Including traditional ecological knowledge (TEK) in agricultural research

Guidelines and lessons learned

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This manual is written within the framework of the ERA-NET Cofund on Food Systems and Climate (FOSC) Knowledge Hub to bring together the insights and experiences gained from NUTRiGREEN and MedAgriFood Resilience research projects. Although these projects are located in different geographical areas, they share a common goal: to address the ongoing challenge posed by the fact that agricultural research and policy perpetually overlook traditional ecological knowledge (TEK). This approach keeps alive a sense of paternalism and prevents diverse knowledge systems from being integrated into research and policy.

The manual was written for fellow researchers and policymakers in agriculture, agroforestry, food security and international development. It aims to bring into focus the effective inclusion of both traditional and scientific knowledge in global research. The manual defines and explains TEK's benefits and limitations in research projects and offers practical guidelines for integrating TEK into contemporary agricultural and agroforestry research practices.

Local rural communities have passed down knowledge and practice through the centuries, which includes a detailed and close understanding of local ecosystems, natural resources and sustainable practices. In the last decades TEK has received increasing attention for its knowledge of strategies and practices that are based on the sustainable use of local natural resources, and for its capability of providing different ecosystem services that directly benefit the well-being of local communities (see Box 3).

TEK is often threatened by poor transmission of traditional knowledge and practices across the generations, often caused by migration of young people. This means that training and dissemination are crucial to preserve this fundamental ecological knowledge.

TEK should be integrated into scientific knowledge and research by:

- applying the principles of co-research
- giving space and weight to local voices
- actively involving all stakeholders right from the start, and
- sharing perspectives.

The FOSC Knowledge Hub

FOSC establishes joint calls for proposals, and also formed a Knowledge Hub to cluster and improve research outcomes and to offer a forum for researchers from participating countries to strengthen their ties and exchange experiences. The FOSC Knowledge Hub goes beyond the conclusions of individual research projects by facilitating the co-creation of cross-project items at the science-policy-practice interface. By bringing together the various perspectives, scopes, disciplines and findings of the funded projects under the FOSC action calls, the Knowledge Hub generates new, high-quality, meaningful and practical content.

MedAgriFood Resilience

The MedAgriFood Resilience project focuses on the identification of social and environmental shocks that impact agroforestry and agri-food heritage systems in the Mediterranean area. The project's multidisciplinary approach links together landscape structure, climatological studies, social and biodiversity assessments.

The project started in 2022 with the participation of partner institutions from:

- **Italy:** Department of Agriculture, Food, Environment and Forestry (DAGRI) of the University of Florence (coordinator)
- **Algeria:** University of Biskra; Scientific and Technical Research Center on Arid Regions (CRSTRA)
- **Morocco:** Mohammed VI Polytechnic University (UM6P); University of Ibn Zohr.

The project is based on three different traditional agroecosystems that are also part of the Globally Important Agricultural Heritage Systems (GIAHS) Programme established by the Food and Agriculture Organization (FAO) of the United Nations:

- terraced olive groves in Umbria region in Italy
- argan forest in Souss-Massa region of Morocco
- traditional ghout oases of El Oued province in Algeria.

NUTRiGREEN Project

The NUTRiGREEN project studies the value chains of traditional African plants, to determine the incremental, systemic and transformative adaptations required to boost their impact in the local and regional agri-food system.

The project started in June 2021, and involves partners from:

- **Burkina Faso:** Institut de Recherche en Sciences de la Santé (IRSS)
- **Germany:** Centre for Rural Development (SLE)
- **Senegal:** Université Cheikh Anta Diop (UCAD)
- **Sweden:** Swedish University of Agricultural Sciences (SLU)

Together with farmers, consumers and other value chain stakeholders, the NUTRiGREEN project researches the current status and future potentials of traditional plants, from farm to fork. Climate-resilient and agroecological practices are at the centre of the project design. NUTRiGREEN employs a co-research approach, where academics and farmers combine their knowledge systems to innovate and create impact. The project actively supports and engages young academics.

Part 1

Integrating traditional ecological knowledge (TEK) in research

What is TEK?

Traditional Ecological Knowledge (TEK) refers to the knowledge and practice that indigenous people acquire over the centuries, from their direct contact with the surrounding environment. It includes a detailed and close understanding of local ecosystems, natural resources and sustainable practices. This understanding is often rooted in the deep observation and interaction of a community with its environment.

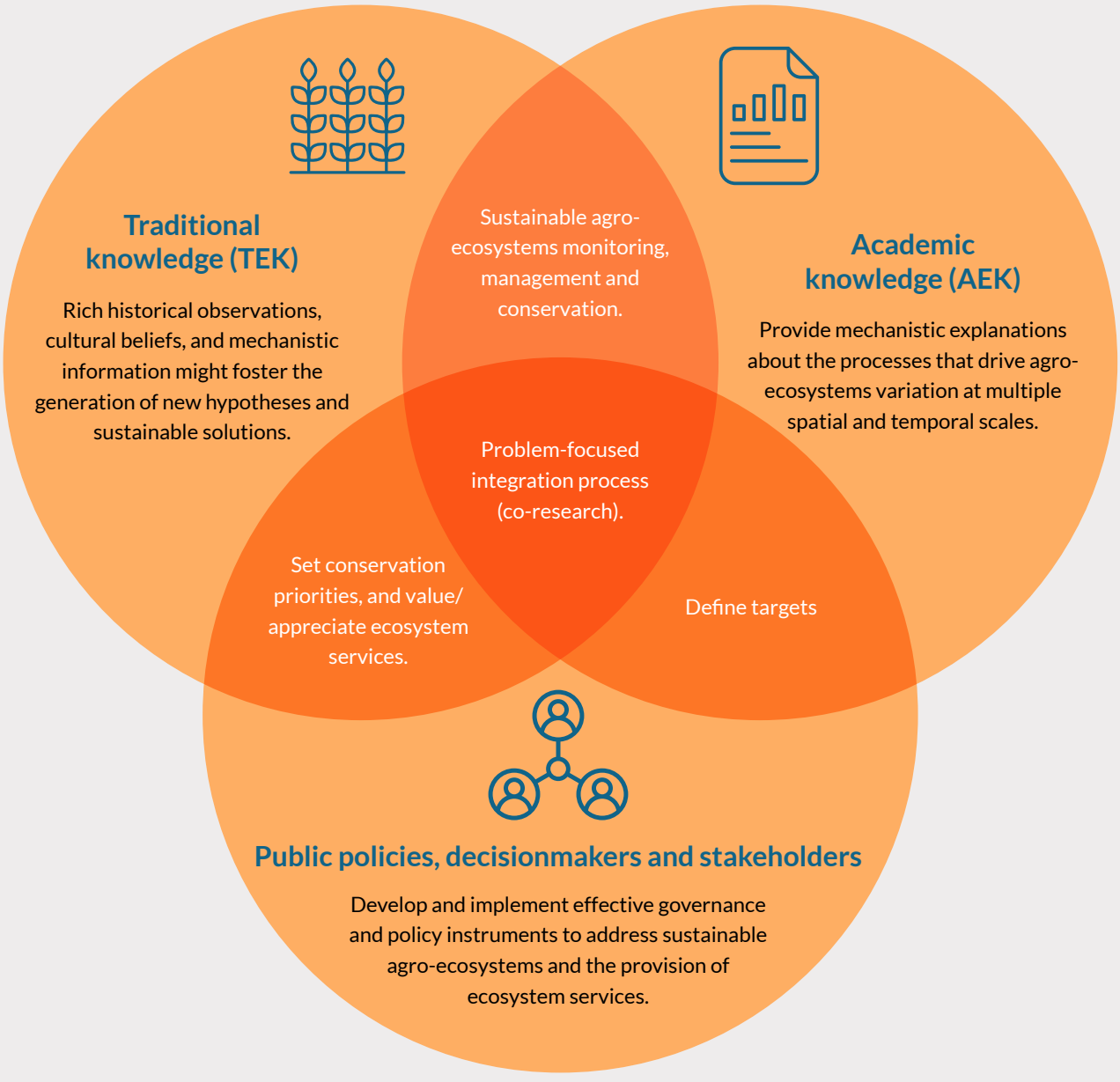
Sometimes called “indigenous knowledge” or “native science”, TEK includes agrosilvopastoral practices that are based on the sustainable use of local natural resources (i.e. water, biodiversity, soil), and that have been developed by local communities through the centuries, as they adapt to different environmental conditions.

Benefits of TEK

TEK not only helps preserve the local natural resources; it also improves many communities’ well-being and strengthens their social cohesion, as it is an important part of their cultural identity. It helps in preserving cultural heritage and fostering a sense of identity among community members.

If it is conducted holistically and implemented diffusely, the recognising, respecting and integrating of traditional knowledge into research will contribute to the development of more sustainable and culturally relevant adaptation strategies. This approach will assist local communities to strengthen their resilience to climate change.

Figure 1: Interlinkages between TEK, academic knowledge and decisionmakers to provide solutions for agro-ecosystem management and preservation. Source: Adapted from Albuquerque et al. 2021



Adapting to climate change

TEK can provide an important reservoir of different strategies, developed at the local level, for dealing with current global challenges, including climate change, loss of biodiversity, cultural landscapes, and soil fertility. In fact, many local communities have adapted to different and difficult environmental conditions, including arid, dry, flooded or mountainous areas, steep slopes facing the sea, and so on, to obtain food and resources for themselves.

Traditional agricultural practices are often based on sustainable and low-impact methods. Traditional farming techniques (such as agroforestry, intercropping, terracing and crop rotation) promote soil fertility and reduce environmental degradation. These practices represent examples of adaptation to difficult and changing environmental conditions that can be replicated in other parts of the world that face similar situations.

Different studies suggest that combining scientific research with TEK can be useful for long-term management and conservation, in particular regarding species interactions and seasonal climatic variations, decreasing soil fertility and water sources.

Limitations and challenges

The utilisation of traditional ecological knowledge in research projects brings several limitations and challenges:

- **Subjectivity and variability:** TEK often varies among different communities and individuals, leading to subjectivity and variability. This can pose challenges in standardising information for research purposes.
- **Lack of formal documentation:** TEK practices are often passed on orally from one generation to the next. They therefore often lack formal written documentation. This can hinder its integration into research projects that require well-documented and verifiable data.
- **Limited accessibility:** TEK may be confined within specific communities or groups, limiting its accessibility to researchers and hindering broader applications or validations. Often researchers investigating local specific practices and their rationale uncover existing TEK only when they engage directly with local actors such as farmers and extension officers.
- **Resistance to external influence:** Some communities may be hesitant to share their TEK due to negative past experiences or fear of potential exploitation. This can hinder collaboration with researchers. Introducing yourself in the initial meeting as someone who has come to listen and learn from the local experts can help reduce hesitation or reluctance.
- **Integration with scientific methods for validation and standardisation:** Using scientific methodologies to capture TEK can be challenging, particularly when dealing with diverse cultural perspectives and practices. This makes it difficult to establish validity and standardisation for broader scientific acceptance of TEK.
- **Dynamic nature:** Traditional knowledge is dynamic and evolves over time. The static study designs of research projects may struggle to capture the fluidity and adaptability of TEK.
- **Loss of TEK:** Younger individuals may not be inclined to acquire or preserve traditional wisdom passed down through generations, leading to a potential loss of TEK over time. In particular, increasing access to digital information sources poses a global threat to the preservation of traditional ecological knowledge among youth. Moreover, the very process of incorporating traditional knowledge into research

can sometimes lead to the erosion, alteration or dilution of traditional practices. Moreover, the very process of incorporating traditional knowledge into research can sometimes lead to the erosion of traditional practices, as external influences may alter or dilute the original knowledge.

Hence, researchers engaging with traditional knowledge must navigate these challenges thoughtfully, respecting the cultural context, and employing collaborative and inclusive methodologies (such as the Co-Research approach) to ensure meaningful and ethical integration into research projects.

Part 2

Combining TEK and Co-Research

What is Co-Research?

Co-research embodies a participatory, inclusive and transformative research approach that goes beyond the classic Participatory Action Research (PAR) method (Henze et al. 2021).

Co-research seeks inclusivity by promoting equal partnerships among all the stakeholders, amplifying local voices, and advocating for a comprehensive and holistic research ethos.

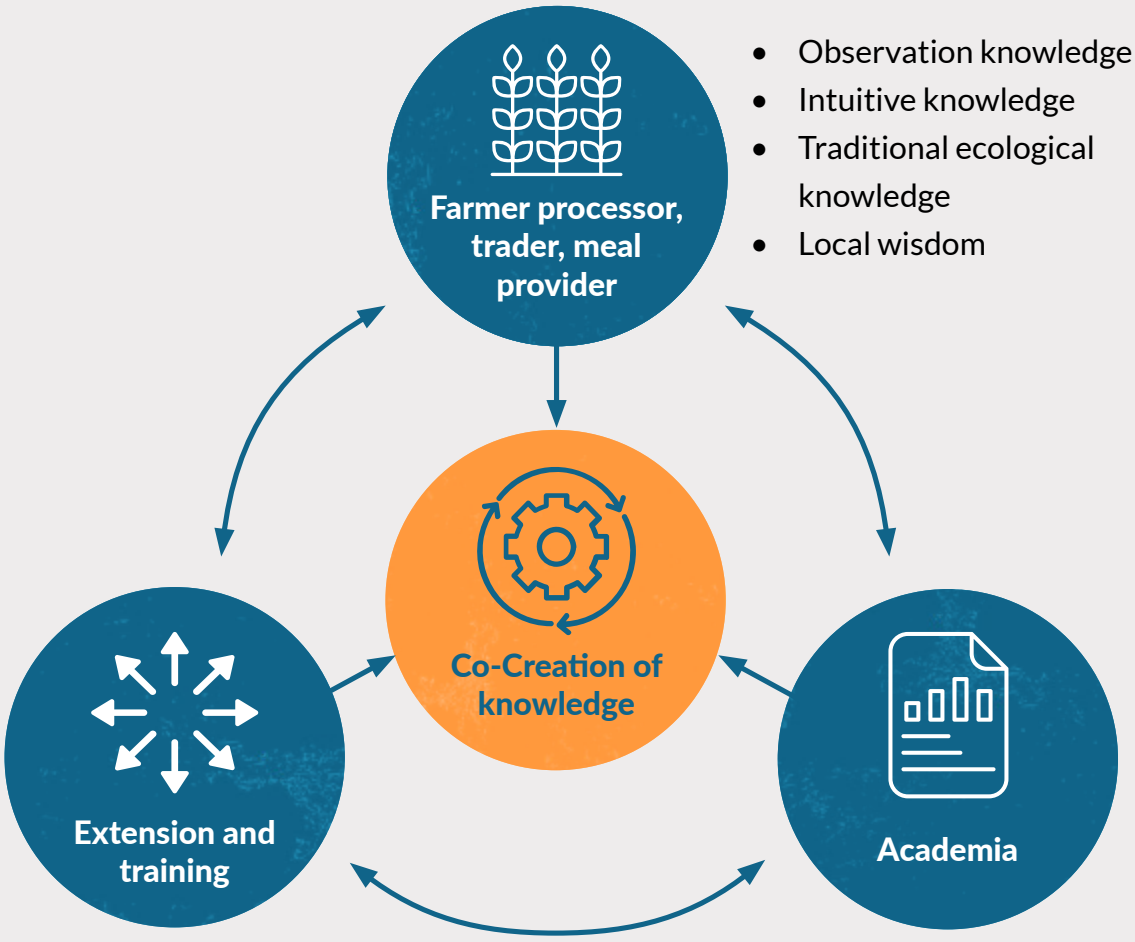
Co-research means solution-oriented research that happens on the ground. Co-research stands for community research or cooperative (joint) research and puts scientists, community organisations and farmers together to jointly understand problems and search for solutions. The community (for example, farmers) together with academia mandate the research and develop the research design, collect and analyse data and disseminate results. In this way, farmers are not the subject of research, but are researchers themselves.

The co-research process differs from PAR by directly engaging all pertinent stakeholders – including farmers, policymakers, researchers and extension officers - ideally from the project start, with crucial participation in all phases. This joint involvement entails collectively defining the research questions and design, conducting the research and analysing the results. The research methods and methodologies are chosen so that they can be integrated into the local settings and are easy to implement by the local community. Furthermore, the local community is actively engaged in the analysis and interpretation, as well as in the scaling, sharing and implementation of findings and recommendations.

A joint analysis of research results ensures that all stakeholders witness the incorporation of their inputs. This helps to foster ownership as well as appreciation for the benefits of a more scientific approach and clearer results. This collaborative approach enriches research projects through embracing local and diverse insights and practices, enabling local voices to be heard, and sharing perspectives. However, involving diverse opinions potentially leads to a lengthier, more cost-intensive and complex process. This is the major drawback of a collaborative approach.

Figure 2: Co-creation of knowledge

Source: SLE 2019



- Observation knowledge
- Intuitive knowledge
- Traditional ecological knowledge
- Local wisdom

- Facilitation and brokerage
- Participatory methods
- Communication (translation)

- Analytical knowledge
- Cross-cutting knowledge
- Literature knowledge
- Methodological knowledge

Connecting indigenous knowledge systems and scientific knowledge (including innovations) can:

- obtain more sustainable and productive agroecosystems
- gain a deeper understanding of ecological, social, and cultural dynamics
- support the local culture, knowledge and sense of place
- contribute to improve the life quality of rural communities.

How to include TEK and Co-Research into your research

Incorporating TEK and co-research into your research project and assessing its impacts involves a systematic approach. Here's a short guide:

Step 1: Develop a plan

Begin by developing a comprehensive research plan that outlines the integration of TEK into your research project. Clearly define your objectives, methodologies and the specific ways in which TEK will contribute to your study. Identify who holds TEK in your planned research project and how to engage stakeholders.

Step 2: Secure funding

Some funding and research agencies fund a preparation phase, following a successful project concept. This phase often entails meetings, site visits and detailed joint planning with all the potential project partners. This helps to optimally align the project with local research needs and engages the relevant stakeholders. If done well, this phase improves the quality of the project proposal and ensures local anchoring and the political backing of the partner government(s).

Step 3: Include and sensitize all stakeholders from the start (co-research)

Engage all relevant stakeholders right from the initiation of your research. This includes representatives from the relevant policy level (national, regional or local) and, crucially, farmers. Provide training and an open forum to ensure that all stakeholders are engaged and can break perceived boundaries, manage expectations and negotiate collective goals.

Step 4: Use suitable research methods

Select appropriate methods that capture TEK. This may include participatory approaches, community-based research, and ethnographic methods (see Stöber et al. 2022)

Step 5: Co-analyse the results and share the merged knowledge

After conducting the research, share the findings with the different project partners and co-analyse/reflect on them together. Additionally, communicate the merged knowledge not only within the academic community but also to the other stakeholders, including local communities (e.g. through flyers, podcasts, videos), policymakers (e.g. through policy briefs), and practitioners who contributed to the research (e.g. through hosting result-sharing sessions, provide guides or posters in the local language(s)).

Step 6: Measure impacts

If possible, develop clear metrics and indicators to measure the impacts of integrating TEK into your research. This could involve assessing changes in community practices, policy developments influenced by your research, or shifts in the perception and preservation of traditional knowledge.

Part 3

Experiences and lessons learned

The MedAgriFood Resilience Project

Co-research yields good information and informs good practices

Investigating the perceptions of farmers or obtaining information about the ancestral practices they apply in their everyday work is crucial for understanding the current relevance and vulnerability of TEK. The use of questionnaires or focus groups, and in general the active participation of the farmers, allows researchers to obtain a large amount of information. This information can be turned into good practices, to be replicated in other agroecosystems that are facing similar challenges.

Traditional agricultural practices are crucial to preserve soil fertility, water and agrobiodiversity. Farmers have adapted to different and difficult environmental conditions all over the world to obtain agricultural products and environmental services for their subsistence. Since TEK does not rely on – or relies on low –external inputs (fossil fuels, chemicals, mechanisation), farmers preserve their local environmental resources to ensure availability for subsequent generations. Therefore, TEK effectively contributes to the preservation of water sources, soil fertility (reducing the use of chemical fertilisers and pesticides), cultural landscapes, and local agrobiodiversity. TEK creates sustainable, resilient and productive agroecosystems and effectively contributes to different ecosystem services.

Soil fertility, water management and agrobiodiversity preservation in arid climates

In the oases of North Africa, local communities have adapted to water scarcity and extreme temperatures by developing a self-sufficient and sustainable cultivation system based on three layers. The upper layer creates suitable conditions for the cultivation of the lower ones, protecting them and the soil from direct sunlight and reducing evapotranspiration (agroforestry effect).

The oases also provide fodder for the livestock. In turn, the livestock provide organic manure for fertilising the crops and preserving soil fertility, and proteins for the local communities. Traditional oases are agrobiodiversity reservoirs, as different species and varieties of dates, fruit trees and vegetables are commonly cultivated. This enhances the overall resistance and resilience of the system to pests and diseases. Traditionally, water sources are usually managed by the community through ancient rules that contribute to strengthening social cohesion (but in recent years, disputes have arisen around accessing and using water, due to climate change and desertification).

Upper layer
Date palms representing the cash crop in the upper layer

Intermediate layer
Olive trees and other fruit trees for self-consumption

Lower layer
Vegetables for self-consumption and fodder for livestock

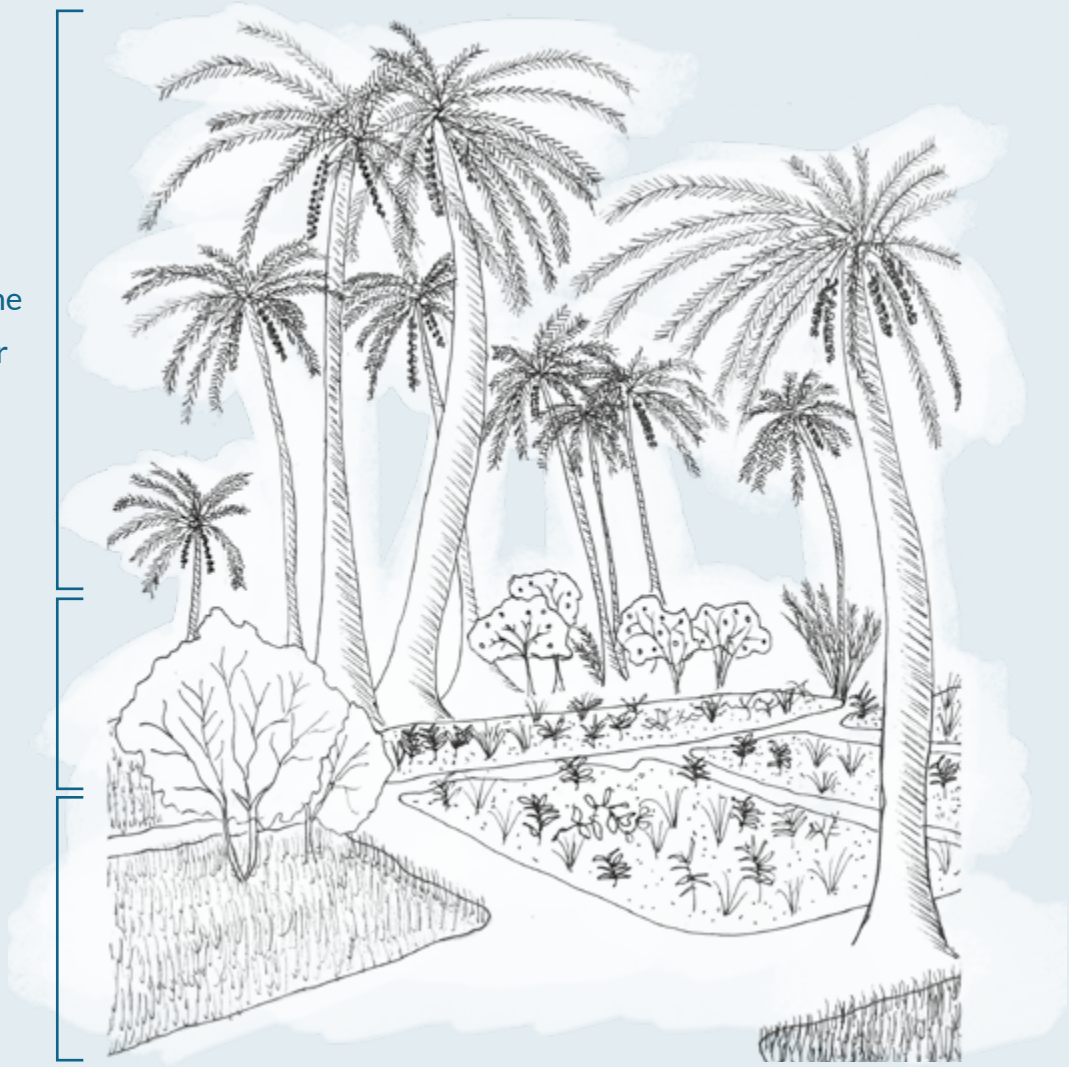


Figure 3: scheme of the structure of a traditional oasis, based on three layers and on the agroforestry effect © Antonio Santoro

The NUTRiGREEN Project

Nowadays, TEK is crucial not only to guarantee sustainable food production, but also to maximise different ecosystem services. In addition, TEK can be used to help decisionmakers to value these ecosystem services (Hill et al. 2020). For example, drystone walls to allow the cultivation of steep slopes are a TEK-based solution adopted in different parts of the world, but they are also crucial in providing different ecosystem services.

- Drystone terraces reduce runoff, thus preserving soil and reducing hydrogeological risk.
- Stones accumulate the heat of the sun during the day and release it to the cultivated plants during the evening.
- Drystone walls can provide different habitats and microclimates that microfauna and flora species can use as nesting places, refuge areas or to find food. Extensive drystone wall systems represent important ecological networks.
- Terraced landscapes are cultural landscapes and part of local or national heritage, thus providing attractive areas for rural tourism.

Figure 4: dry-stone terraces near Spello, Italy (left) and in Cinque Terre, Italy (right). © Antonio Santoro

The NUTRiGREEN Project

The **demi-lune planting system** is an agronomic technique designed to enhance water conservation, soil fertility and the resilience of agricultural systems in arid and semi-arid regions. The term “demi-lune” is French for half-moon, and it refers to the shape of the planting beds, which are crescent or half-moon-shaped and resemble a semicircle or crescent moon when viewed from above. The demi-lune planting system is an example of a sustainable and context specific TEK technique that has been practised in various forms for centuries, especially in vulnerable ecosystems.

The **Zai planting technique**, another example of TEK, is a traditional agroecological method employed in West Africa, especially in areas characterised by arid and semi-arid climates. The technique was developed by farmers in the Sahel region to enhance water infiltration, improve soil fertility, and promote plant growth in areas with low and erratic rainfall.

Zai pits are typically about 20 to 30 centimetres in diameter and depth and are dug in a grid across rock-hard plots of land. Organic materials added to the pits contribute to nutrient concentration and provide essential elements for plant development. Stone barriers built around fields help to contain runoff and increase infiltration from rain.

Figure 5: Demi-lunes © Jean-Luc Galabert

Figure 6: Zai pits © Judith Henze

Part 4

Sharing the results

Inclusive information sharing: Farminar-videos

A key component of the NUTRiGREEN Project included the creation of concise and informative videos that are tailored specifically for farmers in Burkina Faso, where 70% of the local population are illiterate. These videos were produced in the local language, ensuring accessibility and resonance with the target audience, and are supplemented with French subtitles for broader comprehension in other West African countries.

By adopting a visual medium, we aimed to help preserve and promote local agricultural practices and the domestic use of indigenous plants, like baobab and moringa. The videos are designed to empower farmers with practical knowledge that aligns with local contexts. They serve as practical guides, offering step-by-step insights into both the cultivation and post-harvest phases.

This initiative is not solely about knowledge sharing; it also recognises the importance of TEK. By adding French subtitles, we strive to bridge linguistic gaps with other communities in West Africa and to ensure that the content is accessible to a wider audience.

Dissemination and training on simple traditional ecological practices

The main risk related to TEK is its loss among younger generations. To preserve TEK and its benefits for the society and the environment, it is crucial to connect young farmers with the knowledge of experienced farmers, through training and demonstration activities in the field.

In recent years, a growing number of young people have begun to dedicate themselves to agrosilvopastoral activities for the production of quality and environmentally sustainable agri-food products.

Also in developed countries, academics and expert farmers and breeders have jointly carried out successful training activities. These are fundamental to the conservation of TEK and to its transmission from one generation to the next.

Gaining acknowledgement and support

It is important to develop the acknowledgment and significance of TEK among policymakers and at the institutional level. Likewise, it is important to increase the impact of your project findings by involving policymakers and/or institutional levels from the project planning stage. Ensuring these steps can be key to the success of the project.

Step 1. Seek contact with relevant policy and/or institutional levels right from the start

Begin by developing a comprehensive research plan that outlines the integration of TEK into your research project. Clearly define your objectives, methodologies and the specific ways in which TEK will contribute to your study. Identify who holds TEK in your planned research project and how to engage stakeholders.

Step 2: Identify allies and champions

Identify and collaborate with political leaders and local NGOs that are supportive of indigenous rights and environmental sustainability.

Step 3: Engage local communities

Establish open and respectful communication channels with local communities. Collaborate with community leaders, elders and knowledge holders to understand their perspectives on environmental management.

Glossary

Agrosilvopastoral

Agrosilvopastoral practices refer to integrated land management systems that combine agriculture (agro-), forestry (silvo-) and/or livestock (pastoral) activities within the same area or landscape.

Cultural landscapes

Cultural landscapes are landscapes deriving from the combined works of nature and humans, and they express a long and intimate relationship between people and their natural environment. Cultural landscapes reflect specific techniques of sustainable land use, which consider the characteristics and limits of the surrounding environment they are established in.

Ecosystem services

Ecosystem services are the benefits that humans obtain from ecosystems, including provisioning services like food and water, regulating services like climate and disease control, supporting services such as nutrient cycling, and cultural services like recreational and spiritual experiences.

Paternalism

Paternalism in international research refers to the practice of researchers or institutions from one country or culture imposing their own values, priorities or methodologies onto research conducted in another country or culture, often without adequately considering or respecting local academic approaches and the perspectives and needs of the local community.

Social cohesion

Social cohesion refers to the degree of connectedness, solidarity and mutual support among individuals and groups within a society.

Science-policy-practice interface

Science-policy-practice interface refers to social processes that facilitate interactions between scientists and other actors with the aim of enriching decision-making. These interactions allow for exchanges, co-evolution, and joint construction of knowledge.

Resources

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