



TRANSITIONING TOWARDS REGENERATIVE AGRICULTURE, RESTORED LANDSCAPES, AND A VIBRANT RURAL ECONOMY IN ETHIOPIA

Stories and lessons learned from
the Green Future Farming program



FOREWORD

By the Bureaus of Agriculture

“Since 2020, the Oromia Bureau of Agriculture is involved in the Green Future Farming program. The collective aim is to support small holder farmers in the Middle Awash, specifically in the districts of Sire, Jeju, and Diksis, in adopting regenerative farming practices. This program strengthened the Bureaus work in this field and supports in the wish to transition to a regenerative form of agriculture. It equipped the officers with the new hands-on knowledge in innovative intervention areas such as biofertilizer, road water harvesting, and more. In many ways, these initiatives have benefited our rural community. The Oromia Bureau of Agriculture is ready to scale up the programs best practices at the kebele, woreda, zonal, and regional levels. We aim to extend the geographic scope and transfer successful approaches across the region through program-trained individuals that provide technical training and share experiences as resource persons in the regions”.

- Tena Gobena, Senior Natural Resources Expert at the Oromia Bureau of Agriculture

“The Amhara Bureau of Agriculture has been in close partnership with MetaMeta in implementing the Green Future Farming program in GubaLafto Woreda in the North Wollo zone of Amhara National Regional State. The program supports the government efforts in sustainable landscape management and promote innovative regenerative agriculture practices. While doing so, the knowledge building on various regenerative practices such as microclimate management, ecologically based rodent management, and smallholder poultry farming, among our practitioners was remarkable. The Amhara Bureau of Agriculture, through institutional arrangement, commits to further scale up the program's best practices at a wider scale by well documenting, learning and sharing at all levels. It also welcomes other similar projects and initiatives to work closely as a partner for the betterment of our community”.

- Getachew Engdayehu, Amhara National Regional State, Disaster Prevention Food Security Coordination Commission (ANRS DPFSCC), Technical Advisor Food Security

PREFACE

The Green Future Farming (GFF) program aims to strengthen the rural economy by restoring degraded landscapes and introducing regenerative agriculture practice. Regenerative agriculture is the opposite of the degenerative, or linear, agricultural practices that we now often see (mono-cropping, inappropriate synthetic agri-input use, erosive soil practice, high pre and post-harvest losses, lost biodiversity and more).

GFF is working in two woredas in two regions in Ethiopia: GubaLafto in Amhara Region and Middle Awash in Oromia Region. In addition to GFF Ethiopia, two programs with similar objectives are implemented in Kenya and Uganda. The main agenda in GFF is to understand what works and how it works in the reality of these remote rural areas, how regenerative practice lands and how it creates jobs and income opportunities, and what policies and practices facilitate or frustrate stronger local economies on the basis of sound resource management and sustainable agriculture.

GFF Ethiopia works along the cycle of regenerative practice (see figure 1). At every step in the farming system there is scope to do better - less degenerative, with better yields and more income opportunities. We aim to foster the transition of linear agriculture towards productive circular agriculture with better cropping systems, better seeds, better tools, healthier soils, safe control of pests and rodents, better storage, better rural transport, and better local climates. Particularly in the land-scarce context of rural Ethiopia the farming systems can be expanded by complementary non-land based activities, such as beekeeping or courtyard poultry. Many of these regenerative practices are rooted in local services and inputs. As such, regenerative agriculture will increase jobs in agriculture and agri-services, boost the rural economy and create aspirational livelihood opportunities for young people.

Over the past four years, GFF has explored the options for regenerative agriculture and better resource management in these partly conflict-affected areas. As such, the program begun to collect a wealth of practical experience and insights on the various facets of regenerative agriculture and circular local economies through exploration, implementation, and experimentation. These first findings, lessons learned, and recommendations are collected in this bundle through blogs written by the diverse group of individuals working on the GFF Ethiopia program. Each of these blogs represents a piece of the puzzle, offering valuable insights and examples of how regenerative agriculture can be implemented and even scaled in real-world situations, but also where things fail. From using better seeds and tools to improve crop productivity to developing healthy soils and local climates to creating new livelihood opportunities through enterprises like poultry rearing and biofertilizer production; the GFF Ethiopia program is working to develop a holistic and circular approach to agriculture and rural development. The bundle is divided into 10 chapters with each one covering one aspect of the regenerative agriculture transition.

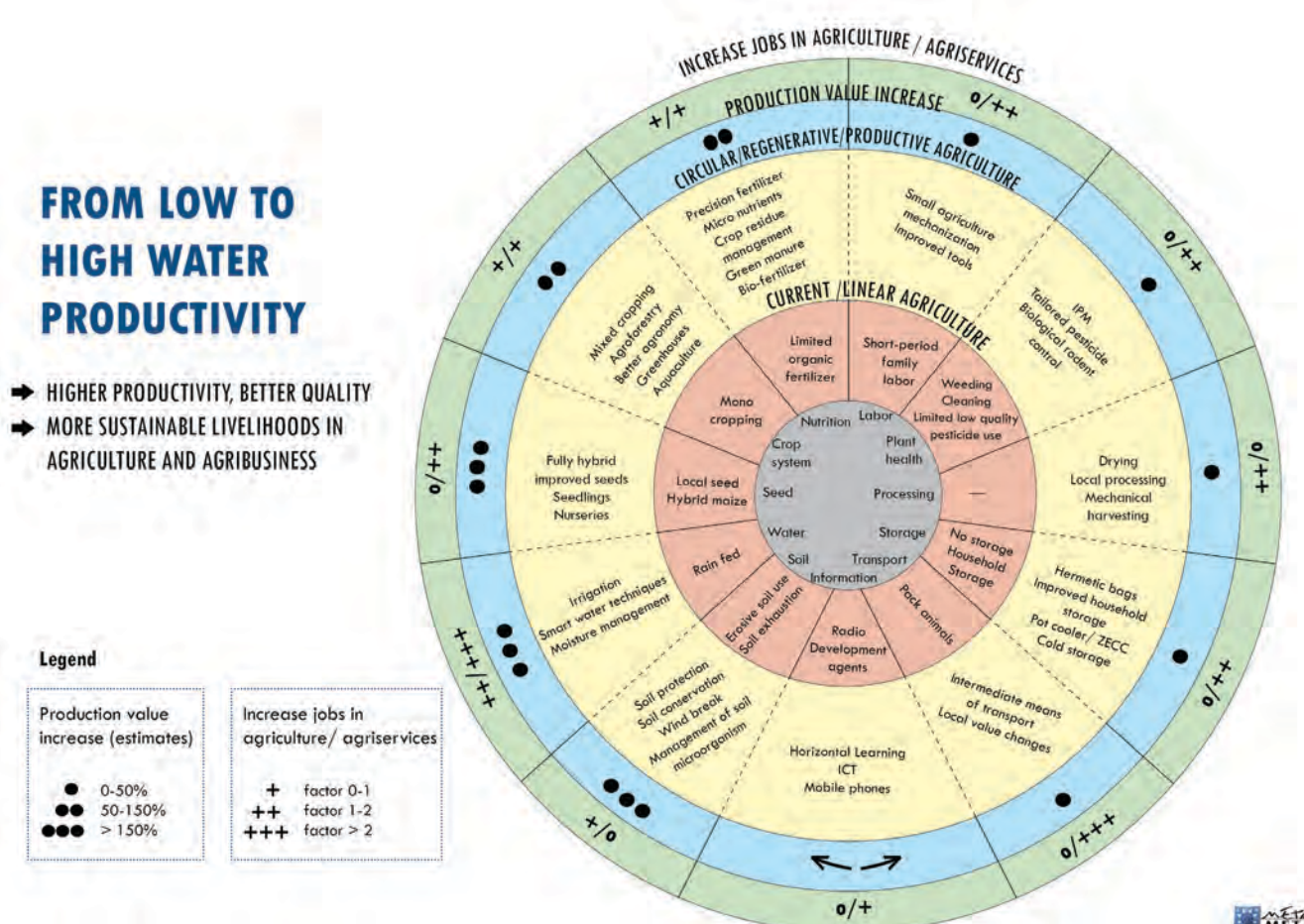


Figure 1 - Transition from linear to productive circular agriculture

Chapter 1 Regenerative cropping systems - Regenerative cropping designs, live fencing (or hedges), and agro-forestry systems increase crop productivity and biodiversity. Using specific multipurpose plant species can also be a source of other products such as fodder, food, timber, wood fire. GFF is building capacity to implement these regenerative cropping systems on farms.

Chapter 2 Improving seed supply - Securing an improved seed and seedling supply with established nurseries. In many developing regions, the seedling market has yet to be found and creating small-scale seedling schemes can create jobs, increase yields, and enhance economic benefits for farmers. GFF empowers rural communities with the capacity to produce, store, and distribute high-quality seeds.

Chapter 3 Conserving and protecting soils - Linear agriculture and unsustainable natural resource management exhaust, erode and degrade soils. Protecting and conserving the soil, including soil microorganisms, is thus an essential aspect of GFF. Soil fungi and earthworms thrive with no tillage, bio-fertilizers, windbreaks, and conducive microclimates with sufficient soil moisture.

Chapter 4 Improving plant and crop health - There is a need to move away from limited low-quality pesticide, chemical fertilizer use, and excessive weeding. GFF aims to move towards integrated pest management, bio-fertilizers, and biological rodent control. Part of this strategy is strengthening local value chains and empowering women and youth as entrepreneurs that enhance the local economy.

Chapter 5 Improving local climates and watershed rehabilitation - Conducive local climates and rehabilitated watersheds are the basis for regenerative agriculture. The landscape management plus approach of GFF aims to systematically improve local climates at a landscape level, consequently improving the microclimate of farms. Moreover, securing sufficient water supply, good soil moisture management, and irrigation systems are essential for regenerative agriculture. This is why GFF is implementing road water harvesting and water conservation practices such as soil bunds on farms and in landscapes.

Chapter 6 Enabling horizontal learning and information exchange - GFF aims to strengthen horizontal learning among farmers to spread knowledge and foster the transition toward regenerative practices. It organizes field days and encourages farmers to capture and share good practices using smartphone videos.

Chapter 7 Developing and strengthening the rural local economy - To establish a vibrant rural economy, there is a need to introduce diverse opportunities in the agricultural and non-agricultural service sector. With more diversification of options, the wheel of income would start to rotate, circulating money locally. This is why GFF supports people in setting up Small Micro Enterprises (SMEs) in poultry, beekeeping, biofertilizer production, tree nurseries, goat rearing, and more. All are essential to strengthen the rural economies as they serve as additional income streams for communities. These activities provide income stability in uncertain times and employment to people from local areas. New credit packages and revolving funds are made available and are coupled with entrepreneurial training and financial literacy to kick-start these SMEs.

Chapter 8 Improving rural transport - Another important aspect in establishing and strengthening local value chains is improving rural connectivity with roads and transport. After roads open up, the number of shops increases - rural transport is the fly-wheel of local economies. This is why GFF promotes intermediate means of transport (of produce and people).

Chapter 9 Improving storage options - There is a need to move away from no or merely household storage towards improved household storage, cold storage, hermetic bags, etc. Traditional storage is often rudimentary and may, for instance, consist of bamboo mats held loosely together. These open storages attract vermin and rodents close to where people live, increasing the zoonotic contact change.

In Ethiopia, storage losses are estimated to be between 3 to 9%. This is why GFF promotes improved storage models such as the “Yekorkoro Gotera”, meaning Iron Plate Storage.

Chapter 10 Improving agricultural labor - Current agriculture in rural Ethiopia still follows traditional ways; promoting new and improved tools can fill this gap and help overcome production challenges.

Before we dive into these chapters we will first present blogs that elaborate more on the context in which GFF Ethiopia is implemented: the life of the rural population in Ethiopia and the response of GFF Ethiopia to the war that erupted in Northern Ethiopia in November 2020.

The GFF Ethiopia Program is about understanding what works and what is difficult, and how and why; what can go further through farmer-to-farmer learning, through adoption in larger programs and what is needed in terms of system change - in policies, regulations, capacity development or removing bottleneck or blockages. We believe that regenerative agriculture and sustainable natural resource management go hand in hand and have much to offer: they form the foundation for local economic development that is a major hope for rural areas.



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UNDERSTANDING THE RURAL ETHIOPIAN CONTEXT

Ethiopian youth are moving away from agriculture. In the 1980s the rural population was 90% of the total population, in 2021 this was 78%¹. The agricultural sector of Ethiopia is not living up to its potential to support young people's livelihoods, hence youth are forced to find jobs elsewhere.

This is a huge missed opportunity as agriculture can be the main driver of rapid and inclusive economic growth. Equipping the youth with the necessary knowledge and skills that enable them to productively engage in the rural economy will make them a powerful development force. Especially as 60% of the Ethiopian population is below the age of 25².

The agricultural added value per worker increased from 685\$ in 2013 to 804\$ in 2019 but still remains low. In general, there is need and scope for far more value addition to come to attractive livelihoods. In comparison to the size of the agricultural sector, the agricultural service sector is less developed - in seed supply, in crop health, in storage and processing, in transport. In general, the diversity of income opportunities in rural areas in Ethiopia is limited.

On top of that, there is a need to shift towards more sustainable, or regenerative, agriculture. Currently, the direct costs of loss of soil and essential nutrients due to unsustainable land management are estimated to be about 106\$ annually. The economic loss resulting from soil erosion and nutrient depletion from the highlands of the country is about 10-11% of agricultural gross domestic products³.

¹ World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision.

² Ethiopia Population 2023 (Live) (worldpopulationreview.com)

³ Tsegaye B (2019) Effect of Land Use and Land Cover Changes on Soil Erosion in Ethiopia. *Int J Agric Sc Food Technol* 5(1): 026-034. DOI: 10.17352/2455-815X.000038

From the perspective of many rural youth the common system of farming is considered physically too demanding and unrewarding.

Most of the youth have high ambitions for a better life. These ambitions are fed by local examples and stories from emigrated middle men. Some of them whose dream is to stay and work in agriculture were compelled to migrate to find a job and support their families because the farm is too small to sustain a larger number of family members and there are no business opportunities in the rural areas.

What rural Ethiopia needs are diverse businesses around agriculture which are attractive for young people. Moreover farmers should be skilled to work more efficiently by learning different, more sustainable possibilities, in crop production and use of better seeds, biofertilizers, and other inputs. Strengths in the road from linear to circular agriculture and towards attractive and sustainable livelihoods are the dynamic group of

young people with a gradual transition to more entrepreneurial mind-set. This youth momentum is used by GFF Ethiopia to move to regenerative agriculture systems. Also the large scale government programs, the high priority given by the government, institutional mechanisms set in place, and the substantial allocation of government resource provide strong opportunities for this transition.



Ethiopian young adults looking at job opportunities

"I am the oldest of 4, 3 brother and one sister, I use to life in the farm with my family but the situation got very critical, we were depend of the rain in our land, so in the dry season we had food shortage, I have a uncle living in Addis Abba and working in the central market, my parent ask hem to take me and teach me how to work as a seller, I went to Addis with my uncle for one year after that I have learn everything that I need to know, and later I found a work here in Oromia region. I earn here 1000 ETB per month, with that money I support my family, I really miss them and would like to be with them, I wish our fam could produce enough for all of us and be together, now I am seeing them just ones a year for the Meskel holydays (finding of the true cross)."



Esubalew Fikadu, 17 years old, from Gurage SNNP, Primary Education, Working in a fruit shop

"I was dreaming to work in my family farm, but because of the water scarcity there was not enough production in the farm to feed all of us. Then I was moving here to Sendafa town to find a job in my expertise, I graduate in Nature Resource Management, unfortunately I have not found what I was looking for, and now I am working in a chewing gum fabric. The problem that I was facing is that after I finish my school I did not have a mentoring or a way to find out how I could get a my knowledge into a practical work, then I move here because here is the office of Natural Resource Management and I thought it could be more easy to find a job here, after being here for some time I realize that it was not easy to find a job in my expertise and start to look for different type of work, that is how I found a vacature in the chewing fabric , my possibilities to get something else has become very little, now it is even more difficult because I work 5 days a week 8 hours a day in the fabric with not change to get information about other work in my expertise, I don't have a network or somebody who can inform me about upcoming opportunities. I love to work with plants and in the agriculture, I hope I can go back to my village and work in our family farm, and in additional work with the local government or privet enterprise in the Natural Resource Management."

- Kebebu Boru, 20 years old, the 7th child of 8, Collage degree in Natural Resource Management, From Ambo (155km from Sendafa), works as a daily laborer at a chewing gum factory

PSYCHO-SOCIAL SUPPORT FOR RECOVERY AND RESILIENCE IN AMHARA

By Nardos Mesresha, Yoseph Cherinet,
Jean Marc Pace, Girma Senbeta

Conflict in Northern Ethiopia

The war that erupted in Northern Ethiopia (November 2020 – ongoing) left millions displaced and in need of humanitarian and recovery assistance. The worst of the conflict unfolded during the main cropping season, resulting in millions of hectares of arable land across Northern Ethiopia uncultivated (a region that was already struggling with food security).

The Amhara Bureau of Agriculture has estimated that the region has lost more than 15 million quintals of production in the last year, not to mention the loss of livestock through looting and needless killing. Looting and destruction also extended to other assets such as tools, agricultural training centres and irrigation infrastructure, which lengthens the road to recovery.

GubaLafto Woreda, the Woreda in which GFF is taking place, was drastically affected, being occupied for over 4 months until mid-December 2021. During the occupation period, we lost almost all contact with our program staff in the area – telecommunications were rarely available, and many went into hiding with their families until the danger subsided. Thankfully all our program staff have come through this difficult period safe and in good health and good spirit.

A Recovery Program for Regenerative Resilience

In light of the overall catastrophe, The GFF team, took the initiative to contribute to

the recovery of affected areas through different agriculture, livestock, and psycho-social support interventions in the four program watersheds in GubaLafto Woreda. In total, around 1500 households affected by the conflict are being targeted in this program (5000-7000 people). A number of interventions were selected based on an initial needs assessment conducted by field staff in January 2022, as soon as the program area became accessible again. These interventions are complemented by close follow up and monitoring. Parallel to these recovery activities, regular program activities are resuming in the area with strong linkages being made between beneficiaries and with the aim of steering development towards a transition to more regenerative agriculture and vibrant circular rural economies.

Beyond the immediate assistance this recovery program is providing to the area, it also offers an opportunity to expand the learning journey that the GFF represents. Lessons are certainly being learned on how to respond to such devastating situations – offering short-term assistance but continuing to steer development in a regenerative and sustainable direction.

Our Psycho-social Support Program

The psychological and emotional well-being of the community in the program implementation areas is the bedrock, or foundation upon which all

development activities are built. As this community was enveloped in conflict and uncertainty for more than six months and experienced various exploitations, post-conflict traumas, and lost assets, restoring the community's wellbeing and creating a positive outlook towards self and future is a crucial first step on the road to recovery.

Training was delivered that focused on life skills and personal development, psycho-social support, psychological first aid, grief, resilience, self-esteem and self-awareness, stigma and discrimination, teamwork, communication, conflict management, peer pressure, and stress management skills – a psycho-social toolkit that will serve the beneficiaries well in these trying times and well into the future.



THE MENTAL HEALTH AND PSYCHO-SOCIAL NEEDS OF PEOPLE CAUGHT UP IN CONFLICT MUST BE A PART OF THE GROWING ATTENTION GIVEN TO MENTAL HEALTH AROUND THE WORLD. WHEN NOT ADDRESSED, THESE NEEDS HAVE A FAR-REACHING AND LONG-TERM IMPACT ON PEOPLE, THEIR FAMILIES, THEIR COMMUNITIES, AND ON THE WHOLE SOCIETY. ”

- Robert Mardini, ICRC General Director

The training is also linked with livelihood improvement activities, most trainees selected are already beneficiaries of the other GFF program interventions and the recovery program. With the aim of harnessing this community support and directing the renewed energy towards productive and beneficial activities to get the community back on track.

Besides the major coping topics, the training also covered topics like effective communication and working in a group which should give a boost to collaboration and productivity. Beyond training, financial support is being provided for additional professional counselors to be stationed at Weldiya Hospital since they only have a limited capacity to do so. This makes mental health services available to more people while creating space for at least one more counselor to earn a living supporting their peers.

How is this being done?

Offering a psycho-social support program is quite far removed from typical program activities so a good amount of time was spent in deciding how to go about it in a way that ensures the intervention is culturally- and gender-sensitive with an ethos of 'do no harm'. Being part of a wider recovery program, it was ensured that all planned activities are in line with international crisis and emergency agreements that mental health and psycho-social support (MHPSS) must be an integral part of

humanitarian responses. Initially, working with motivational speakers and organizing a mass event to address the public was considered, as this is how things are typically done in rural Ethiopia. However, a more intimate and step-by-step way of working to address the psycho-social problems of the community was eventually selected.

Time was invested in selecting the appropriate way to go, trainees, and trainers, preparing localized and suitable training materials, and recruiting professionals that went through the same kind of conditions. This was seen as necessary to successfully execute the psycho-social support skills training in a relatable manner with long-lasting impact. Instrumental in all of this is the partnership between the program and the Psychology Department of Weldiya University which has professionals living in the community who are familiar with the local culture and are intimately connected with their hardship. Weldiya University itself was extensively looted and damaged during the occupation but has since taken long strides towards restoring the campus and resuming educational activities – a truly inspiring effort.



Women group

We trained and trusted healing peer groups selected from the community itself – these peer groups will in turn offer psycho-social support to their wider community. It was important to create a safe space to discuss their traumatic post-conflict experiences, vent out their stresses and frustrations, and get back to their previous social life and work situations.

In total, 75 community members were trained, including religious and community leaders, youth, and women. Trainees were organized into three separate working groups that include the youth group (6 women, 19 men), the women group (25 women), and the community leadership (religious leaders and experts, 6 women, 19 men).



Religious leader and experts



Youth groups

Bringing things to the surface

Once the trainees acclimatized to the environment and recognized the space created as a safe one, many heart-breaking and unimaginable stories emerged. Mutual support between the trainees was delicately facilitated by the trainers, offering support and encouragement. In summary, some of the most pertinent impacts of the conflict on this community (and others) that emerged were the following:

Forcibly displaced: Fearing for their lives, many people fled from their homes and possessions behind in search of a safer place, it is yet to be seen when and if they will return.

Physical torture: Some people were captured during the conflict and subjected to physical torture leaving both physical and mental scars.

Hunger and Health Issues: During the occupation, farming operations were scarcely performed to avoid the risks of exposure. This led to a drastic drop in food security and availability. It was also risky or impossible to access health care during the conflict. Even now, many health stations are operating at limited capacity.

Economic Destitution: It was all but impossible to continue economic activities during the occupation and even since then, the opportunities for rural livelihoods are few a far between. Pre-existing issues are now exacerbated.

Psychological Distress: The conflict has left behind a trail of collective traumas, more acute for some who directly experienced violence and/or loss.

Property Damage and Theft: Whether looted, burnt or destroyed, many assets such as homes,

livestock, seed stores were lost during the conflict – for many, regaining these assets seems like an unsurmountable obstacle.

Lack of services: A communication blackout was imposed on the area during the conflict to prevent militant communications but effectively isolated the local population. Electricity and water supply were also intermittently unavailable.

Loss: Many lost their lives in the fighting, young men in particular, leaving behind grieving relatives who need to balance their grief with the will to rebuild what they can.

Loss of hope: For some, the conflict represented an end to their dreams and ambitions. When presented with a situation of such intense fear, loss, and economic disparity it becomes difficult to envision a brighter future worth working towards.

Women and Children: Women and children suffered uniquely throughout, with many women reporting rapes, unplanned pregnancies (whether as a result of rape or lack of access to contraception) – many infections and diseases were also spread. Children were left without access to schooling, vaccines, and balanced nutrition – many are also suffering psychological issues as a direct result of being exposed to things no child should have to go through.

While it is impossible for a program such as the GFF to solve all these issues, offering a safe space to openly share traumas and worries is already a step in the right direction. Combined with the psycho-social support training the beneficiaries have received, the hope is that they will act as points of reference to their peers, lending an ear and, constructive advice and support where they can.



Participants working in a group to identify the impact of the war on the community, women, and children

The Way Forward

The next steps will unfold in three ways:

Psycho-social First-Aid: All trained individuals are equipped with tools and knowledge to provide psychological first-aid to peers in their respective workplaces, villages, and communities. They will provide psychological support when they face someone who needs it.

Support Groups: 12 youth and women volunteers will create and prepare events like coffee ceremonies and other gatherings for smaller groups to discuss how to cope with traumas and stressors, and focus on the positive and productive aspects of life after war. During these gatherings, the volunteers will identify individuals who need professional counseling and refer them to the clinical counselors assigned to provide the service. The group will also address the wider community through edutainment activities and flyers through big gatherings during open market days.

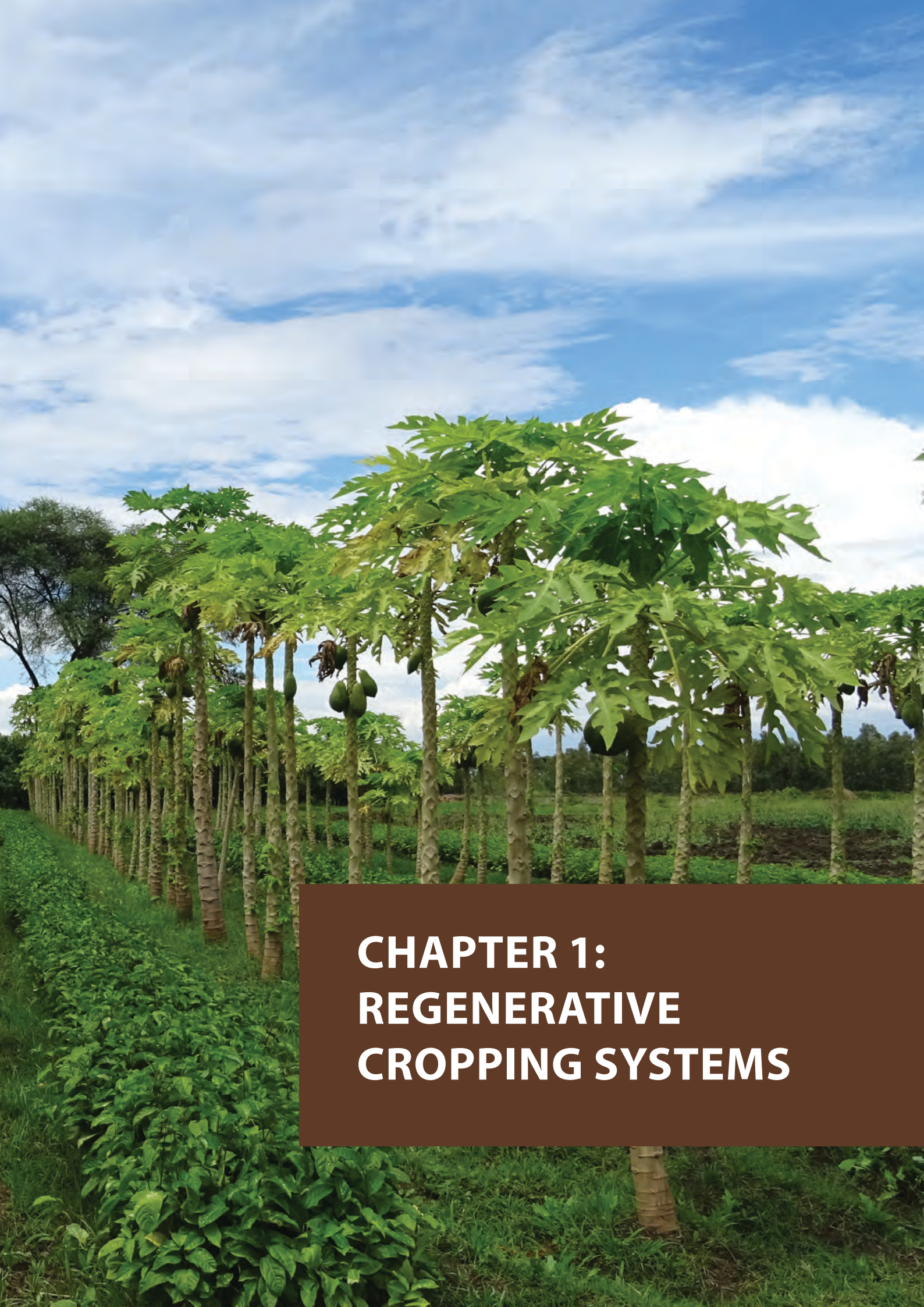
Professional Counselling: As part of the psychosocial support the program is making biweekly clinical counseling services available for people with post-traumatic stress disorder and other conditions that require individual attention. There are two clinical counselors (a male and a female) assigned by Weldiya University who are following up on the referrals from the peer group and provide counseling services at the Weldiya Hospital. The hospital was selected as the venue for this, to reduce the stigma associated with seeking mental or psychological care – there are many other reasons to visit a hospital, offering ample alternative explanations for the visit.

Initial Outcomes:

Testimonies from community representatives so far show that the training has helped in building their self-confidence and working in a team to heal from the war's impacts. Moreover, the representatives of religious leaders from both Muslim and Christian communities said that the skills gained from the training help them to identify the war's impacts on the individual, family, and community levels and how to handle the challenges, especially psychological issues.

It is still early days, but we are already happy to see the spark returning to people's eyes and are filled with hope that this, and the other interventions in the GFF Recovery Program will help people regain hope and positive outlook towards a resilient, regenerative, and Green Future in Farming.





CHAPTER 1: REGENERATIVE CROPPING SYSTEMS

REGENERATIVE HOME GARDEN DESIGNS

By Marina Vara Gutierrez

Well-designed rainfed home gardens can increase crop productivity and increase biodiversity. Sustainably doing this requires a regenerative farming approach with reduced or eliminated use of external chemical inputs and tillage.

Specific targets of the design are:

1. Increase the nutrient content of the soil (especially Nitrogen and Phosphor)
2. Increase the production of fodder
3. Increase plant, crop, and trees diversity
4. Distribute tree and shrub species throughout the whole home garden area
5. Define crop combinations and patterns which maximize production
6. Reduce the risk of pests, weeds, and diseases

This blog discusses the case of small home gardens in the Amhara program area of Ethiopia. The image and scheme show a graphical representation of how the home garden's design will look like. It is proposed to follow a strip cropping pattern to incorporate perennial woody species with crops, herbs, spices, and other plants. This pattern breaks with the traditional horizontal (North Ethiopia) and vertical (South Ethiopia) conventional home layout gardens. Still, it will increase productivity and agrobiodiversity in the tiny home gardens of the program area (0,25-1,25 ha).

The width of the crops/flower plants/grasses and tree/shrub strips will depend on the plot's size. The narrower the stripes, the more intense the pruning of the woody perennials will need to be during the cropping season.



When tree/shrub strips are incorporated (in alley cropping or hedgerow intercropping), the suggested space between rows ranges between 4-8 meters. The distance between seedlings within the tree/shrub strip is at least 2 meters. The strips should be in an east-west direction to ensure they receive sunlight throughout the day.

According to the proposed design, the aerial vision of the home garden could look like the following (the shadow tree area to produce the coffee intercropped with enset will only be considered for homesteads with enough space):

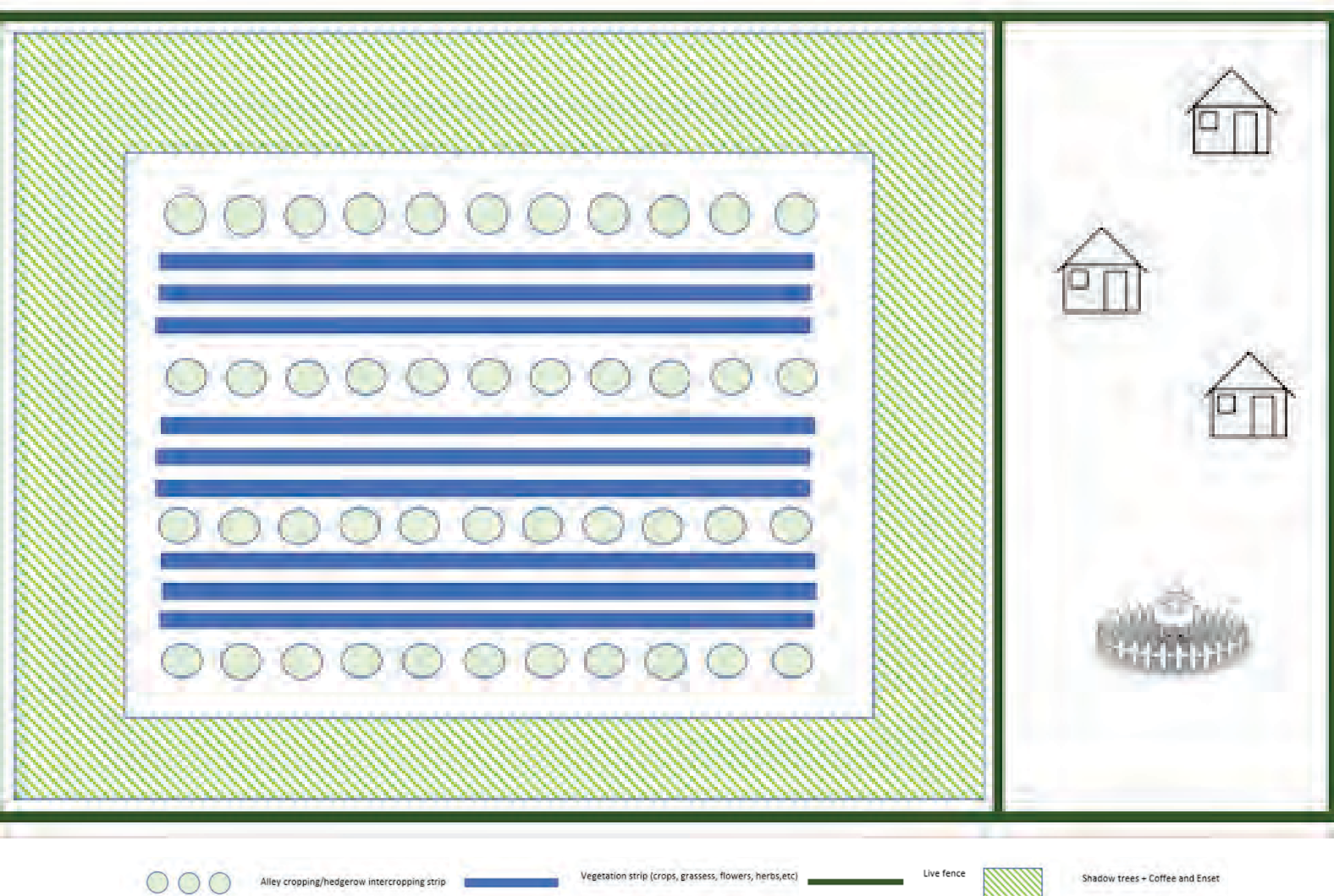
Intercropping crops in strips

Intercropping is a farming method which consists of planting or growing more than one crop at the same time and on the same piece of land. This is in the same row or bed or in rows or strips that are close enough for biological interaction. Mixed cropping, relay cropping, companion planting, and alley cropping, among others, are forms of intercropping with crops or perennial plants.

Intercropping is a practice especially advised for small plots. It is practiced with the aims to:

- Increase productivity per square meter.
- Increase time and energy efficiency.
- Mimic natural ecosystems where plants are always mixed.
- Increase production stability.
- Lower pests, disease and weed pressure.
- Attract pollinators.
- Intercrop a tall, high-standing crop and a short, low-standing crop.
- Intercrop components crops (main crops) with different root architectures: shallow and deep rooting plants.
- To plant component crops with different lengths of growing period or when component crops have a similar length of the growing period, relay planting them.
- Adjust the spacing between component crops if their maturing period occurs at the exact moment.

The main intercropping principles which need to be considered to propose a successful crop combination for a strip are the following:



- Mix as much as possible and plant companion crops with different pest and disease susceptibilities.
- To intercrop a component crop with good soil coverage.
- To take into account negative allelopathy and antagonisms.
- To avoid bare soils and ensure the management steps for one component crop do not inhibit the growth of another crop.
- To plant in rows.
- To intercrop only a few components crops.

Crop rotation

Crop rotation is another crucial practice in agroecological and regenerative farming. Crop rotation means changing the type of crops grown in the field each season or each year. In combination with intercropping, the application of animal and green manure and soil moisture practices will improve soil quality. There are two main types of criteria for defining crop rotation patterns:

1. Based on the family of the crop
2. Based on the crop type (1st legumes, 2nd fruiting crops, 3rd leafy crops, 4th root crops)

Intercropping may also represent a problem for crop rotation. Knowing that one fundamental principle of crop rotation is the separation of plant families in time, replanting two families mixed in the same field may be difficult. However, good planning could maintain a viable crop rotation. For example, suppose a farm grows an area with tomato, squash, broccoli and lettuce. A simple

rotation would put each crop in a different year, with a three-year interval before a crop is repeated on the same bed to control some diseases and pests. It is advisable to plant the previously proposed crop combination strips in different beds each year.

Alley cropping or hedgerow intercropping

Alley cropping, also known as hedgerow cropping, involves managing rows of woody plants with annual crops planted in alleys in between. The woody plants are cut regularly, and leaves and twigs are used as mulch on the cropped alleys to reduce evaporation from the soil surface, suppress weeds or add nutrients and organic matter to the topsoil. Where nitrogen is required for crop production, nitrogen-fixating plants might be the components of the hedgerows.

The primary purpose of alley cropping is to increase or maintain crop yields by improvement of the soil and microclimate and weed control. Farmers might also obtain tree products from the hedgerows, including fuel wood, building poles, medicine, and fodder, and on sloping lands, the hedgerow and pruning may help to control erosion.

Alley cropping usually works best when people need to intensify crop production but face soil fertility problems. This situation is often characteristic of crowded, densely populated areas but may also occur wherever some farmers wish or are forced to increase production on a plot of limited size. It is also a good practice to incorporate in areas where farmers do not implement fallow periods.

Ideally, hedgerows should be positioned in an east-west direction so that plants on both sides receive full sunlight during the day. On sloping land, hedgerows should always be placed on the contour. If it means that they do not have the desirable east-west orientation, then they may need regular trimming to prevent excessive shading of adjacent crops. The position and spacing of hedgerow and crop plants in alley cropping systems depend on plant species, climate, slope, soil conditions and the space required for the movement of people and tillage equipment.

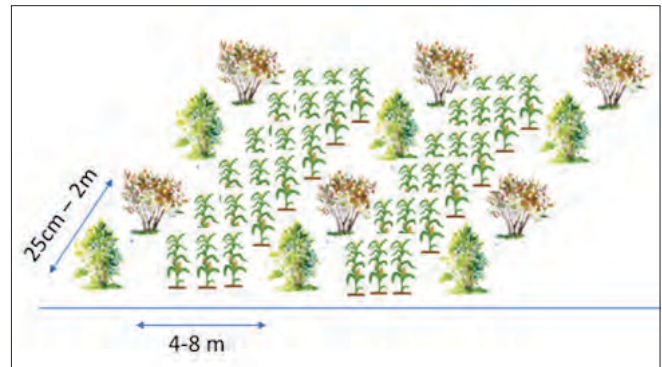
It is advised to combine two or more species in the hedgerows. For example, fast-decomposing leaves trees release nitrogen quickly into the soil. A second species with longer-lasting leaves maintains soil cover throughout the cropping season and builds up organic matter in the topsoil. There is a solid need to combine water harvesting or moisture conservation techniques and adaptable species with alley-cropping practices to optimize the ecological and economic benefits of alley-cropping in dry areas.

For the Amhara region in Ethiopia, alley cropping is a practice suitable for crops such as maize, teff, wheat, barley, sorghum, millet, beans, etc.

Some criteria for selecting trees and shrubs for alley cropping are:

- Have the ability to fix nitrogen
- Have a deep-rooted main root
- Ability to withstand drought
- It should be small-sized for the ease of pruning and pollarding
- Have coppicing ability after pollarding and pruning
- Light crown for light penetration

- High decomposition rate
- Multipurpose



There should be enough space between the alley cropping rows and between the border of the crop strips and the alley strip. This is to avoid shadowing the crops after 4-5 years of establishment of the trees. Other management techniques to consider are: trees and shrubs used in alley cropping should be left to grow for 6-18 months before the first cutting. This first cutting should be late enough to allow the woody plants to have good root development and resilience, yet soon enough to avoid shading adjacent crops. Some fruit or timber trees, dispersed in the hedgerow, may grow to full size with little or no pruning. A standard alley cropping practice consists of coppicing hedgerow plants at the height of 30 to 60 cm, followed by lopping to the same size at intervals ranging from once a month (during the cropping season) to once a year (around the beginning of the cropping

season). Farmers may vary the timing of hedgerow management tasks to fit in with ploughing or weeding schedules. The leaf mulch is usually applied just after land preparation or crop sowing.

Field spacing usually ranges from 4 to 8 meters between rows and 25 cm to 2 meters between trees within rows, depending on the crops and shrubs/trees planted. One or more strips with different crops, as proposed earlier in this blog, will be planted among the trees and shrubs.

Live fencing

Trees or shrubs can be planted as live fences to avoid animal movement and provide plot demarcation. If multipurpose trees and shrubs are planted and properly managed, the live fence can also be a source of other products such as fodder, food, timber, woodfire, medicinal substances, etc. Live fences should be considered to be permanent or semi-permanent structures, and they require maintenance and are likely to affect more than one land user. They can easily be removed, but the labor and costs invested in establishing them will be lost. It is better to locate them carefully where they can benefit long-term. When a live fence is planned to demarcate a property line, all landowners and users affected should agree to its installation. They should also know their rights (harvesting) and responsibilities (maintenance).

Criteria for trees and shrubs selection are:

1. Able to keep off livestock (thorny and/or densely branched)
2. Easy to establish and maintain
3. Resistant to fire
4. Able to provide valuable by-products



The effective height of young trees can be boosted by planting them on earth banks or bunds to add some height in the initial growth stages. Where tree roots may compete with crops for nutrients and water, the borderline roots should be pruned by deep tilling or digging a trench about 50-100 cm away from the tree. In most living fences, most plants are low, rarely over 2 meters tall, and the fence as a whole is dense and impenetrable. Trees or shrubs are planted along the fence line at 30 to 90-cm intervals in one or more rows, straight or zig-zag.

The home garden designs discussed in this blog can be applied in other areas as well, considering the local context and indigenous species of the area.

AGROFORESTRY IN AMHARA, ETHIOPIA

By Bantamlak Wondmnow

Agroforestry is a new name for a set of long-standing practices. Farmers in Amhara have immense traditional knowledge and experience in tree management under different agroforestry systems and methods. They tend to deliberately grow trees on the same unit of land as agricultural crops and/or animals, either in some form of a spatial mixture or temporal sequence where there is a significant interaction between the woody and non-woody components of the system. The purpose of implementing agroforestry practices is both ecological, social, and economical.

Agroforestry has recently been recognized as a central practice of climate-smart agriculture as it secures triple wins of productivity, adaptation and mitigation. The main reasons behind practicing agroforestry include higher productivity, better microclimates through shading and shelter, production of timber, fodder, and other products, improved soil quality, and conservation of biodiversity. These benefits highlight the need to widely scale agroforestry practices. In the GUBalafto region of Amhara, agroforestry extension has become compulsory for the following reasons:

- Population increase, land scarcity and the need to attain productivity per unit of land, labor and water.
- Tree cover loss negatively impacts crop yields and livestock productivity due to poor soil fertility, soil erosion, drought, flood or wind damage.
- Conservation and sustainable management of natural forests and communal plantations in the upper catchment would be attained with reduced pressure due to agroforestry in other land uses.



Trees on farmland in Amhara

- The increasing demand for wood and wood products (specifically the cost and shortage of firewood and building timber) can't be satisfied from the only existing plantations and remnant forests.
- Stronger winds, more prolonged droughts, higher temperatures, decreased seasonal water flow and well recharge increased because of tree loss and have made environments less habitable.
- Conflicts over scarce natural resources.

Traditional agroforestry practices come from dispersed trees in croplands, which have widely been observed in most parts of the Amhara

region. The core of this practice is (1) protection and management of selected matured trees that are already on a site; the most common tree species conserved in Amhara are *Acacia Seyal* (Wachu), *Acacia polyacantha* (Gmarda), *Croton Macrostachyus*, and *Cordia africana*. These majorly multipurpose tree species are consciously and deliberately retained and taken care of by the farmers due to their many benefits. (2) Careful management of seedlings established on-site through natural regeneration. (3) Planting new tree seedlings. Farmers select new trees and shrubs based on their adaptability to the specific environment, the ability to withstand adverse conditions, the growth rate (especially for

branching and the root system), and the ability to cycle nutrients.



Trees on farmland in Amhara

Furthermore, shrub and tree species are often used as biological soil and water conservation structures, such as soil bunds, trenches, and check dams. They can increase the stability and resistance against rain, splash effects, runoff, etc. planting suitable plant species on the structures stabilizes them with their root system and the biomass and/or canopy above the ground protects the structures from erosive raindrops. More importantly, the stabilization of the structures makes the surface area occupied by the structures productive. Stabilized areas are an additional source of timber, fuel wood, fiber, food and forage, palatable grasses and legumes, fruits and other products. Trees or shrubs help to demarcate farm and homestead boundaries, thus providing users with an additional sense of ownership. Achieving proper and productive stabilization will encourage farmers to protect conserved areas and appreciate its effects.



Gully development



Gully development

To make agroforestry extension an integral part of the region's natural resources conservation and management agenda, technical training and awareness creation on the design and implementations of selected agroforestry practices have been given annually for Natural Resource Management practitioners at all levels of the Amhara Bureau of Agriculture.

Ways forward in sustainably scaling the agroforestry systems in Amhara requires awareness creation on farmer-managed natural regeneration,

including designing agroforestry practices, species selection, tree management and benefits. In this, women are particularly crucial as they are responsible for collecting fuel wood. Furthermore, institutionalized Watershed Users' Cooperatives strengthen mutually agreed by-laws among members of the watersheds for the management

of trees. With adequate follow-up, support and encouragement from the Amhara Bureau of Agriculture, peer-to-peer horizontal learning and sharing of experiences among farmers the uptake of these highly needed and essential farming systems is improved.

HEALTH GARDENS

By Frank van Steenberg

Whatever progress happens on the surface, statistics are harrowing. Ethiopia is still an epicentre of malnutrition. Though figures have improved over the last 15 years, UNICEF Global Databases on Infant and Young Child Feeding show that about 38% and 10% of Ethiopian children under five years of age are stunted and wasted respectively. Among children between 5 to 19 years old, 36% of girls and 22% of boys are underweight. On top of overall malnutrition come nutrient deficiencies: Iron Deficiency Anaemia (IDA), Vitamin A Deficiency (VAD), and Iodine Deficiency Disorder (IDD).

There is also an iron-clad chain here: a vicious intergenerational circle. A malnourished mother will give birth to a low birth-weight baby, the low-weight baby will grow as a malnourished child, then to a malnourished teenager, then to a malnourished pregnant woman, and so the circle continues. Poor nutritional status of woman both before and during pregnancy results in children being underweight when they are born. Malnutrition goes beyond physical health. It is related to poor school performance and low productivity of individuals. Malnutrition reduces children's ability to learn, think and become creative.

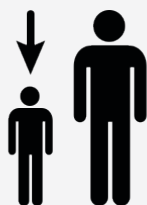
Poor diets might be due to insufficient food, or a lack of variety of foods, infrequent meals, insufficient breastmilk and early weaning. Malnutrition is not the single consequence of a single factor but a mixture of different causes: inadequate care of children and women; poor health services; too many children in a family to feed; food shortage due to small land sizes, low productivity, landlessness (especially among young families) and spending on non-essential things like khat (on the rise), beer (on the rise) or cigarettes. The composition of the diet is also a major factor.



Wasting, or thinness

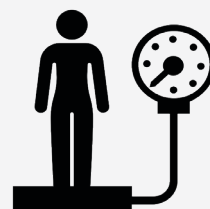
is an indicator of acute (short-term) malnutrition. Wasting is usually the result of recent food insecurity, infection or acute illness such as diarrhoea.

Measurement of wasting or thinness is often used to assess the severity of an emergency situation, with severe wasting being strongly linked with the death of a child.



Stunting, or shortness

is an indicator of chronic (long-term) malnutrition. It is often associated with poor development during childhood and is one of the harmful effects of poverty. Stunting is commonly used as an indicator for development, as it is strongly related to poverty.



Underweightness

is an indicator of both acute and chronic malnutrition. Underweightness is a highly useful indicator when examining nutritional trends.

In Ethiopia, look at the figures of the Institute of Health Metrics and Evaluation: even compared to rest of Africa the intake of fruit and vegetables is extremely low. The same is true for essential nutrients such as Calcium or Omega 3.

Poor diets might be due to insufficient food, or a lack of variety of foods, infrequent meals, insufficient breast milk and early weaning. Malnutrition is not the single consequence of a single factor but a mixture of different causes: inadequate care of children and women; poor health services; too many children in a family to feed; food shortage due to small land sizes, low productivity, landlessness (especially among young families) and spending on non-essential things like khat (on the rise), beer (on the rise) or cigarettes. The composition of the diet is also a major factor. In Ethiopia, look at the figures of the Institute of Health Metrics and Evaluation: even compared to the rest of Africa the intake of fruit and vegetables is extremely low. The same is true for essential nutrients such as Calcium or Omega 3.

In all of this is a huge paradox. In spite of all the shortages, there are plenty of opportunities. Many Ethiopian villages are nutrition deserts, but they should not be. Unlike Asian villages, there are no home gardens. There is no cultivation of vegetables or trees around the houses that could make a difference in sourcing food, nutrition or medicine. Similarly there is not much village poultry. They are strangely missing from the landscape and there is a strong case to change this and develop homestead gardens that provide food that feeds the body and mind.

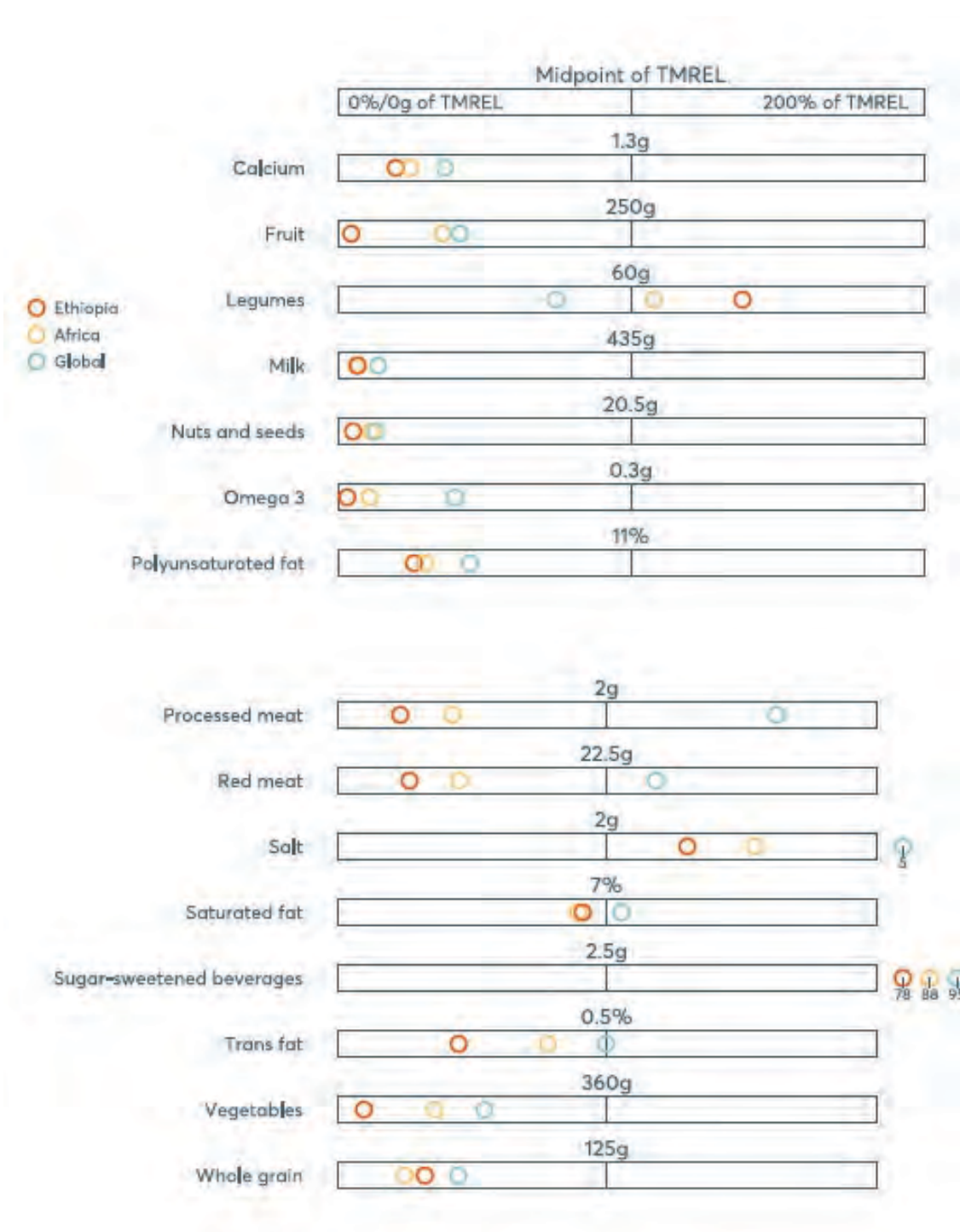
Vitamin B, Vitamin E and vitamin K, Omegas 3, minerals like zinc and chromium, all boost health and cognitive power. One gets them from nuts

and seeds, small red beans, eggs, kale and certain tree crops. These are available in Ethiopia but are not part the courtyard activities. Kale is a special one – common in Ethiopia food – providing more than the daily requirement for vitamins K, A and C; as well Omega 3; and minerals like potassium, copper and manganese, fiber and Omega 3. Eggs are important providers of vitamins B6 and B12, folate and choline (63). Choline is an important micronutrient that helps regulate mood and memory. Nuts (including peanuts) and seeds are good sources of vitamin E, that help cognitive capability. Moringa the superfood tree occurs in many parts of Ethiopia but is not standard around the houses. Its nutritious leaves increase spatial memory, are highly nutritious and anti-inflammatory. Avocado is another good contender. It is rich in monounsaturated fat, which contributes to healthy blood flow good for all organs including the brain. Then there are fountains of Vitamin C that could do a lot of good: papaya and vegetables.

There is a strong case to fill the empty courtyards and schoolyards and tackle malnutrition at the source. Creating such health gardens needs a concerted effort – a change in awareness, skills and mindset. It has been done in other countries in cooperation by government and communities. It can be done in Ethiopia as well.

Dietary needs

Consumption of food groups and components, 2016



Sources: Global Burden of Disease, the Institute for Health Metrics and Evaluation.

Notes: TMREL = theoretical minimum risk of exposure level. Men and women aged 25 and older.





CHAPTER 2: IMPROVING SEED SUPPLY

SEEDLINGS

By Mekdelawit Deribe and Sukru Esin

In the last 30 years a quiet but far-reaching revolution in our diets has occurred. Consumption has increased globally although not uniformly and sufficiently. This is a positive trend as WHO attributes 3-5 million deaths a year to diseases related to inadequate fruits and vegetable consumption. The observed trend, apart from the considerable effect on health and nutrition, has also created a high value sector in the hands of small producers, especially near main urban markets.

Increased demand for vegetables and fruits has resulted in increase in demand of seedlings. Soil conditions are not always optimal for seed sowing and hence seed loss is a common problem. In addition, due to heavy rains, insects and cold weather not all seeds can germinate equally. This is a challenge for a homogenous plant growth. The use of seedlings can alleviate all these issues and also create market opportunity for small holder seedling farmers.

Starting seeds indoors gives crops more time to mature within the growing season. This is critical especially in cooler climate or when working with slow growing plants. Using seedlings results in best results in places where temperature fluctuates quickly. With seedling production, farmer will also use less seeds. Farmer can grow more than one crop in a year with seedlings. Seedlings can also solve damage of seeds by rain, insects and cold weather and ensure homogenous growth, contributing to increased yield.

Both farmers buying and selling seedlings benefit from the use of seedlings. It's not always possible for the farmers to have empty space for seedling growth. Especially farmers who have large scale



lands and intensive cultivation, do not have enough space to grow seedlings. Therefore, buying seedlings is a good alternative for them, opening market for small holder farmers who can cultivate and sell their seedlings. Seedling farmer can also increase their profit by using recycled seed.



There is a great opportunity for the seedling market, especially in peri urban areas near main urban market places. However, there are also risks involved. Harvesting of seeds needs to start

earlier than seed sowing. This requires knowledge of area specific planting calendars for different crops. Growing seedlings also take time. For at least 4 weeks farmers have to take care of the infant plants. This period can be up to 8 weeks. In addition, the seedling market is not yet established in many developing regions. However, low cost, small scale seedling schemes such as low and high tunnel greenhouses and production units can create jobs, increase yields and enhance economic benefits of farmer all around.



SEEDS AS OPPORTUNITIES IN RURAL ETHIOPIA

By Jean Marc Pace

Why are seeds important?

Every meal ever eaten started off as seeds. Seeds are in fact the genetic resources at the foundation of agricultural systems, whether modernized or traditional. You might still be able to harvest a crop without other inputs such as fertilizer, but there is no crop without seeds! It therefore follows that the quality of seeds and their availability has real implications starting at the farmer and all along the value chain to the consumer.

When we consider Ethiopia, seed quality and availability are two crucial issues.

Seed availability refers to the ability for farmers to access good quality seed in a timely manner and at an affordable price. Seeds in Ethiopia are distributed in a some ways. However, improved seed supply targets are consistently being missed. This has been attributed to inefficiencies in seed production, distribution, and quality assurance systems. Many of these issues can be traced back to flaws in the national seed policy and the limited capacity of local institutions.

Seed quality refers to several characteristics that determine the performance of seeds such as trueness to variety, germination percentage, appearance, age, weight, size, cleanliness, and purity, amongst others. Seeds of high quality will produce a vigorous and uniform crop, with stronger resistance to disease and stress, and a minimal number of seeds which fail to germinate.

Seed quality control and assurance are therefore crucial as acknowledged in Ethiopian Seed Proclamation No. 206/2000 which lays out the legal obligations for anyone engaged in the seed



business. This proclamation also legally establishes the National Seed Industry Agency responsible for monitoring and certifying seed quality and assure the competence of actors engaged in the industry. This document was indeed a landmark in Ethiopia agricultural history, but has it had the intended impact?

Where do seeds come from?

The Ethiopian seed systems had undergone many changes and improvements over the past couple of decades, particularly as part of the national Growth and Transformation Plan (GTP). These efforts aim to ensure timely availability of agricultural seed of sufficient quality, and at an affordable price for farmers.

Until recently, the government produced and distributed seeds through a highly centralized system. Under the system, the government would typically supply seed to local agricultural offices, farmers would have to register to purchase seed for the next cropping season and then receive seeds through these offices or local cooperatives.

Of late, Ethiopia has been moving towards more decentralized direct marketing of seeds through Integrated Seed Sector Development (ISSD) for example. The ISSD runs programmes to build the capacity of local seed business while also reviewing seed value chains in Ethiopia. This program opened the market up for seed enterprises, both public and private, by authorizing them to market certified seeds directly to farmers. However, this system is still in infancy and much work is yet to be done to develop profitable and reliable direct seed supply.

In the meantime, seed saving and trading by smallholder farmers and communities is still prevalent. This is the informal seed sector. Despite all the developments of the formal sector, the informal sector is still reported to be the primary source of seed supply in Ethiopia. Somewhere

in between the formal and informal sectors is the emerging intermediate sector, this refers to Seed Producer Cooperatives which have features from both other sectors. These cooperatives play an instrumental role in seed availability and supply through high-volume production, variety diversification and seed delivery to farmers

including direct marketing. The informal and intermediate seed sector are crucial for ensuring the resilience of smallholder farmers, particularly in times such as these where formal seed supply may be compromised.

How is the COVID-19 pandemic affecting things?

At the time of writing, the world is going through a global pandemic of the COVID-19 virus, resulting in various measures and restrictions being adopted



by states. The ISSD is monitoring the situation in Ethiopia and has identified several key issues impacting seed quality and availability. Challenges in seed processing and distribution are highlighted as being of major concern. The mobility of seed transporters and traders is limited, and work at seed processing facilities has slowed down due to a shortage of labor. The shortage of labor is also raising prices due to increased production costs. Social distancing measures are also hampering the state's ability to coordinate seed supply and has disrupted regular interactions between key stakeholders – these interactions are an essential part of the decision-making process.

These issues raise concerns that lower quality seed will make its way onto the market, filling the gap left by the current undersupply. The mobility of inspectors and input supervisors is also restricted so this situation may go unaddressed resulting in poor harvests. This can have severe consequences for farmers' income and food security, especially in this time where food prices are on the increase.

In response to these issues, the government has ordered swift seed distribution and has made some progress with maize, but other staple crop seeds have not seen the same level of success. Farmers have limited options here. They could either find alternative sources of seed – for example seeds saved from previous harvests– or delay planting in hope that seed will eventually be distributed to them.

What does the future hold?

While it is undeniable that progress has been made in making good quality seeds available to Ethiopian farmers, many hurdles remain.

Limited capacity of institutions, a lack of clarity in the roles of the various stakeholders in the system, the narrow focus on a few high-value agricultural crops, issues in supply-demand mismatching resulting in shortages and surpluses, and degradation of high quality seed due to inadequate production, storage, and transportation practices and infrastructure. Added to all this, it is currently of the utmost importance that the formal seed sector continues to function while ensuring the safety of its workers, and the mobility of its distributors.

While the emergence and promotion of an intermediate seed sector is definitely a step in the right direction it is important to acknowledge both on the ground, and in policy, that the informal sector is how the majority of farmers get their seeds. The current crisis further highlights the importance of farmer and community level seed production, saving, and exchange to ensure food security and resilience of Ethiopia's rural population.

A pathway that therefore stands out as a sustainable route to decentralized seed access for farmers is to empower rural communities with the capacity to produce, store and distribute high quality seeds. This can be a great opportunity to synergistically address the seed availability issues while generating rural jobs and contributing positively to food security. With some training and capital investment, unemployed rural youth can secure a livelihood for themselves in small to medium scale seed multiplication enterprises. The benefits from such initiatives will be felt by them, their families and communities. They will also be felt in the form of reduced burden on the formal system which is struggling to meet the seed demands from farmers across the country.

GETTING A HEAD-START: IMPROVED SEEDS AND FERTILIZERS IN OROMIA

By Guta Eshetu Gemechu, Girma Senbeta,
Jean Marc Pace Ricci

Seed is life. Seed is the starter for agricultural development. There are lots of research centers and other governmental and non-governmental organizations working on seed replication. Many of these are releasing improved onions and maize varieties. However, despite these efforts, there is an acute shortage of seeds in Ethiopia, particularly in Middle Awash – the GFF program area. Here, farmers are using local varieties of onion and maize which give low yields and are susceptible to diseases. There are several issues in the seed system of Ethiopia which lead to the low supply and high price of onion and maize seeds in the country.

If seeds are the starter, soil fertility is the incubator. Currently, the price of synthetic fertilizer is very high in Ethiopia. In addition to synthetic fertilizer, farmers here cultivate their crops with various organic soil amendments like farmyard manure to increase their production. However, the volume of manure the average farmer requires is out of reach for most, as they do not have access to a substantial amount of cattle. They are dependent on the use of synthetic fertilizer for soil nutrition, but often apply it in lower quantities than recommended levels. For all these reasons, overall production levels are decreasing.

It is therefore important to show farmers alternative sources of fertilizer for the sustainability of their production and increasing it in an affordable way. Thus, the intervention of GFF program comes at the right time, with the following as its main objectives:

- To promote improved technology with improved crop varieties
- To support farmers to get starting seed for their future
- To increase crop productivity by improving farmers' production system



Farmer Gemechu Negash, recipient of improved onion seeds and training on biofertilizer preparation, from Huruta Dore Kebele

Promotion of Improved Onion variety production with integrated synthetic and liquid biofertilizer at Huruta Dore

Onion is one of the most important bulb crops cultivated at Huruta Dore kebele of Jeju woreda. Although there are lots of improved onion varieties developed by research organizations in Ethiopia, none of them were observed to be in use by farmers in the area. Farmers of Huruta Dore are cultivating a local variety of onion. There is certainly demand from farmers for better varieties but supply of seed is insufficient. There are many reasons for the shortage of seed supply in Ethiopia and lack of improved technologies such as greenhouses for reliable seed multiplication in the country is a major one.

In the current system, all breeders set up seed-to-seed multiplication teams who in turn produce a stock of pre-basic seed. This pre-basic seed is grown and a small amount of basic seed multiplied at large scale by seed enterprises. Finally, the 4th generation of seed – certified seed (C1)– will be distributed to a few farmers.

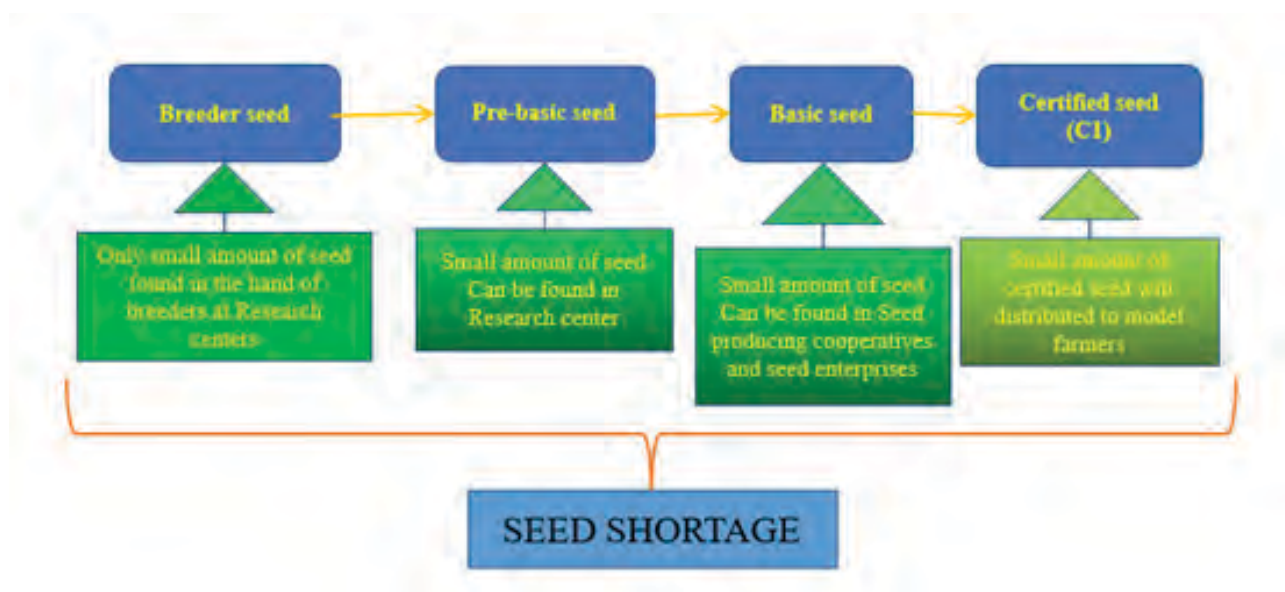
It is not possible for farmers to get early generation seed. As successive generations of seed move from breeder seed to other seed classes, their disease resisting capacity and yield decline. Therefore, a majority of farmers in Ethiopia are receiving a small amount of seed with lower disease resisting capacity and lower productivity. On the other hand, the small amount of certified seed that farmers can access is very expensive. Thus, it is very difficult for farmers to get improved varieties of onion.

The following diagram shows the main bottlenecks contributing to seed shortage in the Ethiopian seed system.

On the fertility side of things, synthetic fertilizer has become very expensive in Ethiopia. It is therefore the right time to seek alternative sources of fertilizer for farmers to sustain their onion production. As mentioned, farmers are accustomed to applying different soil amendments such as compost and manure for crop production. These types of inputs break down and make nutrient available slowly, they are applied in anticipation of the subsequent cropping seasons, and are required in large volumes even to cover a small plot of land. We are finding out that liquid biofertilizer was the right alternative for these farmers to increase their production while drastically lowering their fertilizer

costs. The training of trainers, based on Rockin Soils' formulation was given to different experts at Adama and delivered to all farmers at their kebeles. Then awareness was created through agronomy experts from MetaMeta and Development Agents (DAs) among farmers to prepare their own liquid biofertilizer. Subsequently, about 20 farmers in Huruta Dore Kebele prepared this fertilizer at their home and some of them applied it to local varieties of wheat, maize and onion. Additionally, four farmers got improved onion varieties (Nafis and Nasik) seed support from GFF program for promotion of the technology.

The four farmers who received improved onion varieties performed a small experiment: two of them used both synthetic (DAP and UREA) and liquid bio fertilizer for onion production. One of



them used only liquid bio fertilizer to produce Nasik onion variety whereas another used only synthetic fertilizer to produce Nafis onions. Differences were observed amongst the same onion varieties that received different amounts and types of fertilizer, in terms of leaf color, leaf dimension, plant height, reaction to fungal disease, bulb quality, and yield. The greatest improvements

were observed in the onions produced with both synthetic and bio fertilizer: these could get about 60% yield advantage over the local variety, when used with full production packages. This is a really promising early result and further experimentation will be conducted to confirm that the technology performs consistently.

The distribution of improved seeds combined with alternative biofertilizers through the GFF program is a real game changer for beneficiary farmers in Huruta Dore.



Fig2:Maize produced by NPS and BF



Fig:3 Maize produced with NPS only



Fig:4 Maize produced by BF only



Fig:5 Maize produced by BF+NPS+1/2UREA



Fig:6 Maize produced by BF and NPS



Fig:7 Maize produced by NPS and BF

Promotion of maize production with liquid biofertilizer and synthetic fertilizer at Huruta Dore kebele

Under the GFF program, improved maize variety seed was sourced from Oromia Seed Enterprise for farmers of Huruta Dore, as part of demonstration of the liquid biofertilizer. Nine farmers who prepared their own biofertilizer were supplied with these seeds through the program. All of them used liquid biofertilizer for the production of this crop. The farmers could easily produce enough biofertilizer since the raw materials for its preparation were cheap and easily available. These farmers ran another small experiment: they divided their land into separate plots for the evaluation of this technology. They were quickly and pleasantly surprised with the physical change they observed in leaf color already within the first week. They continued to use biofertilizers by combining it with other synthetic fertilizers (NPS and UREA). They realized that by using the biofertilizer as a supplement, they could use less urea on their land than recommended levels. The plots on which a combination of reduced synthetic fertilizers and biofertilizers were applied benefited the most farmers and reaped the highest yields. Farmers also observed that the biofertilizer also enables maize to resist fungal diseases – this is due to the beneficial microbes created during its fermentation and the strengthened plant immunity developed after biofertilizer application. Based on the data collected, these farmers could get 55% yield advantage over local variety production with full production packages.

The farmers were also happy with the cost advantage they got by reducing the amount

of synthetic fertilizer. They could reduce cost of fertilizer by 2,900-10,000 ETB/Ha by combining bio fertilizer with synthetic fertilizer.

Lessons Learned and Obstacles

It was a struggle to gain farmers' trust in accepting this technology at the beginning. They had several doubts about this fertilizer since the raw materials used for liquid bio fertilizer preparation were considered as low-value materials of little use. They mentioned that some of them initially offered their cooperation to the program in order to get access to improved varieties of onion and maize. Eventually, they were happy with the result, as reflected in their positive testimonies and feedback.

Promoting this liquid biofertilizer with improved varieties was very effective in attracting more farmers to this new technology. Farmers in neighbouring farms have seen all procedures used in the production and they are now willing to buy these seeds from their neighbors.

Beneficiary farmers are now sufficiently convinced about the biofertilizer's effectiveness to say that they will start replacing urea with liquid biofertilizer – a significant step towards more regenerative agriculture. It is important to keep in mind that these demonstrations were done with just a few farmers and are not representative of the whole farming community within the GFF intervention area. Therefore, these experiences and technologies should be scaled up to other woredas.

For effective promotion of these technologies the program will host field days where farmers who have succeeded in the production of these improved varieties with different types and amount

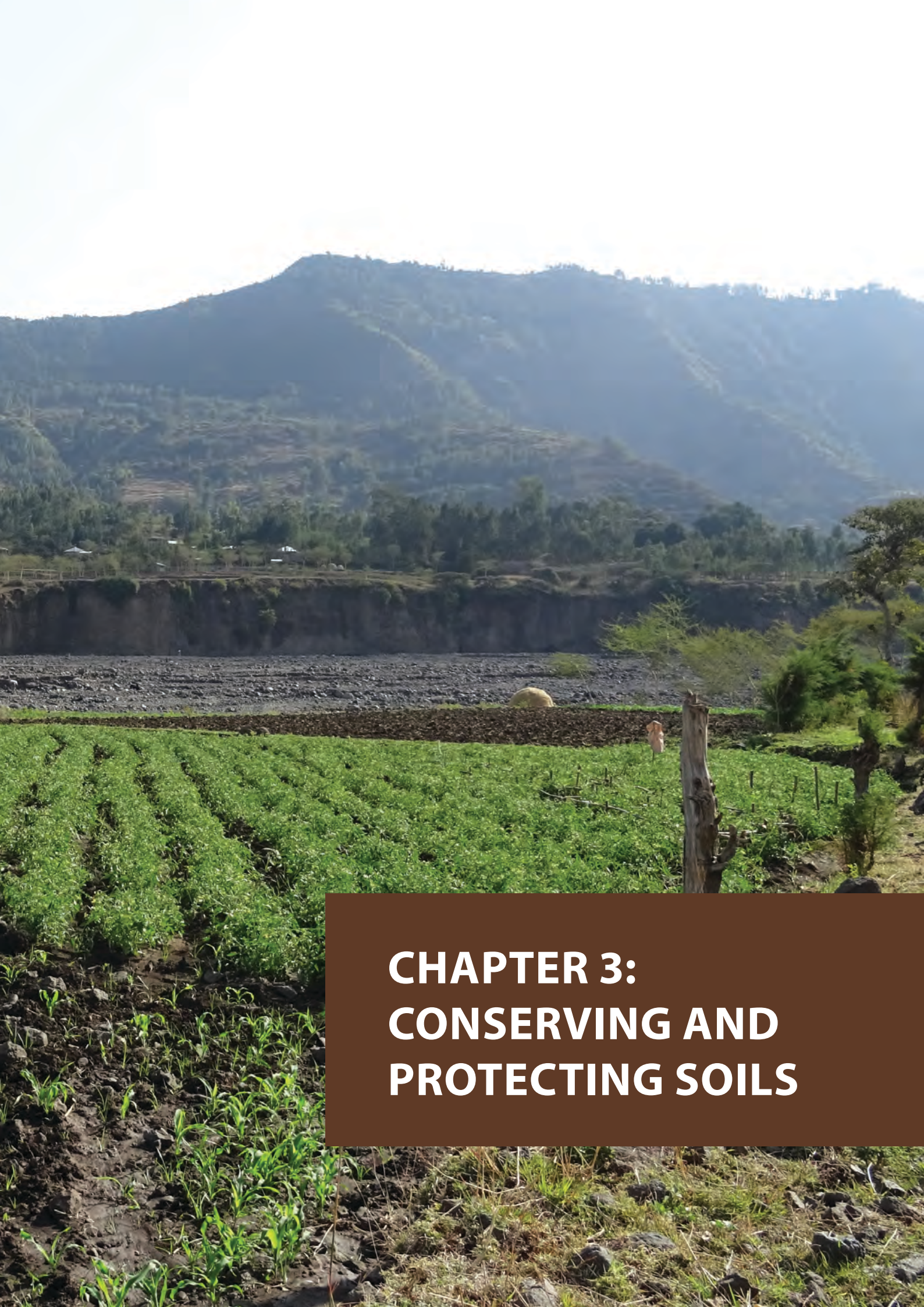
of fertilizer will share their experiences with others. These field days have currently been delayed due to social unrest within the program area, but they will go ahead as soon as it is safe to do so.

Way Forward

To make seed of improved crop varieties more available within the program areas, we are linking farmers with each other within the Huruta Dore kebele. The farmers who received improved seeds through the program have committed to multiplying a portion of the seed stock and sell them to their neighbors. We are currently seeking alternative sources of high quality seed from seed producing cooperatives and seed enterprises. Some of the farmers who received improved onion varieties are also saving the smaller bulbs and sharing it with their neighbors for the next cropping season. Overall, this packaged intervention of alternatives to seeds and fertilizer has had a very positive impact on the beneficiary farmers and, through their testimonies, is having a positive impact on the program.

We are happy to receive more requests for liquid biofertilizer training and enquiries about improved seed, and look forward to continuing building up a regenerative movement within the program area.





CHAPTER 3: CONSERVING AND PROTECTING SOILS

THRIVING FUNGI NETWORKS AND LOCAL CLIMATES

By Femke van Woesik, Frank van Steenberg, Francesco Sambalino

Microclimates are essential regulators of the growth of fungi. Mushrooms, the fruiting bodies of the fungus, prefer a shaded, cool, and moist microclimate to thrive, as the ecological designer Dan Halsey nicely demonstrates in his garden. Furthermore, soil microclimates are essential regulators of the mycelium, the root-like structure of a fungus, as decreasing soil moisture levels can negatively affect their growth and functioning (Castano et al., 2018).

But fungi themselves also influence the microclimate. If this microclimate is not most suitable for them, they have several abilities to alter this to their needs. What if mushrooms need to distribute their spores, but there is no breeze near them to carry these spores to surrounding areas? They will create wind by themselves. Scientists have revealed this impressive secret of mushrooms, or 'ingenious engineers' as Scientist Emilie Dressaire now likes to call them after her discovery. Mushrooms take control of their microclimate by releasing water vapor through evaporation, thereby increasing the air humidity and lowering the temperature of the surrounding air. This leads to a denser air zone, creating small wind patterns around the toadstool. Then the mushroom uses these self-created wind currents to distribute spores to surrounding areas. Because of this, mushrooms can disperse their spores over a wide area even when there is not a breath of wind, showing their extraordinary ability to control the weather. Furthermore, this research showed that air temperatures around different mushrooms were 1-2°C cooler than the ambient air, the mushroom itself being around 4°C cooler than the surrounding air. The lower temperatures result from the consumption of energy needed for evapotranspiration (Dressaire et al., 2016).

This cooling effect of mushrooms was also noticed by the scientists behind the MycoCooler™, a mushroom-based air-cooling system. They showed



Cover crops on vegetable garden beds help maintain an active population of mycorrhizal fungi in the soil

that fungal specimens are, on average, 2.5°C colder than the surrounding temperature. Based on this finding, they loaded the MycoCooler™ with hypothermic mushrooms, cooling the entered air. A prototype model reduced temperature in a closed compartment by approximately 10°C in 25 minutes (Cordero, 2020). Since fungi make up ~2% of Earth's biomass (exceeding the biomass of all animals), their ability to cool through evapotranspiration may significantly affect the temperature of local climates.

Next to their ability to cool and create wind, mushrooms have another trick up their sleeves: they can make it rain. Mushrooms disperse millions of tons of fungal spores, making them the

largest living particles in the air. Along with plant spores and pollen grains, these living cells may act as nuclei for water condensation in clouds: water condenses on the spore surfaces and forms rain droplets. Through this mechanism, mushroom spores may promote rainfall in ecosystems that support large fungi populations. There is thus a positive feedback mechanism at operation in which fungi whose growth is stimulated by rain disperse massive quantities of spores that enhance precipitation (Hassett et al., 2015). However, as fungi thrive in more moist environments, a lack of rain could result in fewer fungi and fewer spores being spread, possibly exacerbating drought.

How can these capacities of fungi serve in landscape rehabilitation and farming operations? There is plenty of evidence that fungi can assist in creating low-maintenance and more resilient landscapes. Fungi can release nutrients into soluble forms that plant roots can take up and, hence, have a critical role in building soils, they reduce nutrient leaching risks (Martínez-García, 2017), increase drought resilience through redistribution of water into upper soil layers, and sequester carbon into the ground. Ecosystems with thriving fungi networks thus store much more carbon than ecosystems without such networks and increase resilience through improved soil quality and drought tolerance.

Together with the weather regulating effect, these capacities make mycorrhizal fungi and mushrooms essential features of thriving ecosystems. Approximately 90% of plant species, including agricultural crops, form symbiotic relationships with fungi networks, providing powerful abilities to forage for nutrients in the soil. These fungal associations between plant roots and beneficial fungi are called Mycorrhizas. Mycorrhizal fungi increase the adaptation of crops to abiotic stress; they can strengthen crop species against salinity, heat, and water-limiting conditions (Yadav et al., 2020). Consequently, an increasing amount of research is emerging on how fungi can play a more prominent role in farming



Fungi growing on black mulch

and simultaneously be used for food and ecosystem rehabilitation (Thomas & Vazquez, 2022). An example is the production of the milk cap fungus on newly planted trees, where the mushroom can be used as a protein source while the fungus-inoculated trees help in ecosystem conservation and rehabilitation.

Another example is cover crops to boost mycorrhizal fungi in the soil. These fungi can

only grow and reproduce in partnership with a host plant. Cover crops can fulfill this host role after the main crop is harvested. Research from South Dakota State University showed that a five-way cover crop mix significantly increased the number of fungi in the soils by up to three times compared to soils with no cover crop.

Improving and protecting fungal networks in a landscape	
Do's	Dont's
<ul style="list-style-type: none">• Maintain above-ground soil coverage with native flora.• On farms, this can be done by using cover crops• Encourage no-tillage agriculture methods• Use manure and compost that nourishes the soil• Use organic fertilizer• Cover soil with organic matter (e.g., leaves)• Create conducive (soil) microclimates (moist and humid)	<ul style="list-style-type: none">• Extensive plowing or tillage• Keep the soil bare between harvest• Use of chemical fertilizers• Degrade microclimates

SOIL LIFE

By Elie Dib and Frank van Steenbergen

Above ground animals and insects are not the only living organisms that have seen their populations decrease alarmingly. Equally, soil life – the network of organisms living in the soil, from micrometers long bacteria to centimeters and sometimes meters long earthworms – has taken a battering. As opposed to aboveground organisms, rainworms and other soil organisms are rarely counted due to their hidden habitats. However, surveys often give an indication of decreases in their numbers.

An example is a research that was conducted by Dr. Jacqueline Stroud in which volunteers from England sampled earthworms. They were asked to dig out a 20 cm per side, and deep, soil pit using a spade or garden fork and a ruler. The earthworms from the soil sample were placed in a pot and sorted between adults and juveniles. Juveniles were placed back in the pit, while the adults were counted and sorted by ecological category. This was repeated ten times per volunteer, meaning ten pits were dug out per field for accuracy. The results for the adults were then sent for analysis along with data on basic field management, including crop, tillage, size, and whether they were under organic matter management (cover cropping, organic composting etc.).

They found that 42% of the studied fields contained few if any of the key types of earthworms, because they were overworked. Human activities such as tillage were found to have a negative impact on earthworm population, and organic matter management did not mitigate its impacts. Therefore it was clear that us humans play a big role in the decline of soil life. We are inhibiting the activities of important soil organisms, such as earthworms, sowbugs or termites. We are preventing them from carrying out their services in the ecosystem, namely improving soil quality



and structure. This is counterproductive. Farmers are forced to take recourse to the use of costly conventional amendments and practices such as ploughing and applying chemical fertilizers. These actions will accelerate the degradation of soil life, thereby increasing the farmers' dependence to them. Additionally, a research on song thrush birds, earthworms' natural predators, associated the decline in their numbers in England to the decline in the number of rainworms, further accentuating the importance of soil life in nature's balance.

Earthworms are classified into ecological categories according to their behaviors and the layers in the soil they occupy. They are classified into:

- Epigeic earthworms, which feed on surface litter (such as dead leaves) and live in the litter layer or top centimeters of the soil. Examples are the red worms, also called red wigglers or manure worms. These species are the most used in vermicomposting around the world.
- Endogeic earthworms, which feed on soil and associated organic matter and live in non-permanent burrows deeper in the soil.
- Anecic earthworms, which can live in deeper layers of the soil and make permanent vertical burrows. They feed on surface litter and dragging it to the deeper layers.

No matter what ecological category they belong to, earthworms are very sensitive to changes in their environment. When under stressful conditions they tend to move to different, normally deeper layers in the soil, or go into 'diapause', which is a state of inactivity. Before going into diapause, the worms tend to form a small chamber around themselves with mucus, cast or large sand grains that adhere to them. They then coil up and become inactive.

There are different ways to evaluate how rich a soil is in earthworms and how much the soil is alive. A practical and simple method would be

to dig out a 200-mm cube of soil with a spade or garden fork as described in Dr. Stroud's research and count the earthworms, placing them in a pot, while taking note of the diversity of species. If less than 15 earthworms with one predominant species are counted, the soil is poor in earthworms. If between 15 and 30 earthworms with two or more species are counted, the soil is moderately rich in earthworms. If more than 30 earthworms with three or more species are counted, the soil is rich in earthworms. If some parts of the land have very different soil conditions—such as different moisture or organic matter contents—earthworms cannot be assumed to be uniformly spread throughout the field. In that case, repeat the process across different patches of the land.

In arid soils, earthworms can increase the organic matter content which increases the soil's capacity to retain water. By forming vertical burrows, earthworms can increase the soil's aeration and drainage with the burrows acting as channels for air and water deep into the soil. This increase in drainage can decrease soil erosion by decreasing surface runoff and hence the dislodgement of soil particles. Earthworms' vertical burrows also increase the soil's resilience to drought by increasing the porosity of soils and hence their water storage capacity.

Earthworms' ability to accelerate decomposition, which is the transformation of organic matter such as manure to available inorganic nutrients (or minerals) for plants to take up, places earthworms in the 'decomposers' category. After feeding on organic matter and nitrogen and phosphorus rich particles, earthworms produce casts which creates nutrient rich hotspots around the roots of the plants. Earthworm cast also creates optimal conditions for microbial activity.

When in the soil, earthworms increase the pH

by releasing calcium carbonate through their calciferous glands, and increase the soil's dissolved organic carbon content. These compounds in the soil trigger chemical reactions, desorbing phosphorus from metal oxides and making it available for plants to uptake.

Earthworms' abilities to enhance nutrient uptake, mix and turnover the soil, and increase drainage, make them huge assets to have in the soil by decreasing the need to carry out several costly practices in conventional agriculture such as ploughing, irrigation and application of chemical fertilizer. Moreover, earthworms perform these functions for free; therefore, keeping them around and keeping them happy can reduce operating costs.

Common misconceptions in agriculture are hurting lands by disrupting soil organisms' habitats and functions. Some of the most common misconceptions are:

- Thinking that ploughing is always necessary. Actually, it dries soil making it cloddy and forcing more irrigation.
- Thinking that more of anything that is beneficial is always better. For example, excessively irrigating and flooding soils which reduces aeration and forces organisms such as earthworms to move to the soil surface where they will be exposed to UV radiation and get picked up by predators.
- Another example is the excessive use of synthetic fertilizers which, in arid areas, can increase the soil's salinity and acidity, or the excessive use of contact pesticides which kill almost all the organisms living in soils.

There are measures and actions that can be implemented to achieve the desired productivity while sustainably maintaining farmlands. These

“Earthworms’ vertical burrows also increase the soil’s resilience to drought by increasing the porosity of soils and hence their water storage capacity.”

consist of creating optimal conditions for soil life to flourish and carrying out their functions. For most earthworms, optimal conditions would be a soil temperature ranging from 15 to 20°C, a soil moisture of 60-70% which allows adequate soil aeration, and a soil pH ranging from 5 to 8. To that end, here are some of the important do’s:

- Adopting a no-till system is a good start in transitioning towards soil-friendly/regenerative agriculture. In the presence of hard-to-control weed, an occasional light tillage by forming ridges to conserve soil moisture can be beneficial.
- Another efficient method to conserve soil moisture is keeping a soil cover. Cover crops will additionally provide a food source of organic matter for earthworms and protect them from predation and UV radiation. Examples of cover crops are Vetch or Soybean, which can also fix nitrogen.
- If soils are acidic with a pH below 5, applying lime can be very useful to increase the pH to between 5 and 8.
- The choice of irrigation method depends on several factors such as the crops being planted,

size of the land and type of soil. However, some irrigation practices are friendlier to rainworms in our farmland than others. It is important to note that, as we previously mentioned, over irrigating and flooding the field can have detrimental effects on soil life. Inversely, practices that avoid flooding are preferable. For example, in the presence of a hard-to-control weed, lightly tilling the field and forming ridges will help conserve the moisture and can provide shelter for worms from water-saturated soils.

- In the case of a pest invasion, releasing the pest’s natural predator or adopting a push-pull system by inter cropping ‘push’ plants which repel the pest, and ‘pull’ plants which trap the pest are more ecological alternatives to chemical pesticides.

To some, farmland is just the place where we work, but to others it is much more; it is a living system that we work with to produce our food and livelihoods. In my opinion, any person who cares about their land should consider adopting this approach to land and water management, which has come to be known as regenerative agriculture.

MAKING USE OF THE EDGES IN NATURE: HEDGING OPPORTUNITIES IN ETHIOPIA

By Frank van Steenbergen and Femke van Woesik

In a landscape, hedges can make all the difference. This is the point of the gem of a book called “Heg: een behaaglijk landschap voor mens en natuur” (Hedge: a sheltered landscape for humans and nature) by Kenneth Rijdsdijk. Hedges, or perennial plantations around fields, were planted initially to demarcate plot boundaries, to provide woods, to prevent livestock strolling, or to prevent large predators from entering farm fields. But hedges have many more functions:

1. They harbor enormous biodiversity in the plant material that makes up the hedges and in the shelter they provide to molluscs, insects, small mammals or birds. This wide variety builds up rich food chains. Hedges also connect habitats making it easier for wildlife to move under the protection of their cover. When hedges are connected to local forests, the variety of plant and animal species multiplies even more, and forests are carried along these transport routes. For all these reasons, hedges are sometimes called biodiversity boosters.
2. The litter under hedges create a healthy basis for soil biota. The soils underneath hedges are more permeable and rich in humus. This helps to intercept rain runoff and to recharge groundwater along the roots of the hedge plants.
3. The leaves and twigs from hedges and trees can serve as compost for the farm fields.
4. Many rural farmers still depend on natural forests as resource pools for their livelihood. Products like fruits, medicines, fuelwoods, teeth-cleaning twigs and fodder can also be taken up from the planted field edges instead.
5. Hedges and perennials surrounding farm fields provide shelter for farmers, enabling more trips to the fields.



Hedges in Ethiopian landscape (Source: Tewolde Berhan G/Egziabher Sue Edwards and Hailu Araya, Institute for Sustainable Development, Addis Ababa, Ethiopia)

6. Farmers who grow large canopy trees could enable certain shade areas in the fields for shade-prone crops.
7. Hedges divide a landscape into smaller compartments. This prevents surface runoff from gathering speed and rolling out the soil during rains.
8. It is the same with the wind: hedges break the wind speeds and keep fertile topsoil from being carried away from the fields.
9. They improve the microclimate – by providing shade, reducing exposure to wind, and regulating local temperature.
10. Hedges shelter numerous small animals that are natural enemies of pests and help to control their numbers in surrounding areas. This effect can stretch as far as 100 meters. For example, the small wildlife domiciles in the hedges can prevent rodent outbreaks. A study by Kebede et al. (2018) on the biocontrol potential of stem borers in Ethiopia found that maize fields adjacent to enset and complex hedgerows had significantly higher abundance of predators, this lead to better pest suppression potential.
11. Hedges support carbon storage and can thus play a role in climate change mitigation. The soil organic carbon sequestration rate beneath hedgerows is 1.48 MG C/h/yr.

There are many different types of hedges; from trees, to shrubs, to grasses. One example is Vetiver grass that is often used in Ethiopia to prevent soil erosion. A study by Tesfaye (2018) showed that within two years after implementing Vetiver grass on farm lands in Somodo Watershed (South-Western Ethiopia), 36 cm soil was accumulated above the hedgerow. This also reduced the field slope by 2.55% on average. Furthermore, the phosphorus availability was found higher above the hedgerow than below, this implies improved soil fertility. Another study by Hailu et al. (2020) showed that the soil organic carbon was significantly higher for cropland with Vetiver grass hedgerows than adjacent untreated cropland. Mean crop yield was also shown higher and the average slope was reduced by 7%.

Another example of a species that can be used for hedging in Ethiopia is the *Calliandra calothyrsus* Meissn; an often multi-stemmed tree or shrub species with an average height of 5-6 meters and a diameter of 20 centimeters. This type of hedge is especially used for fodder and wood production. *Calliandra calothyrsus* Meissn is suited for areas with low to mid-altitudes and high rainfall. Yadessa et al. (2004) did a field experiment on this species grown as hedgerows at the Agricultural Research Center in Oromia. They found that planting the seedlings at 25 centimeter intra-row spacing and cutting at the 75 centimeter cutting heights was the best for fodder production; whereas for both the 50 and 75 centimeter intra-row spacing, the 100 centimeter cutting height was best. For wood production more focus should be given to cutting height.

Despite all the benefits of these hedges, farming practices focus mainly on the fields themselves, leaving the edges of the fields often underutilized

and underlooked. This is where the high potential of the vital hedging functions comes in and integrating boundary plantations (in the form of hedges or trees) should be encouraged. Within agricultural landscape mosaics, the arrangements of hedgerows can positively impact agricultural productivity in fields. Multipurpose species with short, medium, and long-term returns can be planted so that farmers may get additional income at regular intervals.

Hedges or perennial plantations around farm fields should thus be appreciated and preserved. Their essential function and contributions to a more prosperous world of biodiversity and regenerative agriculture should be acknowledged. This is a plea to consider the bigger picture and see what policies and other drivers promote and preserve hedged landscapes in Ethiopia.



A photograph of several corn plants growing in dry, cracked soil. The leaves are green but show significant damage from insects, with many holes visible. A small, leafy weed is visible in the bottom left corner. A dark brown rectangular box is overlaid on the bottom right of the image, containing white text.

CHAPTER 4: IMPROVING PLANT AND CROP HEALTH

RESPONDING TO THE FERTILIZER CRISIS

By Getachew Engdayehu, Frank van Steenbergen
and Girma Senbeta

The Ethiopian synthetic fertilizer system has been under much pressure with demand rising fast. It has been subject to several criticisms. Though there has been much investment in soil mapping in Ethiopia, the fertilizer distribution is poorly targeted, according to the 'Assessment of Fertilizer Distribution Systems and Opportunities for Developing Fertilizer Blends Ethiopia' brought out by the International Fertilizer Development Center (IFDC) and the African Fertilizer and Agribusiness Partnership (AFAP) commissioned by AGRA.

Based on country-wide soil mapping seven fertilizer formulations were prepared, meant to cover most soil situations. However these formulations were not validated and did not take into account the different cropping systems in different parts of the country. Most noticeably, some key micro-nutrients may be missing from the formulations. Another bottleneck is that the capacity of the blending plants in Ethiopia is below the demand for fertilizer blends. In addition, fertilizer delivery also takes place very much through the public sector with cooperatives and their unit groups being the exclusive channel, creating a rigidity on the supply side.

Come 2022 with a global fertilizer crisis due to the war in Ukraine, production problems in some of the large manufacturing sites, and the overall explosion in energy costs. All these problems amplify in relatively poor and foreign currency-strapped economies, with larger challenges to secure supplies under the dramatically changed scenario. Ethiopia is a prime example with fertilizer imports disrupted and delayed. On the ground what it led to is:

- overall shortage, with farmers receiving a third or fourth of what they are used to from their cooperative;
- delayed delivery, with fertilizer arriving after the start of the cropping season and dramatic



Queue at a fertilizer distribution centre

price rice (more than double that of previous years)

- tension at fertilizer delivery points, with fertilizer consignments heavily guarded and some farmers desperate after little/no supply. There is large concern in the grain baskets of the country as to the harvest of this year's crop season, particularly against the background of the overall food insecurity in the region.



This fertilizer crisis opens a window of opportunity for foliar liquid bio-fertilizers that can be made easily by farmers and small local businesses and can be quickly picked up. Liquid biofertilizer are made based on a fermentation of cow dung, sugar, yeast, milk, wood ash and rock dust. The liquid fertilizer is

then diluted and applied by knapsack sprayers. The cost per ha for liquid biofertilizer is a fraction (less than 10%) of that of synthetic fertilizer. There are indications that combining foliar biofertilizer with a reduced application of urea may still result in similar or even higher yields. Moreover, foliar bio-fertilizers do are rich in micro-nutrients, particularly magnesium. Apart from the cost and the yield, the advantage of this regenerative recipe is that it also contributes to control of pests and diseases, and does not lead to the soil degradation associated with poorly managed application of synthetic fertilizers. The current fertilizer crisis can hence be mitigated by a massive drive in local biofertilizer production.



A farmer in Ethiopia's Amhara region spraying biofertilizer, which he made himself after a training organised by MetaMeta/Rockinsoils

THE MULTIPURPOSE BIOFERTILIZER

By Bella Arlman

Biofertilizer is a proven effective way to increase crop yield either as an alternative for the expensive chemical fertilizers or in combination with it. It is made of cow dung, sugar, yeast, milk and dust (of volcanic rocks) providing many nutrients to crops. Due to the simple accessibility of these products the fertilizer is easily made at home by the farmers themselves. Costs of the biofertilizer are estimated at 37.5 Birr per hectare per application. This application process is very manageable: the biofertilizer needs to be sprayed over the crop's leaves and is applied regularly, depending on the crop, but approximately once in 21 days. With both the production and application process being relatively uncomplicated for farmers, biofertilizer seems a very good alternative/addition to chemical fertilizer.

Biofertilizer has been proven to have many benefits for farmers; increasing yield, reducing fertilizer costs, less weed growth compared to chemical fertilizer and being made at location, there is no delay in the delivery of the product. However, some lesser known benefits are also worth considering: By boosting a plant's immune system biofertilizer helps to reduce pests as farmers and research have pointed out. Talking to a farmer on the fieldsite he described the disappearance of a worm that had been ruining his crops for months. After one week of using the biofertilizer he had never seen this worm again, highlighting the twofold purpose of the product aiding pest reduction as well as plant growth.

Secondly, farmers mentioned that using biofertilizer caused their products to become more attractive for customers who value biologically farmed crops untreated with unnatural chemicals. Lastly, the usage of chemical fertilizer has a negative effect on the environment; especially



Crops treated with biofertilizer

when through groundwater, the fertilizer flows down the landscape and accumulates in water bodies. The accumulation of these chemicals poses a serious health threat to inhabitants of the area who drink water from the river. Since biofertilizer does not affect the environment negatively and subsequently does not create a health hazard to the environment's inhabitants it helps improve ecosystemic health when replacing chemical fertilizer.

Considering the many benefits biofertilizer has over chemical fertilizer its application is not only favorable for farmers but to their community and its ecosystem. By implementing horizontal learning systems similar to the one in place in Woldia where every model farmer is supposed to train 5 others after their own training is completed, the production process of biofertilizer can quickly be shared within neighborhoods ensuring its implementation in big regions throughout Ethiopia

providing farmers with the opportunity to actively develop their community.



A farmer in Middle Awash with his homemade biofertilizer (middle of image)

EDEN TOXIC

By Frank van Steenberg

Postcard from Koga, Amhara Ethiopia - what looks like a lush little mini-Eden, is in fact far from it. What we cannot see in the picture is the smell – the stale heavy smell, the air carelessly poisoned by pesticide sprayed indiscriminately.

This uncontrolled use of pesticide is repeated all over the country – on vegetables (with tomatoes receiving up to 15 applications), on Teff (the staple grass-grain that is not supposed to need protection), and even on khat, the increasingly popular stimulant leave. Before it is brought to the market, khat is sprayed with pesticide. Soon thereafter it is consumed and chewed many times over, and khat users then keep it in their cheeks. Food habits can hardly be more dangerous.

Pesticide use is on a steep increase in Ethiopia. In spite of laws and a Pesticide Regulation Board, it is largely unregulated. In a research among 600 farm workers it was found that 85% of them had not attended any pesticide-related training and 81% were not aware of modern alternatives for chemical pesticides. Out of 10 workers only 1 used a full set of personal protective equipment, and less than 4 would take a bath or shower after work. Stockpiling, discarding, or burial of empty pesticide containers in the field was common (Negatu et al., 2016).

Another study found that of 30 pesticide retailers 24 had no agricultural background nor any significant related work experience. Very few retailers could read the labels of the pesticides that they sold or provide adequate explanations. 26 out of the 30 retailers did not have information, records, and reports, on pesticides (Mengistie et al., 2017).

Ethiopia has – as other countries – a legal framework for pesticide registration and use. However, even though pesticide use is on the increase, implementation is totally inadequate:



understaffed registration, insufficient testing capacity, missing lab testing facilities, no monitoring, smuggling of pesticides is common. The Pesticide Advisory Board also not been able to turn the tide.



The structure of the pesticide business has been described as atomistic. There is no loyalty to or relationship within the supply chain and there is no flow of information on the products sold, their proper use or environmental effects. All is business, nothing more. At the same time, illegitimate usage of DDT and Endosulfan on food crops and direct import of pesticides without registration occur too.

What we cannot see is still there. And it shows up in the slow poisoning of agricultural workers and customers that are not aware of what comes with the immaculate-looking food they take.

There is something missing in the picture. We have an increasing labour force of graduate, able agriculturalists who have difficulty finding employment; and a burgeoning agricultural sector. There is an urgent need and an easy route to do things differently.

MAN AND ECOLOGY

By Frank van Steenberg, Getachew Eng-dayehu, and Bantamlak Wondmnow

Postcard from Awezet, Farta (Amhara, Ethiopia) - Located at the foot of the Guna Mountain in Amhara Region, life in Awezet has become gradually better over the last twenty five years. First it was the introduction of farm inputs, particularly fertilizers that caused crop yields to go up. The new disposable income was used by most people to build a new house, with stone foundations, tin roofs and a storage room underneath. The old houses were not demolished but kept for livestock and cooking, creating a more healthy home environment in the new main house: less smoke, less ticks and flies.

However, the intensive farming took its toll on the land – erosion accelerated and the common pastures were overgrazed. And then came a new revolution ten years ago that made life even better. Guided by the government, the landscape in Azewet was restored. Each adult devoted fifteen to thirty days in the lean season on implementing a variety of measures – making terraces, placing stone bunds, plugging gullies and controlling the free grazing of livestock. As it was done at massive scale it completely transformed and regreened area. The barren village pastures became green again, with enough grass to cut and take to the houses. There was more on the soil, crops were no longer stressed and soil organisms thrived, increasing natural soil fertility. With the remodelled ecology balances changed, mostly for better: a better water economy, erosion under control, and a better local climate.

Then the rats came in large numbers. The remodelled landscape suited them better too. The various stone structures build to control erosive run-off become safe harbours for rodents. The



controlled grazing helped to regenerate the grass land, but also did away with the trampling of the livestock and the shepherds killing rats. Above all, the success of the watershed re-greening was that food became abundant and available almost throughout the year. All this caused the rat population to boom. Rats multiply quickly: one rat can have 1500 offsprings in a year. Apart from field rats, mole rats made their appearance too. The mole rats found it convenient to make long tunnels in the softer, more moist soils.

The impact of the rodent outbreak is severe. All grass on the grazing area may be eaten by the rats and close to half of the crops may be lost – either devoured or cut and damaged. The mole rats disturb the roots of potatoes, which is otherwise the main cash crop. Around the houses the rats can be unbearable: the running along the ceiling,

the damage to clothes and property, and their constant attack on all food stored.

What happened in Awezet is dramatic but not exceptional. All over the world, rats damage crops either on the field or in the stores. One estimate is that were we to control rodents effectively we could feed 400 Million globally. Losses in many areas are routinely 10 to 15% with occasional peaks. Rats are also a global health hazard – carrying more than 60 known diseases .

The same organized spirit that helped to transform and re-green the watershed in Azewet is now used collectively to control rats with a variety of methods summarized as ‘ecological rodent management’. Best is to control rats in the season when their population is at the lowest. In highland

Amhara, this is when the rains have just started and fields are being prepared. This unsettles the rodents, causing them to escape to grazing land, the church forests, and the houses of people.



are given a better chance to catch the rodents. Another measure is to synchronize the planting and harvesting of the main crops so that rats cannot move from one field to another to still their hunger. Finally, also on the grazing land, minimum controlled grazing is reintroduced – not many animals but a few on a number of days just enough to get the balance back.

Thereafter, there is a range of measures that can be used. One is to destroy the habitat: plugging holes, flooding burrows, strengthening stone bunds. In and around the houses many things can be done: keeping cats, rat-proofing the house, deploying traps and having proper storage – either in store houses on stilts (with medicated disks to keep rats away)– or hermetic bags. There are also plants that rats do not like; that either repel or kill them. Placing sharp bushes or planting Vetiver grass along bunds prevents rats from moving along these ‘highways’. By creating open spaces around the fields or by intercropping, natural enemies

RODENTICIDES IN ETHIOPIA - A SHORT ACCOUNT

By Meheretu Yonas – Rodent Green Management

Rodent pests and rodenticide use in Ethiopia

Ethiopia's economy heavily depends on agriculture, it contributes ~ 37% to the GNP, ~ 80% of the export revenues, and employs about ~ 73% of the population. However, the sector suffers from several problems including pest-related constraints across the value chain. Anecdotal estimates indicate that pre- and post-harvest crop damages and yield losses to pests in Ethiopia account for between 30 and 40% annually, though empirical data is generally lacking. In Ethiopia, 100+ species of rodents have been recorded, approximately a dozen are significant agricultural pests. The main pest species (both field and storage) belong to the following five genera: *Arvicanthis*, *Gerbilliscus*, *Mastomys*, *Stenocephalemys*, *Tachyoryctes*, and *Rattus*.

Apart from being serious concerns to agriculture, rodents have a major public and veterinary importance, because they act as reservoirs and vectors of several infectious pathogens. It has been reported that rodents can transmit over 60 different pathogens to humans and animals, including noxious viral, bacterial, and protozoal diseases. Those most exposed to these rodent impacts are usually poor community who live in poor sanitary conditions and lack the knowledge and the means to manage them.

There is hence a huge need to manage the rodent problem in a safe and responsible way and to build up a sector that deals with this societal challenge effectively. Current practice is far from that with persistent toxins used often without proper guidance.

Together with trapping, rodenticide (mainly zinc phosphide, Fig. 1) application is the most



Fig. 1 A glimpse of zinc phosphide and other rodenticides and traps sold in the streets of Addis Ababa.
(Photo: Meheretu Yonas)

practiced rodent management method in crop fields in Ethiopia. Other rodenticides in use are Brodifacoum, Bromadiolone, and Flocoumafen as observed from the local markets. The rodenticide import, distribution and regulation systems in Ethiopia are unclear (unknown) since data is unavailable (e.g., Mengistie et al. 2016). It is difficult to find information as to which rodenticides are being imported, their expenditures, method of distribution, monitoring and surveillance systems. For instance, according to United Nations COMTRADE database, Ethiopia imported US\$ 6.68 million and US\$ 8.71 million worth of insecticides, rodenticides, fungicides, herbicides, and plant-growth regulators from Germany and Belgium in 2017, respectively. However, it is not clear how much is the share of the rodenticides is this expenditure. The involvement of the private actor too is unclear and only visible from local retail markets. However, the inefficiencies in the supply chain as a whole suggests that the role of the private sector too is weak. These deficiencies have partly contributed to unclear supply chain

actors, inefficient and unsafe use. It is likely that these factors have also contributed to public and environmental safety and risks. Under severe infestation conditions, rodenticides are used in storage areas and houses in Ethiopia risking the health of humans and domestic animals. For instance, a retrospective cross-sectional study from Debre Tabor general hospital, a district hospital in northern Ethiopia, revealed that out of the 102 patients admitted to the hospital presenting acute poisoning between Sep. 2013 to Aug. 2016, rodenticide poisoning accounted for 56.9% ($n = 58$) of the cases with a mortality rate of 18.6% (19 cases) (Endayehu and Shenkutie, 2019). In a study in northern Ethiopia, ~ 93% of surveyed cereal farmers reported the use of zinc phosphide rodenticide in rainfed crop fields to manage rodent pests (Meheretu et al. 2010). About 87% of the farmers decided to buy (apply) the rodenticide after noticing intense rodent activities in the fields, suggesting that rodent management is symptomatic, not integrated into part of the routine pest management activities.

The supply of rodenticides is limited in Ethiopia; hence farmers buy it from local retail markets (Fig. 2) or receive it free of charge (or with a reduced price) from a district agricultural office. Unfortunately, the rodenticides are often sold (packed) in a very small quantity and without user instruction, including expiry dates. Of note, apart from safety concerns, poor awareness of rodenticide application is likely to result in weak efficacy of action and treatment failure, leading to apathy and widespread acceptance of rodent pests in fields and storage areas. For instance, in several regions in Ethiopia, people fear calling rats by the name 'rats', rather they tend to call it 'bride' and 'queen'. This is based on the belief that if one calls a rat by the name 'rat', the rat will increase in number in the fields or storage areas and avenge by attacking crops out of lack of respect. It is a sign of the severity of the problem and the attitude of farmers who do not know how to deal with it.

Recently, a team of researchers from MetaMeta, Mekelle University and Amhara Bureau of Agriculture have developed a prototype bio-rodenticide (rodenticide originated from a blend of plant materials) in Ethiopia (Fig. 3) through laboratory and field testing and it has been proven effective in reducing rodent populations significantly. Efforts are underway to ensure wider use of the bio-rodenticide in Ethiopia and other African countries.



Fig. 2 Example of pesticides sold in local markets without user instructions and user dates. (Photo: Belay Mengistie)

There is also a rodenticide called 'Zera Rat and Cockroach Destroyer' that entered the Ethiopian retail market and is being sold in open markets (Fig. 4). It is manufactured by Zera Corporates (<https://zera-corporate-office.business.site/>) which claims to have been 'manufactured by Ethiopian researchers in a way that does not pose a health risk to the community'. However, there is no report on vital information on the product, including those related to its chemistry, efficacy, and public and environmental risks. Neither the company nor the national pesticide regulators have disclosed such information regardless of its wide-open sales, including on the streets of big cities like Addis Ababa with street advertising taking using loudspeakers (Fig. 4).



Fig.3 A label from the prototype bio-rodenticide developed in Ethiopia.

To address the impact of rodents on agriculture and health in Ethiopia and reduce the heavy reliance on rodenticides, a direction towards Ecologically-Based Rodent Management (EBRM) strategy is recommended. EBRM promotes the need for developing environmentally friendly management methods by combining scientific knowledge on the biology, ecology, and behaviour of the rodent pests locally occurring along with socio-economic dimensions (Singleton et al. 2004). EBRM also promotes a thorough understanding of the traditional pest management practices and combining them with scientific knowledge. EBRM has been introduced to farmers in Asia, Australia, and eastern Africa where several signs of progress have been made.

Alternative management direction

Despite the short-term benefits, the long-term consequences of reliance on rodenticide should

be a concern, particularly in a situation where knowledge of proper utilization of rodenticides (e.g., storage, dosage and time of application) is poor. Farmers and extension workers (district officials supplying the poison to the farmers) should be made aware of the potential danger the poison might result on non-target animals and the environment. Research is needed to evaluate the cost-effectiveness, efficacies and environmental harm of rodenticides sold in local retail and distributed by agricultural offices. The traditional rodent management practices of the farmers should be better understood and combined with scientific knowledge.

Equality important is filling the gaps in clarity in rodenticide import, distribution and regulation systems in Ethiopia and availability of information including in monitoring and surveillance systems. The involvement of the private actor should be encouraged with clear role and responsibility to tackle the problems of inefficiencies in the supply chain.



Figure 4 Zera mouse killer package and a street vendor with his loudspeaker, rodenticide and trap varieties on the street of Addis Ababa. (Source: Zera Mouse killer <https://zera-corporate-office.business.site/> (left). Photo right: Meheretu Yonas)

THE POTENTIAL OF FARMER'S INDIGENOUS KNOWLEDGE IN ECOLOGICAL BASED RODENT MANAGEMENT

By Tadesse Tilahun, Getachew Engdayehu, Bantamlak Wondmnow, and Luwieke Bosma

This is the first in a series of blog posts describing the development and implementation of ecologically-based rodent management (EBRM) in Ethiopia. It describes the realization of the joint approach between farming communities, MetaMeta, and the Amhara Bureau of Agriculture in implementing EBRM with the support of RVO-SBIR and GFF.

Rodents are a major but often unseen problem in food systems, typically causing 10-20% crop loss in the field and storage (Yonas et al., 2021). In Ethiopia, rodents are responsible for an estimated 25% crop loss, which results in a yearly loss of up to 2.5 billion US dollars in agricultural value. As 73% of the Ethiopian population is employed in the farming sector, this affects many people in terms of food security – especially coming down hard on small and marginal farmers. Furthermore, rodents threaten village health as they spread diseases and viruses, and can contaminate food sources.

Despite these severe problems that rodents cause, the situation remained largely neglected. Even though Ethiopian communities have struggled with rodent pests and outbreaks for decades, the problem received very little attention. Over time the problem did not diminish but appeared to have worsened. One of the reasons was rather unexpected—recent watershed rehabilitation programs. While these programmes successfully restored landscapes, they also increased the rodent populations. The water conservation structures (e.g., stone bunds and terraces) and change in cropping calendars provided ample shelter and food to rodents (Meheretu et al., 2014), which vastly increased rodent population numbers and sent alarm bells ringing in farms across Ethiopia.



Group discussion to share experiences on rodent control methods used

Through the extension workers at kebele and woreda levels, MetaMeta and the Amhara Bureau of Agriculture got involved in rodent management and discovered the huge gap in terms of alternative biological and ecological methods for small-holder farmers worldwide. Developing a systematic, communal, and ecologically based approach to this severe rodent issue thus had to start from the ground up. This entailed first engaging with farmers and communities to understand the extent of the problem and combining their indigenous knowledge with scientific research to work towards a sustainable solution.

In the first year, a survey was conducted amongst farmers in the highlands of Amhara to collect farmers' knowledge, perspective, and practices on rodent management. The aim was to get to know farmers' attitudes and understandings on the rodent issue, extent of damage, and their

experiences with botanical and other rodent control methods currently used in their locality. Two hundred household farmers and 52 woreda and kebele experts were consulted during interviews and focus group discussions.

Some indigenous rodent management methods used included plugging rat burrows with stones and toxic plants, flooding and smoking out the tunnels, using stone traps, and fencing with thorny/prickly plants around holes. A combination of methods is also used. In addition, farmers know of botanicals that they suspect affect rodents, either through repulsive smells or by inducing mild toxic effects. All rodent control methods had been applied at a few locations and, at best, one by one. None of the methods were practiced collectively at a community-level. As a result, control on a larger scale at the rodents' habitat did not happen, and the damage continued to rise.

This local knowledge was collected and combined with academic research in different parts of the world, forming the basis and road map to develop a practical collective EBRM approach. Starting the following year, experience-sharing and training workshops were held twice a year for regional, zonal, woreda, and kebele-level agricultural experts, community leaders, and select farmers (women and men). To date, more than 1000 participants have attended the workshops. The primary objectives of these workshops and trainings were to raise awareness, prepare action plans for collective community-level EBRM, share and learn from best practices, and apply bio-rodenticides as a ready product. Participants shared their valuable indigenous knowledge and experiences about rats' behaviour, breeding seasons, habitat utilization, and population dynamics. This was the basis for developing local EBRM action plans – combining habitat control: denying access to food, intercepting rat pathways, removing shelters, promoting predator action, and selective trapping and killing. Participants discuss what they know and traditionally do to control rats, and they also suggest ways to incorporate rodent management as an integral part of watershed development. The fact that the watershed community made the EBRM activities part of their collective work was critical to the success of EBRM in the area.

The field assessments, together with the workshops and experience sharing sessions, highlight the importance of first getting a deep understanding of the problem and then finding a sustainable solution by combining indigenous knowledge with scientific research. This has led to a comprehensive EBRM approach, including an

EBRM manual, different implementation manuals, bio-rodenticide product preparations, and field application procedure protocols. The EBRM manual includes all EBRM methods and innovative and effective bio-rodenticide application methods. It contains farmers' shared, collated indigenous knowledge and special measures such as community-based trap barrier systems (TBS) in crop fields. Many EBRM manuals were printed and successfully distributed to watershed user associations (WUAs). In addition, the scientific protocols and procedures that used to be followed in preparing and applying bio-rodenticide products were prepared and utilized throughout all field trials.

The organized EBRM approach in the region thus originated from the farmer's extensive indigenous knowledge of rodent management, combined with the scientific expertise of new botanical rodent control prototypes. Also, the shift from individual to collective management is an essential factor in the success of EBRM. This way, EBRM can be used to increase food security in Amhara and other regions of Ethiopia, and will be a promising possibility to be systematically implemented in other (African) countries. The following blog will dive deeper into the development of the bio-rodenticide.



Technical training on EBRM



Group discussion presentation during a workshop

DEVELOPING AND TESTING A BIOLOGICAL RODENTICIDE

By Tadesse Tilahun, Getachew Engdayehu, Bantamlak Wondmnow, and Luwieke Bosma

This is the second in a series of blog posts describing the development and implementation of ecological-based rodent management (EBRM) in Ethiopia.

In the previous blog, we read about how farmers' indigenous knowledge, together with scientific research, led to the development of the collective EBRM approach. In this blog, we will dive deeper into how the biological rodenticide was developed and tested as part of the EBRM approach.

The first bio-rodenticide field trial started in the highlands of Mogshe village, close to Gasay in Guna-Begemidir Woreda in the Amhara region. This experiment was conducted at wheat and barley crop fields, covering a four-hectare watershed that struggled with high rodent infestation and crop loss. This first field experiment aimed to assess botanical products of compositions and preparations.

To diversify the knowledge, the trial was replicated the years after on other fields in different localities and other land uses, such as grazing land (Photo 2). This allowed us to verify the results, ensure the efficiency of the various plant sources of ingredients in diverse landscapes, and find the best plant compositions. During the experiments, rodent behavior was monitored with 30 motion-triggered night cameras. In parallel to field testing, lab trials were conducted to test the botanicals in single and mixed forms. Lab trials were done to establish effectiveness, palatability, lethal dose,



Field testing of bio-rodenticide on crop field in Amhara, Ethiopia

and non-target harm. The first result showed higher effectiveness of a mixture of two botanicals as rodenticide treatment, clearly indicating a synergistic effect. From here, we continued to test a range of concentrations for selected mixtures to determine the optimal concentration. Afterward, palatability tests confirmed the attractiveness of rats with their preferred bait. With the four selected blends that scored highest on effectiveness and palatability, trials took place with chickens and guinea pigs to determine non-target harm, which proved highly successful, thus confirming that non-target species would not sicken or die if they would take in the bio-rodenticide. The final lab experiment was to determine the lethal dose, which is the dose that is lethal to 50% of the population of rats receiving the treatment. The bio-rodenticide consisting of 2 botanicals that required the lowest concentration to reach LD50 dose was singled out as the winning prototype.

The parallel trials and fieldwork were essential to widen the experience and prove the product's efficacy. Moreover, conducting these repeated field trials also helped us select the best botanicals that are environmentally sound and feasible, can

be accessed locally, are easy to prepare and apply, and are overall preferred by the farmers. After the field and lab experiments and considering all these factors, a bio-rodenticide product was developed from different plant mixtures.

To monitor the changes after bio-rodenticide application, a study with 30 farmers was conducted in two watersheds in the Guna Begemidir Woreda. Fifteen farmers at each watershed tested the product. They applied the bio-rodenticide on their field, testing impact, ease of application, and user-friendliness. In comparison, ten neighbor farmers that did not use the product were part of the research as a control sample. Results showed that the new prototype bio-rodenticide minimized rodent losses to 9%. These promising results, combined with positive farmer feedback, sparked the interest of the neighboring farmers as well. This highlights the importance of embedding this product in the collective EBRM approach. Scaling the joint EBRM approach is discussed in this series' next and final blog.



Field testing of bio-rodenticide on grazing land in Amhara, Ethiopia

COLLECTIVE IMPLEMENTATION OF ECOLOGICAL BASED RODENT MANAGEMENT AND WAYS FORWARD

By Tadesse Tilahun, Getachew Engdayehu,
Bantamlak Wondmnow, and Luwieke Bosma

This is the third in a series of blog posts describing the development and implementation of ecological-based rodent management (EBRM) in Ethiopia.

In the previous blogs in this series, we read how the EBRM approach was established based on collecting and documenting indigenous farmer knowledge on rodent control practices, as well as extensive scientific research and field testing to create a bio-rodenticide. In this blog, we will dive deeper into how combining the novel bio-rodenticide with community-based efforts resulted in a significant impact in terms of reducing rodents. Community efforts and cooperation amongst farmers are critical in rodent control as rats quickly move from one field or house to another. Therefore, an entire area needs to work together to get good results.

After many lessons were gained and best practices were documented, the Amhara Bureau of Agriculture and MetaMeta introduced the EBRM approach throughout 15 watersheds to widen EBRM activities to other neighboring watersheds. To strengthen and recognize good implementers and create a competitive spirit, champion farmers were selected, who served as ambassadors of the EBRM approach to other watersheds.

To date, EBRM practices have been implemented and adopted in more than 100 watersheds. The EBRM mobilization is



Working together as a community in the planning and implementation of EBRM

continuing and transformed into a routine and regular activity, and community-based campaigns have become common in each watershed. **The three main activities in controlling rodents are:**

- Ensuring the cleanliness of grain storage areas and household compounds and preventing rats from entering these areas.
- Controlling the environment in the agricultural fields:
 1. Improving cultivation practices such that there are fewer opportunities for rats to thrive
 2. Destroying the habitats of rats and ensuring they have no place to hide
 3. Improving the quality of soil and water conservation structures (Photo 2)
- Taking specific actions to control and kill rats:
 1. Using bio rodenticides

2. Promoting natural predators
3. Installing trap barrier systems

With these three main activities, there are three essential aspects: (1) timing (rodent management is most effective in the lean season when they are fewer), (2) collective approach (rodents can only be controlled if everybody is in; otherwise the clever animals will find a way to escape, survive, and thrive), (3) combining methods (as rodents are clever, a combination of control methods is required whereby the focus should be foremost to reduce access to food and shelter before going into direct killing).

The EBRM approach has yielded a quick and overwhelming uptake with immediate results. Farmers witnessed that grazing land improved after EBRM practices– grasses are in a better state and give better results than in previous years,

and crop fields yield more after bio-rodenticide application.

As the model for promoting EBRM practices is based on strengthening local value chains and empowering women and youth as entrepreneurs, the next step was introducing the EBRM approach, including the bio-rodenticide, to the market. To start this, business and production training was provided to 13 women groups. The women groups gained technical skills in EBRM practices and business training on running Small and M Enterprises (SMEs). The aim is to create a solid and robust service sector in which these SMEs can thrive in spreading the EBRM approach.

These success stories advocate for the broader application of elements of this program. However, as this communal and systematic EBRM approach is relatively new, some hiccups persist with respect to establishing it in the broader market. Several challenges still need to be dealt with: (1) supply of the raw materials needed to produce bio-rodenticide, (2) logistics for transportation of these materials and the final product, (3) getting the product on the list of approved trade items by FDRE ministry of trade, and (4) licensing of the SMEs that produce the bio-rodenticides.

Despite these hiccups and challenges, the high potential for the EBRM approach powered by these women SMEs remains. It fills the gap of eco-friendly solutions to tackle the major rodent issues in the country. Creating a local value chain of the bio-rodenticide and a strong service sector selling the EBRM package has considerable potential for creating jobs and increasing the local income and livelihood opportunities in Amhara. Out of the four million small-holder farmer units in the Amhara

region alone, more than 70% are interested in buying the Bio-Rodenticide and applying EBRM. In combination with the absence of similar products in the local markets, this demand indicates a unique selling point for this simple, low-cost, but compelling product and the EBRM approach in the country.

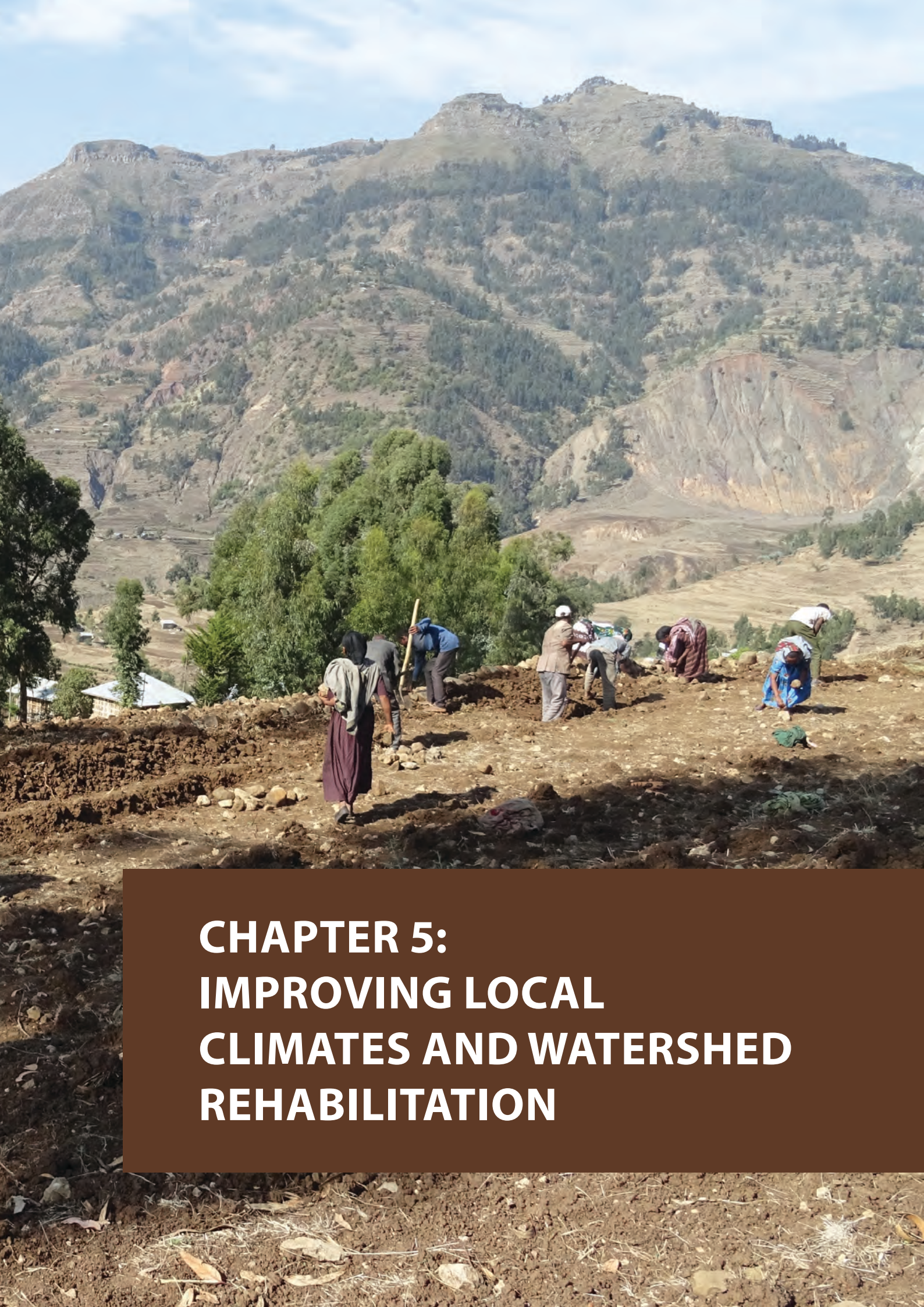


Making stone bunds unfavorable hiding places for rodents



Training small and medium enterprises on the production of bio-rodenticide





CHAPTER 5: IMPROVING LOCAL CLIMATES AND WATERSHED REHABILITATION

FROM THE MOTHER OF ALL PONDS: ROAD WATER HARVESTING IN MASALA

By Francesco Sambalino and Cecilia Borgia

West Hararghe has been for centuries at the cross road of cultures and agro ecological zones. Its specific conditions made West Hararghe and especially Masala woreda a producer of top quality coffee and khat. Nevertheless the rugged terrain poses a challenge in regards of water access. The valleys are blessed by abundance of water in the form of perennial springs and rivers. On the other hands the communities at higher locations have had to rely on water resources outside their village or to ingeniously manage the only source of water available: rainwater.

Water from roads

The closest source of perennial water is four hours away from Kufanzik community. Consequently, over a hundred years ago, the elders decided to construct a water harvesting pond to retain the water that is abundant during the rainy season. The pond location was determined by the presence of highly impermeable clay (called Faaroo in Afan Oromo) and by suitable topography. The pond is situated on a ridge and the water is sourced from the road that winds along the ridge crest through a series of gentle hilltops. In the beginning the pond was of a small size and was sufficient to provide water to the whole community and its livestock. Over the years, the pond has expanded in diameter and depth to accommodate the needs of the growing community. The pond rarely dries up.

The Water Harvesting Pond in Kufanzik

The system is characterized by five main components with distinct functions:



1. A 1.6 km long conveyance ditch that runs parallel to the road and collects water from the adjoining slopes. The ditch is on the same level of the road except when a depression needs to be bridged. In this case the canal is elevated thanks to small embankments.
2. A shallow ford connects the canal to the main reservoir, which is situated on the opposite side of the road (see Figure 2a/2b). By obstructing the canal the water is diverted through the ford into the pond (Figure 2b). Not all the runoff is collected. The first rains are usually flushed away because they bring more dirt and silt (Figure 2a). Since the pond has not a proper spillway, the ford is managed as a gate to stop the flow into the reservoir.
3. The reservoir has a round shape and a diameter of 30 m. It is used only for household uses and its access is well regulated.
4. A ring-shaped embankment around the reservoirs has been formed with excavated earth as well as with the silt that is removed during the maintenance work. The embankment is covered with grass that is kept short and tidy. The grass functions as a buffer strip that helps to clean the inflowing water of debris. Surrounding the outer perimeter of the embankment there is a thick fence made of bushes. A door (4b) with a lock is the only access point and is regulated by strict timing and rules. The key is held by the key master, which is elected by the community and leaves near the reservoir.
5. A secondary, smaller pond has been dug for livestock use.

Water access and use

Three communities for a total of around 200 households can access the pond daily. Each family

has right to two jerry cans of water per day and the water is used to satisfy all household needs. Only in case of special events such as weddings and can the users obtain an extra amount of water. Only those who routinely contribute to the maintenance of the structure have automatic access rights.

The rules that regulate access have changed in time. Nowadays, water cannot be used for livestock and there are strict access times to the pond in order to control unregulated withdrawal. The guardian of the pond guarantees access for four hours every morning. Elders and people with health issues can get special permissions.

Management and Maintenance

The management of the pond is in the hand of the community through a management team comprising of 9 members from 5 core communities. The management team takes decisions regarding operation and maintenance, and decides upon penalties and exceptions.

Maintenance during the dry season implies digging up sediments from the reservoir, strengthening the embankment and filling the gaps in the vegetative fence. During the wet season management operations go together with operations. Each runoff pulse is managed singularly and its water is either collected or flushed out according to the quality of the water and the level reached in the reservoir. The first runoff water of the season is used to clean the canals and is not collected due to its poor quality.

The embankment grass is kept short throughout the year and the cut material is sold on the market. The earnings are used to cover maintenance costs.

To ensure higher water quality four precautions are deployed. First, the first rains runoff is not collected but used to flush debris and garbage out of the canals. Second, no animals can access the perimeter of the reservoirs and people are required to take off the shoes before fetching water. Third, the grass on the embankment not only stabilizes the structure, but also helps filtering the incoming runoff water. Fourth, a flocculent is added to the reservoir twice per season to reduce the amount of particles suspended in the water.

Learning from success

The structure is referred to as the “mother of all ponds” in this area, since it was the fruit of trials and local innovation, and stimulated the construction of similar ponds in other communities along the mountain ridge. Nowadays more than 15 ponds of the same kind are in use. The traditional management system and bylaws that regulate its use are an example of good local governance. The woreda – following the same technical principles – has built a big water harvesting pond.

However, while the good physical design has held on, the good management system has been eroding over the years. The lack of an effective management team, rules and maintenance has led to overuse and mismanagement. An unrestricted number of livestock and people are now able to access the water. It is increasingly difficult to monitor water withdrawal limits, and to keep pollution under check. The absence of well-defined duties and rights has created a situation where no one feels obliged to carefully maintain and operate this otherwise skilfully designed pond.

A 'THIRD WAY' TO COMBAT CLIMATE CHANGE: MICROCLIMATES

By Femke van Woesik

As the most recent IPCC report on climate change was released last month, daunting headlines stating 'code red for humanity' covered the front pages of many newspapers. The world is on course to reach 1.5 degrees Celsius of global warming within the next two decades, and temperature extremes, including heatwaves and droughts, have and will become more frequent and intense (IPCC, 2021). When dealing with this climate crisis, much attention goes to mitigation and adaptation. Mitigation is an intervention to reduce the emissions sources or enhance the sinks of greenhouse gases. Adaptation is an adjustment that moderates the harm of climate change (IPCC, 2001), for example, using crop seeds that are better adapted to climatic extremes.

Even though both concepts are fundamental, there is a third way to deal with climate change: managing the microclimate. Local climates can be a powerful frontier in smoothening out the impact of global climate change and creating more resilient local ecosystems. Good management of local climates can reduce local temperatures by 1.5-2 degrees Celsius (Castelli et al., 2019). This way, local climate management can serve as a buffer against the predicted 1.5 degrees Celsius temperature rise in the upcoming decades. In comparison to mitigation and adaptation, local climate management is highly accessible. It can be done on the most local scale: from complete watershed restoration campaigns to replacing pavement tiles with grass in a backyard.

The idea behind local climate management is to change the energy balance of a local system. As microclimates result from this energy balance, changing the energy balances changes the local climate system. This concept starts with the idea that all energy fluxes within this system must balance, meaning that all the incoming energy from the sun must go somewhere within this



Example of landscape restoration and water harvesting measures. Credits: Giulio Castelli

system. Here, there are two options: solar energy contributes to evapotranspiration or heating the air and the soil. The first route is called the latent heat flux, and the second is the sensible heat flux. How solar energy is diverted into these two energy fluxes is highly dependent on landscape characteristics.

For example, in a desert landscape with very little vegetation and low soil moisture levels, only a little evapotranspiration (latent heat flux) is possible, meaning that most of the energy is used to heat the soil and the air (sensible heat flux). On the other hand, in a vegetated area with a high soil moisture level, evapotranspiration is possible. Solar radiation energy is then used for this process of evapotranspiration. Consequently, less energy will be available for heating the air and the soil, resulting in a cooler local climate. Thus, the more solar energy goes into the latent heat fluxes, the less energy is available for the sensible heat fluxes. Since the sensible heat fluxes increase soil and air temperatures, more significant latent heat fluxes will have local cooling effects. The goal of local climate management is thus to increase the latent heat flux and lower the sensible heat flux. An extensive array of measures can be

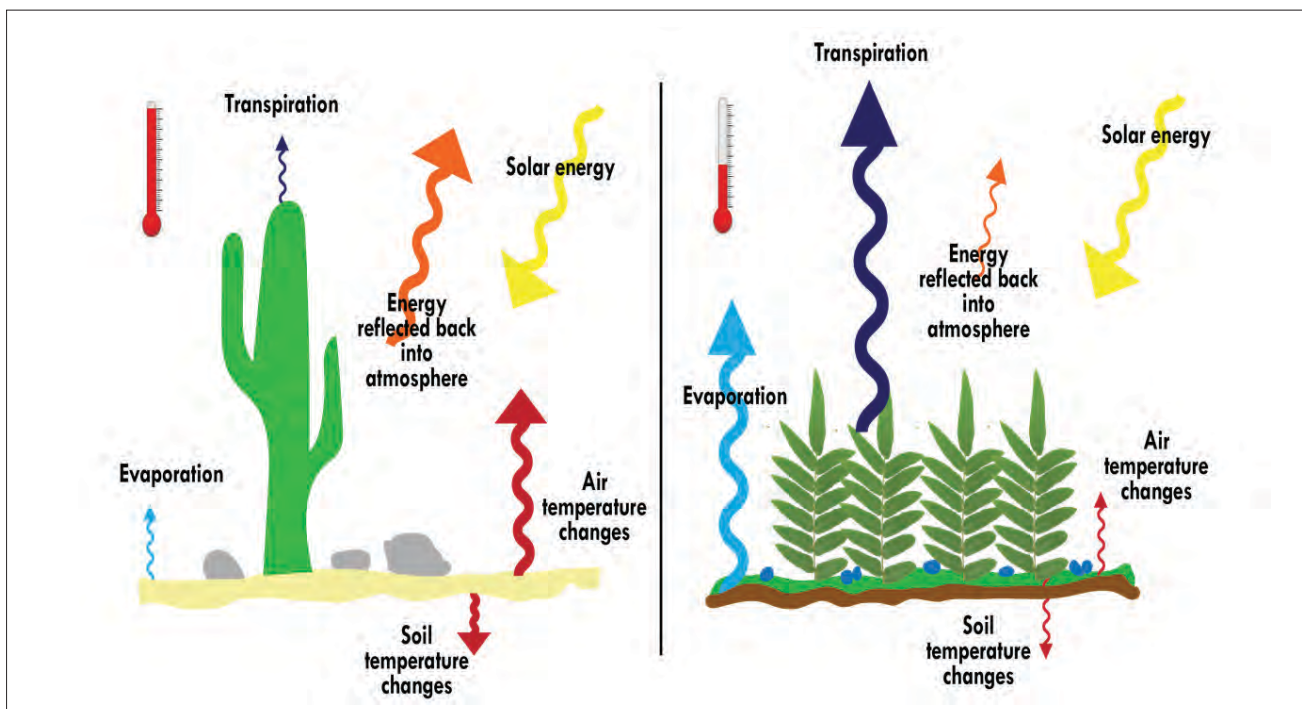
implemented to contribute to this shift in energy balance and create more conducive microclimatic conditions. Some examples are wind management, shading, mulching practices, water harvesting and greening. All techniques aim to preserve soil moisture and to buffer the water balance of a system. Water harvesting can be done with, for example, stone bunds, trenches, check dams, eyebrow terraces, and many more. Increased soil moisture will enhance evapotranspiration, resulting in less energy available for sensible heat fluxes. This will thus provide a local cooling effect. Research in Ethiopia showed that water harvesting measures reduced land surface temperature up to 1.74 degrees Celsius (Castelli et al., 2018).

As plants transpire, greening also results in an uptake of latent heat fluxes. Since vegetation improves water infiltration, reduces runoff, and increases precipitation, vegetation will also increase the local water buffer. This way, increasing vegetation cover on a watershed level can improve the local climate and replace hot and dry air with moist and cooler air (Mekonen & Tesfahunegn, 2011).

Regreening practices in Tanzania showed that increased tree canopy cover reduced local land surface temperatures and a more moderate microclimate (Villani et al., 2020).

This perspective of modifying the local energy balance by increasing soil moisture levels and vegetation shows how the local climate can be managed. This concept of microclimate management highlights the possibility for humans to directly alter their immediate environment and create a buffer against global climate change. By doing so, this perspective presents a promising

third way in combatting climate change next to mitigation and adaptation. Unfortunately, microclimates are often overlooked as predicting larger climate change trends, long-term regional rainfall patterns, and temperature averages are the norm. This lack of consideration makes local climate effects often an unintended by-product of landscape changes. However, when implementing the proper practice in a suitable space and time, microclimates can be enhanced. With more climate disruptions inherent, there is an urgent need for unleashing this hidden potential of microclimate management as a proactive approach in improving local landscapes and increasing resilience.



Visual representation of diversion of energy fluxes for two different landscapes: desert (left) and highly vegetated area (right). Credits: Wim Bastiaanssen

BUILDING A TOOL FOR MICROCLIMATE MANAGEMENT

By Femke van Woesik

Climate change threats and fragile ecosystems are threatening agricultural production and resulting in lower agricultural capacity. This highlights the importance of building climate resilience and improving conditions for better agricultural yield. Increasing climate resilience at a farm level can be done by microclimate management. As was highlighted in the previous blog, the management of microclimates is a powerful but not well understood frontier in smoothening out the impact of climate change and creating more resilient agricultural ecosystems. This blog will pick up the baton and explore how microclimate management can be made practical in the form of an assessment tool.

Microclimates are the local interplays between several factors: solar radiation, soil moisture, soil temperature, air temperature, air humidity, and wind direction and speed. These microclimatic interplays occur on a small scale with a horizontal range between centimetres and a hundred meters and a vertical range between centimetres and ten meters from the ground; or determined by the canopy boundary layer (Yoshino, 1987). Microclimates are thus the conditions in which crops grow, making them an essential factor in agriculture. Due to the high local variability in different soil types, surface slope and orientation, and vegetation cover, this microclimatic scale is highly variable. This high variability differentiates the microclimate from the macroclimate just a few meters above, where atmospheric mixing processes are more active, leading to more moderate and stable conditions (Unwin & Corbet, 1991). On this higher level, climatic conditions are more challenging to control, and there is only a slight chance for humans to modify this climate (Gliessman, 2015). However, unlike this macroclimate, microclimates can be managed. Focusing on a microclimatic scale

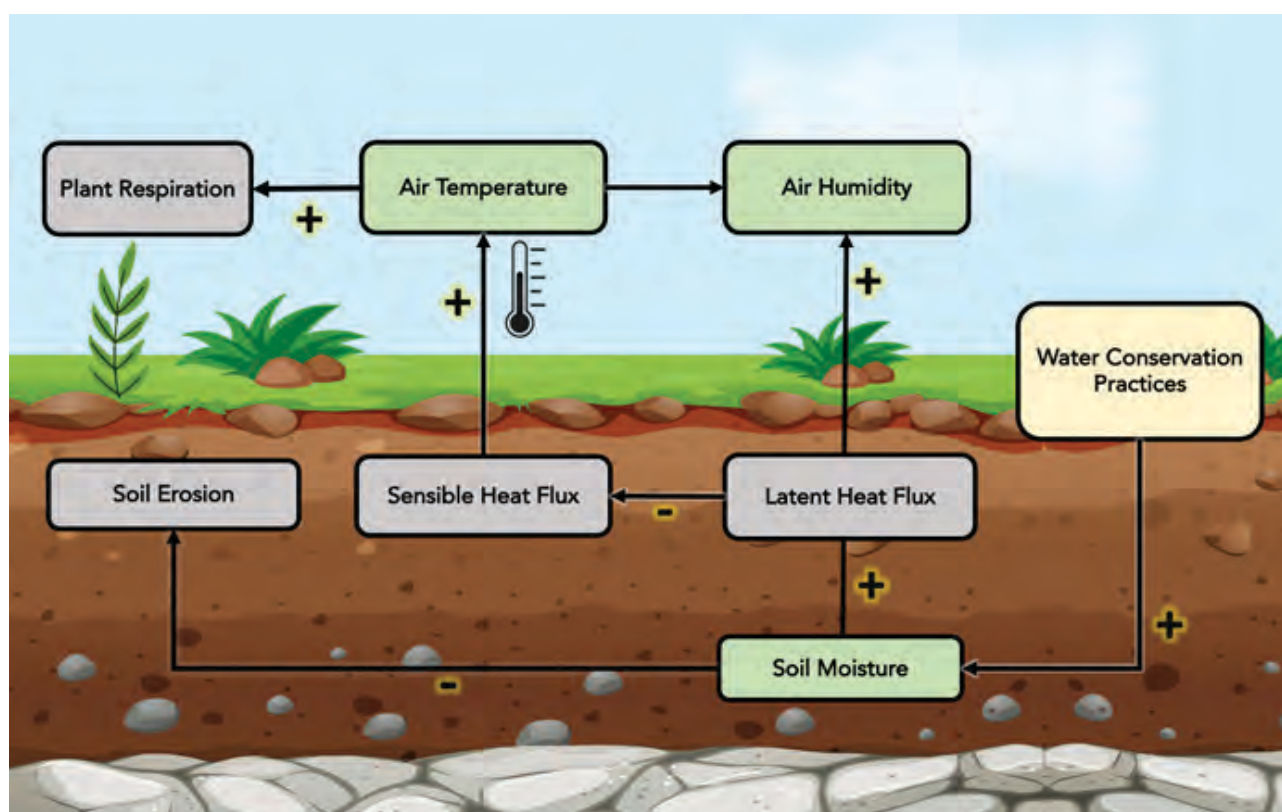


of a small plot or a single planting mound brings the climate back to more manageable levels. This can be done by making changes in a landscape. Certain land and water management interventions on a site affect the microclimate and, if done right, can improve it. As the microclimate is the scale on which plants grow, modifying the microclimate can improve the plant growth conditions (Hadid & Toknok, 2020). Improving the microclimate on a farm level can increase crop production and land productivity by enhancing the agricultural ecosystem resilience.

Water conservation practices, such as trenches and ridge-furrow planting, are examples of interventions on a site that can improve the microclimate. By increasing the soil moisture, the evaporation from a site is enhanced. This enhanced evaporation means that more energy will be used in the latent heat fluxes and less in the sensible heat fluxes. Since the sensible heat fluxes

contribute to the air temperature, less sensible heat flux will contribute to lower air temperatures (Gardner et al., 1999). The uptake of latent heat due to the available soil moisture provides an additional daytime cooling effect on a site (Ismangil et al., 2016).

Increased soil moisture also balances the soil temperature extremes by increasing thermal conductivity, promoting heat diffusion in the soil. This lowers the extremes in both daytime heating and nocturnal cooling, protecting the crop root system against sharp and sudden soil temperature changes (Rosenberg et al., 1983). This moderation of soil and air temperatures extremes thus increase a farm's resilience in the light of climate change. Ridges made on a field also impact the amount of solar radiation received by the surface since the site's slope affects the absorbed radiation intensity. By manipulating the geometry of receiving surfaces, better use of available short-wave radiation can

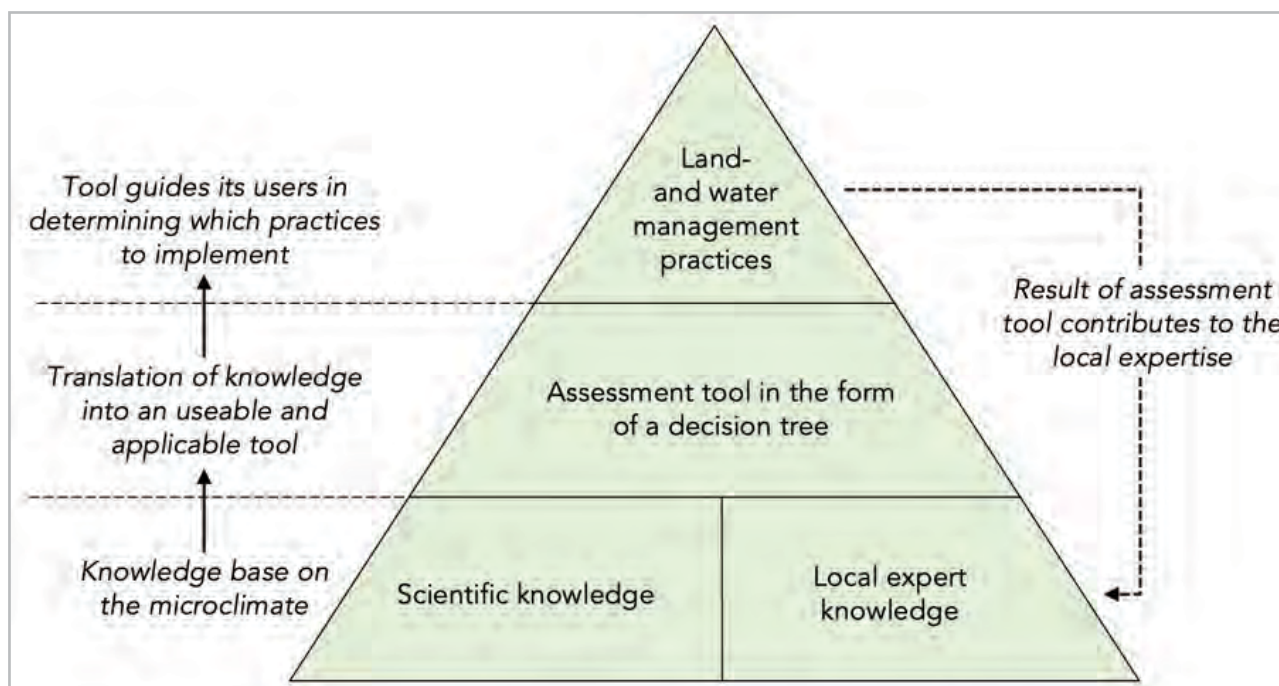


be accomplished. Next, the furrows provide a radiative ‘trap’ for solar radiation and outgoing long-wave radiation. Finally, by enhancing surface water storage, trenches increase the number of water surfaces on a site (Oke, 1995). Since water surfaces are poor reflectors, this serves as an effective sink for solar energy as well. Many water-filled trenches on a site thus absorb the solar energy during the day and radiate this back by night, buffering the air temperatures (Stoutjesdijk & Barkman, 1992). There are many land- and water management intervention options through which humans can modify the microclimate. Other examples are windbreaks, applying mulching material, altering row orientation and spacing, stone bunds, and vegetation regeneration.

Determining which intervention is best suitable for a farm depends on that particular site. This highlights the need for an assessment tool that

reflects local nuances and provides guidance for each specific situation. Such a tool can be built by translating the workings of the microclimatic system into a set of questions and decisions that guides its user to the best suitable intervention to improve its specific microclimatic issues, such as too little soil moisture or too high air temperatures, on the site. This decision tree should be supplemented with landscape characteristics requirements to make the advice suitable for the particular site. Some interventions will not be possible on a farm with a very steep slope or without any access to stones, for example. Notably, a tool should be built upon both a scientific knowledge base and field-level expertise.

This way, local expertise is recognized, and local nuances are taken into account by tailoring microclimate management to the local context.



Such a tool will also contain a learning feature by contributing the results back to the local experts. The more an assessment tool is tailored to a specific situation, the better its workings and the more likely it will be used by potential end-users (Rose et al., 2016). This makes a microclimate management assessment tool an

essential component in smoothing out the impacts of climate change, enhancing farm resilience, and stabilizing agricultural ecosystems. With more climate disruptions inherent and at the same time the urgency to increase farm production, there is an urgent need for further development of such tools.

“ This makes a microclimate management assessment tool an essential component in smoothing out the impacts of climate change, enhancing farm resilience, and stabilizing agricultural ecosystems. ”

LANDSCAPE MANAGEMENT PLUS: IMPROVING THE LOCAL CLIMATE OF THE ETHIOPIAN GUBALAFTO WATERSHEDS

By Bantamlak Wondmnow, Jean Marc Pace,
Getachew Engdayehu, Dr. Dessie Assefa,
Frank van Steenberg & Femke van Woesik

Landscape restoration activities are well-known in the Amhara region of the central Ethiopian highlands. Here, yearly watershed rehabilitation and water harvesting campaigns are carried out through the government's mass mobilization of the local communities. Especially since 2011, the region has been implementing integrated watershed management activities through an organized public campaign in which more than 4 million people participate annually. People contribute their labour and inputs for at least 30 working days a year during the campaign. Many farmers and experts are witnessing convincing results regarding soil erosion control, hillsides plantation expansion, gully rehabilitation, and increased forage availability. Now, these activities got a new dimension: local climate management.

Local climate management is all about making alterations in a landscape or on a farm plot to improve the climate of that plot by considering all microclimatic factors such as solar radiation, wind direction and speed, soil temperature, soil moisture, air temperature, and air humidity. There are many examples of how deforestation or road construction led to increased gully formation, temperature increase and ecosystem disturbances, not to mention increased dust in the air! Luckily, there are also several positive examples of how watershed rehabilitation and soil water conservation harvesting campaigns have increased soil moisture levels and buffered temperatures.

As part of the GFF program, a group of experts working in the Kebele's (sub-districts) and Woreda's (districts) of these watersheds and senior experts at zone level participated in a deep brainstorm on local climate management.



Brainstorm session in Bahir Dar with experts from GubaLafto Kebele's and Woreda's

This group is highly diverse, with expertise in, for example, plant science, soil fertility, and forestry. This deep brainstorming led to additional insights into the workings of the microclimate and how this can be improved. This microclimate knowledge and understanding can serve as a bridging factor between all these disciplines and enhance the integration of multiple practices. When implemented together, this synergistically increases effectiveness and adds an extra dimension and layer to landscape management. The result is a layered landscape approach or landscape management plus.

For example, using mulch and adopting different tillage practices might be more effective if windbreaks are placed on a farm to slow down a strong wind that increases wasteful evaporation rates. Or using several water conservation and shading practices when planting trees can significantly improve their growth rate. It is essential to look at the microclimate as a system,

see where it needs improvement and act upon that strategically. Together all these practices are thus stronger than one. Looking at farms as little microclimate systems will reveal these links and connections. Through this additional lens, farms are seen as little patches in a patchwork quilt whereby each farm's microclimate can be improved, together improving the local climate of the watershed. This extra layer of awareness of how alterations in a landscape change the local climate serves as an extra aim to do certain practices beyond mere farming and crop production.

This local climate management approach also goes beyond farming. It can be applied at the landscape level through, for example, the construction of water ponds, forest restoration, or larger water retention structures. This way, landscape management plus leads to systematical improvement of local climates at a landscape level, consequently improving the microclimate of farms.

Local climate management is thus a powerful tool that improves crop production, improves soil biota and microorganisms, thrives fungi networks, creates better living conditions, and improves buffering capacity against climate change. This way, local climate management can serve as a third way to deal with climate change, next to adaptation and mitigation – putting more control in the hands of farmers and local communities to improve their situation.

To increase awareness and incorporate local climate thinking more strongly into the way watersheds are managed, the Amhara Bureau of Agriculture will closely monitor ten farms in the GubaLafto watersheds by systematically collecting

field observations/measurements, face validations and later with remote sensing to see how the microclimate of that farm is changing because of implemented pro-active local climate-oriented practices. This is valuable information that can be used as a road map for the future to steer practices and guide farmers to improve the farm microclimates and, eventually, the local climate of the watershed even more.



Left side: construction of terraces on a hillside. Right side: Same hillside one year later

MULTIPURPOSE PLANTATION - MAKING PRODUCTIVE USE OF WATERSHED REHABILITATION IN AMHARA

By Bantamlak Wondmnow

In Amhara, yearly successful watershed rehabilitation campaigns are carried out through the government's mass mobilization of local communities. Tree plantation and stabilizing physical soil and water conservation structures with grasses and shrubs species result in less soil erosion, less gully formation, and increased forage availability. Moreover, planting different species makes the watersheds more productive. Not only because of better microclimates, healthier soils, and improved soil moisture levels but also because of other benefits the planted species bring, such as fruit, forage, and timber production. This blog discusses different types of seedlings and their multipurpose use.

Seedlings to regenerate watersheds are usually needed on degraded hillsides with poor soil conditions, forest areas without natural regeneration, and farmlands (on bunds or for agroforestry or amenity planting). The source of seedlings are (1) nurseries of mainly two ownerships which are individual farmer-owned (tiny production <10K) for private planting and sale; and (2) public nurseries (on average 1 to 4 kebeles regionally with a capacity to produce $\pm 0.5M$) supported by mainly projects/programs and government regular budget where seedlings are provided for watershed development for free.

Choosing which species is the most critical and difficult decision to make. Nowadays, the choice depends primarily on three questions, which are asked in the following order: What do the owners/beneficiaries want from the plantation? What species are available that will produce what the people want? Will these species grow on the sites in general? Bearing all these in



Gesho, Pigeon pea, Elephant grass and Sesbania sesban (Left to right)

mind, planting seedlings can be grouped for the following primary purposes: (1) Stabilizing physical structures on farmlands, gullies, and others. (2) Trees on farmland and homestead plantation (agroforestry), and (3) Plantation (artificial forest) on communal hillsides, private woodlots and others. The table presented at the end of this blog gives an overview of all species used for each plantation's purpose and their main benefits.

Purpose 1 - Stabilization of physical structures on farm lands, gullies, others

Stabilization refers to planting grass, shrub and tree species in different combinations on the physical structures such as soil bunds, trenches, check dams, etc., to increase their stability and resistance against rain drops, splash effect, runoff and other inferences. Hence, planting suitable species on the structures stabilizes them with their root system and the biomass and/or canopy above the ground protects them from erosive raindrops. And more importantly, the stabilization of the structures makes the surface area occupied by the structures

productive. Stabilized areas are an additional source of timber, fuel wood, fiber, food and forage, palatable grasses and legumes, fruits and other products. Trees or shrubs help to demarcate farm and homestead boundaries, thus providing users with an additional sense of ownership. Achieving proper and productive stabilization will encourage farmers to protect conserved areas and appreciate its effects.

The most common species for planting in the areas are *Rhamnus prinoides* (Gesho), Desho grass, Pigeon pea, *Sesbania sesban* and Elephant grass. They are selected by considering characteristics to accrue multiple benefits: the ability to fix nitrogen & soil fertility improvement, palatability & biomass production, fast-growing and & extensive root system, cash crop and good regrowth after coppicing and browsing. Here tree/shrub/grass species are planted at close spacing apart on single or staggered double rows (on the berm or at the lower side of the embankment).

Purpose 2 - Agroforestry: Trees on farmland and homestead plantation

Traditional agroforestry practices in the form of dispersed trees in croplands have widely been observed in most parts of the Amhara region, including GubaLafto. Trees are grown on farmer's fields (may be spread widely, sometimes spaced systematically in a grid or scattered at random), while crops are grown in the understory.

The practice is mainly based on the protection and management of selected matured trees already on site, the careful management of seedlings established on-site through natural regeneration, and the planting of new tree/fruit seedlings. These indigenous (majority) multipurpose tree species are consciously and deliberately retained and taken care of by the farmers due to their many benefits. Trees on farmland and homestead provide subsistence value such as food, fuel, building poles, or fodder. Trees also provide a service: they improve soil fertility, conserve soil moisture or improve the microclimate, resulting in increased crop yields.

Several species have been practiced in cropland: the most common species conserved in the farmers' land are *Acacia seyal* (Wachu), *Acacia polyacantha* (Gmarda), *Croton macrostachyus*, and *Cordia Africana*. In almost all situations where trees are grown dispersed in cropland, the main conservation goal is to provide more organic matter and/or nitrogen to the soil and to improve the microclimate for crops. Planting around homesteads also consists of mixtures

of vegetables, fruits, medicinal plants and often fodder grasses, shrubs or trees in small, intensively cultivated plots in and around home compounds. Mango and papaya are common fruit species in the areas which are being introduced. Farmers select trees/shrubs on farmlands based on their characteristics of Adaptability of the species for the specific environment; Ability to withstand adverse conditions; Palatability of the desired package; Tree growth rate and growth habits, especially on its branching and root system; and capability to withstand management practices (pruning, lopping etc.) and ability to nutrient cycling.

Purpose 3 - Plantation (artificial forest) on communal hillsides, private woodlots and others

Plantations aim to produce firewood, charcoal, and wood for building poles and to attain protection/conservation. The most commonly used are *Eucalyptus* (*Eucalyptus globules* in Keyamba and *Eucalyptus camaldulensis* in Jarsa), *Grevillea robusta* and *Juniperus procera* (Tid). The main criteria for selecting these are their relatively short rotation period, market availability on the demand side and reasonably heavy, durable wood and a straight stem (especially for the first two species).

Despite some objections that exotic species are susceptible to increased disease and climate change risks, they have been used exclusively in plantings in the area. This may be because there is much experience and information, especially on *Eucalyptus*. They are planted on (1) degraded hillsides where soil conditions are usually poor, and soil erosion is rampant; (2) forest areas where the plantation is to be established either due to the absence of natural regeneration or replacement of existing crop and (3) woodlots

lands where this plantation is primarily established by villagers themselves in relatively small units usually close to villages as possible to minimize the transport distance.

Planting different species for different purposes thus makes the watersheds more productive.

The following table overviews different types of seedlings and their multipurpose benefit.

Tree/shrub/grass species by plantation purpose	Management	Uses	Description/Adaptation
Stabilization of physical structures/bunds on farm lands, gullies, others			
Cajanus cajan (Pigeon pea)	Establishment- direct sowing at 3 cm depth or transplant seedling in hedge rows at 1m spacing between plants and 2m spacing between rows. Fast growing. Regular weeding. May be grown as a pure stand or with other crops. Harvesting – cut at 0.8 m after grain harvest.	Fodder (leaves), fire-wood, food (seed and pods), bee forage, mulch, nitrogen fixation, soil improvement, soil conservation, wind-break	Is adapted to arid and semi- arid environments, it favors warm climate, it is drought – resistant; it can grow at 500-800mm annual rainfall.
Pennisetum purpureum (Elephant grass)	Establishment-stem cuttings of 2 to 3 nodes planted at 50 cm spacing. Harvesting– cut at 5cm 3 times per year, or every 3 months if good growth. The best use is in a cut-and-carry system, although it can also be made into silage of high quality without additives. For grazing, it is best when the new growth consists of 5 new leaves.	As fodder provides adequate energy and moderate level protein. Recognized for their effectiveness in maintaining ground cover and preventing erosion through soil stabilization. The species has good potential to enhance soil stability and as a windbreak.	Best-adapted to high-rainfall areas, particularly to establish it. Altitude range: from sea level up to 2000m. Resists drought if successfully established. Susceptible to frost.
Desho grass	Plant at 10 cm by 10 cm intervals along bunds for SWC and 50 cm by 50 cm for grazing land management. Needs continuous weeding and gap filling. Cut and carry system is encouraged to maximize the potential of the species. Harvested at 8 cm high from ground level.	A highly palatable, nutritious and fast growing grass characterized by high leaf/stem ratio. Improve grazing land management, even in degraded soils with low fertility. Stabilize the physical soil and water conservation structures.	Indigenous grass of Ethiopia. Perennial grass with an extensive root system that makes it a good candidate to stabilize soils. Can grow anywhere from 1500–2800 masl on medium to low soil fertility
Sesbania sesban (Sesbania)	Establishment: seedlings in hedge rows at 1 to 2m apart with plants spaced 25 to 50cm apart within rows or by direct sowing. Harvesting – coppice at 50 to 75 cm height 3 to 8 times per year depending on growth.	Provide green forage rich in protein, minerals and vitamins during the dry season or in times of drought. Improve soil fertility. Used for fence, wind break, backyard forage, alley farming etc.	Has a wide range of adaptation, 200 - 2400 m. and it grows mainly under moisture -stress free conditions. It is a perennial legume which grows tall.

Rhamnus prinoides (Gesho)	Need to improve the infiltration of the soil. It does not like wet and swampy areas. Adding sand to clay soil will help. Harvest before the branches are coarse (diameter > 1 cm)	Flavoring/beverage (leaves), medicine (roots), Firewood	An evergreen shrub or small tree to 7 m, which may climb over other bushes. It has slender stems and drooping branches.
Agroforestry: Trees on farmland and Homestead plantation			
Acacia seyal (Wachu)	Can be propagated by seedlings, wildings. Medium to fast growing; lopping, pollarding, coppicing	Firewood, charcoal, poles, posts, medicine (bark, gum), fodder (leaves), bee forage, shade, nitrogen fixation, soil conservation, windbreak, gum,	A small to medium sized tree, up to 9 m, rather thin with layered branches or smaller and more rounded. Grows at 500–2,100 m
Acacia polyacantha (Gmarda)	Fast growing on good sites; pollarding, coppicing. Can be propagated by seedlings, wildings and direct sowing at site.	Firewood, charcoal, timber, posts, farm tools, medicine (leaves, roots), fodder (leaves, pods), ornamental, nitrogen fixation, soil improvement, live fence.	A tree to 25 m with feathery foliage but an open canopy often with a flattened but spreading crown. Grows at 500–1,600 m. May indicate fertile soil and groundwater but can also grow in stony soil
Croton macrostachyus (Bisana)	Propagation: Seedlings, wildings. Fairly fast growing on good sites, slow on drier sites. Lopping, pollarding, coppicing.	Firewood, charcoal, timber, poles, tool handles, medicine (sap, leaves, roots, bark), fodder (young leaves), bee forage, mulch, soil conservation	A deciduous tree, crown rounded, light and open with slender trunk and spreading branches, reaching 25 m. Grows 1,100–2,500 m
Cordia Africana (Wanza)	Propagation: wildings, seedlings. Easy to raise and reasonably fast growing. Pollarding, lopping, coppicing.	Firewood, timber (furniture, beehives, boxes), food (fruit), medicine (juice from bark, roots), fodder (leaves), bee forage, shade, ornamental, mulch, soil conservation.	A much-branched deciduous tree with rounded crown and often crooked trunk, to 25 m, from a short bole. It grows well in Dry, Moist and Wet Weyna Dega ACZ; 900–2,500 m.
Plantation (artificial forest) on communal hillsides and private woodlots (roadside and boundary plantation)			
Eucalyptus globules (Nech Bahirzaf)	Propagation by seedlings, direct sowing at site is possible but requires careful management in the early stages. Harvesting management coppicing.	Firewood, charcoal, timber (heavy and light construction), poles (power lines), posts, veneer, plywood, medicine, bee forage, windbreak, essential oil (young leaves)	A tall tree to 55 m, rather narrow, the crown rounded and open, the main stems straight. BARK: Blue-gray, smooth, rough at base. Grows in 1,700– 2,800 m.

Eucalyptus camaldulensis (Key Bahirzaf)	Propagated by seedlings (sow in seedbed and prick out in pots). Requires careful management in the early stages. Coppicing, pollarding.	Firewood, charcoal, timber (construction), poles (power lines), posts, bee forage, ornamental, windbreak.	A tall evergreen tree to 30m, deeply branched but also with a long straight-bole. Grows in 1,200–2,800 m.
Grevillea robusta (Gravillea)	Moderate to fast growing. Pollarding, lopping, coppicing and pruning. Only young trees coppice well	Firewood, charcoal, timber (furniture), poles, fodder (leaves), bee forage, shade, ornamental, soil conservation, and windbreak.	A semi-deciduous tree to 20 m or more with a straight trunk and angular branches. An oval leafy crown. It does well in Dry, Moist and Wet Weyna Dega and Dega ACZ, 1,500–2,700 m.
Juniperus procera (Tid)	Fairly slow growing. Prune and thin trees for timber and poles. The tree takes at least decades to grow to maturity.	Firewood, timber (floors, roof shingles, pencils, joinery), poles, posts, medicine (bark, leaves, twigs, buds), shade, ornamental, windbreak	An evergreen tree about 40 m with a straight trunk, although often fluted. A pyramidal shape when young. The foliage is finer and more open than cypress. It performs well in Moist and Wet Weyna Dega and Dega ACZs.

SUSTAINABLE LANDSCAPE REHABILITATION: THE ESTABLISHMENT OF WATERSHED USER'S COOPERATIVES

By Bantamlak Wondmnow & Femke van
Woesik

To date, watershed development activities are undertaken through investments of large amounts of human and financial resources. To ensure that the watershed development activities are sustainable long-term, a devising mechanism is required whereby watershed users have the responsibility to manage, utilize, and protect natural resources with a sense of ownership. This is why local Watershed User's Cooperatives are created within GFF program areas. The institutionalization of local ownership aims to ensure the sustainability and future scaling of the activities. These Watershed User's Cooperatives should also be supported in reaping the benefits of the regenerated land. They should get the right and mandate to properly manage their productive lands after rehabilitation. Institutionalization is thus essential, as registered cooperatives are needed as legal entities to generate income and manage the watershed themselves.

Institutionalization of Watershed User's Cooperatives includes the following steps, based on the aspirations mentioned earlier;

1. All community members that live or farm in community watersheds covering 500 Hectares should be registered as legal members of the cooperative.
2. Preparation of a long-term watershed development plan based on the principle of participatory integrated watershed development planning.
3. A community watershed development bylaw indicates the roles and responsibilities of the periodic contributions of each member.
4. Installation of benefit-sharing packages and

revolving fund management ratified by at least a two-thirds majority vote.

5. Forming different committees and constructing offices within the watershed for a solid organizational structure.

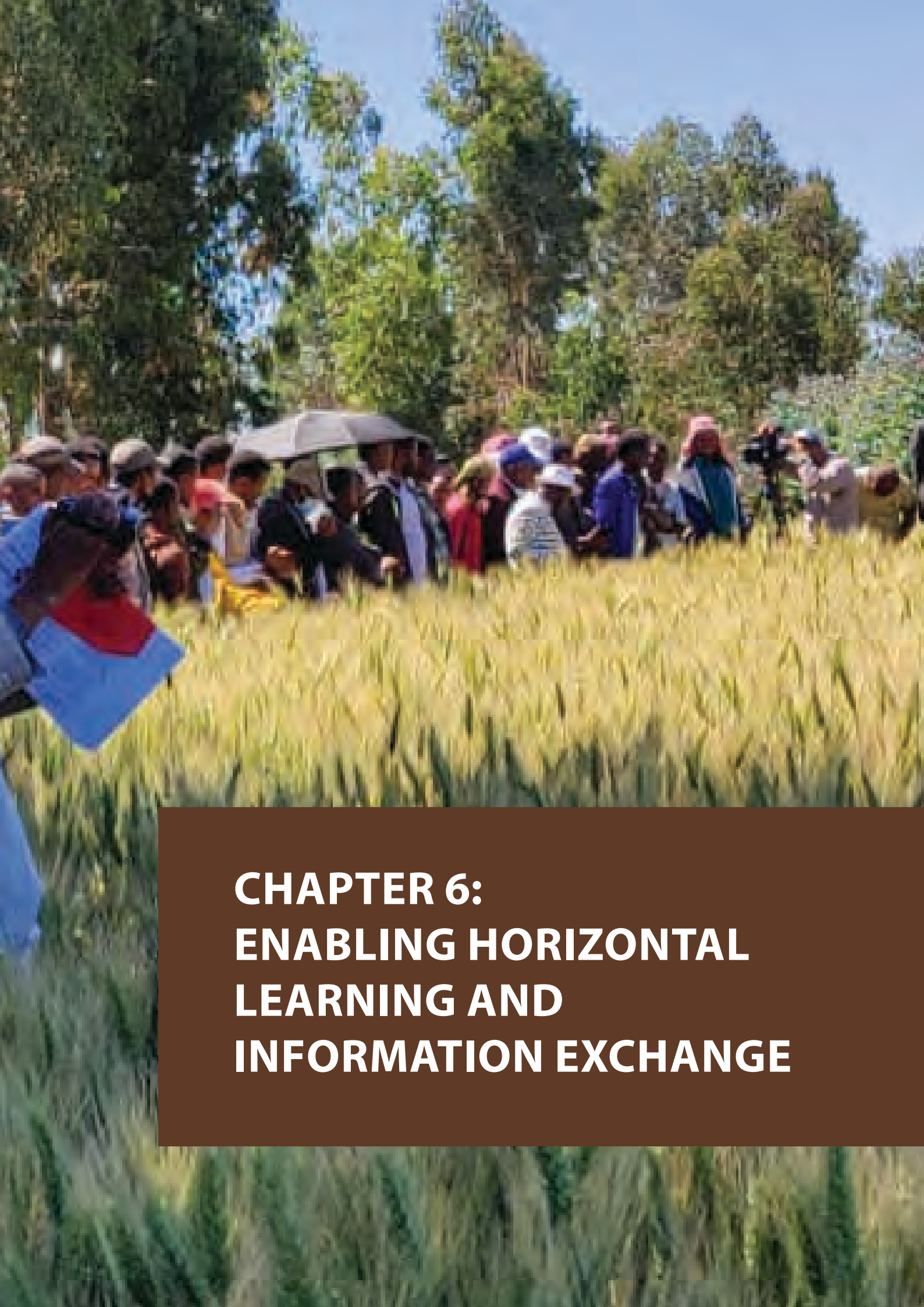


A Watershed User's Cooperative Management Committee in their office discussing watershed management in North Wollo where members are from segments of the community (Women, Youth, Religious leaders, Lead farmers etc)

of watersheds. It results from a need for more sufficient attention to the governance, socio-economic conditions of areas and consent of the local people. Among others, this proclamation aims to establish a system that enables the community watershed users to protect, develop, administer and use natural resources with a sense of ownership to increase the community watershed users' capacity.

The establishment of Watershed User's Cooperatives falls in line with the enacted Proclamation No.1223/2020: Development, Management and Utilization of Community Watersheds by the government of Ethiopia. The reason for this proclamation was free grazing. Free grazing remains the major obstacle to successfully establishing vegetative measures and stabilizing the physical structures for the productive use



A large group of people, mostly men, are gathered in a field of tall, golden-brown grass. They are wearing various types of hats, including pith helmets and wide-brimmed hats, suggesting a sunny day. Some people are standing, while others are sitting or kneeling. In the background, there are tall, thin trees and a clear blue sky. The overall scene appears to be a field visit or a community meeting in a rural area.

CHAPTER 6: ENABLING HORIZONTAL LEARNING AND INFORMATION EXCHANGE

SCALING THROUGH HORIZONTAL LEARNING: LIQUID BIOFERTILIZER TAKE UP IN OROMIA

By Guta Eshetu

Horizontal learning is peer-to-peer learning. It is how farmers learn, share new information and good practices with each other. Horizontal learning can be boosted by organizing activities such as expositions, and exchange visits. These are commonly used to bring together different groups for field learning.

This strategy was also used to share and spread knowledge on liquid biofertilizer in the Arsi Zone of the Oromia region. In this zone, the regional office of agriculture is promoting the use of liquid biofertilizers across 25 woredas. Horizontal learning field days were prepared at Digelu-Tijo woreda with more than 300 participants per field day, from 156 Woredas across the Oromia region. The participants visited farms that made use of liquid biofertilizers: Farms with Teff production using only liquid biofertilizer, and farms with wheat production that used biofertilizer in combination with synthetic fertilizer. The farmers of these farms shared that using the liquid biofertilizer boosted their production with around 50% on the poorly fertile soils.

These field days are of high importance to promote the liquid biofertilizer to other communities outside the program areas. It also provides the farmers with the right knowledge and inspiration to adopt this technology on their own. Moreover, the persons participating during the field days can also share this technology with others; resulting in a snowball effect of information spreading. This enables further scaling of the liquid biofertilizer and thus a broader transition towards regenerative agriculture.

This horizontal learning process can be boosted further when farmers are trained, encouraged, and incentivized to capture and share good practices using smartphone videos. This can be achieved using a combination of training, competitions,

screenings, and social media. Several testimonials of farmers using the liquid biofertilizer are recorded and can be found on the GFF YouTube channel: https://youtu.be/y4y_PrMQat0.



Different experts, researchers, and development agents participating on the field day in Arsi (02/11/2022)



Vegetable farm using the liquid biofertilizer visit at Digelu and Tijo Woreda

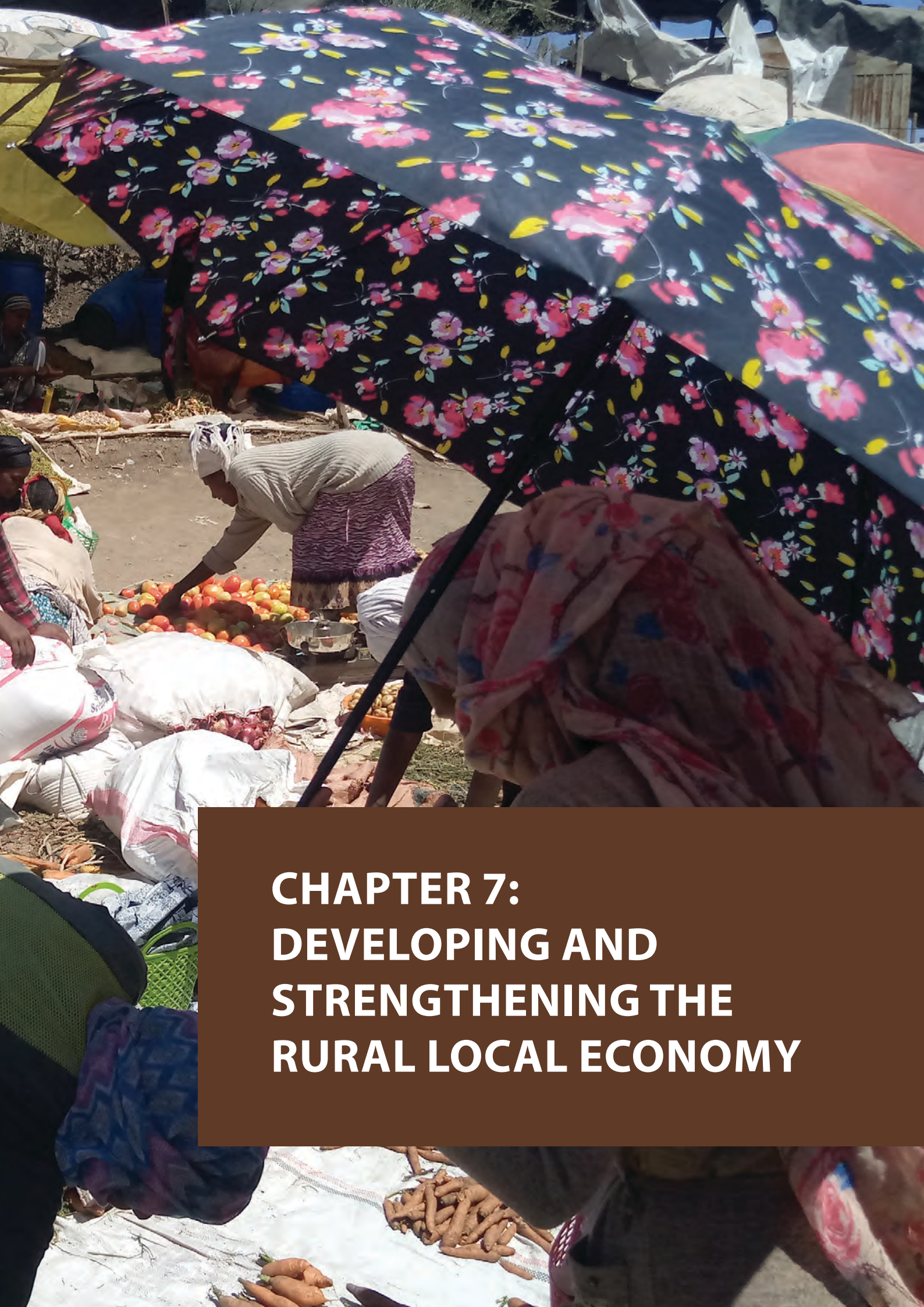


Sudie Field day participants visiting wheat farms that used liquid biofertilizer combined with synthetic fertilizer



Teff produced with liquid biofertilizer at Halila Nagelle Kebele (Sudie)





CHAPTER 7: DEVELOPING AND STRENGTHENING THE RURAL LOCAL ECONOMY

THE ENORMOUS PARADOX OF LOCAL CIRCULAR GROWTH

By Frank van Steenbergen

First, a story with a traveler. One evening a traveller arrives in a small town. His plan is to reach his family in the capital city, but it is late and he does not like travelling at night. He knocks the door of a small village hotel and asks the owner if there is still a bed for the night. There is, the owner says, but "because you will leave early morning would you mind paying in advance?", he asks. And so it so happens. The traveler pays USD 30 and retreats to his room.

As soon as the hotel owner has the money, he goes to the local beer brewer who supplied to his hotel. I still owe you USD 30, the hotel owner tells the brewer. Now I come to pay you.

With the payment from the guest, the local beer brewer runs to the barrel maker. You made this new barrel for me and I did not pay you yet, but here is your payment.

The next step is for the barrel maker to go to the dress maker. "Remember you made the dresses for my daughter's wedding and I could not pay you?" says the barrel maker. "Here is USD 30," the barrel maker says. "Please accept it as a first payment."

Thanks, say the dressmaker, who goes to the hotel owner. "I have been drinking here for many nights and I owe you this USD 30. Please accept."

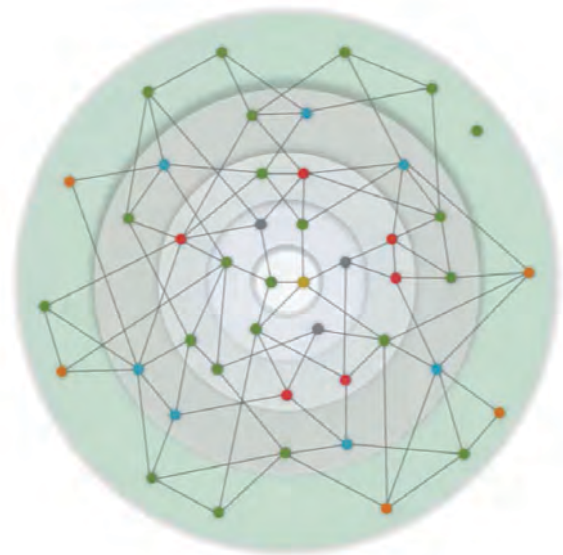
At that time the traveler comes down stairs. "I have changed my mind," he tells the hotel owner. "I think it is better if I proceed to my family and travel tonight." "I understand," says the hotel owner. "Would you mind giving me the advance back?" asks the traveler. "Of course," says the hotel owner.

So this what money is all about: a medium that goes around and that help us to connect and exchange our services and good. The more the variety of good and services that we offer the



Image: Old Road Side Inn by Edward Charles Williams 1807-1881

longer the chain in which money moves around. If no one brews beer, we will not spend money on it, nor are their brewers who may purchase money. If there is no barrel maker, then nobody will produce the useful barrels and no one will spend the money that is earned with making barrels. And the economy will not roll. Same with the dress maker: if there is no one to make wedding dresses, weddings would be less fun, but also no one would be able to spend the money that was earned with making the dresses. And so and so forth. This why diversity is important, why it is a large driver in any economy. It is what creates the circulation, a continuously increasing web of services – with money being earned and spent. Here is the hope for rural economies to create more jobs and have a higher quality of services.



Diversity is not a given. Not every area has the same dynamism. We did a survey on new business that is created in Ethiopia when a road is built and opens up an area. The variety of business was small: primarily general food stores and hair dressers.

There were many other types of useful business one could think of, but they did not exist. Yet in a similar rural area in Kenya one would find hardware shops, food processors, transport business, even investment advisors. It is not that these could not exist in Ethiopia – they just did not.

The reasons can be many: competition from public sector or corporate business, regulatory constraints, no tradition of entrepreneurship or just the way things enigmatically developed. But an overriding one is usual that they did not exist because no one started to create them. At the same time we have the Enormous Paradox – on the one hand we have a lot of useful things that are not done, on the other hand we have many employed people that are unhappy, frustrated and sometimes aggressive. Youth unemployment these days – combined with social media – creates the force to topple governments.

Another example from Ethiopia. In some districts of Amhara 45% of the crop was lost due to rodent infestation. What reaction did it provoke? Not much, surprisingly. No increase in rat trapping or better storage, no increase in specialists providing these. A modest increase in people keeping cats and people breeding them, but all in all not many opportunities were seized.

Now there is enormous good news in this bad news. We now often have the paradox of many things that are not being done (but that would provide a useful good or service) and at the same we have many young people unemployed. In strengthening local economies and providing more jobs, more well-being and a higher level of services in many economies is the way forward. To increase this web of local good and services. In creating strong local economies diversity is better than quantity – as competition means

choices and diversity means additional options and added value. We think this circular growth model is more appropriate for many part of the world, that will never be able to compete with China for consumer items, with India for software, or South Korea for mobile phones. Their way forward is to have stronger locally bolstered economies – not to capture a position in the world market.

We need to look at the inner strength, the viriditas of local economies, rather than the external linkages. In economic theory there has been a strong interest in competition between individuals, enterprises and countries rather than in linkages and adding value. There is a mindset to look at producers and customers as separate entities and not consider that he/ she who is a receiver may also be a giver. We need to understand better how to promote this local circularity – also in the post COVID19 restart of the economies.

How can we do this:

- Invest in diversity of skills and services – through training , loans and contracts, looking at the opportunities: we believe that many of these exist in agri-services, for instance, and providing inputs for regenerative farming
- Look out for leaks – find ways to how to make money circulate locally rather than ‘escape’
- Inject ‘fuel’ – through procurement in large public programs inject money– in the local economy
- Protect against sharks – corporate business expanding into every corner of the local economy, for instance local food and drinks, creating free rides for themselves in the absence of strong local enterprise

- Look out for killers – government organizations and cooperatives providing local quality of services that stand in the way of more vibrant and creative local business
- Look for dead hand regulators – regulation is good but it is sometimes used to exclude competition and set standards that are not useful and only protect well-entrenched large enterprise
- Provide the lubricants – roads and transport – they may lower the costs of local service being provided and for instance create opportunities for marginal items, such as agricultural by-products
- Promote entrepreneurship – the ability to seize opportunities and having the reserves to do so; to think that one can take things in one own hand, that yourself can create something new, useful and viable.

“

We need to look at the inner strength, the viriditas of local economies, rather than the external linkages.

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APPRECIATING LOCAL VALUE CHAINS

By Frank van Steenberg, Rommert Schram,
and Jean Pace Ricci

Value chains have received much attention in recent years. They are the conveyor belts of the economy, they make goods and services go around. These conveyor belts can be long or short, and the length determines the way in which goods, services, and ultimately finance are generated and distributed. Here, we will reflect on the merits and short comings of these two types of value chains.

There has been considerable effort in improving international commodity-based value chains – in particular for major consumer commodities: coffee, cacao, essential oils, tropical fruits, fish, wood products. The aim has been to make more money through better trade, more secure arrangements, and to assure that producers are not exploited but get a fair price. Another target has been to bring in better management of global natural resources such as forests and fishing grounds. The total turnover of 'Fair Trade' was USD 9 Bn globally in 2018 – serving 1.7 Million farmers – and this is increasing every year. These figures are very impressive and a major achievement for those who are making it happen.

Yet we need to remember that most commodities and services are exchanged locally and, therefore, most money circulates locally. The FAO estimates that 80% of all that is produced circulates locally; in many areas there is no export crop, and minimal produce actually leaves the local economy. To put things in perspective, there are 2 Bn farmers globally, so only 0.1% of these are served by Fair Trade. This is because Fair Trade is most applicable to longer global commodity value chains, based on the principle that global consumers are willing (and can afford) to pay more for these products. This principle does not work quite as well in the much shorter local value chains of developing rural areas. In most of these areas there is no commodity



or product that would come in the purview of an improved global or even national value chain. But the hundreds and thousands of transactions occurring daily in these villages and communities do hold a lot of value!

So we want to argue that rather than focusing primarily on long commodity chains it often makes more sense to focus on local value chains – the turnover of goods and services within the economy of a village or rural district. Most money and barter that goes around, goes around locally. Most services that are exchanged are local. The question then is: how can local value chains be optimized to create rural wealth? How can we deliver rural development that is self-generated and is largely independent of external stimuli?

Below the two value chain approaches are compared: local circular and external commodity-oriented. There is no either/or issue here. The argument is to optimize both types of value chains, but especially not neglect local value chains, as is happening currently.

It is not constructive to pitch either of these value chain approaches against the other, as they are not mutually exclusive. However, trends within agricultural development have favored increasing competitiveness on the global market through

long commodity value changes – producing something of higher quality, or lower price, and shipping it off to buyers across the globe. This is all well and good if happening through a framework such as Fair Trade which protects the rights and dues of agricultural producers. This is often not a viable option for the majority of rural producers, and for them it is really the local economy that is key to their livelihoods and futures. Each rural center can, and should, be its own micro-economy offering as many of the products and services demanded as possible to ensure money is made, spent, circulated, and multiplied locally.

This is the inspiration that drives the GFF program – money does not need to trickle down from the urban centers, or from abroad, but can be grown locally. Through the GFF small and micro-enterprises focusing on agri-services will be promoted, reducing the need to spend local money on external services and keeping it within the community. New credit packages and revolving funds will be made available and be coupled with entrepreneurial training and financial literacy to kick-start these SMEs. Interventions like these are the first triggers in the chain-reactions that are vibrant and self-sustaining rural economies.

“Money does not need to trickle down from the urban centers, or from abroad, but can be grown locally.”

Promoting local value chains	Promoting external commodity value chains
Local transaction oriented	Commodity oriented
Extend the chain of local service providers, including transportation and general services - reducing the need to spend money on services outside the local area and increasing circulation locally.	Optimize links between commodity chain actors - adding value to one another; using value chain to introduce and encourage better local practices.
Stimulate diversity and density of local services	Ensure efficiency and quality
Optimize multiplier - make money go around	Reduce uncertainty for producers and intermediaries
Money circulating among local parties	Money moving up and down the value chain
Create money through local credit (postpone payment)	Create money through trade credit (advance payment by capital-rich value chain operators)
Boosting local economy	Increase share in global/ national economy
Focus on local commodities and local import substitutions. Integrating also byproducts, minor crops, and up/recycling and reuse into the economy.	Focus on export and on national import substitution
Enabling Policies: <ul style="list-style-type: none"> • local procurement • cash injection • local entrepreneurship • stimulate diversity of local services and value addition • skill based education • promote transport 	Enabling Policies: <ul style="list-style-type: none"> • improve quality of local production • regulate transactions • address missing links • better deals
<p>Risk 1: too little money in the local economy - transactions do not materialize, even though they are important and would generate added value and economy - but there is no money to get this started</p> <p>Risk 2: money that circulates in the local economy seeps away, it is spent on products that are produced elsewhere - think of manufactured snacks and soft drinks or mobile phones and call credit</p>	<p>Risk 1: in long commodity value chains there is the risk of exploitation by stronger parties or the risk of failure by weakest link.</p> <p>Risk 2: the cost of ensuring that a long international value chain is green and fair is high, making it vulnerable</p> <p>Limitation: in many poor rural areas there are no commodities that can enter into a fair or green long value chain</p>

STRENGTHENING LOCAL VALUE CHAINS

By Frank van Steenbergen, Rommert
Schram, Abraham Abhishek, Jean Marc
Pace Rici

In many poor rural areas, there is no scope to operate in the world market: no scope to compete with China for consumer items, no scope to outbid India's strength in things like software development, no scope to conquer a niche in the global food industry. In addition, the national economy may have limited scope to absorb quality rural produce. Moreover, it is hard for rural producers to access such urban markets as they are faced with thickets of inconsiderate middlemen. Instead of focusing on global opportunities, the main avenue of improvement is in strengthening the local economy – to create more jobs and better livelihoods with what goes around in villages and local districts.

At present the local circulation of goods and services is far from optimal. Not much value is added to agriculture, the main producing sector, either in the form of providing inputs or processing products locally. For many crops there is no market and quality has no value. Processing, grading, and product enhancement is not common. Furthermore, some products that used to be produced locally – such as processed food and household items – have lost their position to competition from industrial soft drinks, snacks and plastic items. What is left behind is an eroded local economy.

What can be done to promote a strong local economy and reverse this downward trend? Given that agriculture is still the economic mainstay in rural areas, what can be done to vitalize rural economies?

Focus on local value chains

Well-functioning local value chains are at the heart of the local economy. They can prove to be the



Spending money on locally produced cookstoves boosts the local economy

difference between an economy at standstill and one that is vibrant with a high level of services. If local value chains function well, the chain of locally provided services is long and money circulates in the local economy. They ensure the circulation of all marketable commodities including byproducts, and keep value from getting lost. Food security is high, as is the quality of life in general. Jobs are created in input supply, in trade, transport and processing. This adds value and that value keeps going around in the local economy.

On the other hand, if local value chains do not work well, circulation is erratic or blocked. Many products do not circulate or they get lost because of lack of storage or transport. The level of useful services is low – and although jobs could be created, they are not. There is little value addition and the local economy simply just does not move.

What can be done to promote local value chains? There are four main directions:

- Creating more diversity and added value
- Increasing the circulation of money
- Improving connectivity with roads and transport
- Fostering entrepreneurship

Adding value and creating more diversity

In many agricultural economies there are typically few locally produced agri-inputs (such as bio-fertilizer, soil improvement additives, compost, bio-pesticide, rodent control measures, locally selected seeds, etc). Agriculture can benefit a lot from better

inputs that are locally produced, from local seeds to biofertilizer. These products and services have a two-fold impact; not only do they open up niches for local employment, but they also contribute to improving the quantity and quality of production and increase the value created by the producer. Many of these local inputs will be regenerative: they will form an agricultural system that is based on low external inputs that renews and improves on its own strength. The production of all these inputs, if done well, helps to get much more out of land, water and labour.

There is also little value-addition to the primary product once it is harvested. The proportion of crops in poor rural areas currently lost pre-harvest and post-harvest is staggering: 8-12%, sometimes even more. There is little storing, grading, processing; even though these activities reduce losses and present a huge local business opportunity. The skills and business awareness for these added value activities may not be there for various reasons: awareness, education, regulation, lack of entrepreneurship, or absence of financial reserves. However, all these blockages can be addressed and removed. In many areas the educational system is leading students away from business orientation and artisanal skills, and is typically preparing people for jobs that do not exist in large numbers. It comes as no surprise that in many countries young people see no future in agriculture. Nevertheless, all the value addition activities described above may make farming and agri-services more aspirational.

Next to agriculture, the second base in rural economies is consumer spending. In many rural areas there is little on offer in local consumer services and goods. Food is monotonous and not attractive, there is little entertainment, housing

is sub-standard, health services are somewhere else, as is quality standard education. This is a pity because such services or goods could improve the quality of life – be it in better food, housing, education, health, household items, entertainment, ceremonies and spiritual care. Where such services do exist, opportunities are created, jobs materialize and chances to earn money and spend again are created. It helps to spin around money and create multipliers.

Hence, there is a clear need to improve the diversity of local consumer products and services and add more value, diversity and pleasure. It is necessary to stimulate such new activities through training, credit lines, and assured supply till they are part of the more diversified rural economy.

Increasing the circulation of money

A second area to improve in local economies is cash flow. A common phenomenon in many rural economies is that they are heavily undercapitalized. There is not much money to go around – to pay for services or equipment. If one adds up all the cash that people in a village or rural district have it may amount to very little. There may be other systems such as bartering. With little money in circulation, there will be few shops that can sell things, even necessary items. It is not a matter of demand or even purchasing power, it is a matter of no supply and not enough on offer. Thus rural areas may have small grocery shops and pharmacies but no hardware shops, no agri-input shops, and few shops that sell consumer items.

Fortunately, there are many ways to inject money into local economies. Remittances are an example. The more effectively these are converted into local cash the better. In this case the M-pesa system in Kenya is exemplary. With a click on the mobile phone relatives can send money to family members in rural areas, who can then retrieve cash locally, which can fuel the local economy.

Money can also be created locally in the shape of circular credit. People deliver services or goods to one another but are not immediately paid. When some cash is injected into the local systems these claims may be settled and in the meantime people can transact with one another on the basis of trust. Another classical way of getting money into a local economies are employment programs, provided that people are paid in cash and not with imported food. The trick is not only to get money into the local economy and have it circulate fast over a range of local producers and service providers, but also to make sure that money does not leave the local economy – that consumers for instance spend it on local housebuilding rather than on imported consumer items. It is particularly effective to stimulate local service providers that cater to basic needs: housing, health, quality food, education, and in all things that contribute to a good quality of life.

Roads, transport and marketplaces

A third area of strengthening local value chains is physical: roads, transport, storage facilities, preservation units, market places, shops, processing units. Roads make all the difference. They unlock the economy – they make it possible

for commodities to be sourced from new areas, for local products to go to all corners. They also make it possible to market items that before were not even part of the economy, such as by-products and chaff. Roads have been found to strengthen the economy just by ‘being there’. A very recent study by the World Bank in Ethiopia found that:

- Development of rural roads increased, on average, household consumption by 16.1 percent between 2012 and 2016 (or 3.8 percent per year).
- The effects of rural road development were largest in the most remote communities. Here they increased household consumption by 27.9 percent.
- In communities most affected by drought, the likelihood of falling into poverty was 14.4 percent lower between 2012 and 2016 if the community was connected by a rural road.

This shows that just by building rural roads, the local economy benefits tremendously. However, by making optimum use of these roads, the impact can be increased. If the roads are used for transporting locally produced crops and goods by trucks, mini-buses and particularly, motorbikes and tricycle carriers the local economy gets another boost. Specifically motorbikes can penetrate into the most remote hamlets – even move on the small foot paths – and unlock the local economy.

In addition, well-organized market places with proper scales, shelters against sun and rain and godowns accommodate an optimum exchange of crops and goods, and prevent wastage. Cold storage and preservation facilities can make products available over an extended period, and avoid distress sales or outright dumping.

All this will create useful jobs and the income

that comes with such jobs will further boost the local economy. In general, it should be easy to open shops and small production centres and do transport business. Programs should stimulate these. Regulations should be enabling and conducive, not complex and prohibitive.

Entrepreneurship

The final element is to promote entrepreneurship. Entrepreneurship can drive diversity and can unlock talents that were hidden before. Entrepreneurship adds to the diversity of services and makes the local value chains move smoothly.

In many rural areas starting a business and running it successfully is – unfortunately – not high in young people's priority lists. There are many reasons – education, access to capital, networks. But one important reason is also aspirational. As more people pass through formal education systems the ambition becomes to enter government service or the NGO sector, but not to become one's own boss. An effort is required to change the perception—through the education systems, as well as by positioning successful young entrepreneurs as role models.

Conceiving a model for boosting rural economies

Rural economic development is not a novel goal for governmental or non-governmental organisations. However, the focus so far has been limited to big-ticket agricultural infrastructure development (such as irrigation projects), or social

safety net programmes. Crucial as these goals are, it is time to look at rural economies as the multi-component, diverse, self-sufficient systems that they are, and that they can be. It is necessary to acknowledge that these rural communities are not solely providers of agricultural produce to the rest of the country.

Based on experiences in Uganda, Ethiopia, and Kenya, the GFF program is designed to strengthen rural economies by diversifying the products and services on offer in the program areas. This requires an investment in training for various agri-products and services, building up the entrepreneurial capacity of local farmers, women, and youth as well as facilitating their access to credit and finance.

Trough the program, we have picked out some key interventions that not only boost agricultural production, but also set up and strengthen local value chains and provide rural communities with the skills to leverage them and build stronger, more diverse local economies. The successful implementation of these interventions will increase the volume of local transactions, kick-starting the circular flow of finance and resource within the communities, and ultimately leaving being economies that continue to thrive based on their own strength and resilient to external shocks.

The interventions will include:

- strengthening the natural resource base (landscape restoration, water harvesting),
- supporting farmers/pastoralists to develop good quality agricultural inputs as new product lines (seed banks, biofertilizer and biorodenticide production, and vermicomposting)

- promoting improved storage and post-harvest solutions (milk coolers, rodent management)
- improved product processing for higher-value output (homestead coffee processing solutions)
- developing supplemental income streams (homestead poultry keeping)
- promoting intermediate means of transport (of produce and people)
- facilitating access to capital, credit, and markets

This holistic approach to vitalizing the rural communities and economies we work with targets multiple of the issues described above. Some of

these activities build upon pre-existing initiatives such as landscape restoration, and some fill in the gaps identified for creating self-sustaining circular economies. This approach is being adopted to ensure that bottlenecks to economic stimulation are addressed and converted to opportunities for employment, capacity development, and personal growth. We have high hopes for the GFF program achieving its goal of creating a better quality of life in our program areas in East Africa through landscape rehabilitation and rural economic interventions, unlocking the great potential that these communities hold.

11 CHALLENGES (AND OPPORTUNITIES!) ON THE ROAD TOWARD A STRONG AND DIVERSE RURAL ECONOMY IN RURAL ETHIOPIA

By Nardos Masresha

Small and Micro Enterprises (SMEs) play a crucial role in the rural economy of Ethiopia as they provide employment opportunities to many Ethiopians living in the countryside. Strong up-and-running SMEs are essential in providing jobs for the many unemployed youths. Moreover, SMEs can supply the required input for regenerative agriculture, such as biofertilizers.

The Ethiopian government in collaboration with NGOs is implementing policies and programs that support the growth and development of SMEs. Despite these efforts, the process of creating a strong rural economy in Ethiopia has faced several challenges. This blog explores the opportunities and challenges faced by SMEs in Ethiopia and discusses the measures taken to promote their growth and development. There is momentum right now to strengthen and diversify the rural economy of Ethiopia: the government is being more and more supportive towards the growth and development of SMEs, the country has an enormous domestic market with a growing middle class, and there is also a significant amount of funding opportunities. Yet, there are still many challenges (and solutions to address them), all listed below:

11 challenges and opportunities in setting up a strong and diverse rural economy in Ethiopia.

1. **Organizational challenges** – In any SME program, identifying the most suitable candidates to guide in setting up a business is crucial. When this process is rushed, and the importance of group dynamics is overlooked the SMEs are bound to fail. Building cohesion

and synergy among SME group members also takes some time to develop. It is important to scout individuals that are motivated and ready to learn and take on the challenge, moreover, they should be motivated to help create opportunities for others. Selecting prospects for such programs that are only driven by short-term and simplistic motives should also be avoided.

2. Inadequate legal and regulatory framework

– SMEs are confronted with legal and regulatory obstacles, such as high taxes and complicated registration procedures. To address these challenges the registration process for new businesses should be simplified, and regulatory barriers should be removed.

3. Lack of network and resources– Many people living in rural Ethiopia lack access to resources and a solid network to learn from and acquire the expertise to succeed in setting up a business. To address these challenges, networks should be made (for example through horizontal learning and promoting collaboration between SMEs). By working together, entrepreneurs can pool their resources, share knowledge and experiences,

and create a stronger presence in the market.

4. Lack of finance resources - Many SMEs face limited access to finance due to several factors. First, many SMEs operate in the informal sector and do not have formal financial records, making it difficult for them to access bank loans or other forms of formal financing. Second, banks and other financial institutions in Ethiopia often consider SMEs to be high-risk borrowers due to their limited financial track record and lack of collateral. The government has several initiatives to support SMEs' access to finance. However, the application process for these loans can be time-consuming and complicated. To address these challenges, kick-start funding or micro-loans should be enabled (for example through a revolving fund). Also, promoting the use of formal financial services such as digital banking and mobile money can help SME members track their finances more effectively and reduce their reliance on informal financial practices. Moreover, the government and financial institutions should collaborate to create financing solutions tailored to meet the specific needs of SMEs and, through this, play a vital role in the country's economic growth.

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What are Small and Micro Enterprises?

These enterprises are classified based on their size, with Micro Enterprises having a maximum of 5 members and Small Enterprises having 6-30 members. SMEs are present in various sectors such as construction, agriculture, manufacturing, and services.

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5. **Lack of experience and knowledge** – For many people who want to set up an SME an obstacle is the lack of experience and knowledge on how to do it. This results in poor decision-making and management practices. They often lack the essential skills and knowledge to handle finances, market their products, and negotiate with suppliers and customers. Especially in rural areas, people face restricted access to educational opportunities and training. Basic business skill training in financial management, marketing, and accounting, and support should thus be given to help young entrepreneurs and SME members develop the skills and knowledge needed to succeed.
6. **Fear of failure and resistance to change** – Starting a business is a risky endeavor, and many are unwilling to take risks due to a fear of failure. This leads to reluctance to innovate or experiment with new strategies that could result in growth and success. These challenges could, again, be addressed by providing sufficient training and mentorship to overcome fear and resistance and increase confidence in setting up a business. In addition, a culture of entrepreneurship and innovation should be promoted. This can involve providing funding and other incentives for innovative business ideas, as well as highlighting success stories and role models in the entrepreneurial community.
7. **Dependency syndrome** – Many SMEs develop a dependency syndrome, where they expect the government and NGOs to solve any challenge they face. This highlights the importance of capacity building and providing good training to ensure that SMEs are well-equipped to face these challenges.
8. **Lack of patience** – Many SMEs may expect quick results and success, which leads to a focus on short-term gains rather than long-term growth. This can result in a lack of investment in business infrastructure, product development, and market research, which hinder the growth and competitiveness of the business. To address this challenge, members of SMEs should be educated on the importance of patience and long-term planning. Business development services can provide training on strategic planning, market research, and product development, helping members to understand the importance of investing in their businesses for long-term success.
9. **Group work challenges** – SME members frequently encounter obstacles when collaborating as a team. These obstacles can include power struggles that arise from ambiguity around roles and responsibilities or when individual members prioritize their interests over the group's objectives. This can result in conflicts that diminish the group's unity and productivity. Another challenge is the lack of trust, which is crucial for successful teamwork. SME members may have trust issues due to their diverse backgrounds or past negative encounters. It is important to promote effective communication and collaboration among group members to address these challenges. This involves developing clear communication channels and establishing norms for how group members communicate and work together. In addition, it is important to establish clear roles and responsibilities for each member of the group, as well as guidelines for decision-making and conflict resolution. This can help minimize power struggles and ensure that each member's

contributions are valued and recognized. Moreover, building trust among group members is essential for effective teamwork. This can involve team-building activities and exercises that help members get to know each other better and develop trust and respect. Also, as mentioned above, the group dynamics should already be considered from the start during selecting SME members.

10. Social challenges – SMEs in Ethiopia also

face social challenges that can hinder their formation and growth. These difficulties encompass cultural barriers, gender inequality, scarcity of role models, and a negative perception of failure. Cultural differences across Ethiopia's diverse communities may make it challenging for young entrepreneurs to commence and operate a business. In some cultures, entrepreneurship may not be considered a viable career path, leading to discouragement among youths. Women in Ethiopia face significant hurdles in starting and growing their businesses, including limited access to education, financial resources, and networking opportunities. Additionally, the scarcity of role models and mentors hinders young entrepreneurs' ability to navigate the complexities of starting and managing a business. Finally, failure is stigmatized in Ethiopian culture, discouraging aspiring entrepreneurs from taking risks and trying new ideas. To address these social challenges, there needs to be a cultural shift toward promoting entrepreneurship as a viable career path, particularly for women and young people. This can involve creating awareness campaigns, providing mentorship and role models,

and addressing cultural and social barriers that discourage young entrepreneurs from pursuing their dreams. Additionally, addressing the stigma against failure requires a shift in mindset towards accepting failure as a natural part of the entrepreneurial process. This can involve promoting a culture of learning from failure and providing support and resources to young entrepreneurs who experience setbacks.

11. Infrastructure challenges – In, particularly

rural, areas with poor infrastructure and a weak or non-existent transportation system, it is challenging for entrepreneurs to access the resources and markets necessary for sustaining their businesses. The good news is that there is huge potential for establishing a strong infrastructure in Ethiopia as many people are eager to jump into this market gap and create a business in this sector¹. See also chapter 10 of this blog bundle.

To conclude, this blog showed that with the right strategies and support, SMEs can play a significant role in enhancing members' livelihoods and the economic development of Ethiopia. Despite the challenges faced by SMEs, there are opportunities for SMEs to grow and expand their operations. In collaboration with nongovernmental organizations, the government has launched various programs and initiatives to support the growth of SMEs. SMEs can tap into the domestic and regional markets to grow their businesses.

WATERSHED MANAGEMENT AND JOB OPPORTUNITY: EXPERIENCES FROM MIDDLE AWASH

By Girma Senbeta

In a watershed, everything is interconnected. The health of the soil and water supply directly impacts flora and fauna living in the watershed, affecting the human beings who depend on the watershed for their livelihoods. Healthy watersheds can provide many opportunities, but in Ethiopia, most people, including the Middle Awash region, rely on farming and livestock rearing. There is a missed opportunity to explore other livelihoods, leaving many communities affected by watershed degradation and less productive agricultural land.

The Biskelo-Worerso watershed, situated in the middle awash of the Oromia region, faces the familiar challenge of low agricultural productivity and rising input costs. Consequently, more people in the community are receiving aid, primarily through Safety Net Programs. The good news is that the government's annual watershed restoration campaigns are slowly bringing about positive change in the area. However, the impact of such interventions often takes time to manifest fully, necessitating a mechanism that provides immediate benefits to the community during the more protracted restoration process. This mechanism is what the GFF program aims to establish. Through its innovative approach, the GFF program seeks to provide short-term and long-term benefits to the community, enhancing its ability to manage the watershed and achieve long-term development goals.

A new approach is being implemented to combat the degradation of landscapes by involving youth and women groups who have low incomes or are unemployed in Small and Micro Enterprises (SMEs). These groups can choose businesses directly related to landscape restoration, such as nursery development, small ruminant rearing/fattening, beekeeping, and homestead poultry. Once the groups meet the necessary criteria, they



Tree nurseries SME

are officially organized as SMEs and receive legal registration, allowing them to access loans for their start-up businesses with accountability measures in place.

The youth and women groups are not only organized into SMEs but are also provided with training on basic business skills and technical knowledge specific to their chosen business. Currently, there are SMEs focused on small ruminant rearing, an SME on nursery development, and an SME on beekeeping in the Middle Awash area. To ensure sustainability, the program has allocated a small revolving initial capital for each SME, which must be fully repaid within a maximum of one year. Once repaid, the funds will be used to finance similar projects for the next group of SMEs as long as the watershed management intervention continues. This initiative benefits the

current SMEs and creates a self-sustaining system for future communities.

In 2022, 83 SME members were organized in this approach and started their businesses. The nursery developer SME, with 23 members, started their business with 63,000 ETB (1100 euro) capital supported by the program and some materials from the agriculture office. The program has also provided them with an improved variety of onion seeds to diversify their business. Within a year, this SME has earned about 195,000 ETB (3400 euros) from the sales of different forest seedlings and onions. Unfortunately, security issues in this area did not allow sufficient technical support and follow-up for the nursery SME.

In the same year, seven SMEs were established for small ruminant husbandry and started their business, beginning with a total capital of 285.000

ETB (4979 euros). Out of these, two SMEs located in the highland area of the watershed invested 75.000 ETB (1310 euros) in purchasing 60 sheep, which have since grown to 92 in number. The remaining five SMEs located in the mid-land invested 210.000 ETB (3668 euros) in purchasing 126 goats, which have reproduced and increased to 151 in just six months. The group has reported that many sheep and goats are currently pregnant, but there were also seven deaths (five goats and two sheep) for various reasons. While some SMEs have expressed concerns about repayment due to negative experiences with NGOs, most small ruminant husbandry SMEs have successfully made their first instalment of the revolving fund payment. They are on track to repay their initial capital within the upcoming months fully.

A group of five individuals was organized as an SME for beekeeping. It provided ten modern beehives, two for each member, and necessary materials and training on transitional beehive production from local materials. The beneficiaries have successfully produced three transitional beehives each and anticipate their first harvest in May. Since beekeeping was introduced as a pilot project, repayment of the initial capital is optional. It is worth mentioning that the beneficiaries brought the bee colonies to the hives themselves.

The agricultural development agents in the respective kebeles and agriculture experts at the woreda and zonal offices play a pivotal role in the organized SMEs' close monitoring and technical support. Experts have observed that the approach, which links job opportunities with watershed management, has spurred motivation within the community and has bolstered the government's efforts in landscape management activities.



Small ruminant husbandry SME

To create further job opportunities and benefits for the SMEs, efforts to link with additional sources of financing, such as micro-finance institutes and other potential funds like productive safety net programs, as well as establishing market linkages, should be prioritized as the next steps. Additionally, plans for organizing the subsequent batches of similar SMEs are underway.



Beekeeping SME

PRODUCING BIOFERTILIZERS TO PROMOTE CIRCULATION OF MONEY

By Meghna Mukherjee and Jean Marc Pace

A while ago, I was reading a book on Rethinking Money by Bernard Lietaer and Jacqui Dunne. As an economist, I was fascinated to reflect upon my own understanding of money and its importance. The authors have beautifully explained that in Economics, 'Money' has never been defined; we talk about it as a store of value, as a medium of exchange but never has money been defined on its own. At present, money is a scarce resource and it creates competition among each other (Lietaer and Dunne, 2013). And in this competition, where one individual is pitted against the other, few individuals emerge rich while many others remain poor.

Traditionally, people belonging to higher social class like industrialists or businessmen invested their money to earn interests or gain profits by selling varied goods and services. They would hire people who would work for them in exchange of minimal wages. The working class would then spend the wages earned to consume different goods and services sold by the same industrialists. In this way, the money that was invested by the rich would travel from the pockets of the wage earners back to the hands of the rich. Such circulation of money was centred towards investors and did not help in strengthening the local economy or development of local regions. A new approach now is to turn consumers to investors so that it helps local businesses and create employment opportunities for people.

Over the last few years, the concept of circular money has been gaining popularity. The model of circular money helps in creating a close knit community by motivating people's behaviour and supporting local businesses by ensuring that currency is circulated locally, which can stimulate employment and foster local development



Large scale biofertilizer production

(Top) A farmer in Ethiopia ploughing the field with oxen (Source: Stevie Mann, ILRI). (Bottom) Liquid biofertilizer being produced at a large scale (Courtesy: Simón Cañarte, via Ruben Borge)

(Lietaer and Dunne, 2013). The idea of circular money has been promoted through the use of local cooperative currency. Cooperative currency also known as complementary currencies are designed to work in tandem with official system. They balance the conventional system by reducing the competition which arises due to money, thus dampening the scarcity created by the banking system. There have been many cases around the world where cooperative local currencies have been developed to save local businesses from phasing out like LETS in Vancouver in Canada, Regio in Hannover in Germany, EURHINE in the Rhine region etc.

The development of a new currency is a task for another day and a topic for another blog! The focus here is on strengthening local economy and promoting new employment opportunities through circulation of money. In simple terms, it can be thought of as increasing the number of transactions of the money (Velocity of Money)

locally, that is to say, between members of the same locality or community. Circulation of Money is useful in addressing unmet demands by making use of unused resources. An example can be seen by looking at the demand for biofertilizers – a fermented product made from cow dung, milk, sugar, a yeast, that boosts soil fertility – as a sustainable input for agricultural production. In GFF, the idea is to make circular agriculture a profitable opportunity for farmers by local value chain reinvestment and landscape improvement. There is, thus, potential in developing and supplying farmers with the knowledge and support to produce biofertilizers using locally available materials. The production costs are minimal and the finished product can be cheaply sold to different farmers who suffer from productivity and soil fertility issues. This can lead to increased productivity and ultimately to overall progress in the region.

Circulation of Money: A Model based on Biofertilizers



Farmer with his cattle in Egypt (Source: middleeasteye.net)

By taking cow dung as the main input for biofertilizer production, we can assume the following to get an overall idea:

- One cow can produce ~30kg of cow dung every day i.e. ~25 litres/day (conservative figure) and it only takes 4Litres of cow dung to produce up to 20Litres of concentrated biofertilizer.
- So, 20 liters of concentrate translates to 400litres when diluted for use (1:20)
- Now, 400litres is enough for 20ha of crops.
- And with a rough estimate of 25litres of manure/cow/day then in a day, there's enough to repeat the above 6 times = 120ha



A young farmer takes his cattle out for grazing (Source: adaptation-undp.org)

So, the cow dung from one farmer's cow is enough to produce fertilizers for all his neighbour's fields at a very minimal cost. The biofertilizer produced will boost the agricultural productivity and promote sustainable production of crops. The increase in agricultural products will give them more marketable produce, and thus increase their income. This income will keep circulating between the biofertilizer producer, the pastoralist, the farmer, the milk consumer and other people engaged in transportation to nearby markets for

example, and lead to circulation of money locally. The income generated can be reinvested into scaling up the production of the next round of biofertilizer production. It can help in development of new value chains and forward linkages which can improve the local conditions. All of this will lead to increasing the wealth of the community collectively.

Alternatively, in the case of buying-in synthetic fertilizers, the generation of wealth and its circulation is much reduced because the money moves out of the system with that first transaction, rather than recognizing and increasing the value of what the community already has available.

In addition to this, synthetic fertilizer creates a dependency where payment is done for every agricultural season but it leads to diminishing returns (due to soil degradation). On the other hand, with biofertilizers wealth is accumulated in economic terms as well as in term of richer soil fertility season after season.

Reducing leakages in money circulation

This shift in dependency of farmers from an external synthetic fertilizer manufacturer to a local biofertilizer creates a close knit community that strengthens the bonds among the people. It also helps in supporting local businesses as the money spent on fertilizer does not leak out of the system. The money spent by the farmer in purchasing the manure from the cattle farmer will be used by him to buy vegetables or perform daily tasks which will in turn boost the local economy. The reduction in leakages allow everyone to invest in locally produced goods and collectively grow as a community.

BROODY: THE ESSENTIAL ART OF HATCHING

By Frank van Steenberg, Abraham Ahishek,
and Reinier Veldman

The difference a village chicken can make to the life of a poor woman is amazing. A safe source of income, independent capital asset, universal delicacy, main source of protein, eggs ranks high in the list of essential brainfood. They are a major ingredient in diets that stimulate the development of mental capacity in villages all over the world.

In many countries, village poultry make up the major share of national poultry population. For instance, In Ethiopia it is more than 95%. Whereas 20 years ago less than 30% of animal protein produced in the world come from poultry, nowadays this is closer to 40%. In developing countries the consumption of poultry has more than doubled in the last two decades.

Among poultry, chicken are becoming more and more important. However, there is much scope for improvement in how chicken are kept. Currently, scavenging is the norm, which leads to underweight and diseased chicken. There are simple ways to turn this around – and make a big difference in the production of meat and eggs, and to rural health in general. The key element is better hatching. This is where we bring the hatching pan into the picture.

The hatching pan is a significant innovation, and at the same time a basic tool. What it does is simple – it combines a comfortable place for the chicken to hatch its eggs with two small containers– one for water and one for food. Thus, the hen always has food and water at hand. This keeps it from foraging around to satisfy its hunger and quench its thirst, and neglect its eggs in the process. The hatching pan has been seen to double the number of eggs that are successfully hatched. It also allows the hen to grow in size. A larger hen can lay and incubate more eggs. She can hatch eggs weighing half her



'Hazol' hatching pans developed in Bangladesh (left), adapted to Ethiopian conditions (right)

body weight. For instance, if a hen weighs 1.5 kg, it can incubate 750 gm of eggs (around 20 eggs). Therefore large-sized hens, rather than the usual scrawny village versions, are good news.

There is more to the art of hatching than the hatching pan. Providing a bedding of ash, straw, and naphthalene insulates the eggs better. Besides, warming the eggs slightly (up to 24 degrees centigrade), and placing them in the afternoon, ensures that they do not get a cold shock at night.

Here are a few more chicken essentials:

- To increase productivity, chicks should be separated from the hen a week after they hatch. This will induce her to produce more eggs and go broody again.
- If one wants to separate eggs that are fertilized from those that are not, one can 'candle' the eggs after five days— this means shining torch light through the translucent shells. If veins appear to develop, it means that the egg is fertilized and can be left to hatch. One can also look at the shape of the eggs – a pointed egg usually contains a rooster, an oval shape a hen. Thus, one can sort eggs strategically and increase the number of hens.
- Ensure balanced feed: A chicken eats typically 50-60 gram of food a day. It is best to have grains, some protein, some calcium (old crushed egg shells) and a pinch of salt in the mix.
- Provide a sand bath for the chicken – so they can clean themselves with the sand
- A small, double-storied, well-ventilated pen on stilts will do wonders for the health and well-being of the chicken. It protects them from predators and from cold, dampness, and diseases. The chicks can be kept separate from the hens at the top floor.
- Finally, providing vaccination is important. It protects the chicken and its extended family from diseases such as the Newcastle disease.

PROMOTION OF IMPROVED HOMESTEAD POULTRY KEEPING

by Getanew Tesfaw

Livestock and poultry are essential to strengthen the rural economies as they are serving as supplemental income streams for communities. Especially for women, homestead poultry keeping can be a great opportunity to generate income in a rural setting. Moreover, chickens and eggs are an important source of protein and contribute to a balanced diet and keeping them contributes to the health of the soil and lawn. Homestead poultry keeping thus contributes to food and nutrition security, and fertilizer production through the phosphate-rich manure. This is why in GubaLafto, farmers are supported in homestead poultry keeping; 120 farmers, including women and youth have been trained in how to keep poultry and have started preparing the required sheds and tools from local materials. Next, 3000, 45-day-old chickens have been distributed.



Participants in GubaLafto receiving Homestead Poultry Keeping training

Having poultry is one thing, but being able to grow and feed them is another. This is why participants often mentioned the major challenge to buy and get chicken feed in the current post-disaster conditions as most of the previous season's agricultural products have been destroyed. As a solution, local experts are now

supporting beneficiaries by training them on how to prepare their chicken feed at home themselves. The training also included experience sharing between two kebeles: Jarsa and Key Amba. Key Amba participants visited Jarsa, and Jarsa participants visited Key Amba.



Kebele visits for horizontal learning on homestead poultry keeping

During the training, participants were also introduced to the hatching pan. A hatching pan is a very productive tool for egg laying: it provides a comfortable place for chicken to hatch its eggs with two small containers (one for water and one for food). The participants appreciated the hatching pan but also had a few remarks that should be taken into account for a successful way forward in improving homestead poultry keeping. (1) A farmer with 25 chickens needs around 6 hatching pans, this might be costly and thus local and cheap materials to make the hatching pan should be promoted. (2) As the pans are made from clay, they may break fast; other materials should therefore be explored (for example, simple metals).

This promotion of improved homestead poultry keeping in the program areas aims to develop supplemental income streams, especially for

women. One woman for example managed to save 20,000 birr (around 340 euros). With this money she is able to buy other important items. Others are planning to save up to 100,000 birr (around 1716 euros) to start other business or reinvest in their poultry business. By generating income and selling goods, this also strengthens and diversifies the local economy. Merchants come daily to these kebeles to buy eggs and after the women started their business, the exchange of farmers to market is increased which contributes to the local economy.



Demonstrating of a hatching pan





CHAPTER 8: IMPROVING RURAL TRANSPORT

THE WIDER ROAD TO INCLUSIVE GROWTH

By Frank van Steenberg, Crelis Rammelt,
Kebede Manjur and Letty Fajardo Vera

Here is a gruesome news item from the Guardian on 31 March 2017.



A KUWAITI WOMAN FILMED HER ETHIOPIAN MAID SURVIVING A SUICIDE ATTEMPT AND THEN POSTED THE INCIDENT ON SOCIAL MEDIA, AL-SEYASSAH NEWSPAPER REPORTED. THE 12-SECOND VIDEO SHOWS THE MAID HANGING OUTSIDE THE BUILDING, WITH ONE HAND TIGHTLY GRIPPING THE WINDOW FRAME, AS SHE BEGS FOR HELP IN AN APPARENT LAST-MINUTE CHANGE OF MIND. THE WOMAN HOLDING THE CAMERA IS HEARD TELLING THE HANGING MAID: "OH, CRAZY, COME BACK." THE TERRIFIED MAID IS SEEN SCREAMING "HOLD ME, HOLD ME", JUST BEFORE HER HAND SLIPS AND SHE FALLS DOWN TO HIT THE AWNING, WHICH APPEARS TO SOFTEN THE IMPACT. THE EMPLOYER MADE NO REACTION AS SHE CONTINUED FILMING."



The saddest thing of all is that this employment in the Middle East is often the only dream that young people have, as they try to leave behind the life they (maybe do not) have in villages in Ethiopia.

A combination of not very well-maintained roads, the lack of (intermediate) means of transport, and relatively high fares has a strong effect on young people. Very few young people from rural areas are getting high school education in nearby towns: distance and costs prohibit many from attending. Among those that do attend, many are not able to complete high school. This leaves them with



very few chances to do things differently and have choices in life. In rural Ethiopia, jobs are few and the economy not diverse.

Lack of education and the meagre local economic opportunities combine into a dangerous brew of profound hopelessness. A respondent in a recent research explained the so-called 'Middle East Syndrome' – young rural women and men have no faith in developing a decent livelihood locally and put all their hopes on a job in one of the Arab Countries. This is fuelled by high promises from middlemen, who are supposed to arrange the necessary work permits as they promise lucrative job opportunities and high salaries.

It is often a case of hope against knowing better. There are several examples of people duped by such middlemen. Despite families paying them a lifetime of savings, they often do not deliver the required travel documents and simply

abscond. Those that go to the Middle East are often thoroughly disappointed, and return to Ethiopia under debt and with mental health issues following a history of exploitation. A most tragic practice is this: many girls marry young and then also divorce quickly. This to protect from the shame of that comes with the expected abuse during the job in the Middle East.

The alternative dream to the Middle East syndrome is to cross into Europe – again a route often full of abuse during the journey and deep disappointment at the end. Several of those who travel overland to the Mediterranean Coast carry amphetamine and other endurance drugs with them to be able to escape thugs that harass and extort from them, official and unofficial.

The problem essentially is that local rural economies have very little to offer to young people. There are no jobs – the economy has little

diversity and few opportunities. The system is not inclusive – neither for vulnerable people nor for young people at the productive peaks of their life. Instead there is much idling away and empty dreams.

There is a need to create vibrant rural economies – with diverse jobs that add value, where services are provided from one to the other, where the local economy promotes local specialization in things that individuals are good at and have a talent for, where a strong and level relation exists with the larger world. There is a huge difference between village economies in different part of the world – in terms of liveliness and entrepreneurial opportunities.

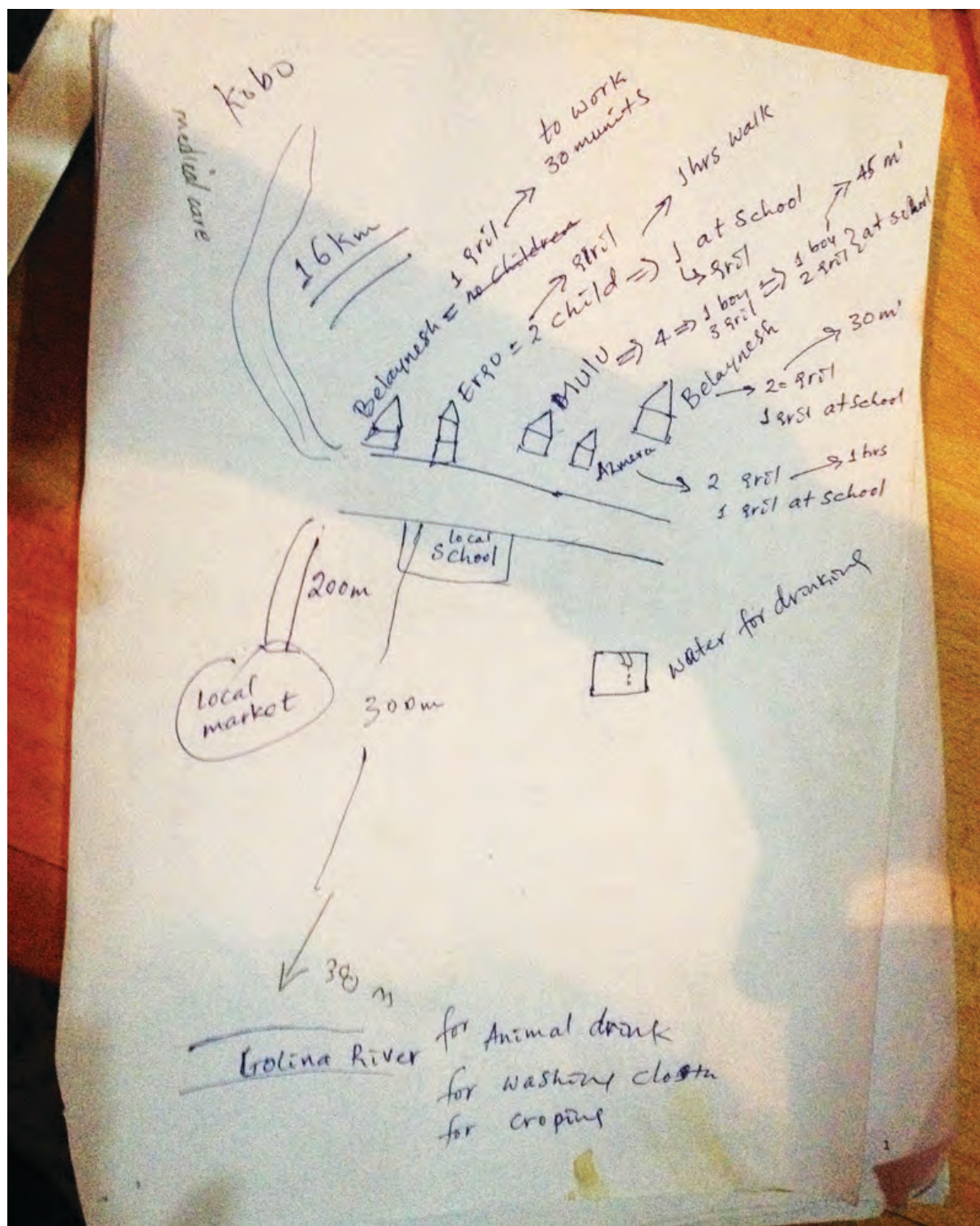
It is important to use any investment as a huge multi-faceted opportunity. Take the development of feeder roads, for example. Feeder roads are typically unpaved roads, connecting rural areas to main roads and urban centres. They have the potential do many things and make an enormous impact on inclusive growth:

- they unblock access to rural goods and services, particularly if the development of the feeder road is matched by the promotion of local transport – from wheelbarrows, to bikes and motorbikes, to intermediate means of transport, to small buses and trucks. The development of rural roads and especially rural transport can be ‘the best thing ever’ for local value chains
- they create direct labour opportunities – that may be benefit those that are most vulnerable and those who have the largest future potential (young people). With the labour opportunities also come opportunities to build new skills and build small financial reserves. There is a case to view the investment in feeder

road development also as a shot in the arm for the local economy

- they trigger the development of local businesses – road side stalls, bars, hair dressers for sure, as brought out by numerous studies. We may go further with investing in local retail and business and services by systematically rooting programs through local retail, by providing retail credit and promoting more business development in areas that have just ‘opened up.’
- roads change the physical environment –they have a large imprint on the local surface hydrology, they affect local dust development and accelerate sedimentation process. All those changes now come as threats, but they can be turned around and into assets. Roads can be used to facilitate water harvesting and water management in general. Road-side tree planting will control dust and will also create a lot of other benefits. Trees are sources of timber and fruit, act as wind breaks and provide shade. Besides, employment opportunities can be generated from systematically harvesting sand and gravel along roads.

All this amounts to a new vision on rural roads: as development vectors, as breakthroughs for change, as instruments for inclusive growth, and for green growth. It is important to see roads as more than transport lines. It is important to see them as bringers of change and local development – as alternatives to idling away and having dreams of faraway places that, in reality, are disillusionment postponed. Roads can bring much change, facilitate opportunities at the doorsteps, especially when investments are made in opportunities that they hold: transport, credit, water and trees, capacities, business skills and life visions.



A road connectivity map prepared by a rural community in Kobo district, northern Ethiopia

CREATING 500,000 JOBS IN RURAL TRANSPORT IN ETHIOPIA

By Frank van Steenbergen, Kifle Woldearegay, Mekdelawit Deribe and Kebede Manjur, Theophilus Kioko, and Abraham Abhishek

Rural transport is the fly-wheel of local economies. In particular, it is the intermediate means of transport (IMTs) – the motorbikes and three-wheeler transport vans – that circulate goods and services. They also improve access to vital services, schools, health centre, government offices. On top that rural transport creates millions of jobs.

For instance, in Ethiopia, in a single cost-free move, 500,000 jobs can be created; the marketing of rural products can be improved; and many people can gain better access to health and other services. What this needs is improvement in availability of motorbikes and removal of all restrictions.

In neighbouring countries such as Kenya, Tanzania or Uganda the use of motorbikes made a major change. In Ethiopia this is lagging behind. Many rural roads are empty and have no transport to speak of. In between buses and trucks and people walking along the road, there is no intermediate means of transport. The exception are the three wheeler Bajaj vans. Because of their low wheel axle they are inappropriate for rural Ethiopian roads: unpaved, often steep, and sometimes weathered. Furthermore, the costs of bajaj are prohibitive due to high taxes and duties.

Experience from the region

Promoting motorbikes on rural roads and in small towns would make a huge difference, as shown by experience from other countries:

- In Tanzania the number of motorcycles has increased from 2000 in 2003 to more than 800,000 in 2014 after restriction on importing motorbikes were lifted (Starkey, 2016). It is estimated that in a country of 56 Million, this has created over 500,000 jobs for young men operating motorbike taxis.



In absence of adequate transport, rural Ethiopia remains an overwhelmingly walking world

- In Uganda the motorbike business has expanded so much that it may now be the second largest source of employment after agriculture. 7% of Uganda's population depends on this industry. Majority of these are men between the ages of 25-29 years (Turyahikayo & Ayesigye, 2017)
- Motorcycle taxis contribute to more than 75% of annual passenger transport and small freight on rural roads in Ghana, Malawi, Mozambique, Sierra Leone (Starkey, 2016, Unescap, 2005). On a rural road surveyed in Cameroon, 82% of passenger movements a year were on motorcycles, as well as 74% of the produce and goods going to and from markets (Starkey & Hine, 2014)
- Motorcycles taxis are profitable to operate and profitable to lease out, due to low capital costs, low operating costs, unfulfilled rural transport demand and informal private-sector systems for the leasing motorcycles for a daily fee (Unescap, 2005)
- Babinard and Roberts (2006) summarized studies from around the world to analyze how poor access was a major cause of prenatal mortality, with an estimated 75% of mortality resulting from inadequate transport to access basic health facilities and/or transport for referrals to hospitals.
- Research in Liberia suggests that more than 75% of people who come to a health clinic are brought there on a motorbike.
- Modelling longitudinal household data from 15 villages in Ethiopia, it was found that improved access (all-season, motorable rural roads) reduced poverty by 6.9 percentage

points and increased consumption growth by 16.3 percentage points.

This is hence a strong plea to promote intermediate means of transport, in particular the use of motorbikes on the rural and small town roads of Ethiopia. This should be both two-wheelers and motor-bike vans, as developed in many countries. Motorbikes vans are particularly appropriate for moving medium-size quantities of commodities.

The development of an intermediate motorbike sector in Ethiopia should also be accompanied by investment in the so-called first mile roads– the paths and trails that connect to the feeder roads. It is believed that the development of such smaller tracks and better motorbike transport will also go a long way towards better safety for women, and reduced sexual harassment along small tracks.

How motorbike taxis are organized in Kenya: an inspiration

There is much apprehension in Ethiopia on the feasibility of having more intermediate means of

transport, in particular with regards to the security and safety. Experience from elsewhere can remove these worries. Motorbikes are ubiquitous in Kenya, Uganda and Tanzania. In much of East Africa they are called boda-boda. The word is derived from the phrase 'border to border.' (It is believed that motorbike taxis originated from transport business at the border of Kenya and Uganda).

Boda-boda motorbikes have become a common means to transport people and their light luggage from one point to the other. In rural areas they are popular since the roads and paths are in poor condition, steep, and narrow; but can still be navigated with a motorbike. The distances that people used to walk were long, but motorbikes are now able to go even into hilly terrain. In towns, motorbike taxis can navigate around traffic congestions. Boda-bodas are also popular among city dwellers who are in a rush.

In East African countries the boda-bodas have created a crucial economic sector. They have helped to move people and goods from one point to another, which has created job opportunities for male youth. The fares charged are affordable to most of the customers: another factor which makes them popular.



A boda-boda taxi stand in Kenya (Image courtesy <https://kenya-safaris.co/>)

How did boda-bodas rise?

In the 1990's motorbikes were introduced which had capacities of 50-150cc. The prices of the motorbikes were high due to the taxes levied on them. During President Kibaki's first term (2002-2007) he removed and reduced taxes and levies on motorbikes. From then onwards, the prices were affordable to many people and motorbikes became popular.

How many motorbikes are there in Kenya?

In 2007, an estimated 100,000 motorbikes were registered. In September 2016, the number reached over 700,000 and the number is still growing. Probably 450,000 of the motor-bikes are used as motorbike taxis. Since a boda-boda is often used by more than one rider, the number of driver jobs created is even higher. By now there are 21 assemblers in Kenya. Furthermore, there is considerable employment from repair shops and driving schools.

How is it organized (through companies /cooperatives)?

Boda-boda are owned by individuals who are either the drivers or individuals who rent out the motorbikes. The proportion is approximately 50:50. If rented, a rider pays approximately 3 USD per day to the owners. There are cases where people jointly invest in a company that rents out motorbikes to drivers on a daily basis.

What does it cost to start a motorbike taxi business?

The cost of purchasing a motorbike varies with the brand and the Cubic Capacity. The ones commonly used have a capacity of 150cc which retail at around 1000 USD. There are brands which are cheaper especially those from China, like Skygo and Jiachin. Those going for slightly above 1000 USD are Indian brands like Bajaj and Hero. Other than the cost of the motorbike itself, a buyer has to at least have third party insurance which costs between 30-50 USD.

Can one get loans?

Banks and lending associations are at the frontline of lending money for purchase of motorbikes. It costs less to buy directly from the assemblers' outlet; as that slices off the bank's profit and interest rates. Riders can also get loans through SACCOs (Savings and Credit Cooperative societies).

How is it all regulated- licenses/ insurances/permits?

Licenses- All boda-boda riders are required to possess driving licenses of class F/G. Motorbike riding is taught at local driving schools over a period of one month, after which one sits for an exam. One can also learn through a friend's motorbike and apply directly for the license.

Insurances- A motorbike has to be insured before it is used for public transport. The minimum cover

costs between 30-50 USD. A comprehensive cover costs around 100 USD.

Permits- there are no permits required to ride a boda-boda if the license and insurance are in place.

How are the fares regulated?

There is no structured way of calculating and regulating the fare. The rider and customer approximate the fare by taking into account the distance, terrain, time, weather conditions, and the amount of luggage. Until the rider and customer are satisfied with existing price, they negotiate. Basically, pricing is more tied to a mutual agreement on what is reasonable (rather than a fixed tariff).

How is the traffic safety regulated?

Riders should have their licenses and insurances at all times. Riders are expected to wear protective and reflective gears, which include helmet and reflector jackets for both rider and customer. They are not allowed to carry wide loads- more than 30 centimeters off the sides. The regulation requires one passenger per bike.

What are most trips for?

Most trips are for people and their small luggage. Delivery companies are now coming up even in

small towns, using motorbikes to deliver goods to clients, such as those engaged in online sales.

How much can one earn?

An active rider can earn at least USD 10 per day. On good days, earnings may triple. This happens during market days when there are more people travelling. Generally, in urban areas, riders have strategic locations where they operate from, such as close to residential areas, offices, malls etc. At these places, customers take boda-bodas to their destinations. In rural areas, customers call the riders to pick them from their homes.

Are there female boda-boda riders?

There are no female riders in Kenya. Women who own motorbikes do not ride them as taxis. They ride themselves to their destinations only.

How are the taxi drivers organized?

Riders within same area often form their own SACCOs. These motorcycle SACCOs offer their members incentives to save, by setting up savings groups. Some also offer loans. Many act as communities that provide several kinds of social and professional support to their members.

RURAL TRANSPORTATION IN ETHIOPIA: STATUS QUO AND WAYS FORWARD

By Getanew Tesfaw

In Ethiopia, there are roughly 1.2 million vehicles, meaning that in a group of a hundred people, only one has a vehicle. This lack of vehicles is challenging the options for rural transport and, thus, local economies in Ethiopia. Good rural transport is necessary to circulate goods and services, improve access to vital services such as schools, health care, and government offices, and on top of this, rural transport creates millions of jobs. Also, in the transition towards regenerative agriculture the promotion of intermediate means of transport is essential to enhance market access, input supply, and save productive labor and time. This blog explores the status quo of rural transport in Ethiopia and the ways forward to improve and strengthen this sector.

Rural Ethiopia has a severe shortage of transportation; many kebeles need roads connecting to woredas. The rural roads connecting villages and farming areas to market centers are usually inadequate, poorly maintained, and costly to use. This results in the transportation of goods between and within towns and markets being dependent almost entirely on walking and head- or shoulder-carrying. Students have to move for more than two hours to learn, pregnant ladies have no means of transport to reach the hospitals for safe delivery, and people who had accidents need to be carried on the shoulder of other people to get to the hospital. Farmers transport their products to the market by donkeys and horses. Almost all this transport is unmotorized, no wheeled, and dominated by women and children carrying loads up to 30kg.

The shortage of intermediate means of transport originates from a need for bajajs, motorbikes, vans, and rickshaws, dangerous roads, and a lack of knowledge from passengers on using

transport, including payment and traffic systems. Furthermore, there is often a need for more money to invest in motorbikes, and there is no loan from the government available for such types of markets, forming an obstacle for interested adults with ambitions in this business. Also, the driving license and registration system makes the motorbike market highly complex, and the need for repair services in the area is an extra challenge for motorbike vans.

The severity of the problem differs from city to city. In Woldia, a town in the north Wollo zone of the Amhara region with a high population density, the only few motorbikes that are present are owned by government workers, bank officers, and telecom workers. This is because there is no dealer in the city that sells motorbikes, meaning there are only options to buy second-hand motorbikes. Motorbike dealers are only present in Bahir Dar, Addis Abeba, and Kombolcha.

Status quo of the transportation sector in different cities

In Woldia, there are no rickshaws present at all. There are multiple reasons for this. First, the geography of Woldia is full of mountains, rivers, and other road development challenges, making it difficult to push or pull such types of transportation modes. There is one guy that distributes soft drinks in something that looks like a rickshaw created by a local garage. He paid 2500 Birr to make this and indicated that it is good to work and economically affordable. Kombolcha city is a more industry-oriented city in Ethiopia and has, for that reason, more motorbikes than Woldia. Merchants distribute fruits and vegetables using rickshaws. Rickshaws are available at a lower cost (new 5000-7000 BIRR). Also, there are well-organized repair services available. Still, it is hard to get transport service



People transporting goods over difficult roads

to more rural areas. Two reasons were found for this. First, the price drivers ask is high, and second, there needs to be a right road that connects the city with the rural area. Dessie is a city in the south Wollo zone. Here, a sound transportation system can be found. There are motorbike dealers and well-organized repair services available. Also, the registration process and license processes are simple. Bahir Dar is the capital city of Amhara and the third largest in Ethiopia. The number of motorbikes, motorbike vans, and rickshaws is higher than in other cities due to the high population density and the high number of visitors to the town. Motorbike drivers are benefiting from these visitors. There are plenty of good roads to drive on, favorable for all means of transport. Addis Ababa is the capital city of Ethiopia. The main form of intercity public transport is buses. However, the city's current transportation system is marked by poor access networks, continuous increases in transportation fees, and a need for smoother traffic flow. Considering prices and travel time, most people select motorbikes for transport. The number of motorbikes is high but needs to be better organized. Here the legal systems in place limit operations, and there are many problems related to permission, licensing, and registration processes.

Ways forward to improve the (rural) transportation sector in Ethiopia

According to several dealers in Ethiopia, people buying intermediate means of transportation are authorized persons, merchants, diasporas, and people with wealthy families. There needs to be a

secure financial system that supports transporting businesses. Sometimes the government provides a loan, but this comes with high risks. Also, to lend from the government, the lender must have a house or land. This makes financing a significant obstacle in starting a transportation business. Also the fact that there is often still a lack of (safe) roads is a large obstacle for a strong rural transportation sector.



Farmer transporting his goods with a donkey



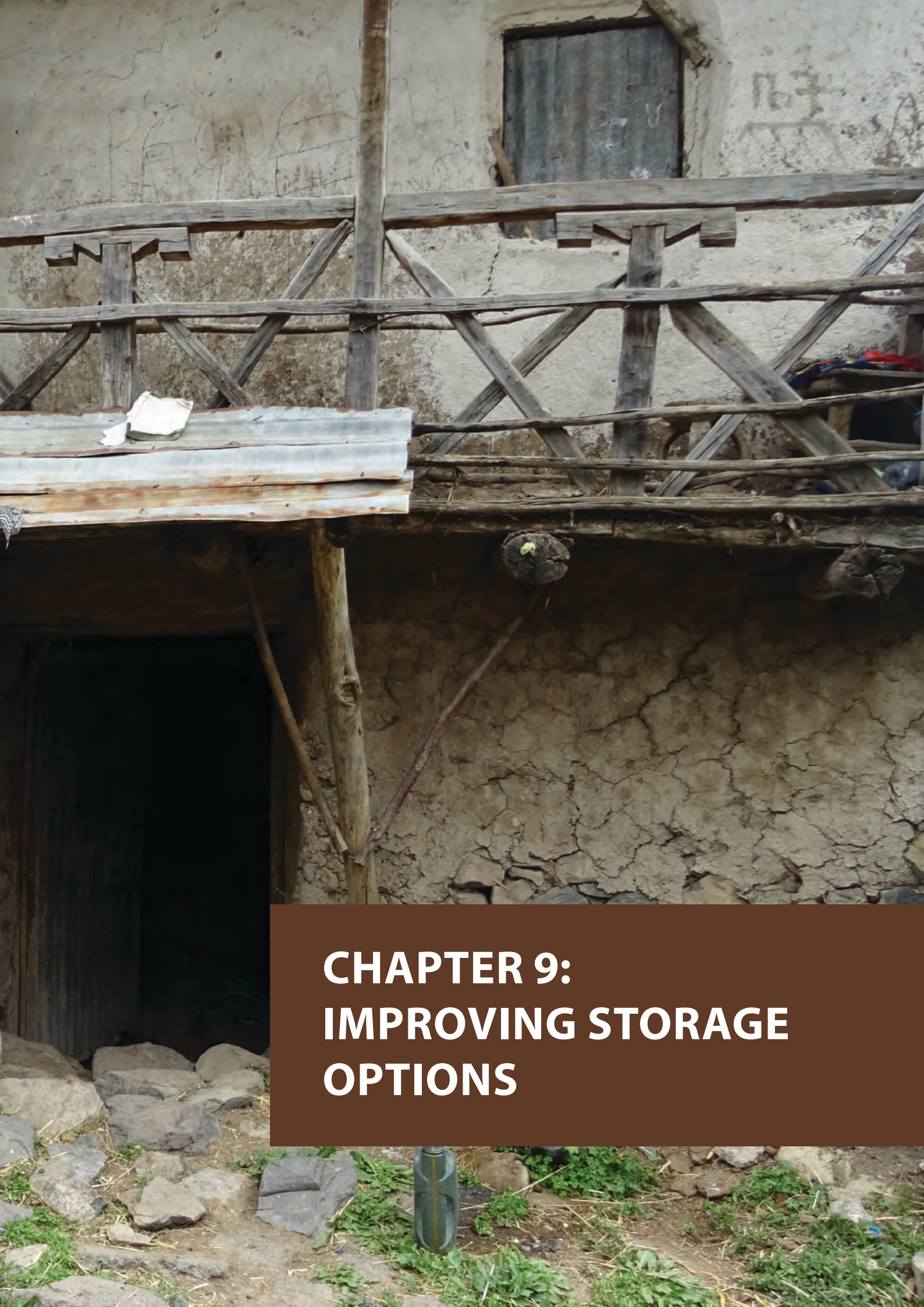
Despite these struggles, there are still people eager to create a business in this sector and be a part of the solution to improve rural transport. One example is Mohammed. Mohammed is a 31-year-

old man born in Bure Dangla, near Bahir Dar. After completing secondary school, he went to Bahir Dar and started a job at a hotel. After three years, he borrowed money from friends and bought a motorbike. After four years, he could pay back his debt by working from 12 in the morning until 3 at night. Now he is a proud business owner with three motorbikes. More people have this aspiration to contribute to the transport sector. But a recurring comment is that they require help in starting up a business and initial investments for motorbikes, drive training, completing the licensing process, and doing the full registration.

To strengthen the (rural) transportation sector in Ethiopia, a secure financial system is required to provide starting businesses with the initial investments that they need. The availability of motorbikes and removal of limiting restrictions should be pushed for. Moreover, more cooperation between actors responsible for the road network in the country and (potential) rural transport business owners would be beneficial to kickstart this sector. Currently, there is only little attention from concerned bodies for transportation businesses.

As mentioned above, pushing the development of the rural transportation sector is also important for the regenerative agriculture transition. With a strong rural transportation network, market access will be enhanced, agricultural input supply will be more secure, and a lot of precious labor and time will be saved.





CHAPTER 9: IMPROVING STORAGE OPTIONS

ON STORAGE

By Bantamlak Wondmnow, Getachew
Engdayehu, Meheretu Yonas and Frank
van Steenberg

Post harvest losses are genuine losses: the crop has been prepared, all efforts made – hard labour, land, inputs – and then the result of the efforts is just lost. Post-harvest losses can unbearably high. They come during harvest, transport and storage. In Ethiopia, grain storage losses are estimated to be between 3 to 9%, with some grains (like teff) more resistant to storage pests than others (such as maize).

There is another dimension to post-harvest losses which is public health and hygiene. Traditional storage is often rudimentary and may, for instance, consist of bamboo mats held loosely together. These open storages attract vermin and rodents close to where people live and this increased the change of zoonotic contact. There are many diseases associated with the presence of vermin and rodents in villages. Here is a list of some:

- Hantavirus: transmitted through the saliva, urine and feces of infected rats. It may affect heart, lungs, and kidneys
- Leptospirosis: a very common but not much recognized diseases, transmitted directly through rat urine or through water contaminated by it, causing high fever and jaundice among others
- Rate bite fever: caused by rat bites or scratches, causing headache, fever, rash, vomiting, muscle pain, joint pain, or swelling
- Salmonellosis: due to contaminated food, one of the four most common causes for diarrhea.

Following the severe rodent outbreaks in the woredas of Guna, Farta and Wadlar in Amhara Ethiopia, ecologically based rodent management campaigns were organized in the most severely affected watersheds. The community campaigns consisted of eradicating rodent shelters, controlling their passage, exposing them to natural enemies, removing access to food, and controlled trapping



and killing. The campaign triggered much change in behavior with cats, village cleanliness and traps getting popular in many villages. In Ata Meher watershed, Ato Sisay Mengistie, a farmer, developed of his own accord a totally new rat-proof storage system, made of wood and corrugated iron. It is called “Yekorkoro Gotera”, meaning Iron Plate Storage. It is a square two-meter high container closed with a door. These are placed in the house, used to store wheat and barley.

The “Yekorkoro Gotera” has a lot going for it:

- Almost perfect in keeping rats from getting inside: the sharp overhanging edge of the corrugated iron keeps the rats away
- Made from locally available materials at a reasonable price, i.e. ETB 1350 (USD 30) – which includes ETB 600 for corrugated iron sheets, ETB 200 for wood, ETB 150 for nails and ETB 400 Birr for carpenter costs.
- It is easy to build, and adaptable and

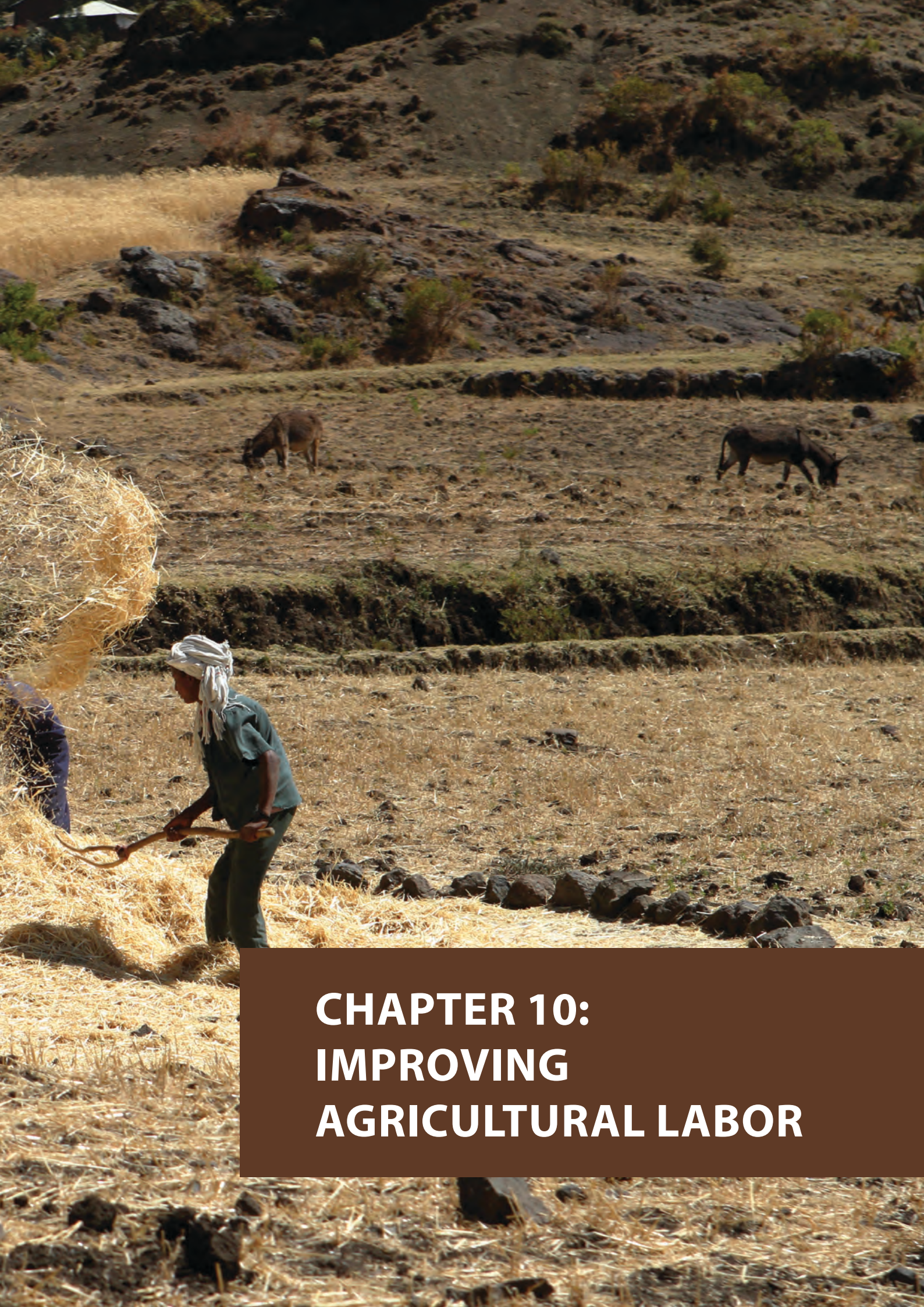
convenient to use and scale up.

- It is able to store large quantities of grain: up to 1500 kg per storage.
- It is durable expected to serve for many more years than traditional storage arrangements
- Creates jobs for local carpenters

The “Yekorkoro Gotera” gained quick popularity and within a year were replicated to several dozen. They were made part of the experience sharing events organized alongside the watershed campaigns in the region. Through such horizontal learning, the storage model and skills to make them are becoming commonplace.







CHAPTER 10: IMPROVING AGRICULTURAL LABOR

HOE IS HOE IN FARM TOOLS?

By Francesco Sambalino

When talking about tools and increasing labour productivity, we automatically think of tractors, combine harvesters, and sprayers. However, on small vegetable farms, the bulk of the work is done with hand tools, and there is an enormous difference between one tool and the other.

The operations are many: unless you run a no-till farm, you start by preparing the ground and creating a fine seedbed to welcome seeds or seedlings. You must then handle weeds and water plants throughout the season and sometimes prune them. When ripe, you then harvest the produce just in time to start the cycle again.

Tools exist for each operation, and while their high-tech motorized cousins continuously evolve, improved hand tools are niche.

Weeding is commonly the task that requires the most time and effort. You think weeding; you talk hoes: one of the oldest tools to humankind. As simple as ubiquitous.

Hoes have existed since the dawn of agriculture. The testimony comes straight from Sumerian mythology scripts dating back to as early as the 3rd millennium before Christ.

In Europe, the Romans then introduced the eye-hoe – a design that is still with us: a sharp metal blade with an eye at one end where to secure a wooden handle (left hoe, in the picture below).

If you close your eyes and think of a hoe, you probably think of an eye-hoe, the most common type of draw hoe. Draw hoes are used for working the ground up to 10 cm in depth. Farmers drive it into the soil in a chopping motion, using two hands, and then pull it towards their bodies to dislocate chunks of soil.



Although primarily used for digging and moving soil, people also use draw hoes with smaller blades for weeding. However, they are not the best hoes for the task. Scuffle hoes should be used instead. Scuffle hoes are lighter tools to scrape the soil superficially and kill weeds efficiently by damaging their roots when they are most delicate.



From left to right: an eye-hoe and two scuffle hoes (stirrup hoe in the middle and collinear hoe to the right)

We see draw hoes everywhere, but the same isn't true for scuffle hoes. Too many times, bare hands or draw hoes are used instead. The draw hoe will work well in controlling weeds, but it is an overkill. It requires more energy and time, and takes a heavy toll on your body, especially with the all-too-common short handle versions you see around.

It is like facing a bear with a bazooka or barehand, instead of having the appropriate rifle: you are either over-equipped or under-equipped.

The other day we did a little experiment. We weeded two garden beds of 10 meters. What took 7 minutes and 15 seconds with a short-handled draw hoe, took only 5 minutes with a scuffle hoe (stirrup in the figure above). The grunting and swearing was reduced sixfold.

The right tool for the right job

There are many kinds of scuffle hoes, and everyone has their favourite. Here is a short description of the hoes we use daily.

There is the stirrup hoe: a smartly designed hoe head that we use when we have to clean a garden bed of weeds that have passed their teens. It is stronger than the other scuffle hoes and can also be used to break the soil surface lightly. It has a hinge that allows the attached hoe head to swivel



Stirrup hoe forth cutting motion (left) and back cutting motion (right). Notice the hinge that permits the cutting blade angle to change

back and forth. This neat design enables the farmer to cut through weeds when pulling and when drawing the tool back. This is excellent for the economy of movements as it effectively cuts the number of times you need to move the tool by half.

There is the collinear hoe: This tool is a clever, simple hoe head. If the garden bed soil has a good tilth and the weeds are young, this is probably the tool for the job. It is used to disturb weeds at emergence when they are the easiest to control. The small blade is scraped just a centimeter under the soil surface to knock weeds out. It was designed to work with the back perfectly straight, thumbs up, and with a perfect economy of movements. When using this tool, you'd think you are sweeping the kitchen floor with a long stick broom. Fast and clean.

There is the wire hoe: This tool is the sniper in the horticulturalists' hands. It is precise and allows you to get very close to plants without damaging them. A steel wire hoop replaces the blade. It is blunt, and for this reason it won't easily damage the plants you are growing. It is perfect for navigating tight corners and handling the most hidden weeds.

There is a catch, though. Even more than the collinear hoe, this tool won't do much if you don't have a good soil tilth.



Collinear hoe

These simple tools make your life so much easier. Their simplicity contrasts with their low adoption found outside specialized market gardeners' circles. They are so simple that a blacksmith apprentice could replicate them blindfolded.

One neat evolution of these hoes is the wheel hoe. Ever heard of it? Get a wheel barrel, strip it of its container and attach a hoe head to the bottom, in between the wheel and the handles. You have a crappy wheel hoe prototype, but you got the idea. Of course, it was refined, made lighter, and agile. Experiments in India have recently shown how

wheel hoes reduce weeding time to between a half and a fourth of the time needed with a traditional weeding knife (Khurpi) (Shahi, 2018; Bajpai, 2018).



Wire hoe clearing weeds in between young onions

Ergonomics

Once you've chosen the type of scuffle hoe you want to use, some features need consideration to make your life even easier.

The handle must be long enough to comfortably work upright and possibly with both thumbs pointing up while holding it. If you try that yourself, you'll notice that you are holding your hands in a neutral position without straining your wrists. It is difficult, if not impossible, to do that with a short handle. You'd need a handle that reaches the area between your shoulders and your nose. It is the same grip used to hold a broom to sweep the floor. And yes, many times also brooms need longer sticks.

The finger grip is another forgotten design flaw. Most handles producers have a one size fits all approach. However, hands are very different. When

a handle is too thick, your grip is too loose, and you are likely to strain your hands because of the extra force required on those tiny hand muscles. What you need is a finger lock. The fingers should easily encircle the handle. To find the right handle diameter, make the ok sign with your hand and measure the diameter of the space formed. That's the right handle size. However, the best grip could also be measured using a hand dynamometer (Moore et al., 2021).

To recap: Right length and right thickness of the handle make your life easier.

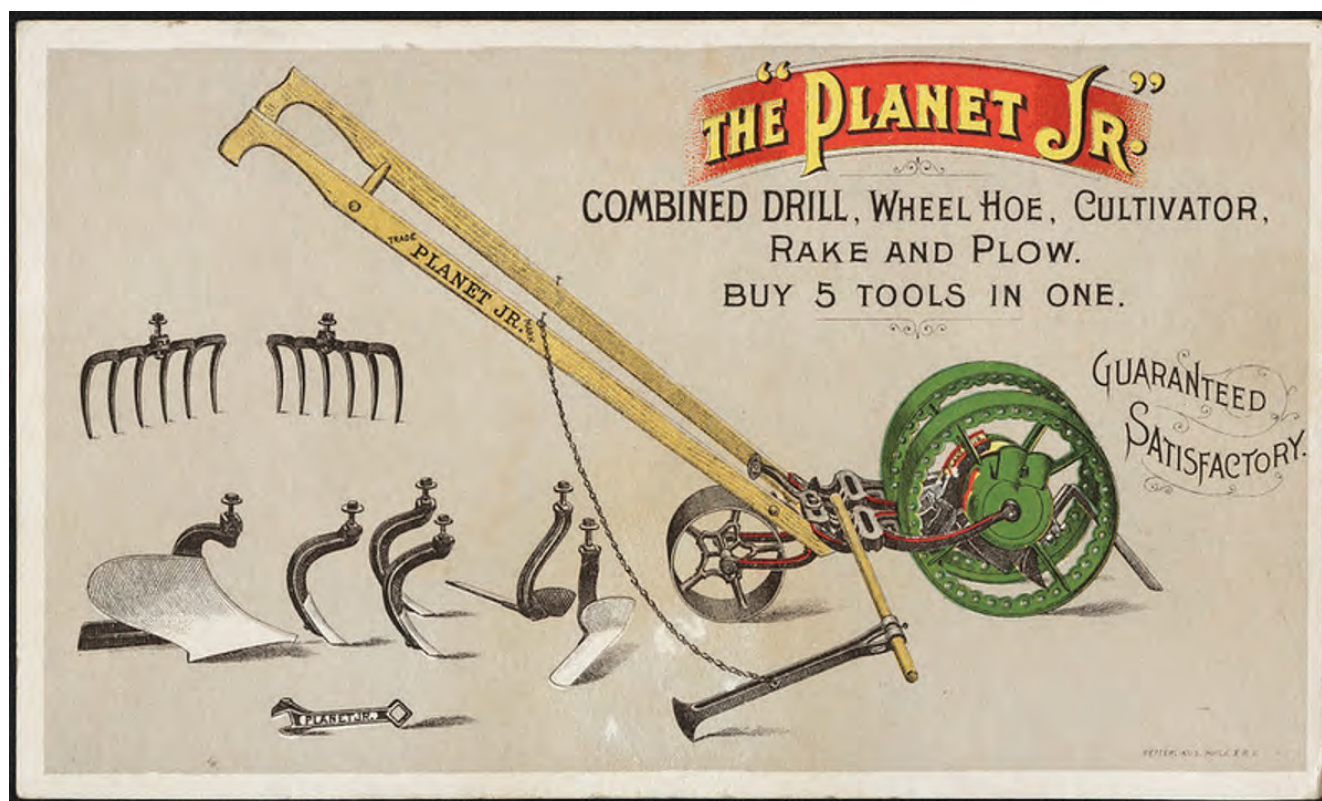
The final point is maintenance. Would you cut bread with a spoon? I hope the answer is No, and if you agree, you'd also agree that you need to keep your hoes sharp and build sharpening into a weekly habit. If you do so, you'll need less power, be faster, and lower the risk of musculoskeletal injuries.

Forget weeding, eventually

Weeding is maintenance time, not productive time. The less time spent weeding is time gained to carry out more productive tasks such as planting, harvesting, and marketing. We want to reduce the time spent weeding to a minimum in the long run. In our journey to a no-till system, we'll reach a point where, thanks to reduced soil movements, we will not expose weed seeds to the right germination conditions, something that constantly happens with tillage. When ploughing, buried, dormant seeds are brought to the surface and germinate. Until we reach that point, we control weed populations by over-crowding them with

crops, smothering them with tarps and mulch, and intervening with scuffle hoes.

(These improvements were tested at Petricor farms in Spain. Petricor and MetaMeta are partners in testing innovative farming solutions for small scale bio-intensive vegetables production)



Wheel hoe model from the bustling “steampunk” period that preceded the petrol engine era and the consequent oblivion of appropriate technologies (Source: Boston Public Library)

MAKING FARMING EASIER: INTRODUCING NEW FARM TOOLS IN RURAL ETHIOPIA

By Getanew Tesfaw

Farming is a back breaking and hard job. Luckily, using the right tools can make it a lot easier and more comfortable. It is for this reason that the GFF program introduced stirrup and wire weeder tools to farmers in the GubaLafto woreda. The farmers identified the use of the stirrup weeder as very useful and of high importance to the farmers removing weeds and unnecessary plants from their lands. It also helps to increase the aeration of the soil, which makes the plants healthy and grow faster, leading to improved yields and food security.



Stirrup and wire weeder, respectively



Farmers being introduced to the stirrup and wire weeder

Next to improved farming productivity, the farmers also indicated that these tools benefited body contact and flexibility. When they use this tool to remove weeds, one hand is free from any dirt on the land, resulting in less damage, injury, and diseases. With this tool that makes weeding a lighter job, they can also elongate farming and need less rest to prevent backbone pain. A farmer that received the tool mentioned, “This tool saves us time; one person can cover two- or three-person power by using this tool.”

Also, the wire weeder helps the farmers protect themselves from injuries from sharp objects and potential infections. It works incredibly well in sandy soil farmlands, as the roots are not tightly bound and can be easily removed. And like the stirrup wire, this tool can also be used for aeration and earthing up. Farmers suggest adding sharp

parts to the wire weeder when used on loam soil to make it even more effective.

The farmers saw the advantage of using these tools and indicated they could become part of the farming culture, like using a sickle. “If some model farmers can get some training to use it and show it to others, we can adapt it quickly. It has a good chance to modernize farming”.

More than merely demonstrating the tools to farmers is required for a complete evolution in farming throughout the region. Integrating these tools into the farmers’ work may take time and extra training. Selecting model farmers and training them about their usage may enhance the uptake. Testing the device in the agriculture office will show all visiting farmers its purpose and effectiveness. Select model farmers and give them training on using the tools to improve the uptake.

If model farmers can get training, they can provide again to others and spread the knowledge.

Also, the local production of the tools is challenging. Local metalworkers raise questions about access to the materials used and finding the proper pricing for their products. More guidance to find the raw materials is needed. Another solution could be to use different locally sourced materials for the tools.

Overcoming these production challenges and scaling the use of improved farm tools in rural Ethiopia is highly important and will enhance many farmers' lives. Current agriculture in Ethiopia still follows traditional ways, and promoting new tools can fill this gap.



Farmers testing the stirrup and wire weeder in the field

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