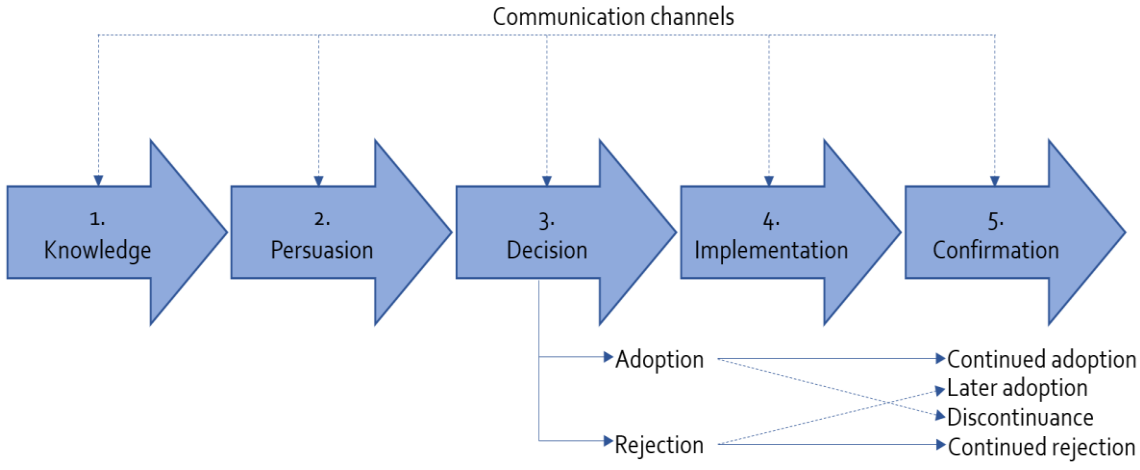


Figure 6: Five-stage Model in the Innovation-Decision Process

Source: Own illustration, adapted from Rogers (1995)

During the innovation-decision process, the potential user makes a decision about whether to adopt or reject an innovation. This process consists of five steps (Rogers 1995):

5 Sometimes also referred to as diffusion.

1. In a first step, the potential user has become aware of the existence of the innovation. An important pre-condition is that the user feels the need to try something new or to change something. If this need is not given, it is very unlikely that the user will be open to anything new and therefore it is unlikely that knowledge about the innovation will reach the potential user.
2. In a second step, the user has to be persuaded to put the potential innovation into practice. During this process, various criteria are important for the user, for instance the compatibility of the innovation with the user's social structure, its trialability, how easy it is to use and the (assumed) advantages of using it. The importance of these criteria can vary between different users. Since the fulfilment of such criteria is a precondition for the user to adopt the innovation, it is important to know exactly what the criteria are and also how important they are to the user.
3. The third step is the adoption or rejection of the potential innovation. It is important to mention that even though a (potential) user might adopt or reject an innovation at first, the decision can be reversed later on.
4. During the first step of implementation, the user tests or tries the potential innovation. At this point, the innovation can still be rejected if the criteria from step two are not fulfilled.
5. Only if the implementation phase was successful will the user decide to adopt the innovation in the long run. Confirming the success of an innovation is the fifth step.

During all steps of the innovation-decision process, innovation brokers such as researchers, extension officers, neighbours, or family members can influence the decision-maker and therefore increase or decrease the probability of adoption. However, the focus of this study is on the individual criteria of the (potential) user.

Objective 2: Develop Target-group-specific Dissemination Instruments – Interdisciplinary Integration of Research Results

The envisioned goal of this study is to initiate the interdisciplinary integration of HORTINLEA research results, the development of dissemination instruments and the description of steps necessary for their completion. The whole process aims to contribute to effective information and knowledge management towards a higher applicability of research results. Drawing on the approach of Integrated Agricultural Research for Development (IAR4D), the focus is on the impact of research and not on its output. Particular importance is given to the effectiveness with which research results and other innovative solutions are disseminated (Anandajayasekeram 2008). Moreover, in coherence with the ISP, a circular and

transdisciplinary understanding of knowledge generation and dissemination is applied and leads to a participatory process of developing dissemination instruments (Gildemacher and Wongtschowski 2015). Here, special attention is paid to a continuous adaptation process which "includes elements of trial and error, interactive learning and feedback between actors" (ibid).

Within this study, the focus is on turning research results and scientific knowledge into major sources of information for the contents of policy briefs and training manuals. AIV farmers based in the project regions of HORTINLEA are regarded as central knowledge holders (Fitzgerald et al. 2002, 15). Farmers are thus depicted as key actors not only in the innovation process, but also in the process of developing dissemination instruments. Their assessment of the current situation is evaluated in the framework of a comprehensive needs assessment. Moreover, they are involved in the development of dissemination instruments: Centuries-old local knowledge and first-hand experiences with (innovative) agricultural practices were documented. Furthermore, photos were taken and used to illustrate the recommendations of farmers. This approach is inspired by the Agroecology concept promoted by the French NGO AgriSud: "Agroecology is a source of emancipation for farmers: instead of receiving advice, they become cofactors" (Schutter 2010). Finally, the conclusion of the first SLE study encourages this approach by stating that "only farmers' participation and empowerment will make research, dissemination and development interventions more targeted, sustainable and pro-poor orientated" (Gevorgyan et al. 2015, 65).

Objective 3: Conceptualise a Knowledge Exchange Network

The third objective of the study, to conceptualise a *Knowledge and Innovation Network*[6] (KIN), is approached by reviewing concepts for multi-stakeholder dialogue and (agricultural) innovation platforms. The analysis therefore draws heavily on different networking approaches, with the World Bank's guide "The Art of Knowledge Exchange" being an essential source (World Bank 2013).

To conceptualise a Knowledge and Innovation Network for AIVs, it is important to realise that circular knowledge sharing processes are the essence of a multi-stakeholder network that is problem-based. That means the network addresses stakeholders' real issues and seeks to find practical solutions through exchange and practical learning.

6 In the literature sometimes also referred to as platform or dialogue.

A widely used approach that puts circular processes at its core is the World Bank's approach to knowledge exchange (World Bank 2013, 2015). According to this approach, knowledge exchange networking can be described as a cycle that begins with a definition of the goals of the network, continues with the conceptualisation and design of the network, the design of knowledge exchange processes, the implementation and launch of the network, and eventually results in reporting and learning from its establishment and progress (World Bank 2013, 2015). Due to its circular nature, the knowledge gained must be re-integrated into the process, and steps must be repeated over time.

A similar approach was taken by Tenywa et al. (2011), who described and visualised the goals and stages of an agricultural innovation platform. This network cycle can be separated into different phases from the initial set up (pre-formation phase) to a mature form of implementation (formation phase), and the last stage in which the network or platform either continues or degenerates (post-formation phase), see Figure 7 below. Tenywa et al. (2011) focus explicitly on agricultural innovations in their work. Therefore, selected aspects of their approach are combined with the World Bank concept of knowledge exchange to develop a comprehensive concept of the AIV network for the empirical analysis.

Moreover, mechanisms of knowledge exchange and learning are important for identifying ways of structuring the network and for stakeholders to be invited to participate. As shown in Annex 1: Selected Concepts for Knowledge Exchange, the concepts of *multi-stakeholder dialogues*, *community of practice* and *innovation platforms* were compared to identify the most important aspects and their potential use in designing the KIN. Each instrument provides certain features to be considered when setting up the network. Consequently, relevant features were identified and integrated into the framework for later analysis. These aspects include goal setting, envisioned outcomes, administrative structure, stakeholder analysis, tools for networking activities, and the sustainability of the network.

Figure 7 combines the World Bank's cycle with the approach of Tenywa et al. (2011) as well as selected concepts concerning the implementation of knowledge exchange for innovation processes. It also includes the cross-cutting issue of sustainability, which is of utmost importance for the design of a socio-culturally, politically, economically and ecologically sensitive network – depicted in the pentagon in the middle of the illustration below.

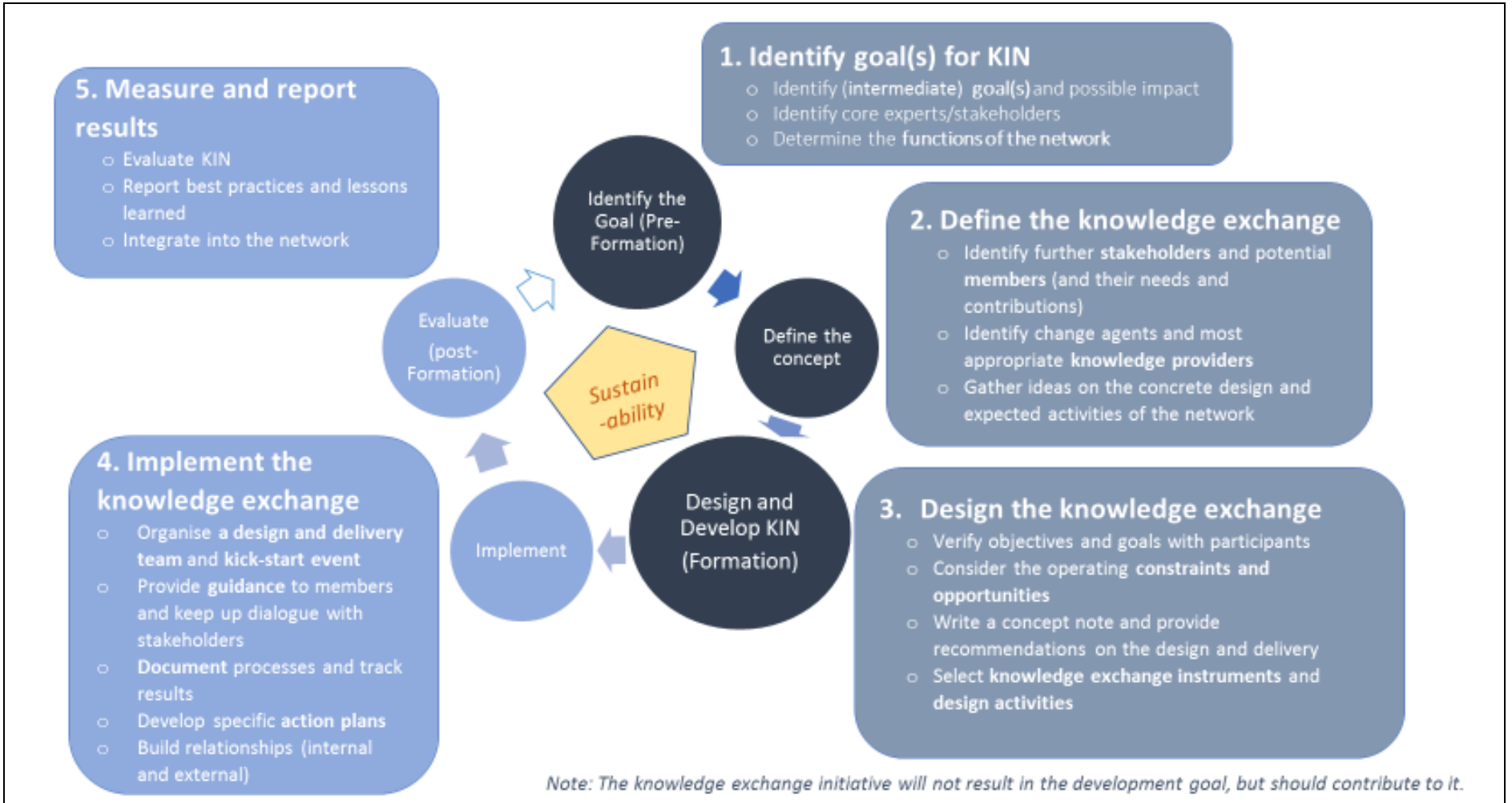


Figure 7: Illustration of the KIN Processes

Source: Own illustration, based on World Bank Approach (2015) combined with the Approach of Tanywa et al. (2011)

Figure 7 shows the five steps illustrating the ideal KIN development process, adapted to the actual research process of this study.

1. *Identify the Goals of the Network*

In the first step, different design options and conceptualisation ideas should be discussed among potential stakeholders. Here, core actors and relevant stakeholders have to be identified and interviewed for their perspectives and ideas on the goals of the initiative. Most importantly, potential intermediate goals and impacts of the network should be considered. This also includes the core functions the network should fulfil to serve the long-term goals. These can be the transfer of knowledge, the mobilisation of resources, lobby or advocacy work, or engagement in capacity development (Alff, Block and Causemann 2016). After defining the goals, further conceptual steps towards the design of the network can be taken.

2. *Define the Knowledge Exchange*

After potential goals have been discussed and identified, the second stage needs to determine what exactly the knowledge exchange should be about. Based on the previously identified core actors, a comprehensive stakeholder analysis has to be conducted to determine potential members of the network. With respect to the KIN this should be based on the AIV value chain and the stakeholder analysis conducted by Gevorgyan et al. (2015). Stakeholders need to be identified who are best suited to participate, have the ability to bring about the aspired change, and have an incentive to contribute. Hence, leading figures on the topic and/or experts in communication and facilitation have to be identified and engaged in the process as resource persons or consultants. These stakeholders must be interviewed regarding their ideas, needs and contributions to such a network. This includes their views on issue areas, administrative structure, membership, and internal and external communication and dissemination tools.

3. *Design the Knowledge Exchange*

The third conceptual step is then to design the network and its processes and tools according to the stakeholders' ideas. Here, some concrete recommendations can be derived from previous research that are then ideally validated and compiled into an actual concept note and action plan for implementation. This should include the network's goals, administrative and working structure, stakeholders and membership, suggestions on exchange and dissemination mechanisms (including communication strategy and networking activities), funding sources, and criteria for sustainability.

4. *Implement the Knowledge Exchange*

After having designed a comprehensive concept and having made some recommendations, the implementation phase begins. This usually starts with a kick-starter event and is closely monitored by a design and implementation team that provides guidance during the next steps. Participants and stakeholders have to be motivated, processes must be documented, and challenges and successes need to be communicated. Furthermore, the long-term process of formalising the network needs to be initiated (including decisions on legal registration, as well as on monitoring and evaluation measures).

5. Evaluation and Reporting Results

The effectiveness of the KIN has to be evaluated after a certain time frame to assess its implementation and results. By learning from best practices or failures of the initiative, the KIN can be adapted accordingly and serve as an example for other initiatives.

Following these five steps, the study develops recommendations for designing a network for AIVs that integrates different aspects of best practices and innovation platform exchanges. Only steps 1-3 were conducted in this study, since steps 4-5 represent later phases in the life of a network. Based on this theoretical review, the empirical data collection serves to fill in the concept with the actual expectations of relevant stakeholders in each case and provide recommendations on the design.

4.2 Empirical Methods

Given the inductive nature of this study, the research adopted an exploratory approach characterised by the adaptation of methods and the specification of the research objectives obtained from the ongoing data collection. Both qualitative and quantitative data was collected in a participatory and circular way. This means that interview guidelines and methods for the focus group discussions were continuously adapted. Furthermore, the collected data was verified by discussing the results with experts.

The research phase was divided into two main phases: a first phase in Germany and a second phase in Kenya and Tanzania. During these phases, literature review, semi-structured interviews, multi-stakeholder workshops and focus group discussions were conducted as the main methods. The study sites in Tanzania were chosen such that they have a similar climate to the HORTINLEA study

region. They are located in semi-arid and semi-humid regions and are characterised by small-scale farming and horticultural activities including the use of AIV innovations. Therefore, the results can to some extent be transferred to the Kenyan context.

During the first phase in Germany, semi-structured interviews with experts and stakeholders in the AIV innovation system were conducted (see Annex 3: List of Interviews). 20 experts were selected according to their affiliation with HORTINLEA or their specific knowledge of networks, AIVs or knowledge exchange.

During the second phase in Kenya and Tanzania, interviews with 27 further experts were conducted, selected by using snowball sampling. Eligible interviewees were those "whose testimony seem[ed] to be likely to develop and test emerging analytic ideas" (Hammersley and Atkinson 2007, 107). The interviewees who were regarded as "experts" either call themselves *expert* or are assigned the *expert* label by researchers (Meuser and Nagel 1994). The participants for the multi-stakeholder workshops were selected using the same approach.

The participants for the 15 focus group discussions and 60 farmer interviews, and the seven extension officers, were selected in cooperation with partner organisations in Kenya and Tanzania. The focus was on small-scale farmers active in AIV production or horticulture. In Kakamega in Kenya, the farmers and extension officers were selected by HORTINLEA consortium members. In Arusha in Tanzania, the farmers were selected by WorldVeg[7] researchers. In Chamwino and Kilosa in Tanzania, farmers were selected together with Trans-SEC consortium members. Trans-SEC, as a research project within the frame of GlobE, follows a similar approach to HORTINLEA (Chapter 4.1) and has already put horticultural innovations into practice (for more information on Trans-SEC see Annex 4.1 Trans-SEC). During one of the first workshops, two innovations from the Trans-SEC project were chosen that are of potential interest for HORTINLEA's research due to their similarity or potential transferability to the results of HORTINLEA projects (e.g. a focus on AIVs, similar technology, etc.). These innovations will be described in more detail in Chapter 5.1. Based on the innovations that were chosen, farmers who participated in the Trans-SEC innovation process for these two innovations were selected for the FGDs and individual interviews.

7 WorldVeg is a HORTINLEA partner also focusing on AIVs.

4.2.1 Data collection

Semi-structured interviews

114 individual interviews (see Annex 3: List of Interviews) were conducted with researchers from HORTINLEA, other research projects, and research centres and development organisations in Germany (20), Kenya (14), and Tanzania (13). Furthermore, 60 farmers in Tanzania and seven extension officers in Kenya and Tanzania were interviewed. The interviews were conducted in a semi-structured format (Gläser and Laudel 2004). For the expert interviews, a set of guiding questions covering all objectives was used, and for the farmer interviews a particular subset of questions (see Annex 4.2: List of Farmer Interviews). The interviewees were free to elaborate on the topic according to their preferences and interests. The interviews were conducted in German, English or Swahili, supported by local enumerators that were trained beforehand. Most of the interviews were recorded and transcribed, for some interviews memory logs were written based on notes taken during the interviews.

Focus group discussions

15 FGDs were conducted with farmers in five villages in Tanzania and in two villages in Kenya. During the first five FGDs in Tanzania, criteria for the adoption of innovations were collected, ranked and discussed with the farmers. The criteria were written on coloured cards in both English and Swahili. In the ten FGDs that followed, both in Tanzania and in Kenya, only the ten most important criteria from the first ranking were presented, ranked and discussed by the farmers (for core questions see Annex 4.3: Method and Questions for Ranking during FGDs). This was done in order to ensure the comparability of the results and to reduce the complexity of the ranking. Each group consisted of seven to eight farmers. The discussions were facilitated by local enumerators, supported by the SLE research team. The discussions were held in Swahili.

Individual ranking

As part of the individual interviews with the farmers, criteria for innovation adoption were ranked according to their assumed relative importance in a participatory exercise. In a first step, ten criteria were ranked regarding innovations in general as well as for the specific Trans-SEC innovation the interviewee used. These methods are explained in more detail in Chapter 5.1.

Multi-stakeholder Workshops

Four expert workshops were conducted: one in Germany with HORTINLEA consortium members, one in Tanzania with researchers from WorldVeg, one in Juja/Nairobi with experts on nutrition and health and a final workshop in Juja/Nairobi with HORTINLEA consortium members and previous interview partners. During the workshops, the study concept was presented and data was collected on specific topics by applying interactive exercises (e.g. poster sessions, thinking hat discussions and expert presentations).

HORTINLEA days

During the research phase in Germany, so-called HORTINLEA days were conducted in which meetings with project partners were organised. The main goal of these visits was to initiate an interdisciplinary integration process with HORTINLEA research results. During these meetings, the study concept as well as results from different HORTINLEA SPs were introduced and discussed with regard to their relevance for this study. Afterwards, HORTINLEA consortium members presented the results from their respective SPs and these results were discussed as well.

4.2.2 Data analysis

Primary data collected was both qualitative and quantitative. For the qualitative data, the records and notes from the semi-structured interviews and the FGDs were transcribed and coded using the software MaxQDA. All transcripts were coded following a code scheme modelled on the interview questionnaire and conceptual framework. To account for traceability and the intersubjectivity of the application of codes, most codes were given an explanatory memo. The results from the workshops (e.g. posters) were collected and archived. Whenever necessary, primary data was complemented with information from secondary literature, e.g. for socioeconomic data.

For the quantitative data collected during ranking in the FGDs and individual farmer interviews, the results were noted in lists and analysed using Microsoft Excel. The overall ranking of the criteria was set by calculating the average ranking from all interviews or FGDs. For the innovation-specific ranking, the total number of wooden sticks was calculated. If no stick was assigned to a criterion, this was calculated as zero; if a criterion was removed from the group it was given a value of minus two (-2). Afterwards, the criteria were ranked by adding up the assigned sticks.

5 Empirical Analysis

This chapter focuses on the analysis of the empirical data collected during the field phase in Germany, Kenya and Tanzania. As described above, the three different objectives focus on different gaps in knowledge exchange between the three main stakeholder groups of the AIV innovation system: policy, practice and research. Therefore, for each objective the data analysis results for the specific gap addressed will be outlined.

5.1 Local Innovation Process and Farmers' Adaption Criteria

This objective focuses on the knowledge gap between research and practice. The local innovation process is defined as the process of disseminating innovations and the knowledge about them – either from research to practice or within practice itself. The analysis of local innovation processes, along with the criteria that are important for a farmer to decide whether to adopt or reject an innovation, aims to close the gap between research and practice.

Achieving this objective involves analysing local innovation processes in the study region and identifying and ranking criteria that are important for farmers when deciding whether to use a potential innovation. Therefore, the focus of the analysis is on the dissemination of research results, which reach the farmer in the form of potential innovations.

The results that are outlined in this chapter are derived from the empirical data collected from FGDs and individual interviews with farmers, extension officers and other practitioners. Although most of the farmers interviewed were involved in Trans-SEC innovation processes, the analysis concerns agricultural innovations in general.

Case Study 1: Trans-SEC Innovations

In Tanzania, two innovations from Trans-SEC were chosen (as described in Chapter 4.2) and analysed in more depth. The aim was to analyse differences in innovation processes and criteria for the specific innovations and to derive recommendations for future similar innovations.

Production Innovation(s)

The production innovation is a combination of two different innovations: micro-dosing fertiliser and rainwater harvesting. This innovation focuses on the production site only (goal: increased production).

The innovation '*Fertilizer Micro-dosing for increasing yields under sole and intercropping systems for rural stakeholders*' focuses on the production of cereal crops. According to Tran-SEC, by applying N fertiliser localised in small doses of 25 percent of the recommended amount, the yield for maize and pearl millet can be doubled compared to the yield without fertiliser application. Adding the micro-dosing fertiliser increases the uptake and reduces the investment risk especially for resource-poor small-scale farmers. According to the Trans-SEC researchers, the costs of fertiliser can be reduced by more than 50 percent compared to normal fertiliser without adversely affecting crop yields or profitability. It increases production and therefore contributes to improving food security and increasing household income through the intensification of the production (Germer et al. 2016b).

Figure 8: Tied Ridges on a Field in the Trans-SEC Project Region

Source: Germer et al. (2016b)

Since the application of mineral fertiliser also increases the demand for soil moisture, in most cases micro-dosing fertiliser was combined with another innovation: the '*Rainwater harvesting for improving smallholder farmer's sole and intercrop yields under a rain-fed farming system*'. Building tied ridges, rainwater-harvesting and thus soil moisture can be increased. This is especially important for the semi-arid region of the Chamwino district (Germer et al. 2016b).

According to Trans-SEC experts, the application of micro-doses of fertiliser is labour-intensive since the fertiliser needs to be placed by hand and not too close to the seeds. Furthermore, misconceptions on mineral fertiliser impede its promotion. In Ilolo especially, myths surrounding mineral fertilisers exist since it is often considered harmful to the soil. Furthermore, the access to fertiliser in rural regions is limited. As described above, the need for more irrigation is also an important factor that was partly solved by combining the micro-dosing fertiliser innovation with tied ridges (Germer et al. 2016b).

The following section summarises the results from the analysis of the *production innovation* from the farmers' perspective:

(Assumed) Benefits of the Innovation

- Increased agricultural production (FI_Tan_20, 28, 45)
- Intensified production due to higher yields on small pieces of land (FI_Tan_7, 32)
- Increased food security (FI_Tan_3, 11, 35)
- Increased household income through occasional sales (FI_Tan_34, 37, 48)
- Increased water/moisture-keeping (FI_Tan_3, 36, 48)

(Assumed) Challenges Regarding the Innovation and its Adoption

- Time-consuming (preparation of the tied ridges) (FI_Tan_30, 44)
- Labour-intense (preparation of the tied ridges) (FI_Tan_45)
- Land infertility through long-term furrowing (FI_Tan_25)
- Yield loss due to pests and insect infestation (FI_Tan_32)
- Low rainfall and water availability (FI_Tan_18, 19, 32).

Production/Social Innovation

The Trans-SEC innovation '*Household centered nutrition training and kitchen gardens of green leafy vegetables for improved dietary diversity and family health*' focuses on improving the nutritional status of the rural population. It takes the production site (goal: increasing production) as well as social components into account since it encompasses nutritional training as well (goal: improved nutrition) (Lambert et al. 2016).

In a base-line study conducted by Trans-SEC in the four villages where the innovation was implemented, the nutritional needs of the population were assessed. Based on the results, Trans-SEC experts developed nutritional training material and provided training. In order to enable the participants to improve their nutrition, kitchen gardens were introduced. According to Trans-SEC, growing vegetables in pocket bags leads to lower demand for irrigation compared to conventional ground gardens. The bags can be placed at the doorstep and need to be irrigated (Lambert et al. 2016).

However, for most of the households in the study region, water sources are located far away and water is expensive, which affects the weekly watering of the gardens (Lambert et al. 2016). The vegetables recommended for the kitchen gardens are among others Chinese cabbage, spinach, collard greens, Swiss chard, amaranth, sweet potato leaves, pumpkin leaves, and African eggplants.

Figure 9: The Kitchen Garden Innovation in Ilakala (with and without a net for protection)

Photo: S. Marahrens

The following section summarises the results from the analysis of the *kitchen garden innovation* from the farmers' perspective:

(Assumed) Benefits of the Innovation

- Increased agricultural production (FI_Tan_20, 28, 45)
- Intensified production due to higher yields on small pieces of land (FI_Tan_7, 32)
- Increased food security (FI_Tan_3, 11, 35)
- Increased household income through occasional sales (FI_Tan_34, 37, 48)
- Increased water/moisture-keeping (FI_Tan_3, 36, 48)

(Assumed) Challenges Regarding the Innovation and its Adoption

- Time-consuming (preparation of th tied ridges) (FI_Tan_30, 44)
- Labour-intense (preparation of the tied ridges) (FI_Tan_45)
- Land infertility through long-term furrowing (FI_Tan_25)
- Yield loss due to pests and insect infestation (FI_Tan_32)
- Low rainfall and water availability (FI_Tan_18, 19, 32).

5.1.1 Local Innovation Processes

One of the most important aspects of the local innovation process is the introduction of an innovation to the farmer. It is the crucial step for knowledge exchange and dissemination of ideas. However, this step is also one of the most challenging ones since different actors have to be involved.

Innovations can be introduced to farmers using one of two main strategies: either they are 'brought' to the farmers by researchers or development practitioners (innovation brokers), or they are introduced by fellow farmers (farmer to farmer exchange). However, it is important to notice that these are not closed processes that can be clearly separated from each other. Once an innovation has been introduced by researchers, it can be disseminated from farmer to farmer as well.

Innovations Introduced by Innovation Brokers

Local innovation processes where innovations are introduced by innovation brokers usually follow a rather structured course in the regions where the research was conducted. The main actors involved in this process are village leaders and extension officers (Info Box 5: Role of Extension Officers). These actors play a crucial role in the introduction of innovations since they have profound knowledge about both village-specific processes as well as technical knowledge about agricultural practices (Exp_Ger_9; FI_Tan_42, 55). If researchers or development practitioners aim to test or introduce innovations in a village, consulting these actors is a very important first step. The village leaders can promote the innovation process, providing information on whom to involve in the dissemination of the innovation and communicating with the farmers. Following these steps is not only important for reaching farmers but it is also a necessary step in order to build trust between external actors as well as farmers and village leaders (FI_Tan_59). This approach can contribute to sensitising village leaders to specific issues, which can help in the further process to sensitise farmers as well (Exp_Tan_6; FI_Tan_25). The whole introduction process needs to be transparent. The innovation brokers have to explain exactly what will be disseminated in order not to induce false expectations by farmers.

Researchers can play a crucial role in introducing innovations to farmers. Researchers and other external experts have a good reputation among farmers, especially in Tanzania, and farmers' trust in the innovation is greater if it is directly introduced by the researchers, supported by village leaders and extension officers (FI_Tan_34, 41, 46).

In contrast, the role of foreign experts is highly disputed. On the one hand, they have a good reputation as being knowledgeable; on the other hand, they are often regarded as not being familiar with the local circumstances (EO_Tan_2; FI_Tan_55). Therefore, the combination and collaboration of experts from a neighbouring community with local and foreign experts can be advantageous (EO_Tan_1; FI_Tan_44).

Info Box 5: Role of Extension Officers

In the project regions, there are different types of extension officers. Governmental extension officers provide services in all regions. They are mainly linking actors between the government (policy), research, and farmers (practice). It is important to distinguish between governmental extension officers and project extension officers (Exp_Tan_7). The extension officers in the study region in Tanzania are employed by the Trans-SEC project and keep very close contact with the farmers. They do not act as direct linking actors between policy and practice – this is facilitated by the project in which they are employed. The extension officers visit the farmers regularly without being approached by them beforehand and are individually responsible for fewer farmers. Governmental extension officers who play an important role in the Kakamega region in Kenya are sometimes responsible for more than 5,000 households (EO_Ken_1) and therefore have less regular contact with farmers, mostly when farmers take the initiative and contact their extension officer.

In the Tanzanian study region, project extension officers play a crucial role in knowledge dissemination and in innovation processes. They are the main source of information for the farmers and have a very good reputation among them due to their education in agriculture (Exp_Ger_9; FI_Tan_42, 55). Most of the farmers trust them more than their fellow farmers regarding the quality of information they provide. Therefore, farmers approach extension officers first if they face challenges and they also contact them if they want to try something new. Furthermore, even if farmers adopt an innovation introduced by researchers or neighbours, they will often ask the extension officer for his or her opinion or recommendation.

Involving extension officers in the innovation process can be of great value since they are able to give advice on the adoptability of the innovation. Since they often have a good reputation, they might be more cautious about supporting the introduction of innovations that could fail and damage their reputation as a result (Exp_Tan_2).

Furthermore, extension officers can act as 'translators' for the experts, bringing information and knowledge to the farmers in a way that they understand (Exp_Tan_8). However, they can also play an important role in communicating farmers' problems, challenges and needs to the researchers since most farmers do not have the chance to contact experts directly (Exp_Tan_8). Additionally, extension officers often have contact with other villages and other extension officers, which helps them to gain knowledge about processes in other villages (EO_Tan_4).

One problem is that some extension officers work as both governmental and project extension officers at the same time, which makes it difficult to be sure of their role. This is because as project extension officers they also sometimes play a role in project monitoring and not only in providing knowledge to the farmers. This can lead to an unclear status and influence the level of trust in the extension officer. This is especially the case in some research projects in Tanzania (Exp_Tan_7). Therefore, the role of the extension officer has to be clearly defined in order for farmers to know what they can expect from them and what consequences emerge from farmers' cooperation with the extension services.

Another problem that was mentioned is governmental extension officers requesting extra payment from farmers. This places an extra barrier discouraging farmers from asking for support.

Training for extension officers is also an important aspect since governmental extension officers especially often depend on the knowledge they gained during their education. Since agricultural practices change continuously, keeping them updated is very important. However, it was also mentioned that extension officers get knowledge from sources that are available to everyone, for example from the internet (EO_Ken_1). Therefore, one important aspect is the development of training manuals, which are described in more detail in Chapter 5.2.

The Introduction of an Innovation - Dissemination Process

Introducing an innovation to farmers can be done in different ways. However, the first step is the sensitisation of farmers as described above. Farmers have to know exactly what they can expect in order to prevent frustration and manage expectations.

As mentioned mostly by researchers, one way is to first approach only some farmers who are especially keen to try out new things or farmers who can act as a role model for other farmers (Exp_Ger_9, 14). These early adopters, who can often be identified by village leaders or extension officers, can then act as innovation brokers for other farmers (EO_Tan_3). This process has often been described by researchers as the most efficient method of dissemination, since the rate of adoption is very high. This is especially important if the innovation is introduced at an early stage of development and the results from the practical implementation need to be examined for further changes and improvement. However, this approach has also been criticised, especially by farmers, since it excludes large parts of the village and favours some farmers over others (FI_Tan_46, 56). Furthermore, this process depends very much on the dissemination capacity of the early adopters (Gevorgyan et al. 2015).

Another way of introducing an innovation is to address and include as many farmers as possible, ensuring an open process of introduction in which representatives from all groups in the village can participate (FI_Tan_29). For this process, the expertise of the village leaders and extension officers is also crucial in order to inform farmers about the introduction of an innovation. Village leaders can organise meetings with farmers to provide them with information on the innovation and the introduction process. Extending the initial introduction to additional farmers who may not all be as innovation-friendly increases the risk of rejection, but on the other hand it makes it easier for those farmers to adopt the innovation because they receive the information directly from the experts. Most farmers prefer this process since they can be part of the innovation process from a very early stage, get all information directly from the experts and, based on this information, decide whether to adopt or reject a certain innovation (FI_Tan_25, 55). Furthermore, this approach reduces the inequality between farmers, as quality information is not limited to only a few farmers. This decreases the risk of nepotism. Choosing only a few innovation-friendly farmers can result in conflict since others feel disadvantaged. Integrating all farmers increases the transparency of the process.

Training

After selecting farmers for the introduction of an innovation, training is a crucial aspect. It is a method of face-to-face knowledge exchange and information transfer (Gevorgyan et al. 2015). Training serves various goals:

- It provides farmers with information on the correct use of the innovation (EO_Tan_2)
- It can show the benefits of using the innovation (EO_Tan_4)
- It can be a way to sensitise farmers to certain topics, for example the importance of sustainability (Exp_Tan_8)
- It can give farmers the opportunity to show their success and knowledge gained to other farmers and therefore provide an opportunity for farmer to farmer dissemination. This can increase farmers' motivation to participate in innovation processes (FGD_Ken_4)
- It can increase trust (Exp_Tan_6).

Farmers mentioned training as the starting point to adopt an innovation. They said "given training firstly and each and everything will be good." (FI_Tan_31). It is the only way to get enough knowledge about the benefits they can get from adopting an innovation in the future. Furthermore, training enables farmers to use the innovation once the support from the researchers or development project has ended (FI_Tan_56). There are different forms of training (Exp_Tan_6, 10).

A common training method is a *field day* (see Gevorgyan et al. 2015). During a field day, the use of an innovation is shown to farmers on a demonstration plot and, as previously described, farmers can also show their own innovations to other farmers and researchers. These plots can either be located within the villages or at research centres. Having the plot in the village increases its accessibility for all farmers, since it is quicker and cheaper to visit (Exp_Tan_6, 8). However, establishing a demonstration plot in a village can be challenging. First, it can be difficult to find a plot since arable land is often scarce, and farmers may be reluctant to give up parts of their fields for demonstrations. Second, as mentioned by researchers, control over the demonstration plot is not ensured, since farmers may apply changes to the innovation or the field without prior consultation with the experts. This might result in a failed demonstration (Exp_Ger_9). Field days are usually short demonstrations in which the results of an innovation are shown but not the whole process of applying it in the long run. On the one hand, this approach saves time for the farmer. It also allows farmers to directly observe the results, which is important since for the farmers "seeing is believing" (Exp_Tan_6).

On the other hand, it is very difficult to oversee the whole process of putting the innovation into practice.

This is only possible using another form of training: *farmer field schools.* These include farmers from the very first stage of applying an innovation and integrate them into the whole process. They can also help to increase the number of adopters by not only showing the advantages and benefits farmers can get from the innovation but also by showing challenges and how to overcome them. This is very time- and labour-intensive but letting the farmers also benefit from the yield can increase their willingness to participate (Exp_Tan_6). However, due to the amount of time and labour involved, usually only a small group of farmers can be included. This group can then act as role models for other farmers.

The integration of farmers into the innovation development process / follow-up

For farmers, their integration during the development of the innovation is a crucial aspect (FI_Tan_48, 55, 57). Only very few farmers prefer to be introduced to a ready for use innovation where they were not able to provide their own ideas and knowledge (FI_Tan_6, 39). The main arguments of the farmers who preferred the introduction of completely developed innovations were that it is time-saving as well as that experts are very knowledgeable. Most of the farmers prefer to be included in the process of developing an innovation at a very early stage. This enables them to integrate their needs and give recommendations on the adoptability of the innovation and ensures circular knowledge exchange (EO_Tan_3). Furthermore, by being part of the development of the innovation, farmers gain more knowledge about it, which will help them solve problems or challenges they face in the process of using and adopting the innovation.

However, integrating farmers into the development process of an innovation means also providing more information on an innovation's social and cultural preconditions. In the Tanzanian study region, many farmers had already been disappointed by the earlier introduction of an innovation by a particular development project. They mentioned that "since the project, people have been afraid of joining any other project [...] due to the disappointment they faced." (FI_Tan_42). Such disappointments can render the introduction of an innovation in the future much more challenging, since a basis of trust may be lacking for future projects (Exp_Tan_7; FI_Tan_33). Furthermore, innovations always contain culture-specific ideas that have to be translated into other cultural contexts.

Farmers want a close follow-up process once an innovation has been introduced (FI_Tan_38). If farmers face challenges in the application of the innovation, they need a reliable contact person who can give them information on

how to solve the problem. Even though the extension officer is the contact person in most cases, farmers often mentioned that follow-ups by the experts are also important for building trust between farmers and experts. It also helps farmers to know whether they are on the right track or if they should change the way they are using the innovation (FI_Tan_37). A close follow-up process can reduce the number of rejected innovations. Rejection can, for example, occur due to fluctuations in the seasons. If there is not enough rainfall in one year, the risk of rejecting an innovation increases if no follow-up is provided by the researchers. In the case of Trans-SEC, this happened during the introduction of the *production innovation*, which led to decreased yields during a dry season. Due to these experiences, Tran-SEC introduced the rainwater harvesting component and integrated it into the *production innovation* (for more detail see Case Study 2 below).

However, follow-ups are not only important if farmers face challenges, they can also provide motivation for the farmers to show innovation brokers and fellow farmers the success they had using the innovation (FI_Tan_35). Generally, follow-ups can improve the communication and collaboration between innovation brokers and farmers.

Case Study 2: Trans-SEC Dissemination and Innovation Processes

The local innovation process Trans-SEC applies in order to disseminate innovations and to approach farmers can be broken down into several main steps that are generally applied, as described by farmers and extension officers. However, slight differences exist according to the innovation introduced or the specific regions.

Generally, the local innovation process of Trans-SEC follows eight steps:

1. **First contact** – Trans-SEC approaches village leaders and extension officers to inform them about the project and create commitment.
2. **Selection of participants** – Local leaders select farmers and inform them that visitors will come and conduct interviews with them.
3. **Data collection** – Interviews with farmers are conducted at the farmers' homesteads.
4. **Training** – Innovations are presented and explained to the selected farmers during a meeting.
5. **Formation of innovation groups** – Farmers chose which innovations they are interested in and form innovation groups with fellow farmers.
6. **Practical training on site** – Innovations are implemented on one or several farms on demonstration plots or "shamba mamas" (mother plots). Depending on the innovation, additional practical training is provided.
7. **Individual implementation** – Farmers implement the innovation individually.
8. **Follow-ups** – Follow-up visits on-site and meetings take place.

Farmer to Farmer Exchange

As well as having innovation brokers introduce innovations, another important route to adoption is by peer example, farmers seeing or hearing of other farmers using an innovation (Exp_Ken_3; FI_Tan_24, 37). Even though most farmers mentioned the extension officer and researchers as the main source for new tools and technologies, many farmers also adopted innovations learned from their neighbours or family members. This happens mostly if farmers face challenges or see that the changes others have made result in higher yields or other benefits.

Info Box 6: Social Innovation – Formation of Innovation-specific Farmer Groups by Trans-SEC

As shown in the Case Study 2, an important aspect of dissemination was the formation of innovation-specific groups. In these groups, farmers were trained on the same or a similar innovation. This not only helped in providing target-group-specific trainings but also created a new kind of network between farmers. Even those farmers who did not usually work with one another were brought together (FI_Tan_32). These group meetings turned into more, as some farmers started to sell their products together and supported each other in case of financial problems (FI_Tan_12). Forming the groups also increased the capacity of the farmers to solve problems without external assistance (FI_Tan_18). By having these groups in a village, farmers who did not participate in the Trans-SEC trainings knew who to approach if they wanted to try the innovation or get information on it after the experts left (FI_Tan_59).

The farmer to farmer innovation process is also a very important aspect if only some farmers are selected in the process of introducing innovations through innovation brokers. If this is the case, whether other farmers will approach them for help or information very much depends on the farmers' performance and the results they achieve with the innovation. Therefore, it is also crucial to facilitate good knowledge exchange between early adopters and other farmers, for example through village meetings.

However, even though farmer to farmer knowledge exchange can be cost-efficient and fast, it cannot be guaranteed that farmers get all necessary information on how to apply the innovation. To ensure this, training needs to be provided to all farmers (Exp_Ken_3). By educating farmers as trainers (Training-of-Trainers), the quality of information spread among farmers through farmer to farmer exchange can be improved (Exp_Tan_8).

Info Box 7: Farmer's Story – From Hand Ploughs to Tractors

We saw other farmers ploughing using oxen, tractors and the produces were different from those using hoes [so] we decided to use oxen. (FI_Tan_37)

The most frequently mentioned innovation introduced to many farmers in the research regions is the use of oxen or tractors for ploughing. This innovation was not introduced by a research or development project but by fellow farmers. Most farmers mentioned that they saw increased yields and improved time efficiency at other farmers' fields and therefore decided to do the same (FI_Tan_19). Since the information was given from farmer to farmer, it is difficult to determine where it came from in the first place, but it was mentioned that an extension officer from another region and farmers who visited other villages brought it and taught other farmers (FI_Tan_27, 44, 49).

However, even though the new tool increased farmers' yields and decreased labour intensity, many farmers stopped using it after only a few seasons. The reason is a lack of capital, because the tractor or oxen have to be rented from other farmers (FI_Tan_6). Nevertheless, some farmers mentioned that they will use these tools again if they can afford to. Therefore, even though the tools are not used anymore by many farmers, it can be seen as a successful introduction of a potential innovation via farmer to farmer exchange.

Figure 10: Hand Ploughing

Photo: J. Legelli

5.1.2 Criteria for Adoption

The adoption or rejection of innovations is based on different criteria. These criteria are taken into account by each farmer individually when making a decision. For that reason, in a first step, farmers' criteria were collected during focus group discussions and individual interviews with farmers. In a second step, farmers were asked to rank the criteria according to their importance.

The criteria that were collected during the first phase of the research (Chapter 4), during workshops with researchers and focus group discussions with farmers, can be divided into two main categories. First, criteria that are related to the process of knowledge/innovation dissemination (process criteria) and second, criteria that refer to the characteristics of an innovation (innovation criteria). Both categories have to be taken into account but at different stages of the innovation process. Figure 11 displays them in the entire innovation process.

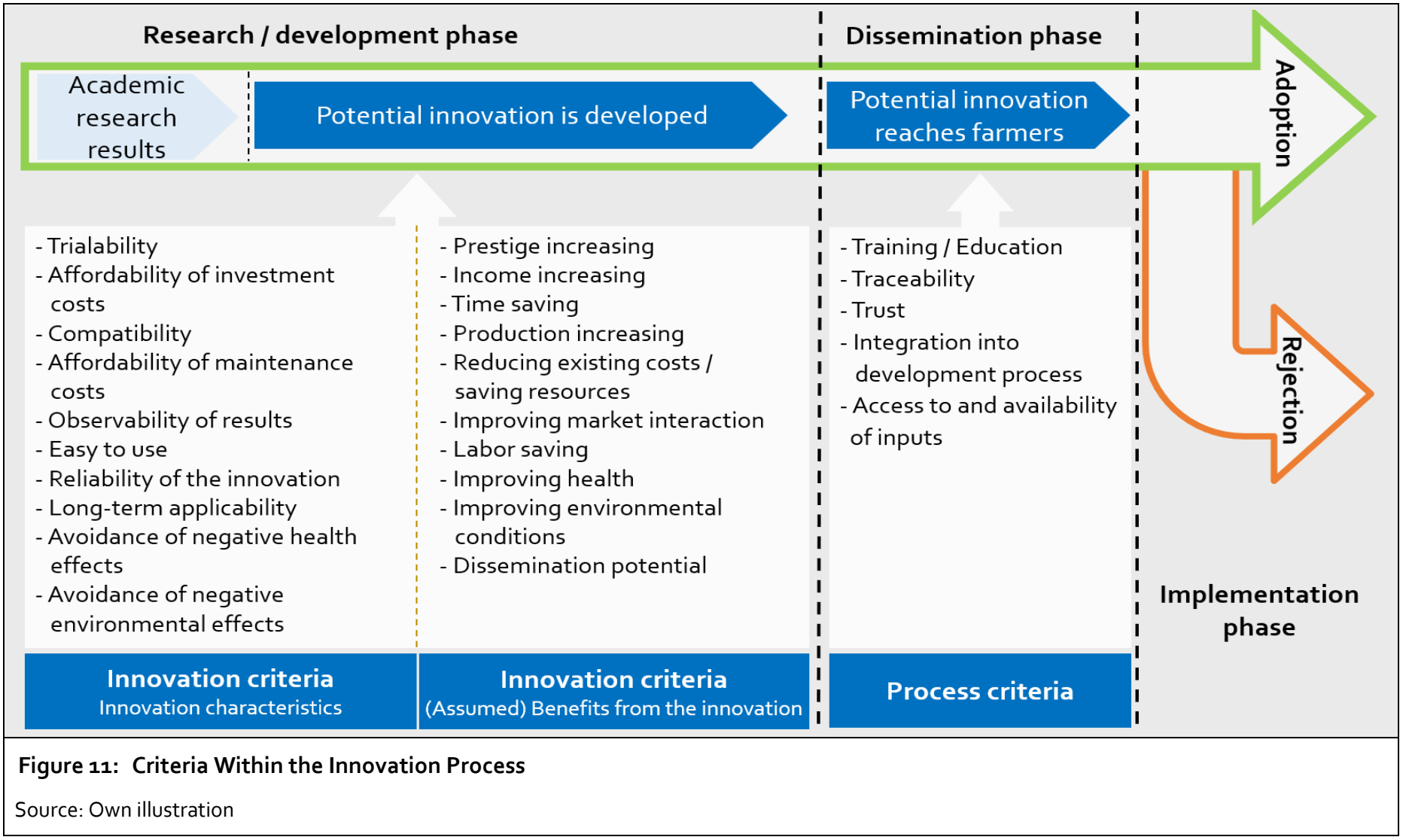


Figure 11: Criteria Within the Innovation Process

Source: Own illustration

A. Innovation Criteria

Looking at a specific innovation, there are criteria that are important for the farmers in order to decide whether they will adopt the specific innovation or not. These criteria are independent of the way the innovation is introduced to the farmers (the process criteria). The innovation criteria refer to the *characteristics of an innovation* or the *assumed benefits or outcomes* the farmer expects from the use of the innovation.

Innovation Characteristics

Trialability

> *"If you receive something, you must try first."* (FGD_Tan_9)

Before adopting an innovation, farmers usually test it to compare the new tool, technology or practice with the one currently used (FI_Tan_46). Therefore, if an innovation is easy to try the first time, for example because of a simple technical facilitation, or if it easily understood or has low trialability costs, a farmer's motivation to try, or to retry after failure, is greater (FGD_Tan_4, 5, 8).

Affordability of Investment Costs

The calculation of whether investment and running costs are covered by the potential financial surplus obtained through the application of an innovation is crucial (FGD_Tan_6) but often difficult for farmers to conduct/assess (FI_Tan_3). Lack of financial capital or access to financial capital in order to afford innovations is often one of the key obstacles preventing famers from changing current practices (FI_Tan_3, 14, 19). However, short-term investments (such as hiring a tractor or cow for ploughing) are common if financial means are available (e.g. through loans (FI_Tan_9, 15, 16)).

> *"If I am not able to afford it [the innovation], there will be nothing."* (FGD_Tan_5)

Affordability of investment costs is an exclusion criterion for farmers. If farmers are not able to cover the investment costs (e.g. through savings, loans or co-funding) they will reject an innovation (FGD_Tan_5; FI_Tan_24).

Compatibility

The compatibility of an innovation refers to at least three dimensions and puts an innovation in the wider context in which it emerges:

> *"It is difficult to do an innovation which my surrounding environment doesn't agree with."* (FGD_Tan_5)

Social and cultural compatibility addresses the local, social, cultural, religious and traditional environment. An innovation which fits these dimensions has higher chances of being accepted than an innovation which interferes with them (FGD_Tan_5; EO_Tan_2). For some farmers the decision about whether to try something new is also based on the potential reactions of the neighbourhood to the innovation. If an innovation might worsen relationships with neighbours, the chance of adoption decreases and vice versa: for some farmers the chance of adoption increases if neighbours benefit from the innovation as well (FGD_Tan_4).

Household labour and production compatibility refers to the idea that an innovation is more applicable for farmers if it builds on a practice/tool, standard production habit or household production system which already exists and is accepted in a certain context. If so, it can be more easily integrated (FI-Tan_26; Exp_Ger_1; Exp_Tan_7).

Time and harvest calendar compatibility addresses the compatibility of a new practice or tool with the household's harvest calendar. The chance of adoption increases if the innovation is introduced at a time compatible with the household's harvest calendar and if it takes the local and regional seasonal conditions into account (FI_Tan_7, 31).

Affordability of Maintenance Costs

> *"I just leave it [the innovation], if I do not have the money." (FI_Tan_24)*

The potential maintenance costs of an innovation and investment costs are closely related to one another. A lack of financial means or access to capital is one of the main factors famers take into account when trying/adopting an innovation (FGD_Tan_3; FI_Tan_21, 24). For instance, due to a lack of capital, a common practice in the research areas is that farmers divide their plots into several areas. On some parts they practice "local farming" (low running costs), on other parts they practice "modern farming" (higher running costs) e.g. by using non-organic fertiliser. If financial means are available, the areas for finance-intensive farming are occasionally enlarged in order to increase agricultural production (FI_Tan_17).

Observability of Results

> *"I will compare the produce of the innovation with my produce."* (FGD_Tan_4)

If improvements or changes as a result of the innovation are easily observable in comparison to the current practices and tools, there is a greater chance that an innovation will be tried/applied (FI_Tan_35, 46, 49). It is crucial for the farmer to see how, if and to what extent changes occur (FI_Tan_35, 42, 59). Comparative observability plays an essential role in influencing the threshold to either try (*Trialability*) or adopt an innovation in the long run.

Easy to Use

> *"They [farmers] perceive that the work [related to the innovation] is complicated, hence they don't do it."* (FI_Tan_54)

Whether an innovation is easy to use and which potential challenges might emerge are further important criteria for farmers to consider when adopting or rejecting an innovation (FI_Tan_1, 54; Exp_Ger_14). It should be easy not only to adopt an innovation but also to use it in the long run. This is closely linked to *Trialability*, but goes a step further since, especially for technical innovations, the need for maintenance can make them complicated to use in the long run.

Reliability of the Innovation

> *"I always try first. If it (new practice or tool) goes well, I continue, but if it goes wrong I leave it."* (FI_Tan_34)

Innovations which are disseminated need to work. For some farmers the motivation to try the same innovation a second or third time after initial failure is rather low. Whether the failure is due to the innovation itself (FGD_Ken_2) or due to other circumstances e.g. weather conditions (FI_Tan_46) does not necessarily play a crucial role. An innovation's proven reliability is closely linked to *Trust*.

Long-term Applicability

> *"I like to use innovations which can stay long."* (FI_Tan_34)

Whether farmers consider an innovation applicable or not in the long run plays an important role (EO_Tan_1; Exp_Ger_7). Farmers are more inclined to invest (with time and other resources) in the adoption of an innovation if they can use it in the long term.

Avoidance of Negative Health Effects

"If I want to do something new, first I think if it affects my health." (FI_Tan_28)

Avoidance of negative health effects refers to the fact that an innovation should generally not cause a farmer's health to deteriorate (FGD_Tan_3; FI_Tan_16, 28). Negative health impacts can be an exclusion criterion for adopting an innovation (FGD_Tan_2).

Avoidance of Negative Environmental Effects

"No innovation will be a success if it is introduced in an ecologically unstable environment or that itself results to ecological disruption." (FI_Tan_36)

For some farmers avoiding negative environmental effects is an important factor, for example, the adoption or rejection of new fertiliser due to assumed positive or negative effects on long-term soil fertility (FI_Tan_25, 31, 39). Farmers are less inclined to adopt an innovation if it (allegedly) harms the environment. Beyond that, a healthy environment is often deemed a prerequisite for considering and adopting innovations (FI_Tan_35, 36, 58).

(Assumed) Benefits from the Innovation

Prestige Increasing

"People can admire me, if I can practice this innovation." (FGD_Tan_5)

People who have adopted innovations may be admired by fellow farmers since they become the experts and opinion leaders for a certain innovation (FGD_Tan_5). New practices can also bring prestige in the form of increased production or income (FGD_Ken_1; FGD_Tan_9). Prestige is seen as an effect of adopting an innovation, but not always as a reason to do so. Admiration, however, can provide motivation to copy an innovation (FI_Tan_29, 55, 59).

Time Saving

"Time is the greatest treasure in production." (FGD_Tan_7)

Innovations which reduce the time needed for a certain activity have a higher chance of being considered than innovations which are time intensive (FGD_Tan_3; FI_Tan_37, 48). Time-saving innovations can also allow farmers to reduce the time spent far away from the homestead (e.g. for collecting firewood or gathering water) (FGD_Tan_4; FI_Tan_4, 13).

Income Increasing

> *"If I produce more, I get (more) money, which helps me to overcome the challenges I face."* (FI_Tan_48)

Increasing income is one of the most important motivating factors for farmers to change current practices (FGD_Tan_9; FI_Tan_37, 41), though it is often regarded as a consequence of the other benefits that an innovation can bring (FGD_Tan_5, 6). For example, increasing production is often seen as a requirement for increasing income (FI_Tan_14, 34, 48). However, it can be difficult for farmers to estimate whether an innovation does in fact increase household income (FI_Tan_3).

Production Increasing

> *"I will think on the production. If the innovation will make me to produce more, then I will adopt the innovation."* (FGD_Tan_6)

Among the most discussed criteria was increasing production. Increased agricultural production can be derived either from an *intensification of production* or from an *extensification of production.* An intensification refers to increases in agricultural outputs given a specific input (e.g. a certain unit of land) (FI_Tan_5, 31), for instance through an increase in annual harvest periods due to an innovation. An extensification refers to an enlargement of plots being cultivated due to an innovation (FI_Tan_21, 44, 48). Increasing a household's agricultural produce (quality and quantity) mainly serves two purposes: to improve the household's food security through an increased availability/accessibility of foodstuffs for a household's own consumption (FI_Tan_41, 42, 56), or to increase a household's income through increased sales of produce (FI_Tan_10, 34, 48).

Reducing Existing Costs/Saving Resources

> *"The innovation has helped me to reduce the budget [of the household]." (FI_Tan_55)*

Innovations which reduce running costs (e.g. on foodstuffs) and save resources in a farmer household increase famers' motivation to try an innovation (FI_Tan_21, 55, 59). The money saved is then used for household expenditures or for investments.

Improving Market Interaction

Improved market accessibility, availability and stability as well as market information can be a motivating factor for farmers to change current practices. The improvement of market interaction refers to at least four dimensions:

> *"You cannot sell without market." (FI_Tan_28)*

- *Market accessibility* refers to the limited (e.g. physical) access to markets to sell produce as well as to the challenges of attracting new customers beyond the village market (FI_Tan_34). Many farmers seem to depend heavily on local markets for selling their produce and for purchasing inputs such as seeds or fertiliser.
- *Market availability* refers to a (perceived) limited customer base at the local market and to a lack of networks to other markets (FGD_Tan_4; FI_Tan_8, 39).
- *Market stability* refers to the stability of prices and demand and the perception of some farmers that prices (FGD_Tan_2, 5) are determined by the customers rather than the vendors (FGD_Tan_2; FI_Tan_5, 39) due to a lack of customers at the local markets (FI_Tan_39).
- *Market information* refers to knowledge and information about prices at markets (FI_Tan_34).

Labour Saving

Innovations which reduce farmer labour for a certain practice can have a higher chance of being considered than innovations which are more labour intensive (FGD_Tan_8; FI_Tan_15; Exp_Ger_10). Reduced labour expenditure refers to:

> *"[The innovation] has simplified the work." (FI_Tan_15)*

- A reduced number of activities
- A reduced frequency of activities
- A reduced effort for an activity
- No longer needing to carry out an activity
- A reduced time investment (time-saving).

Improving Health

> *"I joined the nutrition and kitchen garden knowing that I will get good food and healthier life." (FI_Tan_21)*

Improved health refers to the positive impact of an innovation on an individual's or household's well-being. In this research, nutrition security (e.g.

more balanced or healthier dietary intake) (FI_Tan_21, 55, 57) and food security are closely related to this criterion.

Improving Environmental Conditions

"*[We had]* the idea of planting trees in farms that will attract rainfall." (FI_Tan_41)

This criterion refers to the improvement of ecological sustainability. Farmers are more inclined to adopt an innovation if it improves environmental conditions, for instance by improving soil fertility. This is closely linked to the criterion *Avoidance of Negative Environmental Effect*s, but goes further by also considering positive effects.

Dissemination Potential

"*Due to the innovation, now I am like half a teacher.*" (FI_Tan_3)

The dissemination potential of an innovation refers to the possibility of farmer to farmer exchange. This criterion is closely linked to whether an innovation is easy to understand (*Trialability*) and also to the criterion *Prestige Increasing* since being able to disseminate can also mean increasing a farmer's prestige (FI_Tan_4). Therefore, farmers also take into consideration whether it is easy for them to teach others (e.g. family members) an innovation (FI_Tan_13).

B. Process Criteria

During the innovation process, many factors can influence the success or failure of dissemination. For the farmers, the way an innovation is introduced and brought to them is very important. These criteria are relevant for the success of the innovation process and have to be reflected in specific steps of the innovation process.

Training/Education

"*Good farming comes with receiving training.*" (FI_Tan_3)

As described in the preceding analysis, training plays an important role in the entire innovation process. Among the most discussed criteria farmers take into account when considering adopting an innovation is *Training/Education*. Training regarding the innovation increases farmer motivation (FI_Tan_6, 23, 57) and confidence (FGD_Tan_5) and reduces the fear of trying a new practice or tool (FGD_Tan_4). It increases farmers' ability to understand the innovation and its potential benefits, and to deal with challenges that arise individually (EO_Tan_4; FI_Tan_3).

Traceability

Traceability refers to the fact of having a person or organisation farmers can address in case they have questions or problems, which occur during the adoption or long-term use of an innovation (FGD_TAN_5, 7; FI_TAN_35). Furthermore, it is important for farmers to know who is legally responsible in case problems occur with the innovation (FGD_Ken_2).

> *"I will not be afraid to join the innovation since there is someone to consult on whatever challenge I face."* (FGD_Tan_4)

The availability of a contact person (e.g. local extension officers, external experts or fellow farmers) can increase farmers' motivation to try an innovation since it decreases the risk of failing and therefore increases the chance of long-term adoption (FI_Tan_18, 24). The opportunity for farmers to contact an expert who is familiar with the innovation also has an influence on the level of trust in the innovations or the innovation brokers.

Trust

> *"Without trust you cannot do anything."* (FGD_Tan_9)

Trust refers to the relationship between farmers and innovation brokers such as extension services, NGOs as well as facilitators and other farmers (FI_Tan_55; EO_Tan_3; Exp_Ger_13). Farmers have repeatedly reported that in the past, innovations brought from external NGOs had negative effects and that promises made by innovation brokers were not kept (FGD_Ken_2; FI_Tan_6; 32). As a consequence, trust in innovation brokers was eroded (FGD_Tan_9) – (assumed) hidden agendas of innovation brokers, especially those from abroad, can play a major role in farmers' decisions (EO_Tan_3).

The relationship between farmers and innovation brokers is often difficult, so that some farmers reject any innovation introduced through them (FI_Tan_31, 34, 42).

However, if an innovation has successfully been adopted, the readiness to try another innovation introduced by the same innovation brokers is increased (FGD_Tan_9; FI_Tan_58). Trust in this sense can be both a requirement for and a result of innovation adoption.

Integration into the Innovation Development Process

The integration and participation of farmers in the development of a potential innovation is a crucial criterion for farmers to decide whether to try and adopt an innovation (EO_Tan_3). Integrating farmers into the innovation development process can make the adoption phase shorter since farmers already know what to expect from the innovation (FI_Tan_32).

> *"I would really prefer to be part of the innovation process, that my ideas and opinions are integrated." (FI_Tan_32)*

Access to and Availability of Inputs

Some innovations only work if very specific inputs are used (such as fertiliser, ploughs etc.). Especially in the trialability phase of the innovation process it is important for farmers to have access to required inputs (FI_Tan_2). Farmers also mentioned that it is important to not only be provided with the financial means to buy inputs themselves but to actually be provided with specific inputs directly (FI_Tan_36). Moreover, it is important for farmers to have reliable access to these inputs once the innovation broker has left.

> *"We accepted the innovation due to all the materials (that) were already brought by them (the NGO)."* (FI_Tan_57)

Info Box 8: Further Factors for Adopting or Rejecting Innovations

Besides the innovation and process criteria that farmers actively take into consideration in order to decide whether to adopt or reject an innovation, there are several other factors that influence a farmer's decision. These criteria are also important to take into consideration in the dissemination process.

Individual Farmer Habits, Capabilities and Attitudes

These factors can play an important role in adopting or rejecting innovations:

- Individual farmers' habits and attitudes such as the individual willingness to take risks and try something new (FI_Tan_8, 42, 43)
- Individual understanding and learning capacities (FI_Tan_39, 54; EO_Tan_4)
- Personal motivation (FI_Tan_42, 54, 55)
- Individual perseverance in case of setbacks (FI_Tan_36, 55)
- Individual physical and health conditions (FI_Tan_31).

Beyond these factors, attitudes towards innovations in general and the preference for local or traditional knowledge (FI_Tan_34; EO_Tan_1, 2), as well as misconceptions or negative attitudes towards an innovation (FI_Tan_60), for example due to negative experiences or beliefs, influence farmers' decisions.

Environmental Factors

Environmental factors, for example the absence or emergence of floods or droughts (FI_Tan_46, 57; EO_Tan_4), can determine whether farmers decide to reject or adopt innovations.

5.1.3 Ranking of Criteria by the Farmers

As previously described, ranking was conducted with the farmers, applying different steps in order to analyse the importance that individual criteria have for farmers. This ranking needs to be understood as context-specific. Out of 25 criteria collected during the field phase in Arusha and Changarawe, the ten most important ones were selected and used in three villages for ranking (Ilakala, Ilolo and Idifu). The criteria were presented to the farmers on cards, written in Swahili, and the farmers were asked to rank them according to their importance from 1 (most important) to 10 (least important). It was not allowed to rank two criteria at the same level of importance. This ranking was conducted twice by each farmer: once in the focus group together with the other participating farmers and once individually during the interview that followed.

The ranking was conducted for the general criteria for adopting an innovation, asking this key question:

How do you rank the importance of the presented criteria
in order to adopt a new technology or tool for marketing and/or production?

Two results are summarised and depicted in the following graphs: first the ranking by the groups and second the ranking from all individual interviews.

In both rankings *Training/Education* and *Trialability* were ranked as the most important criteria whereas *Compatibility* and *Affordability of Investment Costs* were ranked as the least important criteria. *Trialability*, as described above in the criteria section, is important for farmers as they want to try the innovation themselves without requiring too much support. Since all farmers who ranked the criteria were part of a Trans-SEC innovation process, it could be due to bias that *Training/Education* is ranked so high, due to the training provided by Trans-SEC.

Interestingly, the criterion *Affordability of Investment Costs* did not play a major role for the farmers, even though it can be a criterion for exclusion if the farmer cannot afford the innovation at the outset. An explanation for this is that farmers may look at this criterion at the end of the process and only consider it if other criteria are already fulfilled.

There are differences in the rankings of the criteria *Production Increasing* and *Prestige Increasing*. *Production Increasing* was ranked lower in the individual rankings whereas *Prestige Increasing* was ranked higher. These differences may be due to the fact that during the FGDs, not all farmers participated equally actively in the ranking. It may also be the case that farmers do not like to mention certain criteria in front of their peers. For example, to admit that *Prestige Increasing* is an

important criterion might be taken as an admission that one does not already have enough prestige.

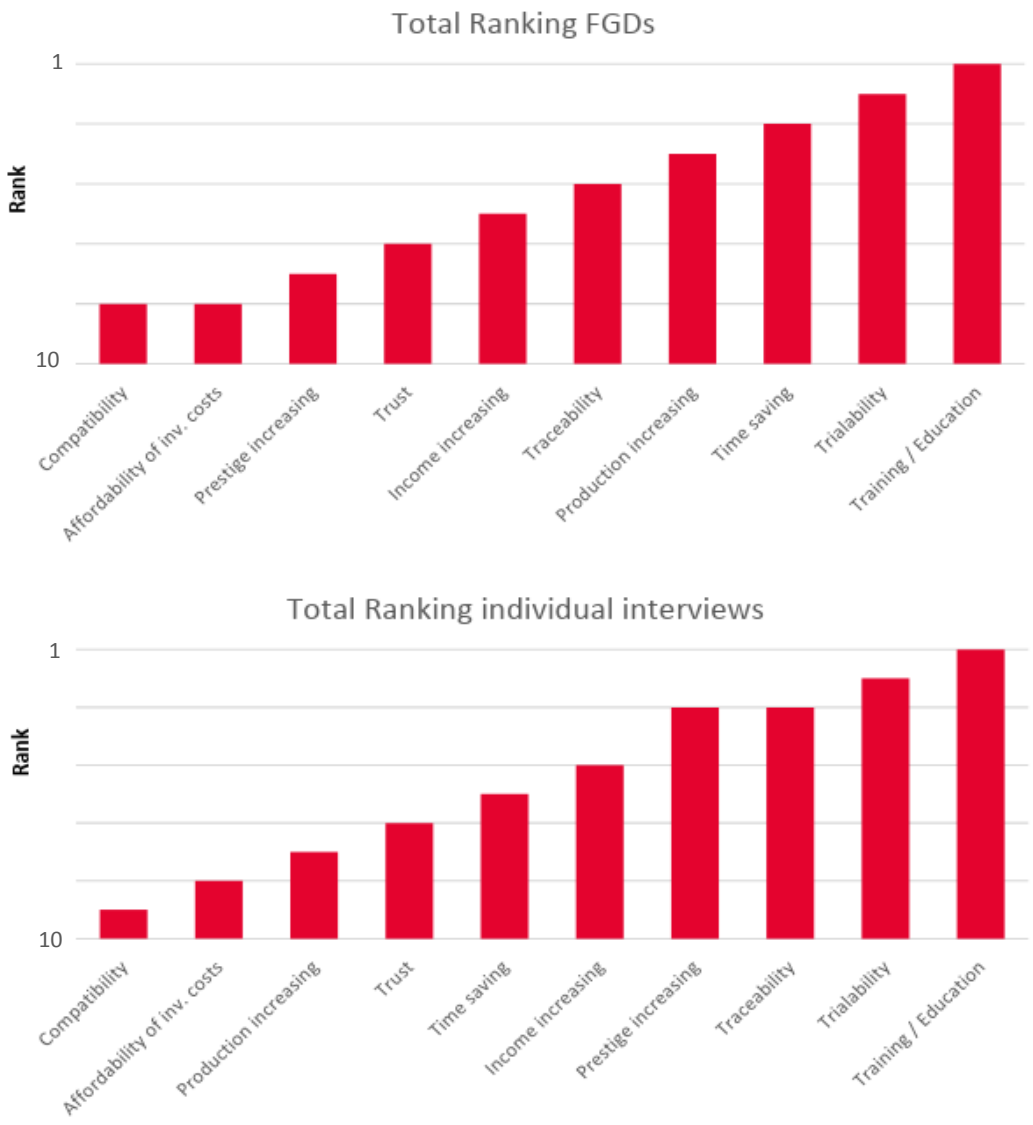


Figure 12: Ranking of Criteria in Focus Group Discussion and Individual Interviews

Source: Own illustration

Since both rankings were conducted in three different villages, the results can also be compared between the villages. In the FGDs in Ilaka, *Prestige Increasing* and *Trust* were ranked higher than in the compiled results, whereas *Income Increasing* and *Production Increasing* were ranked lower. However, *Training/ Education* and *Trialability* were also ranked the highest. For Ilolo, *Time Saving* and *Production Increasing* were ranked the highest whereas *Prestige* was ranked the

lowest. For Idifu, *Training/Education* and *Trialability* were also ranked the highest, as well as *Income Increasing*. In this village, *Affordability of Investment Costs* and *Compatibility* were ranked the lowest, as was also the case in the general ranking.

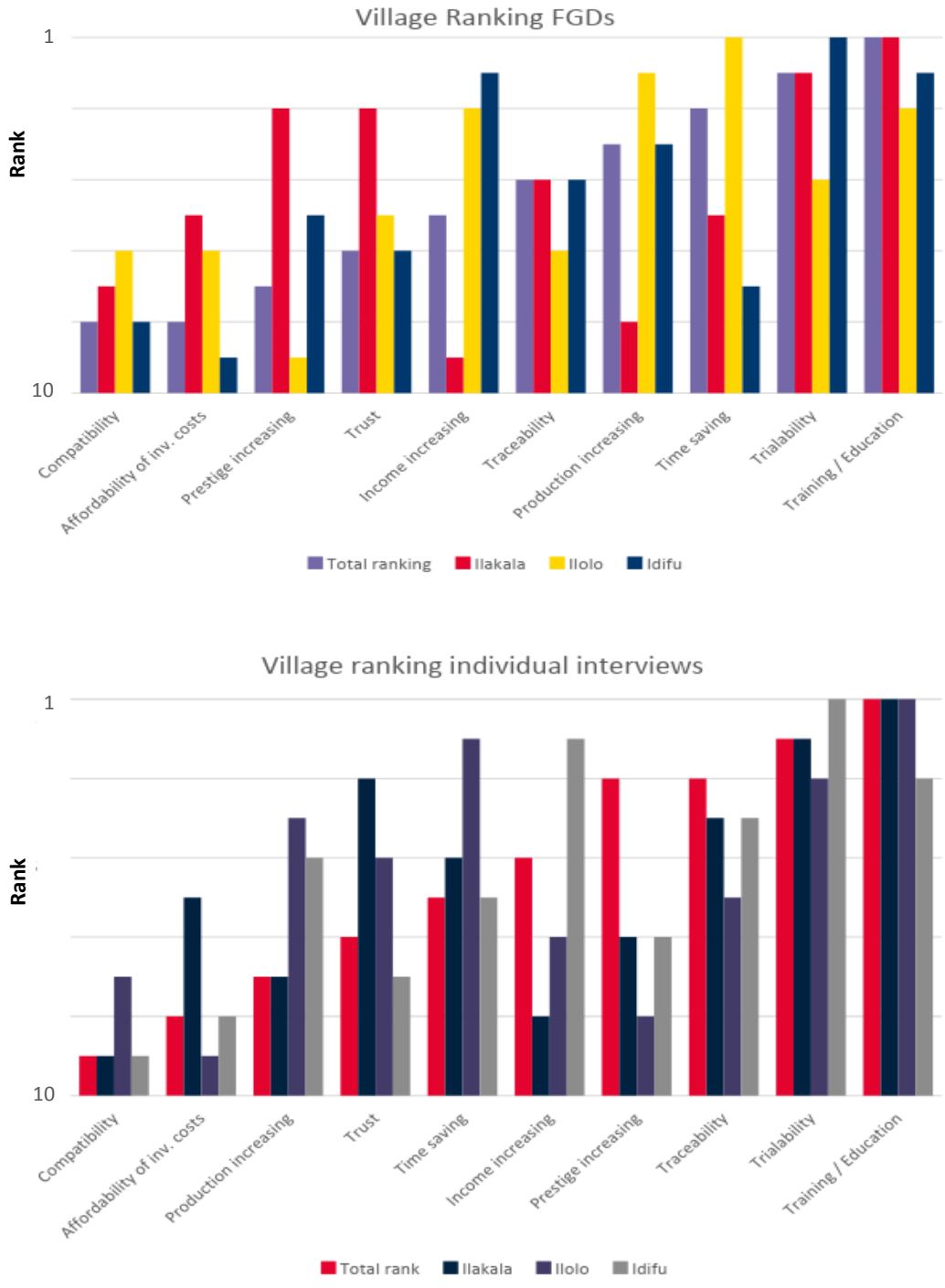


Figure 13: Ranking of Criteria in FGDs and Individual Interviews, differentiated by villages

Source: Own illustration

In the individual ranking, *Income Increasing* played a less important role than in the general ranking, and *Prestige Increasing* especially played a less important role than in the FGD results. *Income Increasing* was ranked very low in the individual ranking compared to the focus group ranking in Ilakala. For Ilolo, the results do not differ much between the focus group and the individual ranking. This is the same for Idifu. In Idifu, the least economically developed of the four villages in the study region, farmers ranked *Income Increasing* high in both rankings in comparison to the average ranking. An important explanation for the contrast in the ranking is the differences in the composition of the farmer groups that were interviewed. In the village of Ilakala and Ilolo, the majority of the participants were using a different innovation than in Idifu.

Case Study 3: Innovation-specific Ranking

In a second ranking during the individual interviews, farmers were asked to choose the criteria that influenced their decision to adopt or reject the specific Trans-SEC innovation. For each of the chosen criteria, farmers received two wooden sticks, which they then assigned to the criteria. The maximum number of sticks that were handed out was 20 (for ten criteria). The more sticks assigned to one criterion, the higher its importance for the farmer's decision. It was also possible to assign no sticks to the criterion – then it was counted as zero. If a criterion was completely removed from the group it was given a value of minus two. Afterwards, the criteria were ranked by adding up the sticks assigned to each.

For the **Production Innovation**, the most important criterion is *Production Increasing*, whereas *Compatibility* was ranked the lowest. It is important to mention in this context that some farmers did not participate in the innovation process due to concerns about the use of mineral fertiliser. This kind of fertiliser is often regarded as harmful to the soil and does not fit with the local traditions. This might explain the low rank of *Compatibility* since farmers who ranked this criterion higher did not participate in the innovation process at all and therefore also did not take part in the focus group discussions.

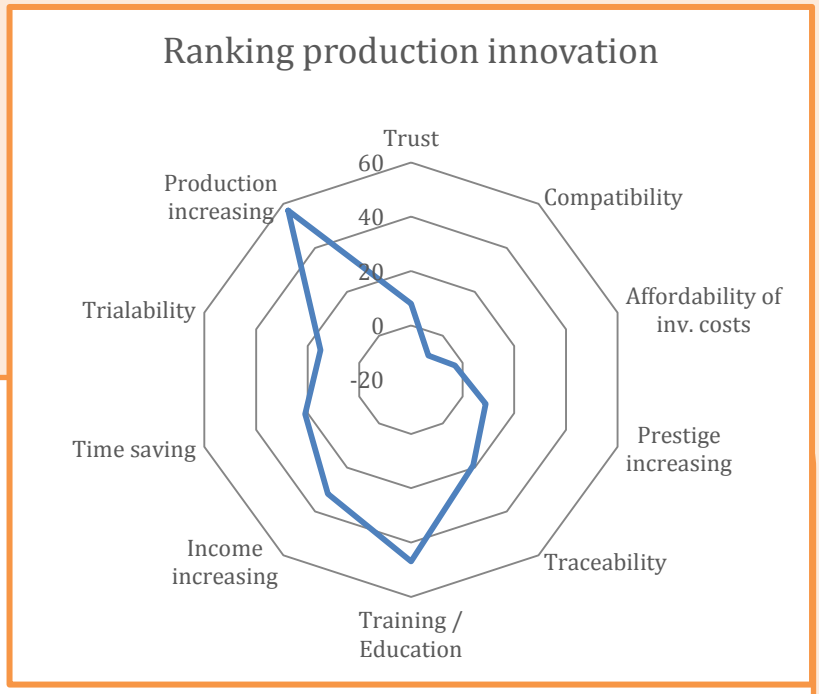


Figure 14: Ranking of Criteria for the Production Innovation in Individual Interviews by Number of Sticks

Source: Own illustration

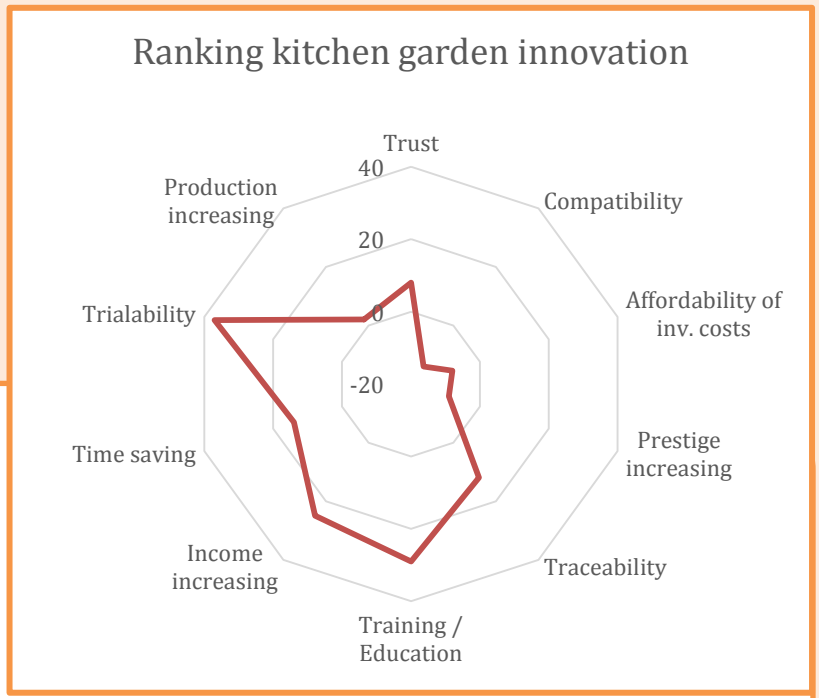


Figure 15: Ranking of Criteria for Production/Social Innovation in Individual Interviews by Number of Sticks

Source: Own illustration

Rainwater harvesting played an important role, especially in the semi-dry areas. Many farmers mentioned this part of the innovation as the most important aspect for their motivation to try the *Production Innovation* in general (FI_Tan_35, 36).

Production/Social Innovation - Kitchen Garden and Nutritional Training: For the participants using the *kitchen garden innovation*, *Trialability* was the most important criterion whereas *Compatibility* played the least important role.

During the interviews it was often mentioned that due to the closeness of the kitchen garden to the homestead, long distances to the market or the fields were avoided (FI_Tan_8, 13, 18). This can be reflected in the criterion *Time Saving*, but also plays a role in other criteria, e.g. *Compatibility with household labour*.

Another important criterion that is partly reflected in *Income Increasing* is the reduction in costs for buying vegetables at the market. Linked to this criterion is the increased provision of vegetables, which has a positive effect on nutrition. Nutrition was often mentioned as crucial and was an important aspect during the training (FI_Tan_4, 29). Furthermore, farmers mentioned that the aesthetic aspects of having green vegetables in the garden also influenced the decision to try the kitchen garden innovation (FI_Tan_27).

Training/Education played an important role for both innovations whereas *Compatibility* was the least important criterion for both. Also for both innovations the provision of material and tools such as seeds, fertiliser and ploughs motivated farmers to try and adopt innovations.

5.1.4 Farmers' Decision Making Processes

The decision to adopt or reject an innovation is mostly made after consulting family members (FI_Tan_18, 52, 53), even though the final decision is normally made by the household head. Occasionally, the decision is also made by someone who is not the household head (FI_Tan_58). In the study region, this was especially the case for the *kitchen garden innovation* which was often implemented by the mother/wife of the household who had participated in the training provided by Trans-SEC.

Besides family members, extension officers played an important role and were often consulted before the decision was made to adopt an innovation (FI_Tan_16, 42). Occasionally, neighbours were consulted as well (FI_Tan_28).

Some farmers mentioned that they did not consult anyone since the training that was given to them provided enough insights for them to decide themselves. Others who did not participate were not seen as knowledgeable enough to give proper opinions on the quality of the innovation and recommendations on either adopting or rejecting (FI_Tan_59).

5.1.5 Sustainability of the Innovation Process

Sustainability plays an important role in different aspects of the innovation process. However, the criteria analysed here are context-specific and depend on the individual farmer – this is also the case for the role of sustainability. It is important to determine which role the different dimensions of sustainability play and how this can be reflected in the local innovation process.

- Social sustainability: Involving village leaders and addressing farmers in a context-specific way are important in order to integrate specific social and cultural characteristics. Furthermore, training and follow-ups ensure the sustainability of the use of innovations in the long run. Even though the criterion *Compatibility* was not ranked very high, it plays an important role during the introduction of an innovation. With regard to the ranking of criteria, no significant gender-specific differences can be seen. However, women in general are less often the household head and therefore have less power to make the final decision to adopt or reject an innovation. This decision is mostly made by the (male) household head. Furthermore, women represented mostly the kitchen garden innovation whereas men represented mostly the production innovation.
- Ecological sustainability: As described in the criteria, ecological sustainability plays an important role especially for small-scale farmers since they commonly depend on a limited area of land. It became evident during the interviews that farmers take ecological issues into consideration. Therefore, ecological sustainability needs to be reflected in the development of innovations.
- Economic sustainability: The economic sustainability of the use of an innovation is an important aspect for small-scale farmers – if a farmer does not expect the use of the innovation to increase income, it is less probable that he or she will adopt it.

Various innovation criteria are of great importance for farmers in order to decide whether to adopt an innovation or not. Therefore, it is important to include them in the development process of an innovation as well as in the follow-up. The specific needs of the farmers have to be integrated into the innovation development process. If a farmer is not interested in an innovation because of a lack of compatibility or trialability, the innovation process is likely to fail.

As outlined in this chapter, training is the most important adoption criterion for farmers. Furthermore, extension services play a crucial role in introducing innovations to the farmers, and their availability and accessibility increases the probability of adopting an innovation in the long run. However, this is only possible if extension officers are well-educated and able to conduct innovation-specific training.

5.2 Participatory Development of Target-group-specific Dissemination Instruments

Researchers don't go out deliberately to translate the results into the end users' language. […] So there is a real problem and there is [a] gap between researchers and end users, where end users includes those who use the information and those who also develop policies that guide the taking up of innovations of the new findings (Exp_Ger_14).

This chapter deals with the development of target-group-specific dissemination instruments. It focuses on the knowledge gap between research and practice as well as between research and policy (Chapter 3). The HORTINLEA context can thus serve as a case study for exploring methods of interdisciplinary and circular knowledge exchange (Chapter 2). The whole process of developing dissemination instruments as well as lessons learned from this process were documented and may serve as the basis for a tool kit on how to effectively translate research results into target-group-specific language.

5.2.1 A Comprehensive Needs Assessment Process

The decision to focus on the development of two particular dissemination instruments was based on a thorough needs assessment carried out in Germany and Kenya within in the first SLE study (Gevorgyan et al. 2015) as well as within the scope of additional HORTINLEA activities conducted in the years 2013-2016. This study was entrusted with concluding this comprehensive needs assessment process concerning the choice of target groups as well as the choice of specific dissemination instruments. Various HORTINLEA consortium members were interviewed, as were further stakeholders within the ISP, especially extension

officers and AIV farmers. This process resulted in recommendations for complementary dissemination tools to be developed in the future. Furthermore, challenges and opportunities concerning the usage of the instruments arose out of the process and are summarised below.

The concluding needs assessment process revealed that there are good reasons to focus on extension officers (Chapter 5.2) when it comes to key actors on the practical level, but that literate lead farmers or, more generally speaking, additional "leading actors" should not be disregarded as a target group (Exp_Ger_18). While extension officers as well as literate farmers would benefit from dissemination instruments and do a better job in bringing research results to the practical level, interviewees pointed out that their needs and interests might differ considerably, thus requiring different types of dissemination instruments (Exp_Ken_6, 9). One reason that was given included extension officers' interest in the question of *why* a certain recommendation is given. The farmers' priority, on the other hand, was on the question of *how* something works and not so much on why this is the case (Exp_Ken_6). It was also emphasised that the varying AIV farming experiences *within* the two groups should be taken into account during the development of dissemination instruments (Exp_Ken_1).

As for the policy level, there was consensus that policymakers on different administrative levels should be targeted, e.g. in the county and the national governments. The importance of addressing policymakers with specific, relevant information was also underlined, i.e. confronting them only with research results that concern their own field of expertise. (Exp_Ger_14, Exp_Ken_8, Hdays_Ber).

Complementary Dissemination Tools

Valuable insights on complementary dissemination tools were obtained; however, they partially referred to different target groups that might be addressed in the future. The majority of interviewees mentioned leaflets, flyers, posters, fact sheets, stickers or brief guidelines as possibilities, especially for farmers (Exp_Tan_3, Exp_Ken_6, Exp_Ger_14, WS_Nai1). In general, illustrative material such as pictures or drawings could play an important role and would ideally take into account the cultural background of the farmers who would ultimately be addressed with the training manuals (Exp_Ken_1). Researchers as well as extension officers recommended distributing such kinds of simplified information material in addition to providing extension officers with training manuals (Exp_Ger_1; Exp_Ken_10). Furthermore, conventional media channels such as the radio and TV were mentioned several times as useful complementary dissemination tools (ROP; Exp_Ger_15; Hdays_Ber, WS_Nai1).

ICT Features

The integration of ICT features into dissemination strategies was brought up rather often as a parallel to those mechanisms that were mentioned as supportive for a sustainable AIV Network (Chapter 5.3). Specifically, the use of text message services as well as the use or development of an AIV application for smart phones came up various times. Moreover, the establishment of special dissemination sections on existing websites, e.g. the HORTINLEA website, was suggested (Exp_Ger_9, Exp_Ken_12). Three major reasons for the particular importance of such ICT features were given. First, the special context of East Africa as a pioneer region in applying advanced digital technologies and the widespread prevalence of mobile phones, and to a lesser degree also smartphones was given. Additionally, the fact that there is already considerable digital literacy played a role – while only 78% of the Kenyan population can read or write, 83% have a mobile phone (CIA 2017). As one interviewee put it:

> *Because many of the people now have got phones, they have these gadgets – you cannot ignore it. There is no communication now you can do without using digital (Exp_Ken_12).*

Beyond their communication uses, mobile phones already serve as a tool for other services such as banking. Therefore, people would have very few reservations about using them for other purposes such as receiving AIV-related information (Exp_Ger_9).

Second, ICT tools could offer the possibility of addressing different target groups at the same time by offering varyingly complex information. For example, the HORTINLEA website could be used to provide a tool through which farmers receive clear and simple answers to their individual questions. Additionally, another tool could provide more information about the background to a certain solution, for example why it was recommended. This tool might be used by extension officers and literate farmers who decided to educate themselves in addition to trainings (Exp_Ger_9).

Third, ICT tools could offer the option of updating information in a shorter period of time than is the case with printed material. For a young research field, such as the innovation system of AIVs where numerous applicable results are expected to emerge during the coming years, this could be an important advantage (Exp_Ken_6; WS_Nai2).

It can be concluded that ICT solutions are perceived as having great potential to enable truly interactive and demand-driven dissemination of research results into practice. However, ICT tools are not intended to replace conventional

instruments such as training manuals – "for the time being, there should be both" (Exp_Ken_12). This sentiment was echoed by interviewees when discussing the role of ICT tools in an AIV network (Chapter 5.3).

Training

Finally, experts underlined the importance of trainings to accompany the introduction and distribution of training manuals, especially training of trainers (ToT) where extension officers learn how to address AIV famers by using a new manual and how to explain the proper implementation of the proposed practices. This face-to-face element was also mentioned as a central component of sustainable communication within a future AIV network (see Chapter 5.3).

For the dissemination of research results into policy, interviewees suggested only a few tools that could complement policy briefs. International conferences, policy dialogues (Exp_Ger_14), conventional media formats such as TV talk shows and the radio came up occasionally (Exp_Ger_22). Apart from this, interviewees strongly suggested that political decision makers should be targeted individually, ideally during regular face-to-face meetings, for example within the institutional framework of an AIV network (Chapter 5.3). Dissemination of new research results via ICT formats such as mobile phone calls, text messages, WhatsApp or Twitter messages, however, was also mentioned as complementary strategy (WS_Nai2).

Info Box 9: Further Results of the Needs Assessment Process

Some of the HORTINLEA results were not meant to reach the practice or political level. A distinction should be drawn between those research results that are derived from an interdisciplinary systemic approach, aiming to assess the impact of context factors – such as climate change – on the AIV innovation system, and those derived from an applied science approach, aiming to formulate concrete recommendations for action (Exp_Ger_13). Only the latter are relevant for the development of training manuals and policy briefs. Furthermore, interviewees confirmed the fact that comprehensive training manuals on the different aspects of AIV production, marketing and consumption do not yet exist due to the fact that research on AIVs is a relatively unexplored field (Exp_Ger_17; Exp_Ken_1, 12). On the one hand, a certain comprehensiveness of training manuals was welcomed. On the other hand, several interviewees pointed out that it might be more user-friendly if several thematically-specific training manuals were developed (Exp_Ger_1; Exp_Ken_6, 9, 10).

In conclusion, interviewees clearly confirmed the need for target group-specific dissemination instruments for AIVs and were in favour of the idea of using the HORTINLEA research results to help close the knowledge gap between research and practice and between research and policy (Exp_Ger_6, 9; Exp_Ken_9).

5.2.2 Development of Dissemination Instruments

In the following section, the focus will be on the process of developing selected dissemination instruments: policy briefs and training manuals. The steps that have been conducted in the scope of this study and the lessons learned will be described. Moreover, recommendations for future steps will be presented, such as a strategy for finalising the selected training manuals and policy briefs.

Circular Knowledge Exchange in Four Steps

The following four major steps can be differentiated in the process of developing policy briefs and training manuals:

Step 1: Decision on Contents

The decision on the contents of policy briefs and training manuals – the identification of the thematic clusters that are most relevant for the selected target groups – was carried out in a participatory way. For this step HORTINLEA consortium members were involved intensively. As the procedure for the two dissemination instruments was not exactly the same, training manuals and policy briefs will be considered separately.

Training Manuals

In accordance with the overall HORTINLEA approach, a thematic separation for suggested comprehensive training manuals was made between production and consumption issues along the AIV value chain. During a roundtable discussion with HORTINLEA consortium members, the proposed division into two thematic areas was supported and marketing issues were included into the production manual. In a second step, a more detailed outline of the envisioned contents was developed. Expert consultations and a literature review resulted in the formulation of the chapters and sub-chapters of the training manuals (Info Box 10 and 11):

Info Box 10: Content of Production and Marketing Manual

Land preparation [season of preparation, inputs for preparation and sources of inputs, soil fertility management (rotations, intercropping), soil structure, tillage]

Seed and seedlings production [seed sources and quality, sawing techniques and nursery management, seed processing/preparation, seed storage]

Agronomical practices [sowing and transplanting, propagation methods and spacing, irrigation: management and water quality, soil cover management (e.g. mulching), weed management]

Crops and disease management [common infestations, causes, prevention, control and management, safe pesticide application]

Harvesting [assessment of maturity of leafy parts, assessment of seed maturity, methods and materials for both seeds and leaves]

Post-harvest handling/ processing [storage and conservation, processing and value addition, transportation, end products]

Marketing [market conditions and infrastructures (where/how to obtain information), pricing, strategies, institutional arrangements]

Info Box 11: Content of Consumption Manual

Health and nutrition [general nutrition info, background info: state of nutrition in Kenya, importance of nutrition and potential problems when nutritional needs not met]

Consumption habits and meal cultures [current practices and trends, focus on children, dietary diversity, recommendations]

Health benefits of AIVs [nutritional benefits, benefits regarding cancer (prevention), focus on (nursing) women and children]

Hygiene [importance, recommendations, fermentation, packaging, market conditions]

Education [nutrition in curricula, AIVs in curricula, knowledge dissemination]

Policy Briefs

The decision to focus on certain innovation areas to be covered by policy briefs was based on the results of focus group discussions with AIV farmers in Kakamega and Nairobi within the scope of HORTINLEA dissemination and capacity development activities conducted in the years 2015-2016. Five types of innovation areas were identified: technological, institutional, social, health- and environment-related as well as culture- and education-related (Exp_Ger_22). In all of these areas, political and institutional conditions need to be optimised to adopt the innovations resulting from HORTINLEA's research (Chapter 3).

Against this background, an interactive roundtable was carried out with HORTINLEA consortium members to acquire the researchers' perspective on which thematic and SP-overarching clusters should be addressed by the policy briefs. The researchers were asked to assign expected HORTINLEA research results to one or more innovation areas. Furthermore, inspired by the concept of 3-D sustainability four additional clusters were identified: environmental, economic, social/human and institutional (Annex 5.1: Results of Thematic Clustering and pre-selection of Thematic Areas for Policy Briefs). The results assigned to these four clusters were combined with the five innovation areas formulated by Kenyan farmers. In order to put the outcomes of this in a broader context, they were then linked to corresponding Sustainable Development Goals

(SDGs) (UN 2015e). This resulted in the identification of the following five policy brief topics:

- Human Health and Nutrition (SDG 2, SDG 3)
- Ecology, Environment and Climate (SDG 12, SDG 13, SDG 15)
- Technology and Economic Development (SDG 8, SDG 12)
- Social Development, Gender, Culture and Education (SDG 1, SDG 4, SDG 5)
- Institutions, Markets and Common Action (SDG 8, SDG 9, SDG 16).

Step 2: Development of Structure and Design

After the decision on the broad contents of both dissemination instruments was made, the focus was on developing an outline for the structure and design of the selected dissemination instruments.

Training Manuals

Based on selected best practices in horticulture, a first outline for the structure of both training manuals was drafted. The Agroecology Best Practices Guide (2010) developed by the French NGO AgriSud served as a valuable example. Moreover, the Crop Production Manual for Agriculture Extension Workers (2012), published by USAID, and the Horticulture Training Manual for Lao PDR (2001), published by the German Development Service (DED), were identified as useful sources.

The outlines were discussed and adjusted accordingly with HORTINLEA representatives in an interactive workshop (WS_Aru, WS_Nairobi) and in different expert interviews. Slight adjustments were suggested, such as changing the order of certain chapters. Additionally, ideas about elements that could be added to the training manuals came up, including a food calendar for AIVs (Exp_Ken_1, Exp_Tan_3) and AIV-specific good agricultural practices (Exp_Ger_21, Exp_Ken_12). Moreover, it was agreed that experience from farmers should be included, for instance in speech bubbles and photos, and to underline connections to ecology, economy, human health and social issues (agroecology approach) wherever relevant.

Info Box 12: Outline of Production and Marketing Training Manual

1 Introduction
- 1.1 Circular Knowledge Exchange and Agroecology
- 1.2 Need for Training Manual
- 1.3 Contributors
- 1.4 User Groups

2 How to use this manual
- 2.1 Modules
- 2.2 Training

3 African Indigenous Vegetables (with Swahili names)
- 3.1 African Nightshade – managu
- 3.2 Amaranth – terrere
- 3.3 Cowpea – kunde
- 3.4 Ethiopian kale – sukumawiki
- 3.5 Spiderplant – saga
- 3.6 Further crops

4 Production
- 4.1 Land preparation and soil
- 4.2 Seed production and storage
- 4.3 Agronomical practices
- 4.4 Crops pest and diseases management
- 4.5 Harvesting
- 4.6 Postharvest handling

5 Marketing
- 5.1 Market conditions and infrastructures
- 5.2 How to supply high price market segments
- 5.3 Pricing

6 Useful material
- 6.1 For trainers
- 6.2 Crop calendar
- 6.3 Example for crop rotation

7 Where to seek assistance?

8 References

Policy Briefs

Based on five topics for HORTINLEA policy briefs, an individual outline for each of the five policy briefs was prepared. All of them had a similar structure and contained the following five main sections: introduction, study approach, results, conclusion and policy recommendations.

After several consultations, it was decided that some changes would be made and certain sections could be combined, for example conclusion and policy recommendations. Finally, a more detailed outline for one of the policy briefs was developed. It can be generalised as follows and serves as a blueprint for writing the remaining four policy briefs.

Info Box 13: Generalised Outline of Policy Brief

1. *Problem Statement*
   - Describe the main problem the policy brief seeks to address
   - Start at a broader (global) level
   - Narrow in and give examples of problem in Kenyan context
   - Explain why solving this problem is important for Kenya
2. *Solution to the Problem*
   - Role of African Indigenous Vegetables and HORTINLEA
3. *HORTINLEA Results and how they contribute to the solution*
   - Introduce and describe relevant research results from different HORTINLEA sub-projects
   - Emphasise how the HORTINLEA research results can help solve the problem (problem statement)
4. *Policy Recommendations and Conclusion*
   - Briefly address existing policies in the relevant sector
   - Describe concrete steps that can be taken based on HORTINLEA research results
   - Integration of HORTINLEA results into existing policies
   - Address importance of cooperation among various actors
   - State how including HORTINLEA research results will help Kenya reach its goals (e.g. Vision 2030)

Note: For some policy briefs, sections 2 and 3 will be combined.

Step 3: Collection of Information

In order to fill the outlined structures of training manuals and policy briefs with content, information, data, knowledge and innovations were collected in a third step. The sources of this information can be divided into four major groups. In the following, they are structured according to their relevance:

- HORTINLEA research results and further knowledge of HORTINLEA partners
- Local knowledge of Kenyan AIV farmers
- Primary literature: existing training manuals and policy briefs recommended by HORTINLEA partners
- Secondary literature on the AIV innovation system

HORTINLEA results represent the major source of information for both training manuals and policy briefs. Additionally, HORTINLEA consortium members were requested to share further knowledge linked to AIVs that was not necessarily developed within the HORTINLEA context. They were also asked for recommendations concerning primary literature, for example existing dissemination instruments. In those cases where HORTINLEA research results were not yet in a "stage of applicability", the corresponding research areas were taken as a point of orientation to identify key secondary literature to complement the collection of information. On top of this, local knowledge collected mainly in the context of the Master Thesis Program of SP 13, but also during this field research, served as an information source especially for training manuals.

Three templates were developed: one template for each training manual and one template for the policy brief. These templates were used for the structured collection of applicable HORTINLEA research results, further knowledge of HORTINLEA consortium members and local knowledge collected within the HORTINLEA Master Thesis Program. The following categories were contained in the templates for the training manuals – unless stated otherwise, all categories were left blank:

- suggested chapters (already filled)
- suggested sub-chapters (already filled)
- corresponding SPs
- corresponding problem statement/ research questions
- corresponding research results
- corresponding local knowledge
- ecology-related issues
- economy-related issues

- human health-related issues/ social aspects
- experiences with application, if any.

The template for the policy briefs contained the following sections:

- thematic cluster of policy brief (already filled)
- rough description of possible contents (already filled)
- relevant SPs (already filled)
- corresponding problem statement/ research questions
- corresponding research results (=potential innovations)
- kind of innovation (process, product, institutional)
- conditions for success of innovation
- further remarks.

The templates were distributed to representatives of all HORTINLEA SPs. In addition to filling them in with information, the HORTINLEA consortium members contacted were asked to send in relevant publications, presentations and additional material. As well as distributing the templates via e-mail, five visits were carried out to the representatives of various HORTINLEA SPs based at different universities and research institutes in Germany. During HORTINLEA Days, the templates were introduced and discussed with the researchers. It was left up to the researchers to decide to which chapter they assigned their knowledge. They gave an update on the current status of the dissemination instruments and contained detailed requests for information on specific subject areas. As a result, additional information was made available and shared.

In addition to this, expert interviews were carried out with HORTINLEA consortium members in Germany, Kenya and Tanzania. Furthermore, content collection and interdisciplinary integration of research results continued in the form of two interactive multi-stakeholder workshops, one in Arusha (Tanzania) and one in Nairobi/Juja (Kenya) in which multiple stakeholders in the AIV innovation system participated and provided relevant information for the contents of the dissemination instruments. The multi-stakeholder workshop in Nairobi/Juja focused on the subject of the first policy brief, namely health and nutrition aspects of AIVs and on the link between research and policy (see Info Box below). Therefore, key experts from fields related to health and nutrition including researchers, NGOs, government representatives and journalists were invited.

As for the training manuals, a closer look will be taken at the intensive involvement of farmers. Four farmer groups in Kakamega and Vihiga counties were introduced to the idea of developing a training manual on the production and marketing of AIVs.

Focusing on content collection for the production and marketing training manual, the Agroecology Best Practices Guide was introduced to the farmers for illustrative reasons. Farmers' assistance was requested for developing a training manual adapted to the regional context in which their needs and knowledge would play a central role. Therefore, the plan was to showcase exemplary practices of those farmers who already cultivate AIVs. The thematic focus chosen on the basis of the farming calendar (visits took place in September) was "seeds and seedling production." To be more specific, information on how to prepare the soil, how to prepare seeds and how to sow was collected. However, additional steps of the production cycle were also addressed.

Farmers agreed to share their knowledge and to talk about particular challenges and advantages of AIV farming. They explained why they did what in a certain way at a certain time and which tools they used. They thus made it possible to include so-called "farmer to farmer messages" in the production and marketing training manual (Chapter 5.1). Moreover, farmers welcomed the idea of taking pictures of their daily practices in order to illustrate their statements.

Info Box 14: Priority of "Human Health and Nutrition" policy brief

The document *Kenya Vision 2030* is the country's policy strategy and planning document to be implemented from 2008 until 2030 in 5-year-plan instalments, the first of which was from 2008-2012. At the time of writing this study, Kenya finds itself near the end of the second five-year period 2012-2017. The main pillars of Vision 2030 revolve around the country's economic, social and political plans for the future that will help transition Kenya into a stronger middle-income country. In order to realise the potential of Vision 2030, a strong and healthy workforce is needed, which cannot exist if the population does not meet basic health standards. A further entry point is through horticulture, as Prof Abukutsa explained:

> [B]y the year 2030 people should be having [a good] quality of life and the reason [...] is having nutrition and having good health. And of course the vision 2030 has identified horticulture as one of the driving engines to solve the problem of poverty, malnutrition, as an entry point. [...] There is no maize, no food. So what are the other solutions? So that's an entry point (Exp_Ger_14).

Step 4: Drafting of Dissemination Instruments and Continuous Feedback Loops

After collecting information and structuring it according to the topics and chapters of the dissemination instruments, first drafts of the health and nutrition policy brief and the training manuals were developed. These drafts then entered continuous feedback loops, facilitated by the research team, in order to increase the likelihood that the finalised instruments will meet target-group-specific needs. Moreover, the goal was to create shared ownership of the end products among multiple stakeholders. This professional review process focused on the structure and contents of the drafts and involved internal and external experts. The first policy brief will serve as an example of how the feedback loops were conducted and the process will be described in Info Box 15.

Info Box 15: Feedback Loops and the Process of Developing a Policy Brief

After a first draft of the policy brief on health and nutrition had been developed, a second version was drafted on the basis of feedback, including some new ideas from the workshop in Nairobi/Juja. It turned out that certain details on the topic were missing in the material received up to then from HORTINLEA consortium members. After having received additional information, a third and later on a revised fourth draft was developed. This new draft was then sent to those representatives who contributed their knowledge for them to look over it and provide feedback, which was integrated afterwards. Moreover, the draft was reviewed by external, HORTINLEA-associated experts. Here it was especially important to include Kenyan partners to have a closer look at the policy area and recommendations. After receiving feedback from HORTINLEA project coordination and members of the project board, selected HORTINLEA researchers were contacted to provide specific missing information and a final draft was then written ready for publication.

5.2.3 Preliminary Findings and Lessons Learned

To close the knowledge gap between research and practice as well as between research and policy, a needs assessment was conducted to identify key actors and dissemination instruments. Based on the results of this assessment, the development of HORTINLEA policy briefs and training manuals was initiated and thoroughly documented. The process followed four major steps. First of all, for the development of the policy briefs, five thematic areas were identified. Moreover, it was decided to develop one training manual dealing with the first part of the AIV value chain (production and marketing issues), and another one focusing on the AIV value chain (consumption and nutrition issues). In a second step, the structure and design of both training manuals and policy briefs were developed. This was based on desk research about good practices, e.g. existing instruments, and intensive discussions with experts in the field of knowledge dissemination. This was followed by collecting information from different sources and structuring it according to the envisioned topics and chapters of the dissemination instruments – the third and most comprehensive step. Here, HORTINLEA consortium members served as the major source of information. Research results that emerged within the framework of HORTINLEA as well as additional knowledge on AIVs shared by consortium members were collected. Moreover, AIV farmers in Western Kenya enriched the manual with local knowledge and illustrative material. Finally, the fourth step was begun, writing drafts and distributing them to experts in order to request their feedback. The feedback provided was integrated by adapting the dissemination instruments accordingly.

Inclusion of Local Knowledge

The general idea of combining local knowledge with HORTINLEA's scientific research results in the training manuals was evaluated very positively (Exp_Ger_13, 14, 16, 18). There was consensus that the farmers' knowledge of AIVs in particular and agricultural practices more generally is enormous and that the potential of this knowledge to complement academic research is far from being fully realised (Exp_Ger_1, 14). While most of the HORTINLEA consortium members said that their research had been informed by the farmers' needs, hardly any of them had personal experience in engaging with the farmers again at a later stage, namely when it came to disseminating the research results. Nevertheless, the wide majority of interviewees supported the idea (Exp_Ken_9, 10).

A major lesson learned was that local knowledge must be validated by scientists once collected from AIV farmers. This means it must be (re)transferred

to the research level where it enters the development phase of the innovation process again (*circular knowledge exchange* – Chapter 5.1). Local knowledge should serve as inspiration for new research questions. As a source for dissemination instruments, it should only be used after having been validated (Exp_Ger_2, 14; Exp_Ken_9, 10). As one expert put it:

> It is definitely a good idea [to integrate local knowledge]. But you know what farmers are practicing, they might have practiced it for a very long time and it needs to be validated (Exp_Ken_10).

Another challenge with including local knowledge as a source of information for dissemination instruments is that traditional AIV farming has so far always been a regional practice. For this reason, most of the existing local knowledge on the production and consumption of AIVs (there is almost no local knowledge on marketing, since until recently AIVs have not been used as cash crops) is linked to regional traditions and culture, such as food culture. Accordingly, local knowledge is not easily transferable to regions with different traditions where people might have just begun to grow AIVs (Exp_Ken_6, 12). These regional differences should be kept in mind when developing target-group-specific training manuals:

> You have done an experiment and got very good results, but if you do not go to Kisumu and talk to the people to know what actually happens there, you will have a very good solution for Nairobi but a catastrophe for Kisumu. Then if you do not go to the "root" knowledge that the people have and you go with your big science that has been proven and as famously known in Nairobi, you are doomed for doing something that will discourage farmers forever from listening to any other researcher that comes (Exp_Ken_6).

Involvement of External Experts

With regard to research results that enter the training manuals and policy briefs in the first place, the idea to focus on HORTINLEA partners was supported and justified by the fact that HORTINLEA was the most comprehensive existing international research project on the AIV value chain (Exp_Ken_12, Exp_Ger_22). However, some interviewees brought up the idea that additional actor groups such as nutritionists (practical level) and private companies (business level) should be consulted as key actors in the AIV innovation system (Exp_Ken_12). The majority of interviewees were supportive when it came to the role of external experts or consultants in reviewing the finalised drafts of training manuals and policy briefs (Exp_Ken_2, 7, 10). However, those external experts ought to be selected carefully:

> Involving people who are external to HORTINLEA – that is critical for backstopping. It is very, very critical. But then they must be identified carefully so that they are not our [...] competitors. [...] Really people who are going to add value and give a genuine, honest, objective critique of the manual that is a perfect, perfect idea (Exp_Ken_10).

The idea arose that each SP leader could name one external expert to review the contents of the training manuals derived from inputs given by the corresponding SP (Exp_Ken_10). Moreover, the reviewing process should not be limited to content-related issues. External experts with a background in didactics or editing should play an important role as well (Exp_Ken_7).

Content Collection

The majority of HORTINLEA consortium members welcomed the initiative to organise a structured content collection of research results with the goal of developing SP-overarching dissemination instruments. However, when it came to the evaluation of the information collection method, there were considerable differences in opinion between the resource persons. While some of them welcomed the templates as a useful tool, others found them too complicated or time-consuming. Some HORTINLEA consortium members mentioned that it would be much easier to add inputs to already existing contents – especially in the context of HORTINLEA where different researchers have been working on the same topic but not necessarily in the same team (Exp_Ger_2, 20). Thus, for the development of further dissemination instruments, the creation of an interactive template where everyone could write his or her inputs at the same time might be helpful. Also, suggestions were made for alternative or additional formats which might be worked on in the future. For example, the idea came up to use the HORTINLEA summer school for PhD students to write a joint policy brief. If the structure of such a policy brief was agreed upon in advance and the process is well coordinated, this would be a manageable task (Exp_Ger_13).

Within this SLE study, the following preliminary products have been developed:

- One policy brief focusing on the human health and nutrition aspects of AIVs, Annex 5.2: Policy Brief on Health and Nutrition
- The design and a rough draft of the training manual on production and marketing issues for AIVs
- Structured collection of relevant information for the envisioned HORTINLEA dissemination instruments (four policy briefs, training manual on consumption issues for AIVs), organised along suggested topics of policy briefs and chapters of training manuals.

5.3 Conceptualising the AIV Knowledge and Innovation Network

The theoretical approach of the *Knowledge and Innovation Network (KIN)* for AIVs is based on the idea of circular knowledge exchange between multiple stakeholders and serves to close the knowledge gap between practitioners, researchers, and policymakers. Based on the five-step World Bank model (Chapter 3), this section outlines the empirical findings from expert interviews and interactive workshop sessions for the first three steps: identifying the goals of the network (step 1), defining the network (step 2), and designing the network (step 3). To complement the analytical findings, some recommendations on the design and implementation leading to steps 4 and 5 are provided at the end of the chapter.

5.3.1 Identifying Goals for the Network

As a first step, different conceptualisation ideas and potential goals were discussed with core stakeholders and experts. Initially, these were mostly HORTINLEA consortium members, though some experts on networking in East Africa were also included. Methodologically, this phase was highly explorative, aspiring to identify potential goals and change objectives for the KIN based on stakeholders' and experts' opinions and experiences. This initial phase also served to identify further interviewees, prepare stakeholder mapping, and acquire contacts.

AIVs, Horticulture and Beyond

Based on the interviews, several problem areas concerning AIVs and horticulture more generally were identified. Most importantly, almost all interviewees expressed their support for the idea of an AIV network and emphasised the need for multi-stakeholder knowledge exchange on the topic. Several experts mentioned that such a network does not yet exist, but they see a need for one in the country and even in the wider region and would personally be interested in participating (Exp_Ken_5, 11; Exp_Ger_14). Most interviewees expressed their desire for a network to be based on solving problems (Exp_Ger_13, 14), stressing the need for a holistic value chain approach that includes not only production and post-harvest, but also marketing, consumption and health issues related to AIVs (Exp_Ken_4, 11; Exp_Ger_6, 13) (Chapter 5.2).

Hence, many interviewees expressed the idea of developing a network that not only addresses AIV-related topics but also more generally horticultural or

agricultural issues to provide a one-stop solution to stakeholders' questions and concerns on the topic of nutrition and food security in Kenya and beyond (Exp_Ger_7, 14; WS_Nai1). As such, the issue of raising awareness of the nutritional value of AIVs and sensitising producers and consumers was mentioned very often as a highly desirable impact of such a network (Exp_Ger_14; Exp_Ken_13). In a similar vein, the experts mentioned the need of famers and extension services to have a joint forum to share knowledge and answer questions among farmers and/or with experts, thus linking the topic to non-academic stakeholders and especially practitioners (Exp_Ken_5 and 13). This goal was also emphasised by local extension services in Kakamega (EO_Ken_1).

Interlinking diverse Stakeholders

A number of researchers mentioned that they themselves would welcome a long-term initiative for exchange between farmers or end users and academia. Most of the interviewees had encountered problems in the past in getting in touch with end users and were therefore very positive about more formalised mechanisms of learning (Exp_Ger_1; Exp_Ger_14). Besides such transdisciplinary exchange, the need for interdisciplinary deliberation and the goal of (project-based) collaboration was emphasised by the interviewees from academia. Joint research, paper proposals, and publications were mentioned several times as very desirable (Exp_Ger_7; 8; 10).

Connecting knowledge exchange and learning to existing HORTINLEA structures and partners was generally welcomed, yet it was emphasised that any sustainable exchange needs to go beyond an academic focus and the time frame of HORTINLEA. As such, some experts referred to the current political momentum to establish a new network for AIVs in Kenya. This was mostly mentioned with regard to the Kenyan policy paper of Vision 2030 as an "entry point" for horticultural issues on policy making concerning poverty reduction and malnutrition in Kenya (Exp_Ger_14)[8]. Similarly, policy work and advocacy activities were identified as important methods by which the network could promote AIVs (WS_Nai1).

5.3.2 Defining the Network

For the second step (as outlined in Chapter 3.1), relevant stakeholders and potential members of the network were identified along the AIV value chain and a thorough stakeholder mapping was conducted. It aimed to identify actors most

8 See also Chapter 5.2 and Annex 5.2: Policy Brief on Health and Nutrition.

suited to participate in the network, determine which capacities they might bring to the network, and understand their incentives to contribute. Comments by interviewees largely corresponded with the actor landscape identified in the ISP approach used in this study and developed by Gevorgyan et al. (2015). Therefore, this section will differentiate the actor groups according to their diverse needs, expectations and contributions to the KIN, as coherent with the ISP and a multi-stakeholder perspective: representatives from academia, the policy and governmental sphere, the private sector, end users (including small-scale farmers), and linking actors such as extension services or non-governmental organisations.

Moreover, the actor groups' views on intervention areas, communication and dissemination tools (internal and external to the network), administrative structure, membership formats, and measures of sustainability (including ecological, economic, and social dimensions) will be described in this chapter following the stakeholder outline.

Stakeholder Groups: Expectations and Contributions

The analysis of stakeholder groups that were considered as members of the network (based on the ISP approach outlined in Chapter 3.1.2) resulted in a stakeholder map. The map (Annex 6.1 Stakeholder Mapping) shows the illustration used to discuss relevant actor groups to be represented and included in the KIN. The figure was discussed with interviewees and workshop participants in order to assess potential members and their assumed expectations and contributions for the network.

Farmers: For the group of small-scale farmers, their views on an AIV network were collected in farmer interviews and discussions in Kakamega in addition to triangulating from other interviewees' perspectives and experts' experiences working with farmers and farmer groups.

Most experts mentioned farmers as an essential part of a network for AIVs in order to tailor the problem-solving approach to their specific needs. As a result, farmers' questions and the long-term integration of farmers into innovation processes for agricultural and horticultural practices should be placed at the core of the knowledge exchange (EO_Ken_2; Exp_Tan_6; Exp_Ger_14; Exp_Ken_13) (Chapter 5.1). Starting from the farmers' concerns and requests, experts and other stakeholders can be involved to provide answers, make use of a knowledge databank, assist in designing upscaling plans, or conduct research on the issue. For the farmers, therefore, the incentive to ask their questions would be that they

will receive a prompt answer or long-term advice catered to their specific needs (Exp_Ger_17; Exp_Ken_13). Moreover, a network could provide them with valuable business ties and possibly even access to markets, which farmers regarded as a vital criterion for successful innovation practices (Chapter 5.1).

By establishing a "one-stop shop" for farmers' needs, the network could be highly effective in improving access to knowledge on AIVs for improved nutrition and as a business model in the long run (EO_Ken_2; WS_Nai1). Moreover, mechanisms for knowledge exchange among farmers within the same region or geographically comparable regions can be helpful for speeding up innovation processes and learning (Exp_Ken_3). Here several examples of ICT technology to link farmers with one other and with experts were given (see section on ICT below).

Farmers would also have to be integrated as fully capable actors in the network, being able to join in decision-making processes. Since not every small-scale farmer would be able to join such a network personally, it is important to consider representative structures or ICT technology for farmers that can be used for successful long-term relations. A suggestion here was to make use of the structure of the so-called *barazas* or community meetings (Exp_Ger_3; FGD_Ken3; WS_Nai1) or even to connect the network to local festivities such as dances (FI_Tan_13).

Public Extension Services: From the end users' point of view, both farmers and extension officers are crucial actors to consider for the KIN. On the one hand, the latter may serve as linking actors connecting policymakers and researchers with farmers as end users. On the other hand, they are also actors with their own specific set of interests and behaviour (EO_Ken_1). Therefore, it is important to consider what role extension officers ought to play for the KIN (Exp_Tan_7). Ideally, extension officers would combine the role of linking the farmers to one another and with researchers, translating scientific and political language (literally and in terms of speaking an easy-to-understand language), and improving personal skills and knowledge concerning horticultural practices and innovations (chapters 5.1 and 5.2). However, this role has to be carefully clarified, depending on the extension officer's position and reputation within the farmer community and the possibility of linking extension services with research or public policy tasks.

Moreover, the mandate of the extension personnel needs to be very clear – whether they are employed by the public sector, private sector, or work independently – and to what extent their tasks include governmental work,

scientific research, development work, or aspects of each (Exp_Ger_14; Exp_Tan_7) (Info Box 5). Furthermore, the idea was expressed of including the education sector in the ongoing training of extension services. It was suggested to train extension officers on AIVs even before they start to engage in the field (Exp_Ger_9; 14). Several interviewees working in extension services in Kenya claimed to be highly motivated to participate in an AIV network. They expressed great interest in learning more about AIVs and market linkages, as well as getting in touch with colleagues working on the same topics (EO_Ken_1).

Other Linking Actors: Other actors linking the end users with researchers and policymakers were identified: private extension services, agrovets, non-governmental organisations, faith-based organisations, education actors, trained nutritionists, legal advisors, youth organisations, and others (Exp_Ger_15, 9; Exp_Ken_11, 6, 7; WS_Nai1). All of them were mentioned as potential stakeholders in an exchange and learning process, serving to link different aspects of a KIN such as production, marketing or human health. Suggestions were made about whom to include for potential membership and further actors were identified for potential interviews. However, only some of the groups mentioned here could be interviewed in this study (namely representatives of NGOs, faith-based organisations and nutritionists) and all expressed interest in the network, especially concerning training and information-sharing mechanisms.

Academia: From the researchers' perspective, which was mostly – but not solely – given by HORTINLEA consortium members, a strong emphasis was put on academic exchange and collaboration between research institutes (Exp_Ger_8, 9, 10). It became clear that a post-HORTINLEA exchange and sharing of academic knowledge would be highly welcomed. Several interviewees were willing to continue with the HORTINLEA project if a follow-up phase and funding were provided, and many mentioned that they would be highly interested in future joint proposals and high-level publications (Exp_Ken_13; Exp_Ger_1, 18). Interviewees suggested that mechanisms for identifying suitable and interested partners for project-based work could be integrated into the network to make future cooperation easier and more efficient (Exp_Ger_7, 8). In addition, the idea of developing a knowledge databank on AIV and horticultural research was mentioned (Ex_Ger_9, 14); it could be based on HORTINLEA results and in close collaboration with the existing structure of the AIV databank established and maintained by Dr Patrick Maundu and his KENRIK initiative in Nairobi (Exp_Ken_13).

Most interviewees also mentioned the benefit of learning directly from the farmers' and end users' perspective as an important aspect of academic exchange and the learning experience from HORTINLEA (Exp_Ger_14; Exp_Ken_13). Additionally, sharing academic knowledge and connecting with farmers often serves to motivate researchers in pursuing their work and getting feedback and ideas from the field (Exp_Ger_14, 7, 8; Exp_Ken_13). Moreover, it was mentioned that researchers could profit from getting in touch with the non-academic community in terms of training their networking skills and speaking to end users (Exp_Ger_14; Exp_Ken_13). As such, they could not only quickly receive feedback on (preliminary) research results but could also stay updated on farmers' issues and questions.

Moreover, researchers could benefit from learning how to translate scientific language for end users and learning advocacy methods (Exp_Ger_10, 14; Exp_Ken_11). The interdisciplinary and transdisciplinary character of multi-stakeholder networking was highlighted for sharing ideas and approaches on how to influence policy (Exp_Ken_13; Exp_Ger_11).

Lastly, it is important to examine the role of most interviewed researchers as employees, mostly of public universities or national and international research institutes. As such, most actors in this group are focused primarily on research and less on development practice. With HORTINLEA being an exception to the rule, researchers' roles, possible contributions, and interests in transdisciplinary work have to be considered carefully when designing the network.

Policy and Governmental Actors: The perspective of the policy domain was largely covered by interviews with policy analysts and advocacy actors on the national and local county level in Kenya (in Kakamega and Vihiga counties). Hence, a range of important contributions and needs for policymakers were identified at both levels.

In coherence with the suggestion to integrate advocacy work into the network's goals, the need for a network to respond closely to existing policy and issues was identified. Moreover, stakeholders from the policy level need to be involved in ongoing discussions about current AIV issues and be presented with comprehensive research results which allow them to follow up on innovation processes and select recommendations for their work (Exp_Ger_17; WS_Nai1). Such recommendations and advocacy should be based on scientific work and the actual needs of the end users, which should be combined in the network. Policy actors identified the main benefits as receiving timely information and easily getting in touch with stakeholders from different target groups, including farmers

or non-governmental linking actors. The importance of engaging in joint meetings or exchange was stressed from all sides in order for end users to voice their policy concerns, for linking actors and researchers to translate these concerns, and for them to be discussed with the policy experts (Exp_Ger_14).

As far as the contributions of policymakers are concerned, most interviewees regarded this actor group to be important for speeding up legislative processes and addressing urgent issues. Moreover, they were identified as important stakeholders in funding initiatives and promoting them to the public (Exp_Ger_10; WS_Nai1).

The suggestions listed here are related to different policy levels, from local communal decision-making structures, which recently gained importance due to devolution processes that began in Kenya in 2013, up to the national or even wider regional levels of advocacy on trade and marketing regulations. The local or county level, however, was identified as the most important for quick responses and ad hoc decision making favouring small-scale farmers (Exp_Ken_4; EO_Ken_2). In addition, the national level has to be targeted for countrywide policy and legislative decisions regarding horticultural production, innovation, health, and trade concerns (Exp_Ken_11, 7; Exp_Ger_10). By connecting small-scale vegetable production to the larger value chain and other stakeholders, the issue may become more viable for political and business interests. This may make the topic of AIVs more politically relevant in the long run, thereby improving conditions for AIV farming (Exp_Ger_10; Exp_Ken_7).

Private Sector: The private sector (large-scale AIV farmers, commercial seed companies, network organisations, and social businesses) were also included in data collection and analysis. Representatives from this actor group expressed their general interest in joining a network to expand their research and development activities, gain access to new technology, and enlarge their customer base and market reach (WS_Nai1). By developing mechanisms for identifying market needs and supply chains, business actors can benefit from knowledge exchange for improved market access and product processing (Chapter 5.1). Moreover, not only commercial AIV farmers but also small-scale farmers or farmer organisations who want to upscale their production could be integrated into the knowledge sharing cycle and learn from one other. Various stakeholders mentioned including the diverse private sector as an asset with respect to drawing up business partnerships and securing investments related to AIV activities for and within the network (WS_Nai1; Exp_Tan_12; Exp_Ger_14).

However, it is important to be aware of profit-driven interests, especially with actors from the private sector, when identifying potential members, as there is the challenge of competition among commercial business actors (Exp_Tan_12; Exp_Ken_4, 13; Exp_Ger_14). Hence, stakeholder interest for potential participants is different here than among the other actor groups. Thus, it needs to be considered to what extent the network should serve individual (business) interests or have a social and not-for-profit purpose. Nevertheless, a common interest in the overall goal of raising awareness on the topic of AIVs was detected.

Means of Communication (KIN Intern)

This section will outline specific tools for internal exchange and knowledge sharing based on the ideas from interviewees on possible tools and instruments they personally would like to have for the network. In addition, the next section will consider mechanisms of external communication and dissemination that respondents thought would be helpful for communication with others outside the network. Whether each tool is useful for each actor group and whether it serves the purpose of the network, however, will be considered in the recommendations section of this chapter.

ICT (Information and Communications Technology): Interviewees mentioned ICT most often as their preferred medium for regular communication (Chapter 5.2). This included emails and a website, as well as an intranet platform in combination with regular newsletters. However, the frequency with which people would like to receive information by email or newsletter differed greatly. Some said they would use an intranet site (such as the existing HORTINLEA structure) regularly, whereas others had never used one. However, most interviewees mentioned that an email once in a while, updating them on recent activities or as a reminder of events and deadlines, was acceptable. Moreover, a well-managed knowledge system and documenting communication over time was valued highly (Exp_Ken_6; Exp_Ger_9). In addition to a formal, structured online platform, several interviewees and workshop participants mentioned social media and smartphone applications as their communication channels of choice. Platforms such as Facebook, Twitter, or WhatsApp were mentioned for regular interaction (WS_Nai1). Despite some remarks that there was a lack of internet access in some remote villages, most interviewees were convinced that rural stakeholders would also access a webpage occasionally or use a smartphone (Exp_Ken_13; EO_Ken_1), which was then confirmed by farmers in Kakamega (FGD_Ken_3). Moreover, most people would like to connect the information system to tools for receiving further information such as real-time market prices, a question and

answer tool, or a hotline for expert services in addition to the information provided on the network, ongoing activities and topic areas (Exp_Ger_13, 14; Exp_Ken_7).

Mobile Phones: Despite the praise for internet-based sharing mechanisms, conventional mobile phones were also mentioned as an important tool for quick and efficient information sharing and exchange, since the general perception was that non-internet mobile phones have a greater reach than smartphones in Kenya. Most interviewees confirmed that nearly every farmer or farmer household has access to at least one mobile phone (Exp_Ken_3). According to the interviewees, mobile phones are commonly used to access market price information by short messages, conduct credit or money transfers, call hotlines or experts to get information on horticultural practice, or use farmer to farmer SMS services. Hence, mobile phones (including smartphones and non-smartphones) were identified as important tools for reaching out to rural areas as well as for keeping stakeholders connected on national and regional levels.

Personal Contacts and Regular Meetings: Apart from virtual communication, many interviewees mentioned physical meetings and personal networking opportunities as crucial parts of successful networking. An annual meeting and/or regular working group meetings were mentioned as highly desirable (Exp_Ken_11; Exp_Ger_10, 13) in order to maintain a social network and get in touch with other members. In addition to the general willingness to travel for regular meetings, interviewees mentioned the desire for trainings and thematic seminars (for instance summer schools for PhD candidates, skills training on networking and advocacy for researchers, and seminars for extension officers) (EO_Ken_1; Exp_Ger_6, 11, 24). However, with respect to different actor groups, one has to consider the ability to travel and carefully consider whether travel costs are to be covered by the network, for which distances, and for whom (see the section on farmers and economic sustainability in this chapter).

Other Tools: In addition to the above-mentioned instruments and communication measures, interviewees suggested a blog with regular updates from the network as well as farmer field schools with leading farmers who are willing to try innovative practices or organise a seed show in which farmers can show their seed varieties (Exp_Ger_4, 9; Exp_Ken_4).

Means of Dissemination (KIN Extern)

ICT (Information and Communications Technology): As with the internal communication mechanisms based on ICT technology, most interviewees mentioned internet-based instruments for external network outreach. Websites, social media, and smartphone applications were mentioned to be of interest for knowledge sharing and dissemination with external stakeholders. This was again based on the assumption that the coverage of smartphones and the acceptance of such technology for professional use are very high in Kenya (Exp_Ger_9; Exp_Ken_13). Moreover, several interviewees mentioned that they personally had experience with the development of smartphone apps or websites providing easy-access information on a certain topic (Exp_Ger_11, 15, 1; Exp_Tan_4, 12). Examples range from farmer information services (Exp_Ger_15) to market price access (Exp_Tan_12) and farmer to farmer services (Exp_Ken_3).

Mobile Phones: Similar to internal means of communication, most experts mentioned the use of mobile phones as important channels for knowledge dissemination. This includes a database of phone numbers to call and text individuals in addition to sending out information to groups of people (Exp_Tan_12; Exp_Ger_14). Group messaging for large-scale use was explored when talking to representatives from a service provider of text messages and different ICT developers. Here it was confirmed that text message services provide wide coverage in Kenya and the wider region due to advanced technological development in the sector. As well as the option to send out information to potential stakeholders in the field, it can also be used to engage people in conversations, for instance by connecting farmers to each other for guidance and help. For instance, this approach is pursued by WeFarm, a social business based in Nairobi (see Info Box 16). Similar mechanisms of wide-scale dissemination were suggested by the AIV experts (Exp_Ger_14). However, it was also emphasised that any use of ICT needs to be accompanied by trainings on how to make use of it, especially at the end users' level (Exp_Ger_15; Exp_Ken_3).

Info Box 16: "WeFarm"

With a customer base of more than 300,000 small-scale farmers in Kenya and Uganda, WeFarm is a social business that provides farmer to farmer text messaging services. In addition, to answering farmers' and extension officers' questions in short messages from other farmers or experts, the network also sends out information such as "farming tips" to disseminate valuable information on agriculture and livestock keeping in the region. Moreover, all communication is made available online as a live feed for non-subscribers to follow (Exp_Ken_3; WeFarm 2017).

Conventional Media: In addition to new technologies and tech solutions, interviewees also mentioned conventional media tools such as radio, television or newspaper articles. There was some positive experience with knowledge sharing using the radio, as most farmers in rural areas seem to make use of it (Exp_Ger_14; Exp_Ken_5). Television was mentioned once as a mass medium for outreach, but there were few prior experiences with its effectiveness (Exp_Tan_6). Lastly, newspaper articles, magazines, and press releases were listed as having been useful tools in the past for spreading knowledge and raising awareness (Exp_Ger_10; Exp_Ken_5).

Scientific Publications: Academic publications such as journal articles or dissertations were mentioned by the research community as a main motivating factor to participate in a network (Exp_Ken_6). At the same time, interviewees were very aware of the fact that this type of output entails little benefit for the non-academic stakeholders if not made available and comprehensible to them. Hence, it was suggested to include not only high-impact publications but also mechanisms of translation and simplification for research results (Exp_Ken_13; Exp_Ger_10, 1). Nevertheless, other stakeholders expressed their interest in academic research and the opportunity to receive access to current research and publications (EO_Ken_1).

Personal Contacts and Public Events: For sustainable networking and maintaining personal contacts, most interviewees agreed that regular personal meetings or calls are necessary. The interviewees emphasised that inter- and transdisciplinary exchanges are especially important to them, and they wished to

meet regularly in person (ranging from every couple of months up to every second year) with not only network members but also external stakeholders (Exp_Ken_6; EO_Ken_1; Epx_Ger_4). Extension services were again identified as playing an important role when connecting the end users to the academia and policy levels (FI_Tan_55).

Moreover, it was mentioned that visits between county representatives and different policy making levels (including national and local) are highly desirable in order to understand contexts better and engage in communication and dissemination (Exp_Ger_10, 13). Furthermore, it was envisioned to have a physical one-stop location based in a strategic location for external partners or stakeholders (WS_Nai1).

In addition, public events like thematic open days (for instance concerning awareness raising or advocacy), workshops, open farm visits, or round tables were mentioned as possible formats (Exp_Ger_10; Exp_Tan_12; Exp_Ken_4). Again, for political and advocacy work, personal contacts and networking were identified as being essential (Exp_Ger_14; Exp_Ken_7).

Other Activities: Furthermore, it was mentioned that a magazine for regular information on the network's activities could be published. This would be a tool not only for sharing information on AIVs and horticultural practices, but would also be a marketing and advertisement tool for the network itself (Exp_Ken_5).

Lastly, trainings for and with external partners were deemed essential, especially by the farmers (Chapter 5.2). This perspective was supported by the researchers (Exp_Ger_15), who emphasised the need for integrated dissemination tools for sustainable knowledge exchange.

Setup of the KIN

The following section describes how interviewees envisioned the setup of the network with respect to its administration, membership, and working structures. This section also presents several suggestions that were made regarding so-called leading actors or "AIV champions" (Exp_Ger_14), highly renowned actors who could steer or advise the network. This is followed by some more general remarks by interviewees on different dimensions of sustainability. Recommendations will be derived at the end of this chapter.

Administrative Structure: From the interviewees' perspective, a clear organisational structure and administrative responsibilities are necessary for a new KIN. Opinions on how exactly the network should be administered ranged from having a permanent secretariat to attaching the network to the bureaucratic structure of

an existing organisation. Most people agreed that a new structure should be based on the existing HORTINLEA consortium, including existing mechanisms of exchange and established contacts. However, it was also suggested that it needs a certain degree of formalisation – in addition to flexibility – to include other stakeholders, motivate them to participate, and make contributions easy and continuous (Exp_Ger_6, 19).

Contrary to the existing HORTINLEA network, the need for a permanent secretariat, sub-groups and offices for regional or county level exchange, and a chairing board were mentioned (WS_Nai1; Exp_Ger_19; Exp_Ken_7, 11). Suggestions for the physical location of a permanent structure were given, with two main ideas: the Kenyan Agricultural and Livestock Research Organisation (KALRO) as a well-established actor able to connect stakeholders from different policy and working areas, or a university-based location (Exp_Ger_14; WS_Nai1). In addition, the option of sub-offices or local branches on the county level was mentioned (WS_Nai1). It was generally agreed upon that a secretariat is needed to administer membership, organise activities and meetings, and to attend to decisions in the network and follow up on them. It was also suggested to have a governing board responsible for steering and monitoring the network. Members of the board could be elected by the network's members and possibly reflect the participants' structure or origin in order to be able to make representative decisions for the network. Moreover, a presidency or chair position could be established in a rotating manner (WS_Nai1). Lastly, all decision-making and leadership structures of the network must be given a legal framework that suits the national and cultural contexts of the participants and stakeholders (Exp_Ger_19).

Membership Structure: From the leading figures to the general members, there were several comments made about how to motivate people to become a member of a KIN for AIVs, as well as on the roles, rights and duties of members. In general, it was mentioned that the barriers to becoming a member must be low; it must be easy to decide to participate, and it must be possible at a low cost (relative to the means of the actor group in question) and with very little effort. Interviewees stressed the fact that the application process should be quick and easy, and if there is a selection process, it must be very transparent. This is not only in order to avoid frustration but also to manage people's expectations (Exp_Ken_4). Moreover, it needs to be considered whether invitations, information material, and the activities themselves should be conducted in one or several languages, possibly including local languages, to make the network participatory and inclusive for people from different communities and backgrounds (WS_Nai1).

Furthermore, the question of a registration fee, a membership fee, or voluntary contributions needs to be settled. As with the administrative structure, the rules and regulations regarding membership need to be written down and codified somewhere for members and others to access easily (WS_Nai1; 2).

Leadership and AIV Champions: Aside from the active participation and continued motivation of members and stakeholders of the network, it was frequently mentioned that there should be a few leading actors who are responsible for the general supervision and promotion of the KIN (Exp_Ger_19). Necessary qualities of those actors include topical knowledge and expertise in the field of AIVs and horticulture as well as communication and marketing skills to advertise and lobby for the network and its goals. However, these qualities do not necessarily have to be found in just one person; it was also suggested to have a "core group" to steer the network, composed of some thematic experts and others who are explicitly non-experts but contribute with the necessary communication skills (Exp_Ger_16). In this regard, several names of individuals active in the AIV subsector and leading figures in AIV research and policy were mentioned, including Prof Mary Abukutsa-Onyango who is a renowned figure in AIV research in Kenya.

Working Structure: For the working structure, several ideas were mentioned revolving around the vision of having sub-structures such as working groups and thematic platforms (Exp_Ger_18, 7; Exp_Ken_11). This not only includes ad hoc working groups that initially develop the structure and setup of the network, but also permanent thematic exchanges between members. Moreover, external experts should be included in such working groups in order to expand the visibility of the network's activities and its qualitative outputs (Exp_Ger_9). Again, the initiative of thematic sub-groups or fora was suggested, potentially based on the HORTINLEA thematic approach of different subtopics along the AIV value chain (Exp_Ger_13, 14)

Lastly, interviewees emphasised including cooperation with other networks or platforms in the permanent working structure of the KIN. Several examples of networks active in the agricultural or horticultural sector and in the region, and how they function, were collected during the interviews and workshops. These range from farmer representation and civil society umbrella organisations (such as PELUM, EAFF, KENAFF), to advocacy and policy organisations (such as TAHA, KENAFF, EAGC), academic networks and initiatives (such as HAK, AIRCA, icipe, WorldVeg, PAEPART, or the KENRIK AIV database) and others (Annex 6.1 Stakeholder Mapping). Since these networks or organisations are already highly

integrated and well established in Kenya and Tanzania, interviewees repeatedly suggested linking any new initiative to their work and knowledge systems. Moreover, it was emphasised that the network should work on different policy levels, including not only national structures and representatives but also subnational and international levels when necessary.

Sustainability of the Network

The final section of the network analysis outlines aspects related to the sustainability of the KIN and possible challenges to be addressed in the long run. As described in the conceptual chapter, sustainability is examined along three dimensions: the ecological, economic, and socio-cultural.

Ecological Dimension: For the ecological sustainability of the network, interviewees mentioned that the recommended innovations and agricultural practices discussed within the KIN should be open to an ecologically sustainable approach. However, stakeholders also mentioned the need to adapt to the local context (Chapter 5.1.3), raise awareness of the production of local varieties, produce cash crops for foreign markets, and promote ecological practices (Exp_Ken_4).

Economic Dimension: Most of the remarks made about the sustainability of the network concerned the economic dimension. The question of sustainable funding to kick-start activities and cover running costs was especially discussed. Membership fees, voluntary contributions, and external project funding were mentioned as ways to cover expenses such as office costs, equipment, personnel, and travel costs (Exp_Tan_6; Exp_Ger_6, 10, 18). However, gaining donor funding from umbrella organisations and networking was described as very difficult by both experts and end users in the field of networking (Exp_Ken_4; Exp_Ger_19). This is due to the fact that it is usually difficult to relate networking activities to a direct impact or output and beneficiaries. Therefore, funds would probably have to be acquired from different sources for different network or project activities in order to provide continued funding. One suggested solution was to identify a sponsor from the governmental or international level such as the Kenyan government, African Union, European body, or another international organisation that might be interested in the long-term maintenance and expansion of an AIV network or project-based funding (Exp_Ger_7; Exp_Ken_13, 4). However, interviewees were generally positive about minimal membership fees – some even mentioned that having too low a fee would make the organisation appear non-professional, and that a participation fee of a certain amount would actually motivate people to continue to participate (EO_Ken_2).

Social Dimension: The social dimension of a sustainable network was mentioned several times in relation to potential stakeholders and their representation and participation. As most interviewees wished for a multi-stakeholder network, it was discussed how a KIN can be accessible and sensitive to different member groups and different types of capital or resources (Exp_Ger_15; Exp_Ken_4). One recommended best-practice example was to include permanent personnel in the network's administration to account for issues such as gender, women's representation, youth issues and the inclusion of elderly and disadvantaged people (Exp_Ken_7). The network and its structure could also integrate a certain degree of sensitivity to existing power structures and hierarchies that are of utmost relevance to understanding the interactions and exchanges between stakeholders (Exp_Tan_7). Failing to account for such differences, on the other hand, may lead to some stakeholders and decision makers being disempowered or intimidated by others (Exp_Ken_4). Representatives on the farmer level also emphasised this risk, reflecting on previous experiences with failed development and capacity building initiatives (FGD_Ken_1).

Furthermore, it was mentioned that there are acute cultural preferences in communication tools and mechanisms depending on the region and country of origin. Thus, the network must remain flexible in the choice of tools and opportunities for member or stakeholder engagement (Exp_Tan_13).

With regard to wider political implications and accountable institutions, interviewees mentioned the difficulty of sustaining the interest of political decision makers over terms of office and constantly changing policy preferences (Exp_Ken_2). This issue becomes especially urgent during phases of political change, as during the period in which this study was conducted. Moreover, several interviewees mentioned the problem of promises made by policymakers and high-level representatives that were not kept. Additionally, the issue of corruption impeding development processes on all levels of governance was mentioned by several stakeholders (FGD_Ken_2).

Closely connected to this structural problem of corruption and providing selected benefits is the issue of vested interests in a diverse set of stakeholders. Each arrives with their own expectations and needs that may include specific interests to the disadvantage of others. Usually this response was closely linked to business interests or private sector participation (Exp_Ken_4, 9).

5.3.3 Designing the Network

The third conceptual step is to provide concrete recommendations and show some best practice examples for the prospective implementation of the KIN (see also Chapter 3). Based on the interviews and feedback from experts, the potential objectives and outcome of the network were verified, the stakeholder mapping of the KIN was validated, options for an administrative structure were suggested, possible mechanisms for communication and exchange were identified (including the use of training for stakeholders) and sustainability mechanisms were explored. After analysing the primary data and best-practice examples from the field and the literature, this section provides a set of recommendations for the next steps on how to implement a network.

All recommendations are tentative and should be understood as a condensed version of the empirical findings. What interviewees individually preferred is compiled into a comprehensive list of steps and follow-up phases to allow for the future kick-start of the network. However, all findings need to be considered within a certain set of conditions. First, a committed core group of delegates needs to be identified who can begin putting the networking process into practice. Second, the amount of funding crucially determines the initial kick-start and growth opportunities for the network. Finally, a list of next steps for implementing the network is provided in Annex 6.2 Next Steps for Implementing the AIV Network.

The text below provide concrete recommendations for a *draft concept note* on how to design a Knowledge and Innovation Network (KIN) for AIVs based on the empirical findings of this chapter.

Recommendations for Implementing a KIN for AIVs

Long Term Impact

Decide on a set of long-term goals or change objectives the network aspires to achieve in the future – if possible specify indicators for measurement. Some possible recommendations based on the findings:

- Raise awareness on AIVs' potential for nutrition and food security in Kenya and Tanzania
- Improve livelihoods of small-scale farmers and consumers by promoting the value chain and economic benefits of AIV production and consumption
- Promote knowledge exchange to close the gap between research, practice and policy concerning horticultural knowledge.

(Intermediate) Goals

Set concrete intermediate goals that are realistic, measurable, and achievable for the network in general or for sub-groups of members. For example:

- Support the AIV value chain - from production to marketing to consumption - to contribute to increasing per capita production and consumption of AIVs in Kenya and Tanzania
- Help create a positive policy environment by contributing to policy processes on local and national levels and carrying out advocacy work on behalf of the network's members
- Support rural youth, young business professionals and researchers to actively engage in the topic and promote AIVs.

Membership Structure

An appropriate membership model should be specified. Some important considerations to be made are:

- Decide who can become a member and whether there are different types of membership (individual or organisational registration)
- Determine the membership registration model (online, personally)
- Decide whether there is a registration fee and/or an admission process to apply for membership and if there are criteria attached (e.g. motivation statement, organisation's size, previous experiences)
- Set a fixed annual contribution or frequent membership fee, e.g. a regular fee according to member groups (individual: student, professional), have a minimum contribution and allow for voluntary extra payments, or do not collect a fee at all
- Decide whether there is a member codex or code of conduct all members should adhere to (consider connecting it to the registration or make it voluntary to sign up later)
- Codify the rights and duties of members (including internal voting and decision-making powers)
- Discuss mechanisms of exclusion from the network (on what grounds and how)
- Decide on a steering body, its rights and duties (e.g. should there be a chairperson, a board of selected representatives for coordination, or a working group to provide guidance to the network?)
  - Which positions are necessary and/or optional (chairperson, secretary, treasurer, marketing etc.)

- Which roles and responsibilities exist
- Decide on how roles are assigned and for how long.

Administration and Business Plan

A decision has to be made on whether any permanent structures are needed and if they should be newly created or attached to any existing facilities (such as an own secretariat, meeting rooms, etc.):

- Look for office space and locations for networking meetings
- Decide which services should be provided (online, physical).

Funding mechanisms:

- Consider public fundraising and promotion activities and the approximate amount it can generate
- Decide whether to collect (individual) member contributions
- Consider applying for international donor funding
- Consider applying for project-based funding (national and international).

Communication Strategy and Dissemination Tools

Decide which *internal* communication tools the network should use for communicating with and between members. Here are some frequently mentioned tools:

- Send regular email updates or internal newsletters including recent activities and opportunities to connect among members
- Once in a while call people to remind them of the network, its activities and opportunities to contribute
- Arrange face to face meetings, video calls, workshops, and regular events where people can meet
- Connect with members on social media (including WhatsApp, Facebook, Twitter)
- Offer new and creative (ICT) solutions to provide innovative tools for members, but consider accompanying those with trainings or assistance in how to use them
- Provide an internal databank (for instance intranet based) to document communication and have a current list of all members, possibly including contact details.

Consider *external* dissemination tools to promote the network, raise awareness on AIV-related issues and the network's or members' activities:

- Print brochures, flyers, or posters informing others about the project. Keep them current and distribute them at strategic locations or via focal points
- Write and distribute media updates such as articles or press releases
- Use radio, television and other news outlets to raise awareness and spread information on activities
- Have regular open meetings or public events
- Have a website and social media activity (including WhatsApp, Facebook, Twitter)
- Provide a public newsletter or other social media format to sign up for
- Include new and creative ICT solutions and services.

Preferences for communication and dissemination tools vary greatly based on regional and cultural differences – therefore, it is important to offer different tools for different user.

Sustainability of the Network

Consider the long-term sustainability of the network and its activities, including ecological, economic, and social dimensions:

Ecological: It should be considered which role ecological awareness should play and whether to create a focal point to monitor and follow up on issues of ecology. This could for instance be related to:

- Creating a marker or criteria for ecological projects and activities (for instance when considering innovations or new technology)
- Consider a policy on individual travel for networking activities or meetings (for instance restrict aircraft travel or compensate emissions)
- Consider regional and local sensitivity of ecosystems for interventions.

Economic: For the economic dimension, the funding of the network needs to be considered – where to gain financial support and how to ensure a sustainable business model. Moreover, divestment strategies and ethical banking should be taken into account – at which financial institution should the network's funds be deposited? Moreover, a membership fee and how much it should be for all potential stakeholders needs to be decided upon.

- Decide on fundraising strategy and ethical banking
- Consider raising membership fees and which amount(s) for whom.

Social: Equal participation and inclusion measures need to be included for stakeholder groups that may be less powerful, compared to others, and whose interests are oftentimes marginalised. They should actively participate or mechanisms of representation to include such stakeholders have to be included.

These groups may include, among others: women, children and youth, the elderly, handicapped people, illiterate persons, migrants/refugees or persons identifying as LGBTIQ. For each group, a more thorough analysis in terms of representation in the target region and policy needs to be conducted before giving profound recommendations. Yet, some common mechanisms to create sensitivity for issues of intersectionality and power within organisations are:

- Have a focal point or elected representative for one or several topics
- Create a working group on the topic, including representatives from the specific groups
- Invite external experts to talk about a topic
- Write an organisational guideline, codex, or policy
- Provide awareness-raising workshops or trainings for network members (for instance empowerment workshops, critical whiteness trainings or cultural sensitivity trainings)
- Develop a marker or criteria for the issue to be included in all projects and activities of the network.

In addition to the social sensitivity described above, some thought needs to be given to social hierarchies and power structures. This not only focuses on empowerment but also on the risk of some actors being suppressed by others. When implementing the KIN, therefore, there is a need to be aware of vested interests that might (but do not have to) be contrary to the network's goals. This becomes especially relevant when including powerful actors (such as high-level policymakers or business representatives) together with less powerful groups (such as small-scale farmers or linking actors). Reducing such inequalities is extremely difficult and depends very much on the context, yet some general recommendations can be given:

- Have a conflict prevention mechanism or similar tool that helps to discover hidden agendas of actors or at least provides mutual understanding for different positions
- Create a position of councilor or ombudsman to complain to if one feels marginalised
- Include anti-corruption measures and reporting mechanisms.

In conclusion, the preceding list of recommendations for possible tools and mechanisms is a start to be considered when establishing the KIN. It is by no means exhaustive. Emphasis is placed on the fact that the actual contents of the network can only be created by the members themselves and not through conceptual preparation or by the delivery team alone. Instead, the preceding list should serve

as a rough guideline to the most essential aspects to consider when taking the next steps – implementing the network and adapting it to members' needs.

To gain some insights into how these theoretical considerations can be validated by the actual members, the last workshop in Nairobi/Juja included an interactive method that can be regarded as a first trial using the method of "thinking hats" (Brouwer et al. 2015).

Info Box 17: "The Five Thinking Hats"

Each workshop participant was assigned a role (any other than his or her real-life profession) of a potential KIN stakeholder: either as someone from the policy sphere (one role being a local policymaker and another a national representative), farmers (small-scale and commercial), public extension services, academia (social sciences and natural sciences) or private sector (seed company, agrovet).

After taking their role, workshop participants were invited to discuss their views on the KIN – what they think, what are the most important goals and changes a network should bring about, how to measure change, and how to implement their suggestions.

The results and participants' feedback from this session showed that all stakeholders valued the perspective change as a way of thinking about the network from different points of view. Moreover, it was once again emphasised that a network enables people to come together and allows for different dynamics among members (WS_Nai_2). Though the network deals with many different expectations and interests, it may provide inspiration, confidence and synergies between members, prompting them to start working together and to share common goals. Consequently, using interactive methods or tools to bring stakeholders together and actively engage them at the start of the network is highly recommended.

5.3.4 Preliminary Findings for the AIV Network

To summarise the findings of the empirical part of this chapter on conceptualising a network for AIVs in Kenya and Tanzania, there is a need for knowledge exchange on AIVs and there is ample opportunity to implement such a network in the future. Interviewees confirmed their interest and provided a range of ideas regarding who should participate and how the network could be structured. One important aspect of the network is sharing and disseminating knowledge and ongoing research about innovation processes in order to stay up to date. By using a combination of tools, including ICT applications, policy recommendations and hands-on training manuals, a network can integrate diverse interests and fulfill diverse expectations.

The network can contribute to closing the knowledge gap between research, policy and practice. Designed as a representative, multi-stakeholder platform, with the flexibility to adapt to participants' needs and integrate their ideas continuously, a Knowledge and Innovation Network can support sustainable development.

However, it is crucial to keep in mind that the members should be the drivers of the network and its operational procedures. All recommendations provided by this study depend heavily on the commitment and motivation of the potential members and leaders to contribute to the success of the initiative. Furthermore, the setup and activities of the network are highly dependent on the amount and timing of any funding that is gained for the initiative. Funding becomes especially crucial for physical meetings, virtual and physical infrastructure, and activities. Therefore, it is of utmost importance to gain funding for the kick-off or support from any source for a successful launch of the network, in addition to providing further motivation. Aside from achieving a good start, the sustainability of the structure and initiative itself needs to be designed and continuously evaluated – the network should allow for equal participation or representation, be inclusive and be flexible to changing needs and conditions.

Making the network a reality is another big step, for which this study can only lay the groundwork. Next, one needs to organise a delivery team for the actual establishment of the KIN and finalise its design. Funding needs to be applied for, potential members need to be invited, possible activities designed, and the initiative publicly announced. Finally, the network needs to be maintained and members' ideas supported, and it needs to be determined how the network will further develop.

6 Conclusion and Recommendations

The knowledge gap between research, policy and practice – as identified for AIVs in Kenya and Tanzania – is an issue that must be addressed from different angles. At the same time, only if research results are adopted by the end user can the introduction of an innovation be considered a success. Therefore, as illustrated in Figure 16, this study analysed knowledge exchange at three main levels and highlighted three major instruments that contribute to closing the knowledge gap.

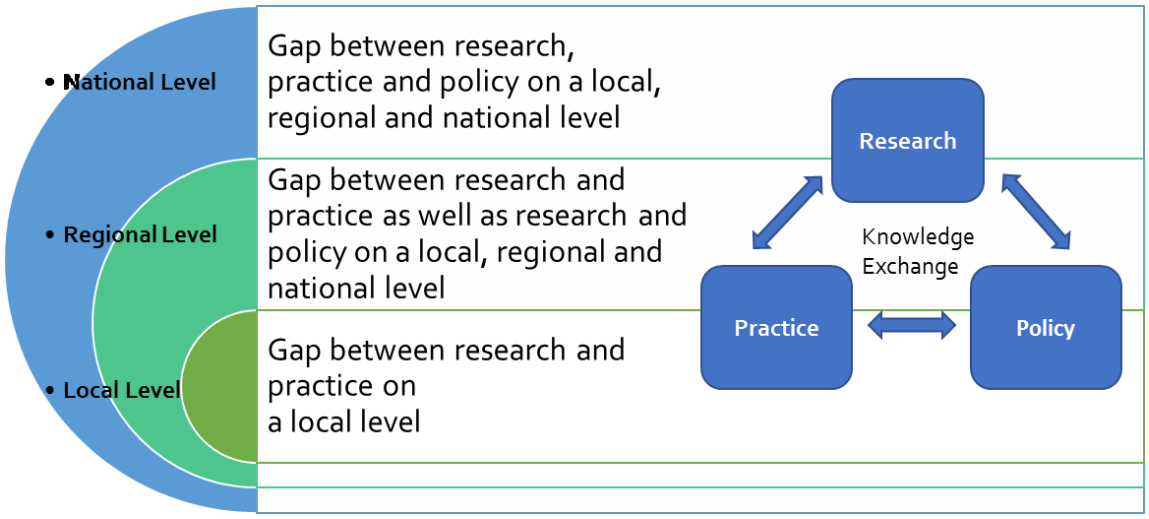


Figure 16: Closing the Knowledge Gap between Research, Policy and Practice

Source: Own illustration

Closing the Knowledge Gap between Research and Practice

For the gap between research and practice on a local level, the innovation process and farmers' criteria for deciding whether to adopt or reject an innovation were analysed. For the general design of a local innovation process, three main aspects should be considered:

1. Training is an essential part of the local innovation process. During training, farmers can get information on the use of the innovation. Training shows the benefits of using the innovation and can be important for raising farmers' awareness of different issues. Furthermore, training increases trust between innovation brokers and farmers, and can give farmers the opportunity to share their own knowledge and local innovations with other farmers or with innovation brokers

2. Village leaders, extension officers and representatives from other local authorities should initiate contact between farmers or other end users and researchers or external actors. This increases the acceptance of innovation brokers and of the innovation itself and helps to ensure compatibility with local circumstances
3. A close follow-up has to be ensured in order to give users the chance to get help if problems occur. It also serves to build trust and ensure circular knowledge exchange.

Concerning the criteria that farmers take into account in order to decide whether to adopt or reject an innovation, various criteria were described and analysed. However, these should be regarded as individual criteria that have to be analysed within their specific context. Moreover, the ranking presented in this study should not necessarily be used as a blueprint for other regions or other innovations. It gives an idea of which criteria are most important within a specific context. The criteria for farmers adopting innovations should be considered during the entire innovation process, starting with goal setting and continuing with innovation dissemination by integrating feedback mechanisms. The criteria should be reflected in all steps of the innovation process and context-specific criteria should be analysed in order to increase success when introducing a new innovation.

Closing the Knowledge Gap between Research and Practice as well as Research and Policy

To close the gaps between research and practice and between research and policy, the development of two target-group-specific dissemination instruments was initiated and thoroughly documented. HORTINLEA research results were introduced to the key actors in a user-friendly language. This includes actors on the practical level – e.g. local extension officers – and key actors on the policy level, such as political decision-makers at different administrative levels in county and national government. In this way, the relevance of the research results becomes clear to the target groups, making it more probable that they will apply the results. The process of developing dissemination instruments followed four major steps:

1. Thematic areas of both the training manuals and policy briefs were identified in a transdisciplinary and interactive manner
2. Based on discussions with experts in the field of knowledge dissemination and on desk research on good practices, the structure and design of the training manuals and policy briefs was specified

3. Research results that had emerged in the framework of HORTINLEA and additional knowledge on AIVs shared by consortium members were collected. Moreover, local knowledge was compiled and categorised under the corresponding training manual chapters and policy brief topics
4. After drafts of the training manuals and policy briefs had been written, they were distributed to experts with requests for feedback. Based on the comments received, drafts were revised and improved.

Closing the Knowledge Gap between Research, Practice and Policy

A Knowledge and Innovation Network (KIN) can be an important mechanism for closing the gap between research, practice and policy on local, regional and national levels. In Kenya especially, there is political momentum to set up a network initiative for AIVs and horticulture – Kenyan politics are supportive concerning the promotion of AIVs since food and nutrition security is a major policy issue in the country. Moreover, the new initiative can build on existing HORTINLEA structures and the consortium network to gain potential members and have a sound knowledge base as a starting resource.

However, establishing the network is a long-term process that needs to be done step by step, developing the concept and preparing the launch together with key stakeholders. For the KIN to be successful and sustainable, potential participants and key stakeholders need to be involved in the final goal-setting process and the creation of the network. Only by including different actors along the AIV value chain can circular knowledge exchange between all involved stakeholders (from the policymaker to the farmer) truly be enabled. For instance, knowledge and research findings about local innovation processes can be shared and developed within a network of academics and practitioners. Furthermore, adequate instruments for communicating and disseminating knowledge are essential. For a network to enable fruitful knowledge exchange among diverse members and with external stakeholders, a mix of dissemination instruments ranging from policy briefs to training manuals and ICT solutions is highly recommended.

Based on these conclusions there are three major groups of recommendations that should be considered while disseminating HORTINLEA research results.

Recommendation 1: Regarding the local innovation process, the inclusion of the farmers' perspective in the entire process is key. This ensures that the criteria relevant for farmers to decide whether to adopt or reject an innovation are considered throughout the entire research and dissemination phases of a project. The criteria collected for this study and the findings on the design of the local

innovation process can serve as a starting point for analysing innovation processes in other contexts. Taking these criteria into account can give an idea of how and when they have to be considered and how information on context-specific criteria can be collected. Nevertheless, it is of great importance that the criteria are collected and discussed with the farmers for each specific local innovation process.

Recommendation 2: The detailed documentation of the development of HORTINLEA dissemination instruments (policy briefs and training manuals), as well as the lessons learned, may serve as a basis for a toolkit on how to develop further dissemination instruments. Applying a participatory and transdisciplinary approach, i.e. involving researchers, farmers and political decision makers alike, will increase the probability that research results are "translated" into a target-group-specific language. Ultimately, this is a crucial condition for research to have a positive impact on development.

Recommendation 3: The development of a knowledge and innovation network can serve as an exit strategy for scientific and/or development projects and thus ensures their long-term sustainability. Within such a network, knowledge exchange continues after the end of the specific project. It is important to create a feeling of shared ownership by integrating potential members into the process of network development. Furthermore, to ensure long-term economic sustainability it is recommended to develop a strategy to gain independence from external support as early as possible. By doing this, donor dependency can be decreased, and the network can continue to grow independently of the research or development project from which it initially arose.

These three groups of recommendations aim to simplify and promote the dissemination and circular knowledge exchange processes. These recommendations are also relevant for similar inter- and transdisciplinary research initiatives, especially for IAR4D-projects. As HORTINLEA will end in 2018, it is now the moment to combine and strengthen efforts to close the knowledge gap between research, practice and policy. In order to achieve this goal and disseminate HORTINLEA research results successfully into policy and practice, the following concluding note should be taken into consideration:

Understanding local innovation processes and using target-group-specific dissemination instruments that are embedded in the wider context of a knowledge network can contribute to closing the knowledge gap between research, policy and practice. This is a prerequisite for research to have a positive impact on sustainable development in the long term.

7 Critical Reflection on the Research Process

The SLE study was carried out over a time period of six months from June to December 2017. It is worth noting some limitations that may have influenced the research process and the results of this study.

In August 2017, Kenya held presidential elections, and after the election the country was politically unstable. Field research therefore began at the World Vegetable Centre in Arusha, Tanzania. The situation in Kenya remained unstable for the whole duration of the research project. Moreover, there was a presidential re-election in Kenya during the last week of October, which further influenced the study. The closing workshop for the study was initially planned for the last week of October but was postponed one week due to the re-election. The research team also ended the field phase one week earlier than planned, resulting in an overall field phase of only two months instead of three, which led to considerable time constraints.

Due to the uncertain political situation in Kenya, one important stakeholder group – policymakers – were underrepresented in workshops and interviews. This resulted in fewer inputs from policymakers regarding the creation of a Knowledge and Innovation Network and the creation of dissemination tools (including policy briefs). The uncertain political situation in Kenya also led to changes in the initial research concept. Although the dissemination instruments and the Knowledge and Innovation Network were analysed in Kenya, some research objectives were reformulated to focus more on Tanzanian farmers. Therefore, during the field phase one sub-team worked very closely with Trans-SEC extension officers to contact farmers in Tanzania. Thus, there may be some farmer bias towards Trans-SEC (e.g. higher ranking of the importance of training and extension officers).

In general, many of the farmer groups involved had already been visited by external organisations – through extension officers and local NGO workers. Such farmer groups may have better access to innovations and funding than others without regular contact with external organisations and/or extension officers.

An additional limitation was the method used for collecting information for dissemination instruments, especially training manuals. This research project made it clear that not all HORTINLEA research results were designed for being disseminated into practice. Moreover, not all HORTINLEA research results may be applicable for farmers and/or extension officers.

8 Bibliography

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9 Annex

Annex 1: Selected Concepts for Knowledge Exchange

Concept	Multi-stakeholder Dialogue[9]	Community of Practice [10]	(Agricultural) Innovation Platforms[11]
Features	• one-off event or series of meetings • to solve a specific issue, e.g. problem-based meetings	• interacts regularly, long-term meetings	• regular exchange processes that are problem-oriented • format ranges from internet platform to physical meetings etc.
Main objective	• increase trust and encourage communication between diverse stakeholders • make different perspectives visible	• speak /deliberate on a common topic to learn from one another • includes stakeholders from different levels	• share information and knowledge creation • diagnose problems and knowledge gaps • identify opportunities
Possible goals	• common understanding of a topic • consensus on an issue • encourage (collective) action	• interaction • communication • tacit knowledge exchange	• explicit and tacit knowledge exchange • joint activities or making an action plan
Preconditions	• contribution by participants • stakeholder's interest in solutions • equitable, accountable communication processes	• common interest in a topic • existence of knowledge to share • equitable, accountable communication processes	• common interest in solving a problem and finding solutions via communication and action • (expert) knowledge for innovation processes
Similarities/ Differences	• diverse stakeholders included • problem-oriented • deliberative / potentially action-oriented • limited timeframe	• diverse stakeholders included • focus on tacit knowledge • deliberative • long-term	• diverse stakeholders included; also external • problem- and innovation oriented • action/activity oriented • limited timeframe

9 Based on (Dodds and Benson 2013; Hemmati 2001; World Bank 2015, 119).

10 Based on (World Bank 2015, 125 ff.).

11 Based, inter alia, on (Adekunle and Fatunbi 2012; Swaans and Hendrickx 2014; Tenywa et al. 2011).

Annex 2: Interview Guidelines

Annex 2.1: Interview Guidelines for HORTINLEA Experts

PART 1: General questions on knowledge gap and exchange in the frame of HORTINLEA

Introduction

[As mentioned], this interview will be structured in four parts; from some broader questions to our three research areas or products. These are also illustrated on this graph.

Here you see the innovation process, linking academic research with the practical users of research results. We think there are two connecting strands, we think are the most important linkages: academic publications and knowledge transfer to the direct beneficiaries/users. However, the red flashes also indicate that we believe there is a gap in knowledge exchange between research, policy and practice. This gap hinders the implementation of research results from HORTINLEA in practice and therefore makes it less probable that a result becomes an innovation, actually used by the particular user group.

Based on this assumption, we are working on improving the knowledge exchange in order to improve the innovation process, from the research result to the actual application by farmers etc. This is reflected in our three products from the study as can be seen here.

Questions

PROBLEMS/GAPS

1. From your experience and SP research, do you agree with the different kinds of problems we identified that create the knowledge gap? (e.g. accessibility, availability)
   1.1. Are the problems we metioned relevant for you? Is something missing?

TARGET GROUPS

2. We identified four most relevant target groups a research result can be directed to: scientific community, multiplicators, political decision makers, and actual users.
   2.1. Who are the most important actors to be targeted for you?

3. Which (group of) actors has to be further involved?
   3.1. Who is missing? During which phase?

IMPLEMENTATION OF RESULTS

4. From your SPs perspective, do your research results find their way into the practical implementation (to farmers or multiplicators)?
   4.1. Have you been (able to) communicate to local partners? Why (not)?
   4.2. How does local knowledge play a role in the knowledge exchange?
5. Did you have any experience with results reaching the policy level? Why (not)?
   5.1. How do you assess the institutional and organisational preconditions (e.g. rules and organisations) in order to implement HORTINLEA results?

PART 2: Innovation Criteria

RESULTS TO INNOVATIONS TO PACKAGES

6. What results do you have? Summary – Looking back
7. What potential innovations can be derived from the results?
   7.1. Can innovation packages be created (with results and innovations) from this and other SPs?

CRITERIA FOR RESULTS TO BECOME INNOVATIONS

8. In order for invention / results to become innovation and to be put in routine use, literature suggests lists of criteria (e.g. affordability). In your opinion, what are the general criteria for adaptation?
9. Concerning your SPs and the potential innovations we discussed. What are the specific criteria for adaptation?
10. If you change the perspective. What do you think, would be most relevant criteria for farmers?
    10.1. How did you integrate that into your research approach?
11. For an innovation to be applied the first step is users to try it. How? --> put into long term routine use)
12. There are different ways of communicating results to the local level. One is piloting on test fields? How should a test field be organised?

13. Do you think / which sustainability criteria do matter for users?
    13.1. How can they be integrated? Are they integrated by the researchers?
    13.2. How could the further adaptation be promoted and integrated into research?

PART 3: Dissemination Tools

Show templates for policy briefs and training manuals.

PART 4: Output 1 – Knowledge and Innovation Network

To overcome the identified knowledge gaps on AIVs, our third approach is to develop a concept for the establishment and maintenance of a network in which actors are interlinked. This serves to improve the innovation process and to really make it circular. I.e. to link back the farmers with the academia, and to report back the adoption criteria to the research process and for further research projects.

STAKEHOLDERS

14. In your opinion, who should be involved in such a network for knowledge exchange of Hortinlea results and AIVs in general? (e.g. researchers, linking actors/farmers representatives, decision makers) [ideally some names are mentioned]

EXPECTATIONS/INCENTIVES

15. What would you, as a researcher, need to be able to contribute at a knowledge exchange mechanism with your research findings?
16. How should a knowledge exchange mechanism look like in order for others to participate, for instance other researchers (e.g. in Kenya), local farmers, NGO partners, extensionists or political decision-makers? [based on the stakeholders that were mentioned before by the interviewee]
    16.1. What do you think these actors would need to be able to contribute?
    16.2. What could be incentives for those actors to participate?

EXPERIENCES

17. What is your experience with such kinds of knowledge exchange mechanisms (in the HORTINLEA project)? What kind of mechanisms have you used (website, email etc.)?
    17.1 Why have you not been using them?

SUSTAINABILITY

18. How do you think could such a network be sustainable in the long run, in the sense of economic, ecological, and social sustainability?
    18.1 What do you think are necessary criteria for it to work?
    [e.g. Extending Hortinlea after 2018, including more stakeholders (other than Hortinlea), ensure financing etc.?]
    18.2 Who could /should take the lead in order to maintain the network?
    [e.g. finances, coordination…]

End: Thank you and further information

This was our last question, and if you don't have any remaining comments or questions to us we will stop here. However, it would be great if we could come back to you (by phone or mail), in case we identify another crucial question? [note email address].

Thank you very much for your contributions and remarks on our project! We highly appreciate your insights and will integrate them both into our process analysis and preparation of empirical work in Kenya.

Annex 2.2: Interview Guidelines for Practioneers (Kenya)

For Farmers:

Warm-up Questions:

1. Which (indigenous) vegetables do you grow on your farm? Nightshade, amaranth, etc.
2. How long have you been growing indigenous vegetables for?

"Quote" Questions:

3. Why did you decide to start growing AIVs?
4. How has your life or your farm changed since growing AIVs? (for better or for worse)
5. What is difficult about growing AIVs in comparison to exotic vegetables?

Training Questions:

6. What topics have you received trainings on in the past? From whom?
7. What topic(s) would you like to have a training on?
8. We are developing two training manuals, one for production and one for consumption (health, hygiene, etc). What information do you think is important to include in the manuals for other farmers?

Health/Nutrition Questions:

9. What health benefits/information do you know about AIVs?
   a. Where did you get this information?
10. What does traditional knowledge say about AIVs and health and/or disease?

Network Questions:

11. Are you already a member of /or supporting a network? If no, why not?
12. If a network specifically on AIVs existed, would you like to be part of it?
13. Which functions should such a network have for you?
14. How would you like to be informed on news about AIVs/ Innovations?
15. How would you like to communicate/participate actively?
16. How would you like to contribute?

For Extension Officers:

1. How often would you say you interact with farmers? In what form? What size are the groups on average? How many farmers are you responsible for?
   a. Do you think you should have more or less trainings/field days with farmers?
2. Do farmers you interact with grow AIVs? Approximately which percentage of farmers you interact with farm African indigenous vegetables? (amaranth, nightshade, etc.)
3. Do you concentrate more on production (farming methods e.g. watering, seeds), marketing information, or nutrition information about the vegetables? What percentage of time would you allocate to each category?
4. Where do you get your information from? How do you update the knowledge that you teach? (government, own research)
5. Do you integrate local practices into your teachings?
6. We are developing two training manuals, one for production and one for consumption (health, hygiene, etc).
   a. Would you be interested in receiving such a manual to use for trainings? If so, specifically which sections would interest you?
   b. What information do you think is important to include in the manuals for farmers?
7. Are you already a member of / supporting a network?
   If yes, which one?
   If no, why not?
8. If a network specifically on AIVs existed, would you like to be part of it?
9. Which functions should such a network have for you?
   a. How would you like to be informed on news about AIVs/ Innovations?
   b. How would you like to communicate/participate actively?
10. Would you be willing/able to travel for networking activities?
11. How would you like to contribute? Would you be willing to pay a membership fee/ would your employer provide such a budget?

For Nutritionists:

1. Who is your main target group? With whom do you interact (share information with) the most and in which setting?
2. When did you first become aware of African indigenous vegetables and their health benefits?
   a. What information have you received about AIVs since and from whom did you get it?
3. Which benefits of AIVs do you share the most with clients?
4. Which illnesses/diseases do you supplement with an AIV diet?
5. In your opinion, who could benefit the most from increased consumption of AIVs? Why?
6. What is important in the preparation of AIVs before meals? (Hygiene, etc.)
7. What are the best ways to cook AIVs?
8. Which health/nutritional aspects do your clients seem most and least aware of?
9. What information do you need more of to share with your clients in order to convince them of the health benefits of AIVs/get them to consume AIVs more regularly?
10. Who else has an interest in promoting AIVs?

(transition into network questions here. Last question specifically open and not related to health benefits in order to link to other actors who are/may be interested in promoting AIVs).

Annex 3: List of Interviews

Expert Interviews Germany

Citation Code	Name	Position and Organisation	Date	Location
Exp_Ger_1	Prof Christian Ulrichs	HU SP2	2017-04-08	Berlin
Exp_Ger_2	Prof Christoph Engels	HU SP3	2017-04-08	Berlin
Exp_Ger_3	Grace Odongo	SP5	2017-07-08	Freiburg
Exp_Ger_4	Dr Evelyn Lamy	SP5	2017-07-08	Freiburg
Exp_Ger_5	Dr Bernhard Trierweiler	MRI SP4	2017-07-08	Karlsruhe
Exp_Ger_6	Dr Kalis Briviba	MRI SP5	2017-07-08	Karlsruhe
Exp_Ger_7	Dr Markus Schmidt-Heydt	SP5	2017-08-08	Karlsruhe
Exp_Ger_8	Dr Dominic Stoll	SP5	2017-08-08	Karlsruhe
Exp_Ger_9	Prof Hartmut Stützel	LUH SP1	2017-10-08	Hannover
Exp_Ger_10	Henning Krause	LUH SP9 und 12	2017-10-08	Hannover
Exp_Ger_11	Prof John Wesonga	JKUAT SP1	2017-10-08	Hannover
Exp_Ger_13	Dr Silke Stöber	HU SP8	2017-11-08	Berlin
Exp_Ger_14	Prof Mary Abukutsa	Berlin	2017-15-08	Berlin
Exp_Ger_15	Judith Henze	HU SP2	2017-16-08	Berlin
Exp_Ger_16	Dr Monika Schreiner	IGZ SP5	2017-16-08	Grossbeeren
Exp_Ger_17	Oshingi Shilla	IGZ SP6	2017-16-08	Grossbeeren
Exp_Ger_18	Dr Benard Ngwene	IGZ SP5	2017-16-08	Grossbeeren
Exp_Ger_19	Corinna Bothe / Monika Pepping	Brot für die Welt	2017-17-08	Berlin
Exp_Ger_20	Dr Susanne Huyskens-Kail	HU SP4,5,7b	2017-22-09	skype
Exp_Ger_21	Anja Kühn	SLE	---	SLE
Exp_Ger_22	Dr Emil Gevorgyan	SLE	---	SLE

Expert Interviews Tanzania

Citation Code	Name	Position and Organisation	Date	Location
Exp_Tan_1	John Macharia	AVRDC – Best practice HUB	2017-16-08	Arusha
Exp_Tan_2	Fecadu Dinssa	AVRDC	2017-16-08	Arusha
Exp_Tan_3	Tsvetelina Stoilova	AVRDC	2017-16-08	Arusha
Exp_Tan_4	Dr Thibault Nordey	AVRDC / CIRAD	2017-16-08	Arusha
Exp_Tan_5	Gideon/Elias	AVRDC	2017-16-08	Arusha
Exp_Tan_6	Hassan Mndiga	AVRDC	2017-23-08	Arusha
Exp_Tan_7	Gundula Fischer / Simon Wittich	IITA	2017-23-08	Arusha
Exp_Tan_8	Andreas Gramzow	AVRDC – Africa RISING-NAFAKA	2017-24-08	Arusha
Exp_Tan_9	Radegunda Kessy	AVRDC	2017-25-08	Arusha
Exp_Tan_10	Elijah Mwashayenyi	Sevia	2017-28-08	Moshi
Exp_Tan_11	Sharanappa	East West Seed Company	2017-28-08	Moshi
Exp_Tan_12	Kelvin Remen	TAHA	2017-29-08	Arusha
Exp_Tan_13	Maureen Meccozi	WorldVeg	2017-29-08	skype

Expert Interviews Kenya

Citation Code	Name	Position and Organisation	Date	Location
Exp_Ken_1	Celine Termote / Isaac Otieno	Bioversity International	2017-07-09	Nairobi
Exp_Ken_2	Nancy Laibuni	JKUAT	2017-14-09	Nairobi
Exp_Ken_3	Teresa Nekesa	WeFarm	2017-15-09	Nairobi
Exp_Ken_4	Zachary Makanya	PELUM	2017-18-09	Nairobi
Exp_Ken_5	Doris Anjawa	the Rural Outreach Program (ROP) Africa	2017-18-09	Kakamega
Exp_Ken_6	Komi Fiaboe	ICIPE	2017-19-09	Nairobi
Exp_Ken_7	Violet Nyando	KENAFF	2017-19-09	Nairobi
Exp_Ken_8	Prof Ann Kingiri	African Centre for Technology Studies	2017-20-09	Nairobi
Exp_Ken_9	Lucy Murungi	JKUAT/HAK	2017-20-09	Nairobi
Exp_Ken_10	Waceke Wanjohi / Shem Bonuke Nchore	Kenyatta University	2017-21-09	Nairobi

Citation Code	Name	Position and Organisation	Date	Location
Exp_Ken_11	Dr David Okeyo Omondi	KNDI	2017-22-09	Nairobi
Exp_Ken_12	Prof Glaston M. Kenji	JKUAT	2017-22-09	Nairobi
Exp_Ken_13	Patrick Maundu	KENRIK	2017-22-09	Nairobi

Extension Officer Interviews Kenya

Citation Code	Name	Position and Organisation	Date	Location
EO_Ken_1	Ruth Apondi	Extension Officer	2017-14-09	Kakamega
EO_Ken_2	Musanga Flora Akanwa	Extension Services	2017-20-09	Kakamega
EO_Ken_3	Metrine N. Muricho	Home Economics Office	2017-20-09	Kakamega

Focus Group Discussion, Workshops and HORTINLEA Days

Citation Code	Name	Date	Location
Focus Group Discussions Kenya			
FGD_Ken_1	Farmer Group	2017-14-09	Kakamega
FGD_Ken_2	Farmer Group	2017-15-09	Kakamega
FGD_Ken_3	Masana Farmer Group	2017-21-09	Kakamega
FGD_Ken_4	Navakhalo Farmer Group	2017-22-09	Kakamega
Workshops			
WS_Aru	Workshop Arusha	2017-25-08	WorldVeg
WS_Mor	Workshop Morogoro	2017-06-09	Morogoro
WS_Nai1	Workshop Nairobi 1	2017-11-09	JKUAT
WS_Nai2	Workshop Nairobi 2	2017-19-10	JKUAT
HORTINLEA Days			
Hdays_Ber	Berlin	2017-04-07	Berlin
Hdays_Karl	Karlsruhe	2017-07-08	Karlsruhe
Hdays_Frei	Freiburg	2017-08-08	Freiburg
Hdays_Han	Hannover	2017-10-08	Hannover
Hdays_Gro	Großbeeren	2017-16-08	Großbeeren

Annex 4: Local Innovation Process and Criteria

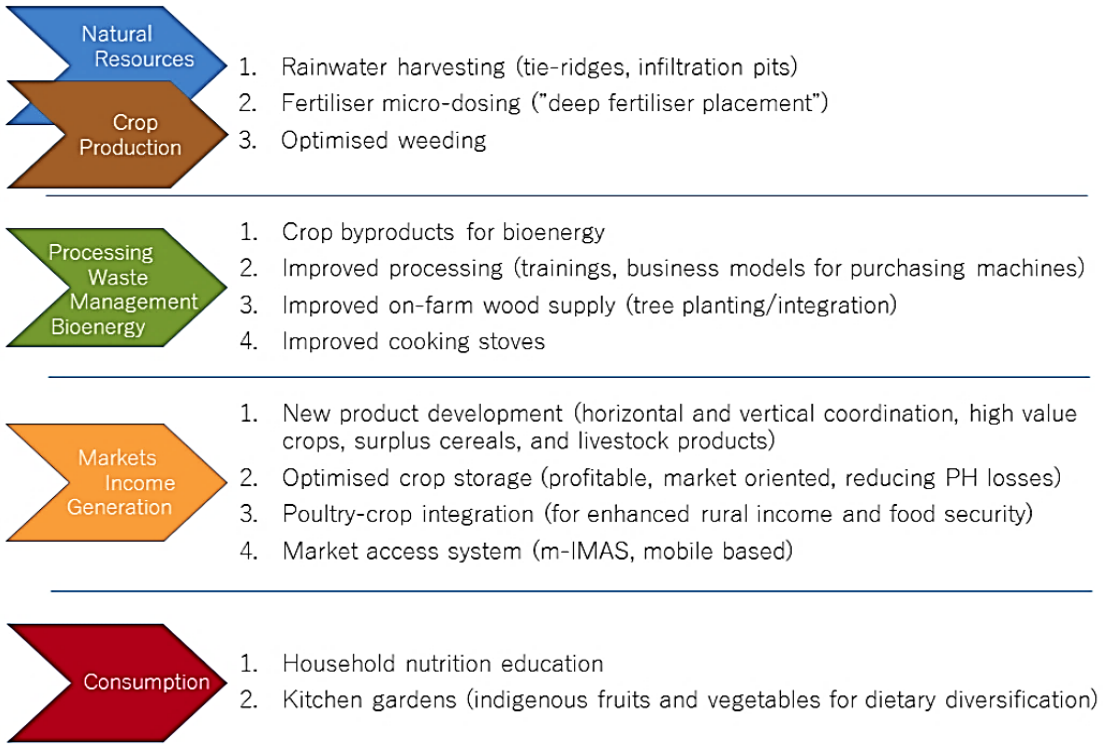
Annex 4.1: Trans-SEC

The research project Trans-SEC *Innovating Strategies to safeguard Food Security using Technology and Knowledge Transfer: A people-centred Approach* aims at improving food security for the most vulnerable rural poor population in Tanzania. In several steps, successful food securing upgrading strategies (innovations) along local and regional food value chains are identified, tested and adjusted to site-specific settings. Additionally, they are tailored for dissemination in regional and national outreach (Sieber and Graef 2012). The analytical steps followed by Trans-SEC are:

1. Stakeholder processes with ministries, NGOs, farmer associations, society and extension services
2. Identification of case study sites
3. Screening of upgrading strategies (success stories)
4. Integrated food value chain analysis
5. Identification of promising upgrading strategies
6. In-depth participatory field testing and/or analysis of selected, most promising technologies (Sieber and Graef 2012).

Following this approach, 13 upgrading strategies along the general value chain were identified. These are shown in the figure below. An integral part of this approach is the high level of participation of all stakeholders and the use of existing local and regional levels (Sieber and Graef 2012). Furthermore, the application of action research allows for subsequent effective implementation.

As can be seen in the upgrading strategies, the focus of Trans-SEC is on agriculture in general. However, AIVs play an important role, especially in the Kitchen garden innovation.



Upgrading strategies of Trans-SEC

Source: Sieber (2017)

The case study sites that were selected are the two regions Dodoma and Morogoro. They differ in climate, with Dodoma region being semi-arid and Morogoro being semi-humid. In both regions two villages were chosen: In Dodoma region the villages Ilolo and Idifu in the Chamwino district and in Morogoro region the villages Changarawe and Ilakala in the Kilosa district. Each of the study sites consists of at least one local marketplace and has partial access to markets for cash crops. However, they differ significantly with regard to climate and market access, which allows for an analysis of the upgrading strategies in different environmental and socio-economic conditions (Sieber and Graef 2012).

The Trans-SEC consortium consists of seven German research institutes (e.g. the Leibnitz-Centre for Agricultural Landscape Research as project coordinator), five Tanzanian institutes (e.g. the Sokoine University of Agriculture and the Network of Small-Scale Farmers' Groups) and two international research centres, one from Kenya (The International Centre for Research in Agroforestry) and one from the USA (International Food Policy Research Institute). The consortium is supported by the funding initiative "Securing the Global Food Supply – GlobE" by the BMBF and BMZ (as is HORTINLEA). The project period is five years beginning May 2013 (Sieber 2017).

Annex 4.2: List of Farmer Interviews

Citation Code	Village	Innovation	Sex	Age	Number of household members	Position in the household	Subsistence or commercial (in percentage)	Farm size (in acre)
FI_Tan_1	Changarawe	m-IMAS[12]	Male	no data	9	Household head	40 % food, 60 % commercial	8
FI_Tan_2	Changarawe	Kitchen garden	Female	51	5	Other	Food more, small commercial	3
FI_Tan_3	Changarawe	Production	Female	49	5	Household head	No data	10
FI_Tan_4	Changarawe	Kitchen garden	Female	57	3	Household head	95 % food, 5 % commercial	2,5
FI_Tan_5	Changarawe	Production	Female	35	8	Household head	Both	2
FI_Tan_6	Changarawe	Production	Female	56	4	Other	Small for food, more for commercial	Land tenant
FI_Tan_7	Changarawe	Production	Male	62	2	Household head	60 % food, 40 % commercial	2
FI_Tan_8	Changarawe	Kitchen garden	Male	48	8	Household head	Maize subsistence (5 %), rest commercial (95 %)	4
FI_Tan_9	Changarawe	Kitchen garden	Female	49	4	Household head	Both (Maize subsistence, beans commercial (90 %))	2
FI_Tan_10	Changarawe	Production	Male	55	4	Household head	Small for food, more for commercial	4
FI_Tan_11	Changarawe	Production	Female	56	1	Household head	80 %	9
FI_Tan_12	Changarawe	Production	Female	56	5	Household head	Food 30-40 %, commercial 60 %	4
FI_Tan_13	Changarawe	Kitchen garden	Male	38	5	Household head	Commercial (beans 60 %, lefuta 80 %)	2,5
FI_Tan_14	Changarawe	Kitchen garden	Male	48	6	Household head	More food, small for commercial	4

12 The Trans-SEC innovation 'Mobile integrated Market Access System (m-IMAS)' was also supposed to be used for the analysis of the local innovation process and the criteria. However, since only one farmer could be identified as using this innovation, the data was not sufficient for an in-depth analysis and it was omitted.

Citation Code	Village	Innovation	Sex	Age	Number of household members	Position in the household	Subsistence or commercial (in percentage)	Farm size (in acre)
Fl_Tan_15	Changarawe	Production	Male	52	8	Household head	20 % food, 80 % commercial	7
Fl_Tan_16	Changarawe	Production	Female	61	4	Household head	20 % commercial	5
Fl_Tan_17	Ilakala	Kitchen garden	Female	54	3	Other	60 % food, 40 % commercial	3
Fl_Tan_18	Ilakala	Kitchen garden	Female	44	6	Household head	40 % food, 60 % commercial	2 (+2 hired)
Fl_Tan_19	Ilakala	Production	Male	50	7	Household head	Beans and peas (100 com), maize and millet 50 com)	5
Fl_Tan_20	Ilakala	Production	Male	60	4	Household head	Small for food, more for commercial	15
Fl_Tan_21	Ilakala	Kitchen garden	Female	56	2	Household head	50 % food, 50 % commercial	3
Fl_Tan_22	Ilakala	Production	Female	49	3	Other	10 % food, 90 % commercial	4
Fl_Tan_23	Ilakala	Production	Female	65	1	Household head	100 % food	1
Fl_Tan_24	Ilakala	Production	Female	No data	2	Household head	Small for food, more for commercial	4
Fl_Tan_25	Ilakala	Production	Male	58	5	Household head	50 % food, 50 % commercial	7
Fl_Tan_26	Ilakala	Production	Male	32	3	Household head	60 % food, 40 % commercial	4
Fl_Tan_27	Ilakala	Kitchen garden	Male	49	5	Household head	Maize (90 com), peas (95 com), rice (100 own)	No date
Fl_Tan_28	Ilakala	Production	Female	31	1	Household head	Small for food, more for commercial	5
Fl_Tan_29	Ilakala	Kitchen garden	Female	40	6	Other	70 % food, 30 % commercial	2
Fl_Tan_30	Ilakala	Production	Male	48	7	Household head	Peas (100 com.), Maize (75 com.), sesame (100 com.), beans (50 com.)	7
Fl_Tan_31	Ilolo	Production	Female	65	8	Household head	60 % food, 40 % commercial	8
Fl_Tan_32	Ilolo	Production	No data	No data	No data	No data	No data	No data

Citation Code	Village	Innovation	Sex	Age	Number of household members	Position in the household	Subsistence or commercial (in percentage)	Farm size (in acre)
Fl_Tan_33	Ilolo	Production	Male	63	11	Household head	No data	18
Fl_Tan_34	Ilolo	Production	Male	31	4	Household head	50 %food, 50 % commercial	10
Fl_Tan_35	Ilolo	Production	Male	44	7	Household head	25 % food, 75 % commercial	6
Fl_Tan_36	Ilolo	Production	Male	45	4	Household head	40 % food, 60 % commercial	3
Fl_Tan_37	Ilolo	Production	Female	27	4	Other	Small for food, more for commercial	3
Fl_Tan_38	Ilolo	Production	Male	31	5	Household head	Small for food, more for commercial	9
Fl_Tan_39	Ilolo	Production	Male	67	9	Household head	Small for food, more for commercial	5
Fl_Tan_40	Ilolo	Production	Male	73	4	Household head	80 % food, 20 % commercial	3,75
Fl_Tan_41	Ilolo	Production	Male	54	10	Household head	60 % food, 40 % commercial	10
Fl_Tan_42	Ilolo	Production	Male	60	10	Household head	90 % food, 10 % commercial	13
Fl_Tan_43	Ilolo	Kitchen garden	Female	29	7	Other	Maize (100 com), nuts and sunflower (50 com)	4
Fl_Tan_44	Ilolo	Production	Male	57	6	Household head	98 % food, 2 % commercial	8
Fl_Tan_45	Ilolo	Production	Female	57	4	Household head	Much more for food	5
Fl_Tan_46	Idifu	Kitchen garden	Male	57	2	Household head	60 % food, 40 % commercial	5
Fl_Tan_47	Idifu	Kitchen garden	Female	40	8	Other	Sunflower (100 com) millet (100 own), rice (100 com)	6
Fl_Tan_48	Idifu	Production	Male	60	6	Household head	Food more, small commercial	6
Fl_Tan_49	Idifu	Kitchen garden	Male	No data	7	Household head	Sunflower (100 com), millet (no data)	5,5
Fl_Tan_50	Idifu	Kitchen garden	Male	43	8	Household head	More food, small for commercial	6
Fl_Tan_51	Idifu	Kitchen garden	Female	53	8	Other	More food, small for commercial	28
Fl_Tan_52	Idifu	Kitchen garden	Male	52	9	Household head	More food, small for commercial	6

Citation Code	Village	Innovation	Sex	Age	Number of household members	Position in the household	Subsistence or commercial (in percentage)	Farm size (in acre)
Fl_Tan_53	Idifu	Kitchen garden	Female	55	6	Other	100 % subsistence	6,5
Fl_Tan_54	Idifu	Production	Female	34	6	Other	More food, small for commercial	5
Fl_Tan_55	Idifu	Kitchen garden	Female	33	10	Other	80 %	8
Fl_Tan_56	Idifu	Kitchen garden	Female	43	5	Other	80 %	6
Fl_Tan_57	Idifu	Production	Female	29	5	Other	90 % food, 10 % commercial	6
Fl_Tan_58	Idifu	Kitchen garden	Male	46	9	Household head	60 % food, 40 % commercial	10
Fl_Tan_59	Idifu	Kitchen garden	Female	20	3	Wife	60 % food, 40 % commercial	2
Fl_Tan_60	Idifu	Kitchen garden	Male	30	6	Household head	75 % food, 25 % commercial	5

Annex 4.3: Method and Questions for Ranking during FGDs

Ranking all cards (for innovations in general)

- Core question: What would motivate you to try something new?
- Show all 10 Cards
- Read them / if necessary explain them briefly
- Facilitate the discussion
- Let the interviewees rank all 10 cards in order
- Only one card per rank
- Facilitate a discussion

Potential Core Questions to ask during the discussion on criteria

- Does the criterion matter?
- In what way does it matter for you?
- Why?
- Has it changed over the past years? → Why? → How? → Is it good/bad for you?
- How do you think is it going to develop in the future?
- How does it influence you?
- What is needed to improve or change it?
- What do the others think?

Core questions to be asked during the discussion

- Why is this the most important criterion?
- What does it mean for you that this criterion is the last in the ranking?
- Are there in your opinion important aspects that are not covered by these criteria?
- What influences the importance of the criteria?
- How do the others see it? Do you agree? Why not?

Annex 4.4: Method and Questions for Ranking during Individual Interviews

1. Ranking all cards (for innovations in general)

- Core question: What would motivate you to try something new?
- Show all 10 cards
- Read them
- Let the interviewee rank all 10 cards in order
- Only one card per rank

2. Choose cards for specific Trans-SEC innovation

- Let the interviewee choose which cards were important for applying/trying the Trans-Sec innovation (focus on one of the three we chose: Kitchen gardens, i-MAS, micro-dosing).
- Take away the non-mentioned cards
- Take the cards left and spread them on the floor in arbitrary order

3. Ranking innovation-specific criteria

- Hand out wooden sticks – **per chosen criterion hand over 2 sticks** (e.g. 4 chosen criteria = 8 sticks)
- Let the interviewee put all the sticks on the cards

Remark: If the interviewee has rejected an innovation, complete step 1. Then ask which criteria were important for him to decide to try the method → for which criteria did he reject the innovation because they were not fulfilled? Or: What were other reasons to reject it?

Annex 4.5: Guidelines Individual Farmer Interviews

Innovation process

A) Introduction questions

Sex: _____

Age: _____

Number of household members: _____

Position in the household: _____

Agricultural products: _____

Subsistence or commercial (in percentage): _____

Other types of household income: _____

Farm size (acre…): _____

B) General questions

1. What were challenges in the production and your daily work you were facing in the past or are currently facing?
   1.1 How did you try to solve them or how are you trying to solve them currently?
2. Who do you ask for information or support if you want to improve something or try something new?

C) Innovation process

3. If you look back the past few years, did you change something or tried something new in order to improve the production or marketing of your products?
   3.1 What and how did you change or try it?
   3.2 Do you still do it? Why (not)?
   3.3 What challenges did you face in the process of improving/changing your production/marketing?
4. How would you like to know about new ways of production and marketing in future?
   4.1 Who should bring the new technology/tool to you? (e.g. foreigners, researchers, people you know)

5. Would you prefer if a completed innovation is brought to you or would you like to be part of the development of the new technology/tool and integrate your ideas?
6. If you decide to try or apply something new, in how far does ecological sustainability play a role in your decision?
7. What do you think are main reasons why some farmers reject trying/using new technologies/tools?
   7.1 How could they be motivated to try/use them?

D) Local innovation process – Innovation-lifecycle (specific UPS)

Adopted/rejected innovation: _____

8. Could you describe the process from the first time you heard about Trans-SEC or the innovation until you tried and adopted/rejected the innovation?
   8.1 Can you describe the way it was presented to you? (if not answered above)
   8.2 What did you like about the process of bringing the innovation to you?
   8.3 What were aspects in the way the innovation was brought to you that we should do in a different way in the future?
   8.4 Were you asked about your specific needs before the innovation was brought to you?
   8.5 Could you suggest changes on the innovation?
   8.6 Was the innovation changed according to your suggestions?
9. What was your motivation to try the innovation?
10. Could you explain if and how the innovation helps you to overcome the challenges you are facing?
11. Did you change the innovation since you are using it? (How? Who did you consult?)
12. Who decided to adopt/reject the innovation?
13. Who did you consult before deciding to adopt/reject the innovation?
14. We want to learn from the experiences you made with new technologies/ tools and with Trans-SEC. From your point of view, what would be the three most crucial aspects that we should be aware of when bringing new technologies/tools to farmers?

E) Conclusion

15. Is there anything you would like to let us know that could be important but has not been mentioned yet?

Annex 4.6: Guidelines Extension Officers Interviews

Innovation process

- According to your opinion and experience, what are the main challenges in disseminating innovations?
- What good and bad practices in innovation dissemination have you experienced in your career or have heard of?
- What are (other) opportunities for farmers to get in touch with innovations and new knowledge (than via extension services)?
- Do you cooperate with other knowledge providers?

Farmers

- Why are some farmers more prone to take up innovations than others?
- Do farmers approach you with problems or questions or do you usually contact them?
- What could make them approach you more?
- From a farmer`s point of view, does sustainability play a role in choosing or applying innovations and new practices?
- What are main reasons for famers to reject innovation and what would potential ways be to reduce the number of droppers?

Extension Officer

- Where and how do you get your knowledge for innovations from? How often?

Closing questions

- Please name the 3 (or 5) most crucial things that we, should be aware of / consider when building up a dissemination project in order to make it a success one.
- Is there anything that you would like to add to our conversation?

Annex 4.7: Characteristics of the Study Regions[13]

	Chamwino district	**Kilosa district**
Region	Dodoma region	Morogoro region
Villages	Ilolo and Idifu	Changarawe and Ilakala
Climate	Semi-arid (500 mm average rainfall)	Semi-humid (800 mm – 1400 mm average rainfall)
Rainy season(s)	Short rains: December – March	Short rains: October – December Long rains: February – May
Population	289.959	587.967
Population density	Below 50 per square kilometre	34 per square kilometre
Literacy	Below national literacy rate (female 62 %, male 72.8 %)	Above national literacy rate (female 73.3 %, male 85.1 %)
Stunting rate for children under the age of 5 years	80 %	60 %
Employment in agriculture sector	87 %	Above 80 %
Agricultural activities	22 % of agricultural households rear cattle Other products: Sorghum, maize, cassava, grapes, sunflower, sesame, groundnuts, bulrush millet and paddy	6 % of agricultural households rear cattle Other products: Paddy, maize, beans, cassava and bananas, sisal, sugar cane, cotton, sesame and sunflower
Use of agricultural technologies (BEFORE TRANS-SEC)	Animal power / tractor for tillage: 14 % / 0,4 % Improved seeds: 21 % Soil erosion control: 16 %	Animal power / tractor for tillage: 3 % / 2.3 % Improved seeds: 16 % Soil erosion control: 4 %

13 Sieber and Graef (2012)

Annex 4.8: Trans-SEC Innovations

Production innovation

Many farmers have not changed their use of the innovation (FI_Tan_11; FI_Tan_31; FI_Tan_45), either because they regard it as sufficient (FI_Tan_22) or because they have not received training for modifications (FI_Tan_57) or are waiting for further training (FI_Tan_10).

Changes made to the innovation by the farmers:

- Increasing the amount of cultivated land / number of plots (FI_Tan_7; FI_Tan_36; FI_Tan_44)
- Using local fertiliser instead (FI_Tan_31)
- Enlarging the holes and reducing their height (FI_Tan_16)
- Not using tied ridges for producing nuts (but for millet) (FI_Tan_45)

Changes suggested for the innovation:

- To change/increase the size of the furrows (FI_Tan_30; FI_Tan_36; FI_Tan_45)
- To use a tractor (FI_Tan_25), ploughs or power tillers (FI_Tan_32)

Kitchen garden

Most farmers have not changed their use of the innovation (FI_Tan_14; FI_Tan_55; FI_Tan_56) because they regard it as sufficient (FI_Tan_18; FI_Tan_53; FI_Tan_60).

Changes made to the innovation by the farmers:

- Fencing kitchen gardens to prevent chickens from eating the vegetables (e.g. with mosquito nets and wooden fences) (FI_Tan_13; FI_Tan_50; FI_Tan_51)
- Planting directly in the ground to avoid using sacks (FI_Tan_50)
- Putting seeds directly in the soil for growth and then transplanting them into the kitchen garden (FI_Tan_58)
- Using small bags to move them around (e.g. to bring into the homestead overnight) (FI_Tan_51)
- Changing seeds since some were eaten by chickens (FI_Tan_59)
- Changes suggested:
- To improve the sacks since they are affected by the sun (FI_Tan_58)
- To provide more bags (FI_Tan_47)
- To fence the kitchen gardens (and to provide training on how to do this) (FI_Tan_13)
- To build wells to facilitate the watering of the gardens
- To use different types of seeds since some are frequently eaten by insects.

Annex 5: Dissemination Instruments

Annex 5.1: Results of Thematic Clustering and pre-selection of Thematic Areas for Policy Briefs

For this activity, participants in the Berlin roundtable were asked to brainstorm about possible invention areas that could be used for the commission of policy briefs (objective 2). They were asked to write down their ideas and to indicate the corresponding HORTINLEA SPs. Afterwards, the ideas were clustered according to the three proposed policy areas of economy, society and environment or another policy area of the participants' choice. The picture below shows the result of this clustering activity:

Results of clustering activity (thematic areas for policy briefs)

Source: Own illustration

The following ideas were developed during thematic clustering and pre-selection of thematic areas for policy briefs:

SP 7 and SP 10

- Awareness and knowledge building (AIV consumer side), e.g. set-up of knowledge bank
- Household infrastructure: Housing policy needed, esp. for water/electricity
- Gender relations, e.g. care work, family and economic work
  - Issue of time: AIV preparation is time-consuming → concerns in particular women (gender division of labor)
- Land rights for women and equal access to land for women

SP 9

- Poverty: Links between society and economy
- Vulnerability of households: Shocks they face, coping strategies they develop
- Informal institutions and services (individual and household level)
- Creation of (formal) credit systems, accessible by farmers in times of shocks

SP 8 and SP13

- Institutions to include particularly poor and marginalised farmers in innovation process (→ incentives to participate)
- Promotion of open markets vs. focus on supermarkets only
- Calculation of profitability of AIV production systems without innovations → hypothesis: Innovations are accepted once it is communicated that they are profitable
- Improvements along the value chain:
  - Conservation/ preservation techniques, e.g. UVC, fermentation and solar drying o Water-saving regimes and strategies
  - Better market access, special case: rural production for urban markets
  - Contact with supermarkets
  - Info on AIV preparation (recipes) and nutrients (e.g. if cooked, more nutrients accessible)
- Nexus between environment/ climate change and water-smart production in the course of the year (overproduction during rainy season, shortage of AIVs during dry season)

SP12

- Implementation of contractual agreements, improvement of market information for farmers, collective action forms, improvement of local market facilities (e.g. with regard to institutions and hygiene)

In general

- Formulation of good production guidelines necessary?

The results of this clustering activity will be used as an important source for the definition of 3-5 AIV invention areas. These areas will serve as orientation whenever it comes to putting research results into practice or communicating them to policymakers.

Annex 5.2: Policy Brief on Health and Nutrition

HORTINLEA
DIVERSIFYING FOOD SYSTEMS

Policy Brief N° 1

Human Health and Nutrition

African Indigenous Vegetables for Enhanced Nutrition Security in Kenya

Emil Gevorgyan, Colleen O'Connor, Elena Ammel, Rebekka Goeke, Julia Legelli, Sönke Maharens, Florian Neubauer

Micronutrient malnutrition is a pressing issue in Kenya. African indigenous vegetables (AIVs) are rich in a number of micronutrients and can contribute to a healthier Kenyan population. The production and consumption of AIVs need to be supported in order for this to happen, which is why researchers from the HORTINLEA consortium have been working along the AIV value chain. In this document the nutritional benefits of AIVs will be laid out as well as recommendations for improving AIV production and consumption.

Introduction and Problem Statement

Vision 2030 is Kenya's long-term development plan to "transform Kenya into a globally competitive and prosperous nation with a high quality of life by 2030."[1] The current health and nutrition status of the country's population and labour force, however, will prove a challenge to achieving Vision 2030 as well as the Sustainable Development Goals (SDGs). Not only will a healthy Kenyan population contribute to achieving SDGs 2 and 3 ("end hunger, achieve food security and improved nutrition and promote sustainable agriculture" and "ensure healthy lives and promote well-being for all at all ages")[2] but a healthy labour force is a prerequisite for Vision 2030 to be fulfilled.

25.8% of Kenya's population is malnourished[3], contributing to the two billion people worldwide who suffer from "hidden hunger," meaning they do not obtain the necessary daily requirements of micronutrients through their diets.[4] These micronutrients, also known as vitamins and minerals, are essential for many aspects of health, ranging from enzyme and hormone production to growth, working capacity and development.[5] Micronutrient malnutrition significantly contributes to morbidity and mortality in addition to having negative effects on productivity and economic growth.[6] According to the Hidden Hunger Index (2013), Kenya was ranked second among countries affected by multiple micronutrient deficiencies. Micronutrient malnutrition, in addition to growth problems such as stunting (measured by height-for-age) and wasting (weight-for-age), is a pressing public health issue in Kenya, with 26% of the population stunted and 11% underweight.[7]

Moreover, Kenya is also a victim of the "double burden" due to its rapid economic growth. This malnutrition "double burden" manifests itself when both overweight and hungry people are affected in the same country.[8] Although overweight and obese people consume more than enough calories, they may not be getting enough vitamins and minerals. Top risk factors for non-communicable diseases (NCDs) such as cancer, diabetes and heart disease include unhealthy diets and poor nutrition.[9] These growth and micronutrient deficiencies could be corrected by consuming foods naturally rich in vitamins and minerals.

Importance of Micronutrients and Healthy Diet

From a public health perspective, vitamin A, iron, iodine and zinc are extremely important since Kenyan diets typically lack one or more of these micronutrients.[10] Micronutrient (vitamin and mineral) deficiencies affect the following populations most of all in Kenya: children under five years of age, refugees, and women, especially pregnant and nursing women.

Vitamin A: Supports healthy eyesight and plays an important role in the immune system. Deficiency can lead to increased risks of blindness, night blindness, slow recovery from illnesses, severe infections and death from infections, for example measles and diarrhoeal diseases in children.[11,12]

Iron: Necessary for cognitive and motor development in children.[15] Iron deficiency can eventually result in anaemia which results in an insufficient number of red blood cells and a reduced capacity to carry oxygen, with the result that the body's needs cannot be met.[16] Anaemia increases the mortality risk for both mothers and infants because it "increases the risk of haemorrhaging and bacterial infection during childbirth."[17]

Iodine: Needed to produce the thyroid hormone, which is responsible for the regulation of cell growth and differentiation in the fetus as well as infants.[19] Iodine deficiency can thus potentially affect brain development in the fetus and infants, resulting in brain damage and "depressing the children's learning ability and handicapping their prospects for productive earnings later in life."[20]

Zinc: Contributes to immune function as well as reducing the risk of gastrointestinal infections.[22]

HORTINLEA Project

Since 2013, the interdisciplinary research consortium Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa (HORTINLEA) has been at the forefront of research on horticultural production and consumption of AIVs.
HORTINLEA addresses food and nutrition security in East Africa, particularly in Kenya. Nineteen East African and German universities and research centres work collaboratively to collect, generate and distribute knowledge on the production, marketing and consumption of AIVs.
HORTINLEA is additionally currently concentrating on research and awareness raising campaigns in schools and refugee camps in Kenya to complement existing activities.

African Indigenous Vegetables (AIVs) at a local market in Kenya.

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HORTINLEA
DIVERSIFYING FOOD SYSTEMS

Policy Brief N° 1

Human Health and Nutrition

Zinc deficiency also plays a role in child deaths due to diarrhoea[23] and has been labeled "among the most important causes of morbidity in developing-countries.[24]

The direct link between poor diet and hidden hunger cannot be ignored; the current reliance on staple crops such as rice and maize, which is used to make the main staple food ugali, may provide enough daily calories but it does not provide sufficient vitamins and minerals, resulting in hidden hunger.[26] Consuming more nutrient-rich foods year round and thereby increasing dietary diversity is a necessary step to combat hidden hunger.

African Indigenous Vegetables: The Dietary Diversity Solution

Despite the widespread prevalence of these micronutrient deficiencies, Kenya's own rich agricultural biodiversity is currently significantly undervalued but can play a substantial role in improving human health.[27] African Indigenous Vegetables (AIVs) such as African nightshade (bot.: *Solanum species*, Kiswahili: *mnavu)*, amaranth (bot.: *Amaranthus spp*, Kiswahili: *mchicha)*, cowpea (bot.: Vigna unguiculata, Kiswahili: *kunde)*, Ethiopian kale (bot.: *Brassica carinata*, Kiswahili: Sukuma wiki) and spider plant (bot.: *Cleome gynandra,* Kiswahili *mwangani)* contribute to Kenya's agricultural biodiversity and dietary diversity.

These AIVs provide a cheaper alternative to meat and eggs as sources of iron and significant amounts of further micronutrients. This is particularly important for micronutrient-deficient populations, such as those with HIV/AIDS, as well as growing children and nursing mothers, for whom AIVs can provide up to 40% of proteins.[28] When compared to exotic vegetables, AIVs such as amaranth are clearly superior in providing the highest share and cheapest source of proteins.[29] The prevalence of AIVs in Kenya as well as the population's familiarity with them makes them a natural choice for contributing to nutrition security and combating hidden hunger. Moreover, their agro-economic advantages make it relatively easy for resource-poor households to adopt them.[30]

Supporting increased consumption of AIVs would not only be a smart health move, but also wise economically. Kenya loses approximately 2.8 billion US dollars (approx. 289 billion KES) per year from its gross domestic product (GDP) to vitamin and mineral deficiencies.[31] According to the Kenya Micronutrient Survey (2011), investing in nutrition can increase GDP by at least 2-3 percent each year. Improved health and nutrition is also a long-term investment which, in turn, can result in a healthier workforce requiring lower healthcare costs and leading to up to 11 percent GDP growth annually.[32] While the following recommended investments in nutrition will require initial input costs, the gains in reducing malnutrition pay off economically, producing returns "up to 16 times greater than the initial investment – for every 100,000 KES spent, we generate 1.6 million KES in economic returns."[33] Economic perspectives may be improved at an individual level as well, as AIVs can generate income as a cash crop for rural farmers and communities.[34]

From Post-Harvest to Consumption

Multiple HORTINLEA sub-projects conducted research on health and nutrition for AIVs. It is worth noting that the researchers carried out analyses under laboratory conditions, which may differ from everyday local conditions. Starting with post-harvest, proper hygiene and handling of the vegetables is very important since markets and transport provide ample opportunities for bacteria and dirt to contaminate them. The loss of water-soluble vitamins B and C can be prevented by washing the AIVs with clean water before cutting/chopping them.[35] Storing African nightshade at 7°C (as compared to 20°C) significantly reduces weight loss of the vegetables as well as the microbial growth (e.g. yeasts and moulds) on the vegetables post-harvest.[36]

Processing: freeze drying leads to the smallest nutrient losses, followed by cooking, followed by drying. The availability of freezing facilities, however, proves challenging.[37] Fermentation, specifically lactic acid bacterial fermentation, provides a more cost-friendly alternative for small-scale farmers when it comes to preserving AIVs. When fermentation is conducted with appropriate starter cultures, the vegetables are not only preserved safely in good quality, but the shelf life of the vegetables is also extended, providing a supply of AIVs even in the dry season. Fermentation also leads to a reduction of pathogens alongside the preservation of vitamins and minerals, such as Vitamin B2.[38]

The researchers found that AIVs such as cowpea and African nightshade are rich in micronutrients such as vitamin A.[39] The traditional way of preparing AIVs passed on from generation to generation includes boiling the leaves for a relatively long (>40 minutes) period of time and discarding the cooking water, which still contains water-soluble vitamins B and C. It is also

Micronutrient Deficiencies in Kenya

Vitamin A Deficiency[13]
4.5% of the population including
4.7% of children 5-14 years old
5.4% of pregnant women
0.0% of men
While 9.2% of pre-school aged children (6 months to 5 years old) are deficient in vitamin A, a marginal vitamin A deficiency (still under the recommended amount in the bloodstream) exists in 52.6% of pre-school aged children, which could easily transform into a full vitamin A deficiency, leading to more serious health consequences.[14]

Iron Deficiency[18]
18.4% of the population, including
21.8% of pre-school aged children (6 months to 5 years old)
36.1% of pregnant women
Anaemia :
26.3% of pre-school aged children
41.6% of pregnant women

Iodine Deficiency [1]
22.1% of school-aged children (5-14 years old)
25.6% of non-pregnant women of reproductive age

Zinc Deficiency [25]
82.8% of pre-school aged children
67.9% of pregnant women
80.7% of non-pregnant women of reproductive age

Promoting the use of kitchen gardens is one way to increase the consumption of AIVs.

HORTINLEA
DIVERSIFYING FOOD SYSTEMS

Policy Brief N° 1

Human Health and Nutrition

recommended not to add sodium bicarbonate (Kiswahili: *magadi*) when cooking as it causes vitamin B complex nutrients to be lost (especially B1, B2 and niacin).[40]

These AIVs contain relatively high amounts of diverse secondary plant metabolites (phenolic substances, glucosinolates and caroteinoids) that vary enormously in their profile and concentration. A significant amount of these phytochemicals are still preserved when processed (by cooking) for a short time (up to 20 minutes). Owing to the known bioactivity of these phytochemicals, the regular consumption of a mixture of these AIVs can be recommended to contribute to different health benefits (antioxidants, pro-vitamin A, anticarcinogens) and reduce the incidence of different chronic diseases like diabetes, various cancers and cardiovascular diseases.[41]

Specifically regarding Ethiopian kale, regular consumption of the vegetable after preparing it by boiling for 10-20 minutes showed the potential to reduce DNA damage induced by aflatoxin B1 in human liver cells in vitro.[42] Consuming high amounts of Ethiopian kale (boiled, 10 minutes) for five consecutive days significantly reduced aflatoxin-induced DNA damage in peripheral blood mononuclear cells (PBMCs) in a controlled randomized crossover intervention study with humans. Therefore, regular consumption of Ethiopian kale is further recommended in addition to its micronutrient advantages. Regular consumption of AIVs (especially Ethiopian kale, amaranth, African nightshade) should be encouraged as they have the potential to help prevent aflatoxin-induced diseases such as liver cancer.[43]

Policy Integration

According to Article 43 of the Kenyan Constitution (2010), every person "has the right to the highest attainable standard of health,[...] to be free from hunger, and to have adequate food of acceptable quality." Alongside the existing government policies and the 11 High Impact Nutrition Interventions (HiNi), the regular, increased consumption of AIVs in general and the specific recommendations from HORTINLEA should be integrated into existing Kenyan policies. The Kenya National Nutrition Action Plan (2012-2017), Nutrition on the Rise: Raising Kenya's Future, and the National Food and Nutrition Security Policy (2011), all currently do not mention AIVs as an abundant source of micronutrients and a viable solution to the existing malnutrition problem. Increasing dietary diversity and micronutrients in the diet through AIVs should be mainstreamed alongside other existing nutrition policies, such as food fortification and the Scaling Up Nutrition (SUN) program. AIVs provide a low-cost solution to the problem of micronutrient malnutrition.

Promoting the consumption of AIVs can be done through having a higher diversity of AIVs at markets,[44] lower food taxes, and promotion through media, such as radio broadcasts, and awareness-raising campaigns. One specific suggestion would be the production and distribution of cookbooks or leaflets including recipes on how to cook AIVs in a healthy way, which would be directed towards women as the main actors buying and preparing meals. Special focus should also be put on vulnerable groups such as pregnant and nursing women, as well as mothers, to make sure the information and benefits reach them and their children. HORTINLEA researchers additionally found that when women are given more freedom of choice regarding how household finances are spent (e.g. cash transfer program), there is a positive effect on AIV consumption, which in turn could contribute to increased consumption of micronutrients.[45]

Along with promoting the consumption of AIVs, increasing the production of AIVs should also be supported. This ranges from including AIVs in small-scale kitchen gardens and school gardens up to large-scale production. The main challenges currently facing AIV producers are seed quality (including improved varieties) regulation of improved seeds, and information services.[46] Such activities also contribute to behaviour change communication which is crucial in order to "educate people about health services, sanitation and hygiene, and caring practices as well as the need for greater empowerment of women at all levels."[47] The capacities of agricultural extension services and community health

Adequate nutrition is important especially for children, as it directly contributes to growth and development.

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HORTINLEA
DIVERSIFYING FOOD SYSTEMS

Policy Brief N° 1

Human Health and Nutrition

workers should be strengthened in order to achieve this.

Since malnutrition is a multi-sectoral problem, naturally the solution will require joint efforts and cooperation by various ministries, state services, and private actors (extension services, NGOs, CBOs, private sector, etc.). Together, the Ministry of Health and Ministry of Agriculture, Livestock and Fisheries could take the lead on the issue of improved nutrition through AIVs. This would require very close cooperation, planning and communication between the two ministries. Further cooperation with other ministries, for example, Education, Environment, Water, and Natural Resources, Devolution and Planning, and Treasury is needed to mainstream AIVs in nutrition policy and promote nutrition practices to combat hidden hunger and micronutrient malnutrition. Further links between micronutrient malnutrition and other existing policies, e.g. poverty reduction, are also recommended and first steps have been taken according to the Kenyan Micronutrient Survey (2011).

HORTINLEA researchers have also recommended further postharvest treatments that could contribute to improved nutrition via AIVs in Kenya as well as reduce contamination of AIVs from moulds which generate mycotoxins.[48]

Some of these are seen as too costly for production at this time, especially for small-scale farmers. Examples here include freeze drying and using modified atmosphere packaging (MAP) to preserve the vegetables. Vegetables stored in MAP at 7°C experience less weight loss and keep their green colour better than those stored in open air.[49] However, due to the fact that most MAP material is plastic, the ecological sustainability of this option may be questioned; environmentally-friendly packaging would be ideal but would in turn increase costs. In order for these options to be seriously considered, the AIV industry would need to be significantly developed. There is also the option for the government to subsidize the cost of these advanced technologies which would raise awareness of the issue and inspire trust in the communities. Naturally, the communities would require training on how to operate the technology as well as maintenance. It is important to make sure all social groups currently involved in the AIV value chain, including women and other potentially marginalized groups, are included when developing the industry and training.

As long as the problem of malnutrition remains unsolved, Kenya's young population and future labour force will be drastically affected, making it challenging for Kenya to reach its economic and social goals. However, with cooperation between all levels, from ministries at the national and country level to community-based organizations and community health workvolunteers, reducing hidden hunger in Kenya is possible. As a result, Kenya will have taken steps forward on the path towards achieving the SDGs and Vision 2030.

Authors

This HORTINLEA policy brief was developed as part of Sub-Project 13: *Transferring research results into politics and practice*, in close cooperation with the SLE Postgraduate Programme. The intention of the current policy brief is to communicate valuable research results in the field of health and nutrition and to encourage decision makers to better integrate African Indigenous Vegetables (AIV) into Kenyans' dietary diversity to effectively fight *hidden hunger*. This policy brief was developed with substantial contributions - data, analysis and knowledge - from HORTINLEA consortia members:

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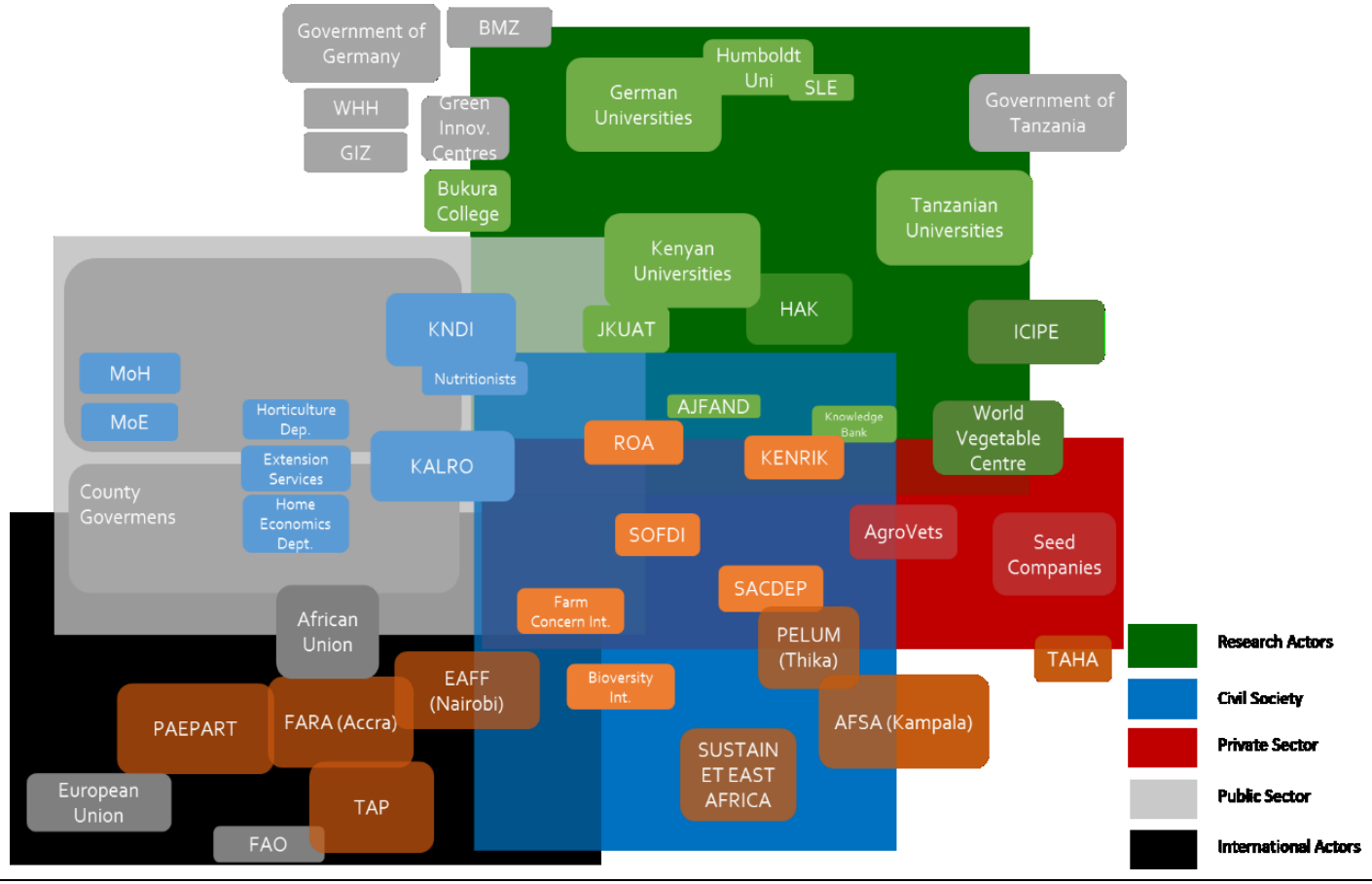
Annex 6: Knowledge and Innovation Network

Annex 6.1: Stakeholder Mapping



Source: Own illustration

Annex 6.2: Next Steps for Implementing the AIV Network

To successfully implement knowledge exchange and a network for AIVs, best practices suggest providing close guidance to the members during the initial stages of implementation (WB 2015). The delivery team and core promoters of the network need to be very active during this phase, in organising meetings, setting up structures and following up on discussions and decisions from the members. Codes of conduct, administrative and legal structures and action plans ought to be developed during this stage while promoting participation, and links to other stakeholders have to be established at the same time (WB 2015). Thus, for the AIV network the next steps for implementing the KIN would be to:

- Identify a core group of members based on HORTINLEA and other existing initiatives
- Appoint a delivery and implementation team to lead the next steps
- Draw up a comprehensive calendar of events/schedule to establish the network (promotion and kick-off phase, first activities, annual meeting etc.)
- Decide on legal structure (e.g. association, NGO etc.)
- Determine how facilitation should take place and which roles and responsibilities exist
- Secure funding for the network and its desired activities
- If desired, create permanent structures (e.g. secretariat)
- Decide on a communication strategy and dissemination tools
- Agree on a network codex (including conflict prevention mechanisms etc.)
- Establish monitoring and evaluation tools

This list of steps is by no means exhaustive. Rather, it should be regarded as a rough guideline for the next phase of establishing a network and making the idea of a KIN for AIVs a reality. It should be noted that each step needs to be deliberated in close collaboration with actual members of the network because the stakeholders should determine what kind of network they themselves need. The design and delivery team need to implement and assist throughout the process but should not decide on the final setup of the network themselves. They can provide suggestions, such as the recommendations given in Chapter 5.3.3, but should keep the concept flexible and open for adaptation according to members' needs.

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