Integrated vegetable seed systems development
in ethnic minority communities in Northern Vietnam
for enhanced nutrition and income security

TRAINING MANUAL ON VEGETABLE SEED SYSTEMS

MODULE 1: INTEGRATED VEGETABLE SEED SYSTEMS

NWO

CGIAR INITIATIVE ON Nature-Positive Solutions

Alliance Bioversity & CIAT

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TANLOCPHAT SEEDS

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MANUAL GUIDELINES

Vegetables are a main source of income and nutrition for ethnic minority farmers in Vietnam's Northern highlands. While value chains for fresh produce and seed markets offer significant opportunities for development—particularly for women and youth—the current smallholder seed systems suffer from multiple problems. Such problems include inadequate access to quality seeds, lack of guaranteed product quality, poor storage and treatment practices, and limited smallholder participation in seed value chains.

The project ***"Integrated Vegetable Seed Systems Development in Ethnic Minority Communities in Northern Vietnam for Enhanced Nutrition and Income Security"*** (2019-2022) aimed to address the mentioned challenges. It focused on enhancing farmers' access to and use of good quality vegetable seeds, allowing higher vegetable yield and productivity, increased income, increased quantity, and more diverse vegetables in their diets.

The training manual, of which this module is part, is based on the project's experiences and lessons learned, particularly through capacity-building activities for and participatory action research with local partners and ethnic minority farmers in the north-western part of Vietnam.

The training manual is designed to assist facilitators in designing and customizing their own training sessions on seed system related topics. Each module provides facilitators with theoretical knowledge, practical experiences and examples from the field, group discussions and exercises to connect theory and practice, reflection questions, and tips/guidance organizing and delivering sessions.

The training manual is made up of four (4) modules with the following topics

Module 1	**Integrated Vegetable Seed Systems -** introducing formal and informal vegetable seed systems, their differences and complementarities, key activities and actors, the relation between food security, seed security and diversity, and how challenges can be addressed through integrated seed systems.
Module 2	**Nutrition, Vegetables and Seeds -** presenting the fundamentals of dietary diversity and balanced diet, food sourcing and processing with a focus on nutritious vegetables.
Module 3	**Seed Production, Handling, and Storage -** introducing the principles of seed production, coupled with the project's lessons learnt in providing technical training for farmers
Module 4	**Seed Value Chain Development -** looking at the organization of seed value chains and provides self-assessment tools and guidance for farmer groups interested in producing and selling seeds as a business

Approach

The curriculum incorporates the following training approaches.

Practical, contextualized learning – Uses meaningful and relevant context so participants can have a more engaging and internally motivating learning experience.

Learner-centered – Aims to acitvely involve the participants in the training process, encouraging them to share their knowledge, past experiences, interests, needs, and ideas.

Difficult-to-easy and complicated-to-easy – Helps participants understand the training content, especially the more theoretical and technical concepts.

Learning-by-doing – Provides a space to learn through demonstration and knowledge-sharing activities.

Using the training manual

The manual content largely draws from knowledge relevant to the project sites; however, it caters to a broader audience. It is applicable to other locations in Vietnam and other countries worldwide where information on vegetable seed systems and its relevance to nutrition and income generation are needed.

The manual is intended for agriculture extension officials, local governmental officials, researchers, and development workers involved in strengthening the seed and vegetable sectors. It serves as a guide for designing and delivering training on seed system-related topics. While not fully comprehensive the modules focus on essential concepts and provide references for further learning

Throughout the curriculum, icons are used to indicate the function of each part.

Section learning objectives

Enumerates what participants are expected to learn in each session.

Facilitator notes

Emphasizes the main content which facilitators can use during training delivery.

Link to reality

Provides practical approaches that the facilitator can use to stimulate learning and convey the theoretical content.

Reflections

Highlights questions that can be used to encourage participants to reflect on the key content covered in the section.

Stories from the field

Presents real-life examples from the project on ***"Integrated Vegetable Seed Systems Development in Ethnic Minority Communities in Northern Vietnam for Enhanced Nutrition and Income Security".***

Learn more

Provides information on additional readings and links which facilitators can access to better understand or present the concepts in each module.

CONTENTS

INTRODUCTION

Vegetables are important for nutritional diversity and a potential source of income for smallholder farmers with limited land. To yield high-quality products, farmers need high-quality starting materials. The quality of such starting materials is determined through being available at the right time, having the right cultivar, producing the right quantity and quality and proving its resilience against biological and other environmental stresses. Hence, farmers need access to a wide range of quality seeds and other necessary materials to develop a diverse range of good quality vegetables, making them part of larger seed systems that include different types of actors.

With a "system" understanding of seeds, professionals involved in the vegetable and seed sectors can develop initiatives that will promote the integration between the formal seed system, often dominated by seed companies and government institutes and regulators, and the informal or farmer-led seed systems which thrives on saving, exchange and selling of local seeds. Farmers, on the other hand, will benefit from new insights into seed systems because it will help them understand their roles and how to better engage with other actors to secure their access to quality seeds that meet their needs.

This module intends to assist facilitators in designing their own training sessions on vegetable seed systems. The target participants of these sessions can be governmental officers, agricultural technicians, extension workers, development workers and farmers. It is important that they have knowledge to understand how to better engage with different aspects of vegetable seed systems so they can use them to their advantage.

The module consists of four (4) sections as listed below.

Section 1: Formal and informal seed systems

Section 2: Towards integrated vegetable seed systems

Section 3: Food security, seed security and diversity

Section 4: Seed system challenges and solutions

GENERAL LEARNING OBJECTIVES

At the end of Module 1, the participants will be able to:

- Describe the formal and informal seed systems and the different roles they play for farmers
- Explain complementarities between both systems and possible linkages across key activities and players
- Illustrate the relation between food security, seed security and diversity
- Identify the best options for improving seed systems that farmers use

SECTION 1: FORMAL AND INFORMAL SEED SYSTEMS

Despite the potential, vegetable production often suffers from limited access to resources such as seeds, inputs, infrastructure, knowledge, and value chain linkages. Especially, inadequate access to quality seed of local and improved vegetable varieties can be a major constraint that not only affects vegetable production but also vegetable diversity and diet quality. Public and private seed programs in most countries have targeted the dissemination of quality seeds of improved varieties based on market demand. However, it is important to note that those crops which are commercially less interesting, are often vital for the food and nutritional security of both poor farming and urban households. So, farmers may partially want to preserve their own seed of such vegetables that the formal sector does not provide. In this section we will have a closer look at the characteristics of both the formal and informal seed systems, their differences and complementarities, and the role they play in local communities [1].

Specific learning objectives

By the end of the session, the participants should be able to:

- Understand the differences between the formal and informal seed system
- Map out the seed flows for local/indigenous vegetables and commercial vegetables farmers use

1.1. Seed systems

To grow crops, farmers use starting material, all of which are called seeds. Seeds can be preserved from a previous crop or obtained from others. To use seed from a previous crop, farmers need to carefully select, clean and store seeds properly. To grow a new crop or replace seed with new seed that performs better, farmers depend on options to purchase. The combination of processes and people that allow such access to seed is called the seed system, making it an essential part of the agricultural system.

There are generally two main types of seed systems: the informal seed system and the formal seed system (see Figure 1).

The **informal seed system** is often known as farmers' seed system or local seed system. It is characterized by farmers and communities' participation in the saving, production, exchange and management of seeds to satisfy their seed requirements for the following season's planting [4]. This system also involves the exchange of seeds between farmers and their relatives, neighbors, or community members in the form of gift, barter or sales at local markets.

Informal seed systems play a vital role in smallholder farming systems, more so in rural areas with low access to formal input and output markets. It is also an important source of neglected, and underutilized species (NUS). For developing countries, it is estimated that informal seed systems provide up to 90% of all seeds sown and they also act as an important safety net for farmers during times of disasters and conflicts when access to seeds and food is disturbed [4].

Vegetable seeds from the informal seed system being sold at a local market in Sa Pa township

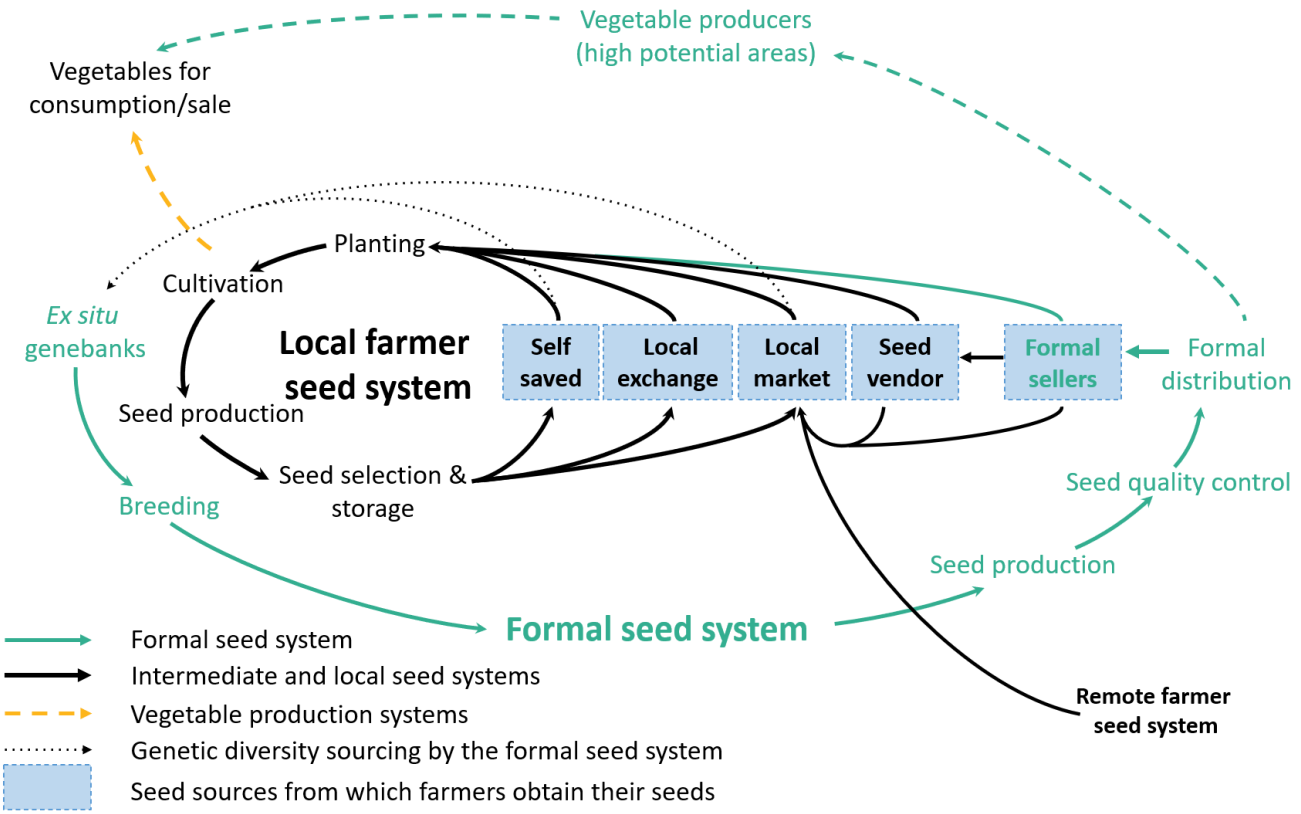

Figure 1. The vegetable seed systems from ethnic communities in northern Vietnam, modified from Almekinders and De Boef (2000) [2,3]

Note: The seed sources (blue rectangles) represent farmers' entry points into different seed systems. On the left, the sources are more closely linked to local farmer seed systems (or informal seed systems), while gradually towards the right, they become more aligned with formal seed systems. The green lines and text indicate aspects of formal seed systems, which are less significant in the context of vegetable seed systems in northern Vietnam [3]

The informal seed system is regulated by social norms and customary practices that have been built up for years amongst the farmers and communities. Quality is ensured through the direct trust relations between actors in the system.

The **formal seed system** can be described as a chain of specialized tasks that are often carried out by separate organizations in either the public or the private sector. These activities include conservation of genetic resources, the release, multiplication, or production of high-quality seed of improved varieties, and the marketing or distribution of these varieties.

In the public sector, universities and research institutes generally focus on scientific breeding of varieties. Private companies, on the other hand, often pay attention to the development of varieties and seed multiplication and marketing of crops with high profitability [5]. In this system, farmers can be the buyers who purchase seeds from agro-input shops or breeding units and/or producers who are contracted to produce seeds for private companies; farmers may also be beneficiaries of seeds depending on the ways seed reaches them either directly or indirectly.

The formal seed system mainly focuses on major food staples and cash crops that can produce high yields, are disease and pest resistant, and tolerant to climate hazards, such as droughts, floods, extreme heat. Additionally, recently it includes varieties with an enhanced density of specific nutrients. In this system, seed quality is guaranteed by quality assurance standards and procedures.

Stories from the field

Informal and formal seed systems in the North of Vietnam

In Northern mountainous regions of Vietnam, farmers often use a mix of seed sources. They engage in the practice of saving, drying, and reusing seeds, particularly for vegetables that are easy to preserve, such as H'Mong mustard, French bean, and spice vegetables. This practice is particularly important for local and indigenous vegetables whose seed is not readily accessible through commercial channels. Although informal seeds may not undergo formal quality control processes, they play a significant role in preserving local traditions and ensuring self-sufficiency in seed sourcing.

The formal seed sector plays an important complementary role in selling high-quality seeds for major vegetable crops. Tan Loc Phat is one of the seed companies participating in the formal vegetable seed system in Vietnam with its brand "Golden Coin" seeds. The company has its own gene bank and breeding center, it produces seeds in their own fields and in fields of farmers contracted by them, and it has a seed quality control and certificate department. They distribute their seeds through formal sellers (see Figure 1), including dealer networks, traders and nurseries, and provincial agricultural extension collaborations.

Thai farmers setting up netting to protect H'Mong mustard plants for seed production in Mai Son district

Link to reality

Group discussion

The aim of this activity is to have participants compile a list of major vegetable crops cultivated in their communities and identify the sources from which farmers obtain seeds for planting. These sources include (1) self-seed saving, or (2) seeds from other farmers/neighbor/relatives/friends; or (3) seeds from market/seed dealers/seed outlets of seed companies and vendors.

Instructions

1. Form a group of 4-5 peoples
2. Instruct each group to discuss the following:
    - What are the major vegetable crops grown by farmers in the community, and where do they typically source the seeds for these crops?
    - For those who produce vegetable seeds, how do they utilize them? Are they primarily used for replanting, exchanged with others, or sold in the community?
    - Do farmers sometimes purchase seeds with company brands from dealers or vendors?
3. Invite the groups to share their findings at the end of the session.

1.2. Differences between the formal and informal seed system

Formal and informal seed systems have been developed for different purposes. Formal seed systems are often focused on improved varieties for commercial reasons, fitting a wide range of conditions, and quality assurance standards and procedures. Informal seed systems, on the other hand, are often focused on indigenous and local varieties with a stronger emphasis on local adaptation , diversity, tradition, and cultural aspect.

Key distinctive features between the two systems are related to quality control, legal registration, and type of crops:

- **Quality control:** The formal system has fixed procedures and standards for seed quality control, these are monitored and certified at national and sometimes international level by an external agency, whereas in the informal system quality standards and control are based on mutual understanding, developed skills and trust between actors in the local exchange network, often built-up over years.
- **Legal registration:** In the formal system there is legal registration of seed producers or seed companies and certification processes, which are usually controlled by a public regulatory body [6]. In the informal system there is no legal registration. Through time and experience, norms, knowledge and trust are built around handling, sourcing/ exchanging seed and what to expect.
- **Type of crops:** The formal system focuses on a limited number of major food staples, vegetables with a large consumer market and other cash crops and aims strongly on improved vegetable cultivars that often cannot be reproduced or its quality maintained by farmers over a longer period. The informal system harnesses a much larger diversity of vegetables partly with more local cultural values and thereby contributes to the maintenance and conservation of biodiversity.

More specific differences and similarities are described in Table 1.

Table 1. Differences and similarities between the two seed systems

Features	Formal seed system	Informal seed system
Certification	Certified	Not certified
Seed production process	Separate from crop production [7]	Integral part of crop production [7]
Variety release	Formal	Informal/not applicable
Exchange through which channels	Officially recognized seed outlets, agro-dealers [7], government program; government agricultural extension system*	Farmer-saved seed, neighbor, community saved/cooperatives; social networks, local markets, petty traders [7]
Main crop types	High-value horticultural crops Improved, commercial bred varieties Varieties tested for uniformity and stability standards, then released and registered in the national catalogues of commercial varieties	Indigenous crops and varieties Local varieties well adapted [8]to local conditions and robust under the kind of stresses encountered regularly. With a known taste and productivity. Names are locally known but not formally registered Improved varieties adopted, multiplied and exchanged by farmers across seasons
Access as producers	Farming-contract with seed company but little access	Own-production; collaborative groups/ cooperative/community-based with high access
Quality control	Standards for seed quality control, monitored and certified by an external agency.	Based on trust in the network.

Note: In remote areas, this often includes local markets and petty traders (see Figure 1).
While these petty traders and local markets play a significant role, they are not strictly part of the formal system

Hmong farmer watering vegetable seedlings for seed production in Sa Pa township

Link to reality

Group discussion

The purpose of this exercise is to help participants to get a better understanding of the (formal and informal) seed sourcing options available to farmers and the characteristics of these different options.

Instructions

1. Form groups of 4-5 people
2. Instruct each group to choose one local/indigenous vegetable and one commercial vegetable. Ask each group to discuss the following aspects:
    - Seed source: What are the main sources of seeds for each vegetable?
    - Certification: Are the seeds certified or not certified?
    - Quality: How is seed quality confirmed or conveyed, or how do farmers typically assess quality?
    - Producer Access: To what extent do farmers have access to the seeds? (is it easy or difficult for them to obtain or use them?)
3. Encourage the groups to share and discuss their results in a plenary session.

Facilitator notes

Participants may find it challenging to distinguish between formal and informal seed systems or identify their overlaps. Facilitators can acknowledge these questions, explain that real-world practices may not fully align with theory, and assure participants this will be covered in the next section.

Reflections

The questions below can be used for open discussion as an assessment of the participants' existing knowledge of the training topics at the beginning and/or to evaluate their understanding of key learning points at the end of the training session.

- How would you define the informal and formal seed systems?
- What do you consider the advantages and disadvantages of each system?
- Do you find it difficult to place all seed exchange options farmers use in either the formal or the informal system or were there any exchange options that were difficult to classify?

SECTION 2: TOWARDS AN INTEGRATED VEGETABLE SEED SYSTEM

In practice, formal and informal systems are often already interlinked. Farmers have long drawn from both formal and informal systems, accessing seed for different crops from distinct channels. And an increasing number of breeding programs involve farmers in variety selection while improved varieties are diffused through local channels. So far, however, many of these interfaces have been ad hoc and localized, rather than managed and achieved at scale [9]. The key to identifying pivotal points for integrated seed system development is to recognize the key activities and actors involved and how these can work together and benefit each other.

Specific learning objectives

At the end of this section, the participants should be able to:

- Describe to what extent the informal and formal systems co-exist and complement each other
- List key activities and players in vegetable seed systems and how these can be linked to enhance effectiveness

2.1. Complementarities between informal and formal seed systems

Despite many differences between the formal and informal seed system, in practice the two systems complement each other. Farmers rely on own/farmer produced and saved seed for indigenous and local vegetables that best meet their needs, which include but are not limited to taste, preparation properties, cultural and/or medicinal uses. At the same time, farmers that save seeds for the next season may buy new seeds every 3-4 years and proceed to save the resulting seed to maintain the genetic quality of their seed stock. Farmers may also buy improved vegetable seeds from companies to try out new crops or varieties, be it with the purpose of selling high quality vegetables for income generation or for consumption [5].

Improved varieties from the formal seed system are often associated with novel traits, such as higher production, disease resistance or tolerance against heat, etc. The formal system often specializes in certain species/varieties and characteristics, which are often linked to commodity value and certification. These are often seen as strengths and valued by professionals in the formal seed sector, as well as government actors. However, since it is difficult to reproduce and maintain the quality of improved seeds, farmers may become dependent on the improved varieties from public research centers and seed companies. Specialization may also indirectly lead to less diversity in terms of species and varieties, less valued crops at the community or local level, and therefore reduced resilience.

Seed sourcing of local varieties from the informal system is characterized by trust, user value, diversity, and seed sovereignty. In the case of vegetables, the informal system not only provides varieties with ‘old traits’ but also a larger diversity of often nutritionally and culturally (but commercially less) important vegetables. The informal seed system is usually also more resilient to external shocks that may affect seed supply chains, markets and demand (e.g., COVID19, economic impacts). The informal system may face challenges, however, to provide consistent access and availability of seeds. Seeds are also often less uniform. While this could be considered as a positive characteristic by farmers themselves as it provides options for breeding, it may also lead to loss of certain traits over time. Identification of varieties can be complicated and due to the mixing of plants with different characteristics, seed production and quality

may degenerate over time due to genetic erosion. For seed from the formal system to also reach farmers that are at larger distance from larger markets and agro-dealers the informal sales networks are essential. While the formal control mechanisms do not work on these points of seed access for farmers, the trust relations with vendors from the informal seed systems take over quality control.

These various characteristics of the formal and informal seed systems can be seen as either strengths or weaknesses depending on who you ask, the remoteness of farming communities and the purpose of production. The complementarity between the two seed systems lies in the fact that farmers can maintain some vegetables very well themselves and even breed with the crops, while others are too complicated to obtain or store seed and then the formal system, but also informal sales channels can be useful. So, farmers having access to both the informal and formal seed system can maintain a wider portfolio of vegetables and are more secure.

Link to reality

Group discussion

This brainstorm session aims to make participants aware of how formal and informal seed systems complement each other.

Instructions

1. Ask participants – particularly farmers – to reflect on the diversity of vegetables they grow.
    - How many of them come from the formal seed systems (seeds purchased from packages/companies).
    - How many of the vegetables they grow cannot be replaced by (certified) seeds in packages?
    - From the vegetables that they self-save, how many are sometimes purchased, once in 3-4 years for instance.
    - Considering how many vegetables are grown, how many could not be grown if farmers would have access to only the formal system or only the informal system?
2. Facilitate a discussion among participants using the following guiding questions, which will assist them in recognizing the strengths and weaknesses of each seed system:
    - What are your experiences with the formal seed system? What are in your view the strengths and weaknesses of the formal seed system?
    - What are your experiences with the informal seed system? What are in your view the strengths and weaknesses of the informal seed system?
    - How can they make better use of and/or participate in both systems based on the strengths of each and overcome some of the weaknesses identified.

2.2. Key activities and players in vegetable seed systems

The overall aim of seed systems is to make sure that all end users, especially smallholder farmers, have access to seeds in sufficient quantity, quality, and diversity, so that they can sustainably produce nutritious food for themselves and others [8, 9, 10]. To realize this goal, seed systems include various activities. Informal seed systems are characterized by planting, harvesting and selection of seeds, storage of seeds for own stock, farmer exchange and/or selling at local markets. Formal seed systems include variety development, seed production and multiplication, seed quality maintenance, development of delivery and marketing strategies, and information systems to create demand, raise awareness and ensure accountability, etc. [9]. Together, these activities should serve three key interconnected functions to be successful:

(1) Production, storage, and distribution of quality seeds is crucial to have sufficient volume of quality seeds for a diverse set of crop species and varieties at the right time. Such that the different types of demand are met, for example, for household food production and for commercial vegetable production.

(2) Innovation is essential to any seed system because continuous knowledge creation is needed for enhancing productivity, resilience, resistance, and product quality. Innovation not only arises from the creation of new varieties, but also includes the identification and selection of seeds and seed sources that can be matched to other environments to adapt to changes in the climate and the market. Also, improving post-harvesting handling and storage conditions or making distribution more effective are innovations that improve seed system performance. The same for improved knowledge sharing and seed fairs etc. to improve information and seed flow between farmers are methods to generate and support innovation.

(3) Seed quality regulation. It includes both formal and informal regulations, e.g. customary rules around seed exchange in the informal system and seed laws and related relations in the formal system. The rules that regulate the players in the informal seed system are relationship, trustworthiness, and experience. The rules that regulate the players in the formal seed system are well-known company profile, seed laws, and experience; however, it is not just the laws, but the control on their execution that is required. Trust has been replaced by policing, without which laws are not followed.

The above-mentioned key functions are present in any type of seed system, from fully informal seed system to a fully formal seed system and contribute to farmer households' seed security. Instead of artificially separating formal from informal in the seed system, we must create strategies that link actors from the formal and informal systems to enhance this integrated reality.

Most key players in seed systems are associated with either the informal or formal one. Key players in the informal sector involve farmers, traders, processors, cooperatives, and various business individuals. In the formal sector, the players are public breeding and seed parastatals, universities, non-governmental organizations (NGOs), multinational and national commercial seed and agro-input companies, regulatory bodies, and service providers for credit and insurance. In practice, some key players can perform roles in both systems, e.g., petty traders, vendors and open village markets may sell seeds of both sources. Table 2 offers a summary of public and private sector participants in both formal and informal seed systems

Table 2: Actors in formal and informal seed systems

	Public	Private
Formal	Universities, seed parastatals, national agricultural research institutes (NARIs), international agricultural research institutions (IARIs), regulatory bodies	Small-to-medium enterprises (SMEs), seed companies, multi-national & national seed companies, regulatory bodies, agro-input companies, agro-dealers, (petty) traders, vendors, open village markets, financial service providers, credit and insurance providers, seed trade associations
Informal		Farmers, (petty) traders, vendors, open village markets, processors, producer organizations, local credit providers, NGOs, community-based seed groups

Note: Table 2 is modified from Sperling, Boettiger, and Barker (2013) [9]

Key actors in vegetable seed systems: From left to right, top to bottom – seed dealers, farmers, research institutes, and seed companies

While not all these actors need to be engaged in integrated seed system development strategies, it's essential to plan, test, and promote integrated seed system initiatives with the involvement of multiple actors and scale them up if they prove effective [9].

Table 3 illustrates the role that different key actors play in the formal and informal system, and the potential synergies between them.

Table 3. The role of key players in the formal and informal seed system and potential synergies

Key activities	Key actors and role in the formal seed system	Key actors and role in the informal seed system	Potential synergies between both systems
Key actors and role in the formal seed system	Genebanks typically maintained by public institutes and/or research centers for conservation purposes. Companies also maintain genebank for commercial breeding (they may also make use of public gene banks).	Farmers tend to maintain diversity of local/ indigenous vegetables in home gardens, but seeds are usually not uniform. This non-uniformity is a source for breeding and often valued by farmers, but it may also lead to loss of certain traits.	Communities may conserve diversity of local/indigenous varieties through community seed banks with support of extension officers, public research institutes and/or universities.
Seed/variety selection and breeding	National/international research institutes select and breed varieties for public and/or commercial purpose Companies select and breed their own commercial varieties.	Farmers may either select seeds from harvest at end of season or grow vegetables specifically for seed production.	Farmers can be trained in participatory variety selection (and breeding) with support of research institutes and/or universities.
Seed production / multiplication	Seed companies and public research institutes produce and multiply seeds from their own seed production farms. Some may hire farmers to produce seeds under contract farming and quality control procedures	Seed production by farmers themselves. Seed multiplication is not common, although may take place at a larger scale through cooperatives.	National research centers can provide training to extension officers and farmers to improve production, selection and storage techniques based on farmers' needs and capacities Focus farmer selection and seed production on vegetables neglected by companies
Seed distribution, delivery and marketing	Seeds are distributed through commercial companies, government agencies and/or seed AID. Seed retailers/dealers play key role in distribution network for seed companies Farmers are typically seen as receivers/clients.	Seed are used for farmers' own stock, exchanged with other farmers and/or sold at local markets. Dealers may buy at local markets and sell to other farmers Informal seed markets may be organized for exchange of seeds between communities	Improving farmer to seed value chain linkages, e.g., seed companies and/ or government agencies may set up networks for support and easier access to seeds for farmers and cooperatives. Promote and improve farmer exchange mechanisms and networks (e.g., seed fairs) Provide training to local businesses in remote communities to improve their quality control
Seed quality assurance	Seed certification agents do the monitoring and provide certificate for new seed varieties.	Seed quality is based on trust between farmers.	Farmers may establish Participatory Guarantee Schemes, which is an integral component of a decentralized, farmer-led seed system that aims to empower farmer groups with the collective authority to validate the standards of truthfully labelled seeds for the market.

LEARN MORE

This video is titled **"Seeds of Change: A journey with ethnic minority communities in Northwest Vietnam"**. The video highlights key seed-related challenges faced by ethnic farmers in the Vietnam's Northern highlands. Through training on seed production techniques, they learned to improve the quality of their self-saved and selection of quality vegetable seeds during purchase. Some farmers have formed local production groups to earn income from selling their vegetables and seed. Better access to quality seeds has allowed them to have higher vegetable yields and productivity, increased income, and increased quantity and diversity of vegetables in their diets.

Scan the QR code to see the video

Link to reality

Mapping actors within the vegetable seed system

This exercise is designed to map the different actors in the formal and informal vegetable seed sector in an area, describe their role in the seed system, and explore their potential contribution to (integrated) seed system development.

Instructions

1. Form group of 4 – 5 people
2. Present the video "Seeds of Change" to all groups (use the QR code above access the video).
3. Instruct each group to identify actors from the informal and formal seed systems that are featured in the video.
4. Prompt each group to engage in a discussion addressing the following questions:
   - In what ways is this similar or different from their own situation?
   - Are there any actors in your context that were not mentioned in the video but are significant players in your region? See Table 3 for reference.
   - What are the five most important players in your area? What are their roles, and how they can contribute to integrated seed system development in the area.
   - Based on the above insights, what are potential strategies for improving the local seed system in their area?

Facilitator notes

Review the video first yourself. If you are not convinced the video works or if you are not able to show the video, then consider to simply start with step 4, and map all the actors of the formal and informal vegetable seed system in the participants' area. They can start with their own community, but also need to check for actors that operate at district or even provincial level; please be aware that there may be actors that do not seem to be part of the seed system, but may play an important role in terms of regulation etc., such as local authorities etc. They can then discuss the role of each, and to what extent they are working together on improving seed availability and quality.

Reflections

The questions below can be used for open discussion as an assessment of the participants' existing knowledge of the training topics at the beginning and/or to evaluate their understanding of key learning points at the end of the training session.

- Who are the key formal and informal players in the vegetable seed systems in your area, and how do farmers engage in each system?
- What role do these different actors play and how does this contribute to the availability of high-quality seeds?
- What are the relations between these actors and how do they work together?

SECTION 3: FOOD SECURITY, SEED SECURITY AND DIVERSITY

Since this manual is mainly focused on rural communities with smallholder farmers that depend to a large extent on self-saved seed for the production of food, it is important to pay more attention to the concept of food security and how it relates to seed security and diversity, since it has important implications for the challenges that we may want to address through integrated seed systems.

Specific learning objectives

At the end of this section, the participants should be able to:

- Explain how seed security contributes to food security
- Describe different elements of seed security, and how this is linked to seed system resilience and food diversity

3.1. Dimensions of food security

Food security is when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food for a healthy and active life.

At the household level, food security refers to the ability of the household to have adequate food that meets the dietary needs of all members of the household, either from its own farm, collected from the wild, as food gifts or through the market. The dimensions of food security are:

1. **Availability of food, or the amount of food that exists.** For example, if a household has enough food for all members to eat, then food is available.
2. **People's physical, economic, and social access to food.** The capacity to produce/buy/acquire food. For example, a household with a farm or money to buy food has access to food. But if the farm or market is far or they are not able to regularly get to it, then their access may be limited.
3. **Stability of the availability and access of food over time.** For example, if a household does not have enough food for some months in the year, then they are food insecure.
4. **Quality of that food.** The food that a household has needs to provide all the nutrients they need and be safe to eat. For example, if a household has rice in sufficient quantities but no other food available, they are still food insecure because they do not have the diverse foods needed for a healthy life.

A diet composed of a variety of foods is needed throughout the year for adequate health and nutrition. No single food can provide all the nutrients in the amounts required by the body for growth and health. Although people can buy food, for smallholder farmers in rural areas, most of this diversity is from their farms. This also applies to vegetables, which are predominantly produced by farmers for home consumption. For households that sell surplus or commercial vegetables for income generation, food security is only achieved if the income is being used to purchase what the own farm does not provide. This is particularly important during lean periods when households are not able to produce, or access enough diverse and high quality fresh, stored or processed food.

Vegetables play an important role in the dietary quality of households who often lack specific nutrients and vitamins, and which will be the focus in the module 2 of this training manual. Hence, smallholder farmers need access to sufficient and diverse seeds, allowing for year-round availability of nutritious vegetables for consumption.

A H'Mong farmer feeding vegetables to her child in Sa Pa township

Stories from the field

From seeds to plates: How seed security enhances food security

In the project sites in the mountainous highland of Northern Vietnam, vegetables are a crucial food source for ethnic minority communities, contributing to taste, nutrition, and daily sustenance alongside staple crops like rice. Among these vegetables, pumpkin holds particular significance, serving both as a household food source and an income generator for Hmong and Dao people.

Most households in the project sites cultivate one or two pumpkin varieties. Pumpkins are commonly consumed in various ways, from immature fruit, mature fruit, leaves, young shoots and flowers. Mature pumpkins can be stored for an extended period, with some local pumpkins able to be stored for up to a year. Some households earn between 5 to 10 million VND (equivalent to 200 to 500 USD) annually from selling pumpkins. While the amount earned may not be substantial, it can be used to purchase additional daily food such as meat, fish, and eggs, enough to sustain the family for 2 to 3 months. These households recognize that ensuring the preservation of local pumpkin varieties and accessing high-yield and easily marketable (small-size) pumpkin varieties can help improve their food security.

Dao farmers peelings pumpkins before cooking in Sa Pa township

Link to reality

Group discussion

This activity aims to encourage participants to assess the dimensions of food security within the community and explore how seed availability impacts these aspects.

Instructions

1. Form groups of 4 - 5 people
2. Assign each group one dimension of food security: food availability, food access, food quality, and food stability.
3. Also here Instruct the groups to:
    - Evaluate the extent to which households in their community have their assigned dimension (sufficient food availability, adequate access to food, access to high-quality food, and stable and consistent food availability and access) throughout the year or multiple years
    - Explore how the availability of seeds affects the assigned dimensions of food security within the community.
4. Conclude the discussion by having each group share the highlights from their discussion.

3.2. Key elements of seed security

Food security is affected by seed security as seeds are the foundation for agriculture and food production. Besides the contribution to access to a variety of foods for consumption, having access to diverse seed:

- Supports the adaptation to and recovery after shocks such as extreme weather events, such as drought, floods, etc.
- Enables farmers to meet different demand niches for example foods with cultural or health purposes, specific markets, etc.
- Strengthens the overall resilience of the farming system.

The availability of high-quality as well as biotic and abiotic stress resilient seeds to farmers is crucial for ensuring sustainable crop production that contributes to household food and income.

Like food security, Household Seed Security means that both men and women in a household have sufficient access to quantities of available and good quality seeds of preferred crop varieties at all times in both good and bad cropping seasons and for instance with and without external disturbances to trading networks as for instance caused by COVID-19.

Seed security includes several key elements:

- **Seed availability** – the condition when adequate availability of seeds exists from different sources: self-saving, social networks, in local markets, the formal seed sector, and from seed aid suppliers to meet the seed requirements of local farmers. The seed should be in reasonable proximity to the farmer and be available in time for planting.
- **Seed access** – means that the farmers can acquire seed through purchase, loan, exchange, barter or use of power in social networks.
- **Seed quality** – a technical factor that includes good germination and seedling survival and growth, physical purity, varietal purity, and seed health.
- **Stability of the seed system** – seeds are available and accessible during different seasons throughout the year and over longer time periods [11].

Link to reality

Group discussion

This activity aims to promote participants' understanding of aspects of seed security and how these aspects impact the community.

Instructions

1. Divide participants into groups of 4 – 5 people.
2. Assign each group one element of seed security: seed availability, seed access, seed quality, and stability.
3. Instruct the groups to:
    - Discuss the extent to which households in their community experience: sufficient seed availability, adequate seed access, access to high-quality seeds, stability of access and availability of seed.
    - Explore the impact of these experiences on vegetable production throughout the year.
4. Conclude the discussion by having each group share the key points from their conversation.

Facilitator notes

Pay attention to the discussion on the last question in the previous exercise on how seeds affect food security. Perhaps pick on those responses and bring them back in the discussion when each group share the key points of their conversations.

3.3. Resilience and diversity

A concept not discussed yet is resilience. Resilience is the capacity of the seed system to resist, adapt to and recover from biotic and abiotic stress and/or shocks. There are various shocks and stresses that can drastically affect agriculture and in turn seed security and food security. These can include i) weather like drought, floods, landslides, extreme heat, and rainfall, ii) biotic shocks like pests and diseases, and iii) market shocks that affect the functionality of infrastructure like storage facilities, transport, and markets, governance and economic turns that impact trade and prices, and shocks that are result of several factors like the mobility restrictions faced during the COVID-19 pandemic.

Potential strategies, through which seed access can be facilitated after a shock or stress will depend on the type and severity of the shock. Such shocks can be minimized by strengthening the resilience of the seed system prior to shocks, e.g. through profiling and promoting seed with resilience traits, improving farmer seed selection and saving practices, creating or supporting farmer and community seed exchange mechanisms and networks like community seedbanks, and improving farmer to seed value chain actor linkages. Strategies, through which seed access can be facilitated after a shock or stress include promoting and building farmer capacity in seed diversity, resilience traits, and self-saved seed; strengthening community seed networks; and promoting disaster support mechanisms that facilitate seed and input provision in the event of a shock for example through government and non-government systems.

There is always a mix of seed systems and that may differ from place to place and with the number of vegetables we grow. Varietal suitability, i.e. when the accessed crop varieties will function well within the context of the farmers and provides the produce qualities like taste as desired by the farmers or their markets will be critical here. When the farmers can have good access to both the formal and informal seed systems of different crops and crop varieties, they will surely have more chances to diversify their plantings, and this increases their resilience. And this surely also contributes to the diversity of food and food sources as well as nutritional quality.

Thai farmers transplanting H'Mong mustard seedlings in Mai Son district

Link to reality

Group discussion

The aim of this group discussion is to explore recent real-world scenarios involving seed crop challenges and assess how farmers responded to these challenges.

Instructions

1. Form groups of 4-5 people
2. Instruct each group to select a recent real-life example, preferably from their region, that affected vegetable production. That can be an example of a disease/pest outbreak, extreme weather event, seed shortages, or market disruption.
3. Prompt the groups to discuss the following aspects related to their chosen example:
   - How did it affect the farmers.
   - How did it influence farmers' seed security (availability, access, quality, stability).
   - How did they cope with the situation.
4. Encourage each group to brainstorm what could have been or needs to be done to improve seed security and resilience of the system
5. Ask if each group shares the highlights of their discussion.

Facilitator notes

Pay attention to the examples provided in the text on resilience and diversity. You may consider bringing them up during the discussion on how to improve seed security and resilience or when they share highlights of their discussion.

Reflections

The questions below can be used for open discussion as an assessment of the participants' existing knowledge of the training topics at the beginning and/or to evaluate their understanding of key learning points at the end of the training session.

- What does household food security mean, especially in your own experience?
- What does household seed security mean and what do you think are the most critical factors?
- As farmers, what can you do to improve the resilience of the seed systems on which you depend?

SECTION 4: SEED SYSTEM CHALLENGES AND SOLUTIONS

For developing well-functioning seed systems, it is important to identify the key challenges, and how these can best be addressed and by whom. As we have seen in the previous section, there are advantages and disadvantages to different sources of seed, whether from the formal or the informal system. We have also seen that vegetable seeds as used by farmers tend to come from different sources. For the seed systems that farmers use to function better we may try to formulate improvements. These could be called seed system development goals.

Strategies for seed system development may be very different for when we pursue income generation through increased vegetable sales, whether we aim to improve dietary quality through the production of high quality and diverse seeds of nutritious vegetables, or whether we want to increase resilience through the availability of diverse set of seeds which can help to recover relatively quickly in case of shock or stresses.

Key challenges and solutions are often location and crop specific and depend on the priorities of the key actors in the seed system. In this section we will present some tools of how to explore and analyze key challenges and formulate potential ways to address them, whereby participants will be asked to do the same for their own area.

Specific learning objectives

At the end of this section, the participants should be able to:

- Understand key challenges to participants' vegetable seed systems within their immediate communities
- Identify possible solutions which participants can use to address their key challenges

4.1. Identifying key challenges in vegetable seed systems

As indicated above, both the formal and the informal seed systems have challenges that are often location specific and may depend on the type of crop and the main target group. We will present two tools here which can help to get a better overview of the seed systems in a particular area, and which may help to identify key challenges and make decisions.

Problem tree analysis

Problem tree analysis (also called situational analysis or just problem analysis) provides a structural analysis of the causes and effects of an issue or problem [12]. The process of analysis often helps build a shared sense of understanding, purpose, and action.

Problem tree analysis is best carried out in a small group of about six to eight people using flip chart paper. For this context, the problem can be seed insecurity through any of the dimensions of seed security that is, seed availability, access, quality, stability or resilience.

Step 1: Discuss and agree to the problem or issue to be analyzed. The problem can be broad, as the problem tree will help break it down. The problem or issue is written in the center of the flip chart and becomes the 'trunk' of the tree. This becomes the 'focal problem'.

Step 2: Identify the causes of the focal (or core) problem – these become the roots – and then the consequences, which become the branches. These causes and consequences can be created on post-it notes or cards.

Step 3: It is important to further explore the root causes of the problem for this keep asking 'why'. This helps to understand what the 'real' problem(s) is/are that need(s) to be addressed.

The heart of the exercise is the discussion, debate and dialogue generated in the process of creating the tree. Take time to allow people to explain their feelings and reasoning and record related ideas and points that come up on separate flip chart papers under titles such as 'solutions', 'concerns' and 'dilemmas'.

While groups can either form a representation of the community to get a general overview, they can also be more targeted to specific groups with certain characteristics (e.g., gender, age, socio-economic status), especially if there are important differences in the challenges they face.

Below is an example of a relatively simple problem tree.

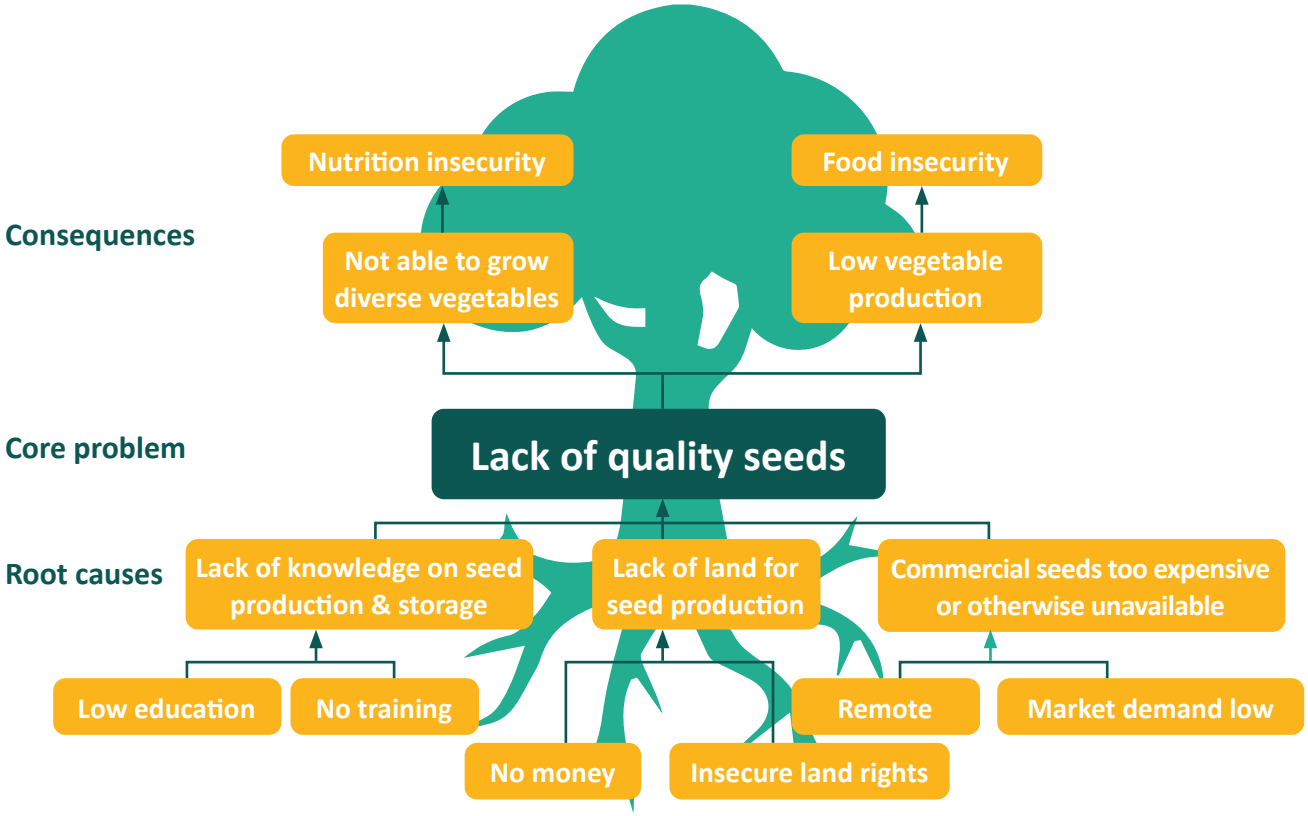

Figure 2. Example of a problem tree

A specific focus may help to define the problem more clearly and then develop specific solutions, however, there is a risk that other challenges are missed out. Hence, it is critical to check if there are other key challenges before starting to work on root causes and consequences. Each key challenge may require a separate problem tree analysis. It is important to identify at least root causes that can be addressed in the short term with key actors in the seed system, and not focus too much on other causes that may need to be addressed in the longer term, possibly with support of other actors.

Seed system characterization

One can also decide to conduct a more comprehensive seed system characterization through surveys, key informant interviews and groups discussions, whereby it is vital to involve both male and female farmers of different age and socio-economic status since they may have different perspectives. We did such a vegetable seed system characterization in Mai Son district (Son La province) and Sa Pa township (Lao Cai province). Vegetable seed systems are very important to the ethnic minority farmers in Northern Vietnam as vegetable production offers an important source of nutrition and income. Therefore, improved access to seeds, especially quality seed of diverse species and varieties is essential for them.

Dao farmers and researchers discussing sources and challenges in vegetable seed systems in Sa Pa township

Key questions to be addressed through such a survey are:

- What do farmers grow and why? Which do they mainly grow for home consumption and which for sales? And in what proportions or percentages do they then use for both?
- How and from whom do they source their seed for different crops and why?
- What knowledge and skills do farmers have in terms of seed production, handling/storage and/or quality assessment?
- What are the main challenges in the seed system in terms of availability, access, quality, and stability?
- Do farmers face any challenges in terms of food and nutrition security and/or income throughout the year and why?
- What public and private sector organizations from the formal and informal seed sector can be identified in the area and what is their role?

These questions can be addressed by farmers, but in some cases, it may also be useful to consult key persons in the community or area that have a good overview of the seed sector and the situation of the farmers, as well as other key actors in the seed system.

The Table 4 below depicts an analysis of problems in smallholder systems in Northern Vietnam, based on results of a seed system characterization study conducted as part of our past project [13]. It can be useful to use the elements of seed security as a framework to identify seed system challenges and possible solutions. The list below is a non-exhaustive list of challenges that highlights a range of issues and their complexity warranting a more integrated approach to seed system development.

Table 4. An analysis of vegetable seed system challenges in Northern Vietnam through seed system characterization

Features	Formal seed system	Informal seed system
Availability	Lack of research and development on farmer seed systems Limited inclusion of ethnic minority farmers (especially women, youth) in seed value chains	Inadequate post-harvest practices due to lack of knowledge and skills
Access	Limited access by smallholder producer groups to seeds of diverse novel varieties	Limited exchange between households / no seed fairs for exchange of seeds
Quality	Limited quality assurance or guarantees by seed suppliers. lack of promotion of seed with invisible properties (e.g., resistances, micronutrients)	Poor seed health and limited farmer knowledge about seed-borne diseases Limited skills among farmers to assess seed quality
Diversity	Only limited set of improved seeds are sold at the market, and only during certain seasons.	Diversity at commune/district level is high, but very low at household level
Resilience	Not clear*	Acute shortages of preferred seed varieties after crop failure

Note: Despite COVID19 impacts on seed supply chains in other regions, we did not find clear evidence for this.

4.2. Possible solutions for seed system improvement

To identify possible solutions for seed system improvement, we can use the same tools as mentioned under 4.1.

Following the problem tree analysis, it is possible to rephrase each of the problems into positive desirable outcomes – as if the problem had already been treated, the problem tree can thereby be turned into an objectives tree. For example, instead of 'lack of knowledge and skills on seed production and storage', becomes 'sufficient and adequate knowledge and skills on seed production and storage' and 'no training' becomes 'adequate training'. Root causes and consequences are turned into root solutions, and key projects or influencing entry points are quickly established. Again, we can make this relatively simple or more complicated. Not all issues can be addressed simultaneously and quickly, we may therefore need to identify 'best-bet' solutions that can be addressed with key players in the seed system and within a realistic timeframe.

Similar, the analysis table, that was presented for seed system characterization, could be used to identify potential solutions to address key challenges, whereby it is important to prioritize those solutions that are expected to have the most impact on the overall seed system.

Again, it is critical to identify what can realistically be addressed with key players from the formal and informal seed systems and develop an action plan with those who are interested and willing to make a change.

Local actors discussing capacity building approaches for vegetable seed systems in Sa Pa township

Stories from the field

Enhancing seed quality, availability, and nutrition among H'Mong community in Northwest Vietnam

The H'Mong community in Sapa, a mountainous area in Northwest Vietnam, faced significant challenges related to seed quality and availability, particularly for key crops like vegetables and legumes. Self-saved seeds incurred high losses, impacting crop yields and food security. Seasonal constraints, pest attacks, and cold weather hampered crop productivity. The community also lacked knowledge and capacity in seed production and storage. Additionally, inadequate practices for selecting seeds from Dark Green Leafy Vegetables (DGLV) plants affected overall seed quality. To improve self-saved seed practices, the project collaborated with researchers from the Fruits and Vegetables Research Institute to provide training on how to produce, harvest and store saved seeds.

Another challenge identified in the study included low demand for vegetables, particularly DGLV. There was limited motivation to allocate resources for nutritious vegetable production, despite the capacity to do so. Lack of knowledge about the benefits of dietary diversity and insufficient skills for vegetable preparation and cooking were also significant barriers to improving nutrition in the community. These challenges called for nutrition education to promote dietary diversity, encourage seasonal planting, and enhance cooking skills, while also motivating households to prioritize nutritious vegetable cultivation and consumption. Hence, the project also facilitated the establishment of community nutrition club meetings delivered through the women's union and supported by local government officials and village health workers. The clubs promoted increased diversity of food groups produced and consumed through two components: 1) nutrition education and 2) participatory cooking sessions and new recipe development (i.e., integrating target crops into traditional and/or appropriate new recipes).

H'Mong farmers in a training session on seed production techniques in Sa Pa township

Link to reality

Group discussion

This activity aims to help participants identify key challenges in the seed system and collaboratively develop actionable solutions through a problem tree analysis.

Instructions

1. Ask participants to select one vegetable crop they would like to focus on and explore the main challenges in the seed system in terms of availability, access, quality, diversity, and resilience.
2. Facilitate a discussion to agree on the primary challenge or problem. Write this core issue in the center of a flip chart; this will serve as the "trunk" of the problem tree.
3. Work with participants to identify the causes of the core problem (the "roots") and the consequences (the "branches"). Use post-it notes or cards to document these causes and consequences and place them around the trunk.
4. Explore the root causes of the problem with the participants by asking 'why'. This helps to understand the 'real' problem(s) to be addressed.
5. Brainstorm with participants on possible solutions by turning root causes into positive outcomes.
6. Discuss what participants can do themselves to improve their seed systems and identify the support they need, and from whom, to implement these solutions.

Facilitator notes

After completing the problem tree exercise, you may want to reflect with the participants on the process and results by asking the following:

- Was it easy or did they face some challenges to come from key challenge or problem to root causes, consequences, and possible solutions.
- Why do they think these challenges occurred?
- How could they have done it better?

Reflections

The questions below can be used for open discussion as an assessment of the participants' existing knowledge of the training topics at the beginning and/or to evaluate their understanding of key learning points at the end of the training session.

- What are some of the key challenges in vegetable seed systems?
- What are some of the root causes and consequences?
- What are potential solutions or interventions that could address these challenges?
- What concrete actions can you take to improve the seed systems within your communities?

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ANNEX: PROGRAM

Based on the content of the module, below is the suggested training program if all sections are conducted. This is estimated to take 12 hours. The program can be adjusted if needed based on interest and available time.

Session	Minutes
Welcome and introduction	15
Section 1: Formal and informal seed system	
1.1. Seed systems	30
Link to reality - Group discussion	45
1.2. Differences between formal and informal seed system	30
Link to reality - Group discussion	45
Reflection	10
Section 2: Towards an integrated vegetable seed system	
2.1. Complementarities between formal and informal systems	30
Link to reality - Group discussion	45
2.2. Key activities and players in vegetable seed systems	45
Link to reality - Mapping actors within the vegetable seed system	45
Reflections	10
Section 3: Food security, seed security, and diversity	
3.1. Dimensions of food security	20
Link to reality - Group discussion	35
3.2. Key elements of seed security	20
Link to reality - Group discussion	35
3.3. Resilience and diversity	20
Link to reality	35
Reflections	10
Section 4: Seed system challenges and solutions	
4.1. Identifying key challenges in vegetable seed systems	45
4.2. Possible solutions for seed system improvement	15
Link to reality - Group discussion	90
Reflections	10
Wrap up and closure	15

Project “Integrated vegetables seed systems development in ethnic minority communities in Northern Vietnam for enhanced nutrition and income security”

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