Food and Agriculture Organization of the United Nations

RESTORATION IN ACTION AGAINST DESERTIFICATION

ACTION AGAINST DESERTIFICATION

A MANUAL FOR LARGE-SCALE RESTORATION TO SUPPORT RURAL COMMUNITIES' RESILIENCE IN AFRICA'S GREAT GREEN WALL

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Cover photo: Large-scale land preparation, AAD project, Djibo, Burkina Faso ©FAO/Giulio Napolitano.

Contents

Tables

Boxes

Figures

Acronyms and abbreviations

AAD	Action Against Desertification
ACP	Africa, Caribbean and Pacific Group of States
CBO	community based organisation
FAO	Food and Agriculture Organization of the United Nations
FIES	Food Insecurity Experience Scale
FPIC	Free, Prior and Informed Consent
GGW	Great Green Wall
GGWSSI	Great Green Wall for the Sahara and the Sahel Initiative
HFIAS	Household Food Insecurity Access Scale
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
M&E	monitoring and evaluation
NGARA	Network for Natural Gums and Resins in Africa
NGO	non-governmental Organization
NTFP	Non-timber forest product
OECD	Organisation for Economic Co-operation and Development
SID	Seed Information Database, Royal Botanic Gardens Kew
UNCCD - COP	United Nations Convention to Combat Desertification – Conference of Parties

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Executive summary

This publication supports processes related to rural communities' resilience in implementing land restoration of the Great Green Wall Programme on the ground. It serves a dual purpose of consolidating biophysical operations and socio-economic assessments, and is mainly built on five-year interventions and practical experiences gathered through the Food and Agriculture Organization of the United Nations (FAO) Action Against Desertification (AAD) project.

The first part of the publication is a practical manual expressly created for stakeholders, partners, non-governmental organizations and community-based organizations. Its purpose is to guide the implementation of restoration operations at scale on the ground, as well as to provide detailed practical instructions based on the successful results obtained by Action Against Desertification. The manual describes how to implement an innovative approach to the large-scale restoration of degraded land for small-scale farming. This innovative approach consists of combining enrichment planting of native woody and fodder grass species and the preparation of large-scale land for rainwater harvesting and soil permeability. 50 to 100 hectares would be the appropriate plot size for mechanized deep ploughing. This is linked to the social mobilization and support of communities to the interventions in their communal lands. Overcoming technical and research challenges of identifying and planting the right species in the right place and at the right time to benefit the maximum rainwater for their growth is a key success factor. Between 10 and 12 well-adapted and useful woody and herbaceous species are combined and planted per hectare so as to maximise investments while sustaining resilience on the ground.

The restoration approach also opts for effective and less costly/cumbersome direct sowing, which produces tremendously good results when applied appropriately during the optimum planting period. These steps and process together have been devised as a resilient land restoration approach, which is highly adaptable to varying ecological and socio-economic conditions and therefore suitable for replication and scaling up.

The second part of the manual introduces a methodology for socio-economic assessments. This easy-to-use approach is based on household surveys and can be used by socio-economic experts to monitor, evaluate and assess the socio-economic impacts of the large-scale restoration interventions. Household surveys are not only used for impact assessment but can potentially serve to collect useful data needed to plan a restoration intervention. Quantitative information is collected through carefully chosen standardized questions to households as samples. The proposed questionnaire is divided into three sections: (i) a first section structured around the Sustainable Livelihoods Framework, used here as a benchmark in order to assess livelihoods in a holistic way, (ii) a set of generic questions drawn from FAO's FIES or Food Insecurity Experience Scale and (iii) data on the main species used at household level. The role of the interviewers or enumerators is crucial, as they deliver the survey to households and are primarily responsible for the quality of the data collected. An informative socio-economic report is produced after analysing the resulted data collected through statistical tools. Such assessments are used for decision making, as baselines and/or for evaluating social impact of biophysical interventions on Great Green Wall communities.

COGES OF BANDIEDAGA VILLAGE,
BURKINA FASO

Introduction

Desertification is commonly found in the Sahel in areas where vegetation has gradually been depleted over the years. This phenomenon is caused by a combination of factors such as climate variations and other constraints e.g. land clearing, over-grazing, deforestation or firewood collection, as well as exposure to wind and water erosion. In fact, climate change has produced dramatic consequences in the region and is expected to adversely influence the effects of socio-economic changes, in addition to potentially trigger faster rates of degradation and landscape-scale impoverishment.

In its 2018 report on land degradation, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2018) warned that land degradation negatively affects 3.2 billion people and represents an economic loss in the order of 10 per cent of annual global gross product. According to IPBES, "combatting land degradation (...) is an urgent priority for the protection of the biodiversity and ecosystem services that are vital to all life on Earth and to ensure human well-being." Furthermore, sustainably managed and restored trees and forests in Africa's drylands have the potential to reverse land degradation and therefore contribute to poverty reduction, food security, biodiversity and climate change mitigation and adaptation. Many well-tested land restoration practices and techniques, both traditional and modern, currently exist. Overall, the benefits of restoration are up to ten times higher than the costs (IPBES, 2018; Nkonya *et al.*, 2016).

Restoration is recognized as a priority by all of the countries of the Great Green Wall (GGW) in terms of intervention, due to the fact that it offers the dual benefit of biophysical, as well as socio-economic enhancement. In fact, it is estimated that 166 million hectares of the GGW core area are in need of restoration and 10 million hectares must be restored each year (Berrahmouni *et al.*, 2016), in order to reach this target by 2030. Out of this total, GGW countries and international partners have recently pledged at the UNCCD COP 14 to restore 100 million hectares of degraded agro-sylvo-pastoral lands in the GGW by 2030. Moreover, African countries at the Paris climate summit in 2015 have committed substantial pledges for initiatives such as the AFR100 with the goal to also restore 100 million hectares in Africa by 2030. The question however of how these numbers can feasibly be transformed into reality remains. How do we win the race against time?

There is no miracle solution: restoration will require substantial investments, including equipment, restoration seeds and capacity development. In addition, it will require the support of the appropriate policies, governance mechanisms and financial assistance, as well as other incentives that facilitate the implementation of on-the-ground restoration interventions on a massive scale. This manual supports rural communities' resilience in implementing on the ground of the Great Green Wall Programme. It serves a dual purpose of consolidating biophysical operations and socio-economic assessments, and is based mainly on five-year interventions on the ground and practical experiences gathered through Action Agaisnt Desertification.

This publication is divided into two parts: the first one is a practical manual based on a step-by step innovative approach for large-scale restoration of degraded land for small scale farming. The second part presents how socio-economic surveys can be used to collect key socio-economic data needed to implement and monitor such interventions. Both these sections complement each other and aim to support large-scale restoration interventions in the context of the Great Green Wall.

LARGE-SCALE LAND PREPARATION AND TREE PLANTING, AAD PROJECT, BURKINA FASO

LARGE-SCALE RESTORATION IN PRACTICE

Although many land restoration projects have been successful, other large-scale restoration projects implemented mainly in the drylands on a global scale have been less successful due to poor technical choices (species and seeds used, inappropriate nursery and planting techniques) as well as an ineffective top-down approaches. To address this issue, in 2015, FAO developed global guidelines on dryland restoration (Berrahmouni *et al.* 2015) that provide general recommendations for both practitioners as well as policy and decision-makers, in an effort to support restoration efforts in drylands. Small-scale or pilot initiatives have also been unable to address the restoration issue at the right scale and can no longer be the only answer. On the other hand, although dryland communities have valuable traditional ecological knowledge and land management skills (such as the half-moon and Zaï techniques used in the Sahel), these techniques can be very demanding and do not suffice when confronted with rapid climate change (Sacande and Berrahmouni, 2016).

This section describes an innovative approach which combines enrichment planting of native woody and grass species with large-scale land preparation for rainwater harvesting and soil permeability. Enrichment planting to re-establish native species has proven to be a more effective method as opposed to natural regeneration, which tends to be very time-consuming or at times ineffective in severely degraded landscapes. In sum, this approach is a powerful tool for combating desertification and is often the only possible option for the restoration of large areas in rural/country side agro-sylvo-pastoral systems.

This approach has been tested in the field with good results through different GGW projects including FAO's AAD project (fig. 1) implemented in different landscapes, ecosystems and countries. Several of the key contributing elements are:

- the use of high-quality restoration seeds and propagation material of well-adapted native species;
- the combined use of a mixture of grasses and woody species to maximize land cover;
- the use of mechanized land preparation techniques in order to reach the targeted scale;
- the participatory approach based on community needs and preferences for species and restoration objectives.

This manual section has been designed for all levels of technical staff (village technicians, project staff in NGO's and other organisations) in addition to other restoration practitioners in the Great Green Wall as well as in other dry areas.

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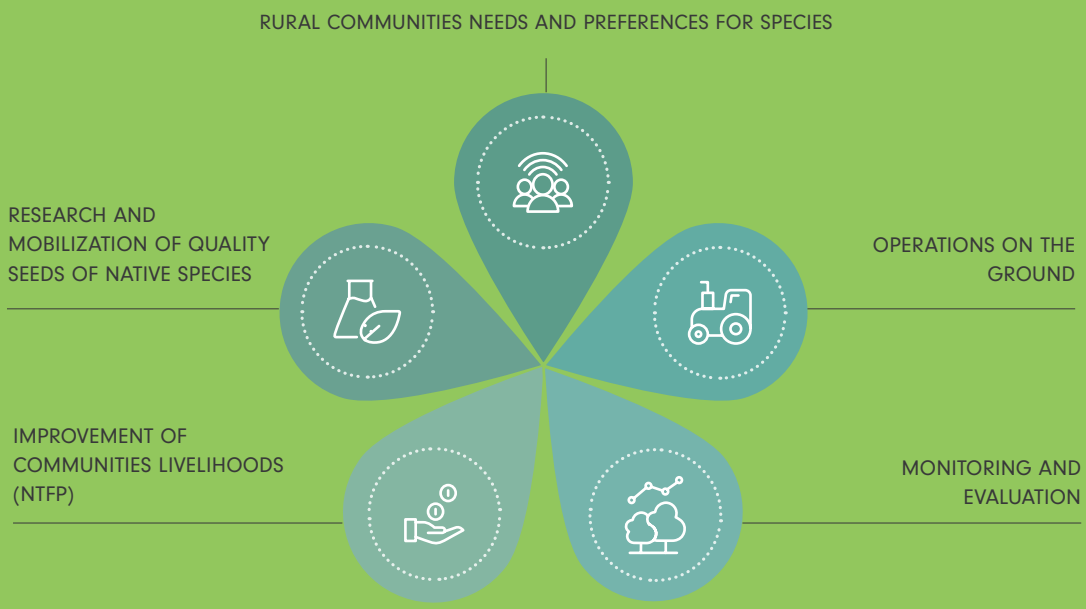
COMMUNITY MEETING, AAD PROJECT, DJIBO, BURKINA FASO

FIGURE 1. The AAD restoration approach



1 Community mobilization and restoration planning

Experience has proven that the level of community participation in the early stages of restoration often determines its degree of success. Communities are central to the restoration process and should be directly involved in the selection of the village sites to restore, species selection, seed collection, and planting and management of the restored areas. Selection of the species used in restoration in particular should be carried out based on the community's needs and priorities, and in consideration of ecological adaptability.

Engaging with rural communities

Depending on the type of initiative and because resources are often limited, the villages and communities destined to benefit from a restoration initiative may require a selection process, which must be carried out according to criteria jointly agreed upon with the partner organizations. The criteria could include:

- the availability of degraded land to be restored in the villages;
- the motivation and commitment of community members to take part in restoration activities, including in-kind contributions such as land and labor;
- the non-existence of unresolved land issues and / or inter-village disputes;
- the pre-existence of community-based structure and organizations.

Communities have the right to give or withhold consent for any restoration project or development activities affecting them or their territories, and to conduct their own collective discussions and decision making independently. For restoration to succeed, an agreement on behalf of the local population for the undertaking of restoration work should be reached. The concerns of the community must be clearly understood and therefore consultation meetings with communities are essential, not only for an assessment of their commitment and motivation, but also for responding to their needs and requirements. Finally, the participatory assessments provide a better understanding of the needs and concerns of the communities. The Free, Prior and Informed Consent is an approach of critical importance that provides a set of principles guaranteeing indigenous communities their rights (FAO, 2016).

Selecting the restoration sites

The choice of restoration sites within a community should be the result of a collective decision-making process, and the ideal site for a larger scale intervention should be easily accessible to villagers. The restoration sites must not be too large for easier management, therefore, 50-100

hectares for a community or a village would be optimal. In fact, this area size, as opposed to a smaller size, allows for more cost-effective mechanized interventions (tractor, plough, transport and operators). A clear land tenure is a prerequisite for launching the restoration activities, hence, priority must be given to an agreement that clearly specifies the restoration objectives, the precise location of the sites to restore, and how to reach the restored sites within the village management committee. Box 1 provides specific guidance on how to select restoration sites.

BOX 1. Selection of restoration sites

SITES TO SELECT

- ☑ Areas of a maximum size of 50-100 ha/village, not necessarily in one piece
- ☑ Sites that are suitable for cultivation, grazing, or forestry
- ☑ Sites which are easily accessible by villagers
- ☑ Sites for which an agreement-in-principle of the local population has been reached to initiate restoration activities

SITES TO AVOID

- ☒ Land with unresolved land tenure issues or possible conflicts
- ☒ Areas that have gold (or other) mining potential
- ☒ Sites located on or close to transhumance routes
- ☒ Sites where other partners have started working
- ☒ Sites with public infrastructure
- ☒ Areas with rocky outcrops

Selecting and prioritising useful species for restoration

One of the key elements of a successful approach presented in this manual is the fact that the communities determine which species (of trees, shrubs and grasses) should be used for restoration, basing their choices on the utility of each given species. Questionnaire based surveys (as detailed in Part II of this manual. A sample questionnaire on species preferences is also provided in Annex 3) and focus group discussions serve as useful tools for collecting traditional or cultural knowledge on how species are currently being used, or were used in the past, as well as their presence/absence in the area. Indeed, traditional ecological knowledge is often poorly documented and sometimes can be identified only through local surveys.

Once the preferred species have been identified, a prioritization exercise is carried out by community members with respect to restoration objectives (often sylvo-pastoral, agro-ecology, agro-forestry or agro-sylvo-pastoral), their lifestyles, well-being aspirations as well as the how to generate income from their environment.

It is important to improve local knowledge and to establish preferences for species with accurate and up-to-date botanical and ecological analyses, given that some of the species chosen by community members may not be suitable for restoration in the targeted sites, as in the case of exotic species or species better adapted to humid environments. Native species should always be given preference, as they are well adapted to local ecological conditions and therefore more suitable for the natural re-establishment of the native flora and fauna species and enhance ecosystem resilience (Sacande & Berrahmouni 2018). Exotic species, on the other hand, may cause major environmental disruptions, especially the invasive species that compete with and/or replace the native species. These species can be used for other purposes, however, this is not advisable if the sustainability/resilience of landscapes is the targeted outcome.

It is recommended to maximize the diversity of planted species on a given site allocated for restoration, in order to maximize ecological functions and therefore build better resilience on the ground, for example, a minimum of 10-12 species planted per hectare, combining grasses, trees and shrubs.

Over 200 plant species have been identified as useful species to rural communities across GGW countries through household surveys, including at least 86 tree species. 50 of these species (trees and grasses) are being planted in the six AAD African countries. Figure 2 shows the top 32 preferred native tree species in the AAD project, ranked by percentage of use by households. The remaining 8 exotic tree species, shown in yellow in the diagram, are commonly used by rural households and although they are not planted for land restoration, some of the exotic trees may still be planted in home/nutrition gardens or agro-forestry systems.

Plant use data has also been recorded and used to classify species. Species with multiple uses and high market value were usually preferred, with the largest proportion of the given uses being respectively destined for human consumption or in veterinary medicine, food and livestock feed. *Acacia senegal* (also known as *Senegalia senegal*) for example, is a major restoration species with multiple uses, mainly for improving soil fertility and producing gum arabic, but also as a source of food, fodder and honey (NGARA, 2017; Sacande and Parfondry, 2018). The categories and proportions of the various uses of species selected and preferred by communities is presented in figure 3 (see also Annex 1) for the planted species, both grasses and trees.

GREAT GREEN WALL NURSERY,
AAD PROJECT, KOYLI ALPHA, SENEGAL

FIGURE 2. Main preferred tree species by households (AAD African countries)

A diversity and important plant species selected and used by AAD 's rural communities for their livelihoods in eight African GGW countries (Burkina Faso, Ethiopia, the Gambia, Mauritania, the Niger, Nigeria, Senegal and the Sudan). Only native species are planted for restoring degraded lands in agro-sylvo-pastoral landscapes, while the exotic species are planted in home-gardens.

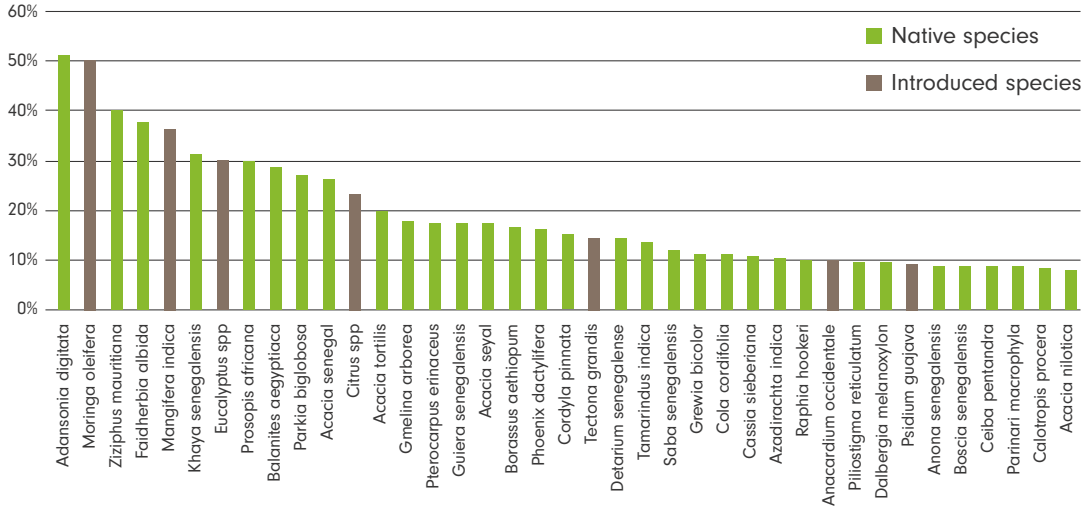


FIGURE 3. Classification of species by use category

Classification of species by use category defined by the rural communities in AAD intervention areas. Out of the 150 preferred species, most are multipurpose. Plants with high market value were usually preferred, with the largest proportion for human and veterinarian medicine, food and livestock feed.

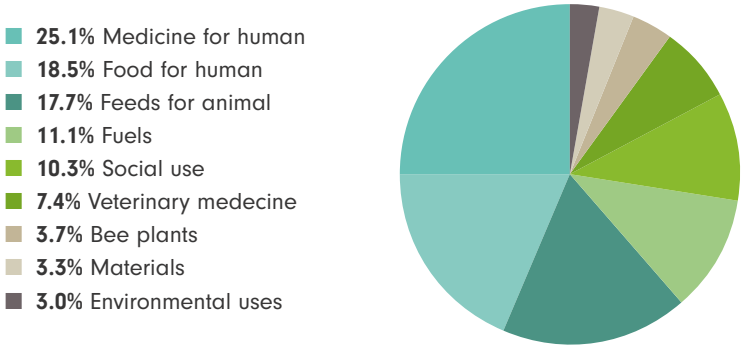
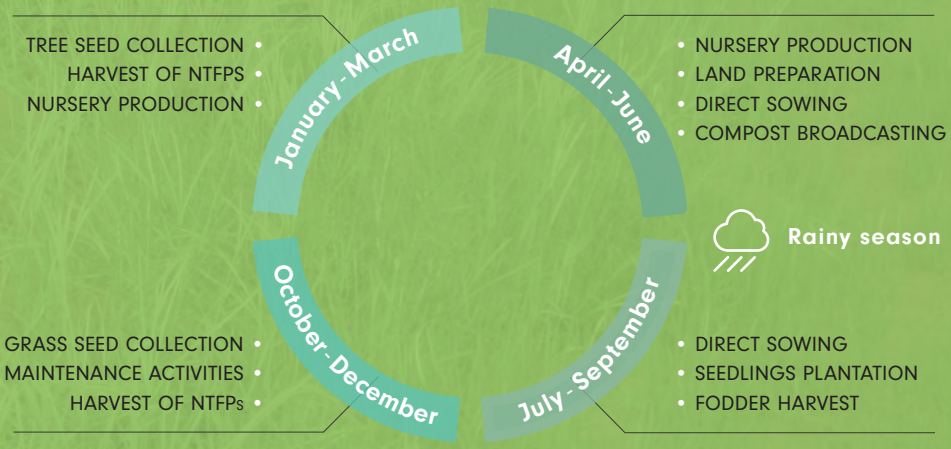


FIGURE 4. The restoration calendar



AAD RESTORATION PLOT IN GARGABOULÉ, BURKINA FASO

Planning restoration activities on the ground in the Sahel

The Sahel is characterized by a long dry season from eight to nine months and a short rainy season from three to four months. Land restoration, like rainfed agriculture, is rainfed agriculture, is closely associated with the seasonal calendar. The rainy season is relatively short, starting around June and ending in September, and planting should be carried out at the beginning of the rainy season to maximize plant growth when rainwater is available.

Planting activities are labor-intensive and very time-consuming. As a result, finalizing the planting activities within a short rainfall period while growing crops at the same time can be challenging. Hence careful planning is crucial so as to ensure that the appropriate species are planted in the right place and at the right time.

The geographical coordinates and surface areas are determined as soon as the sites have been selected, after which the following key elements can be determined:

- the quantity of seeds required (Section 2);
- the quantity of nursery seedlings required (Section 3);
- the workload required for land preparation (Section 4) and plantation (Section 5).

The restoration calendar (fig. 4) indicates how the main restoration activities are spread throughout the year.

KEY RECOMMENDATIONS
CHAPTER 1

Gather information locally on the preferred local species and their uses and complement it with the appropriate scientific knowledge related to adaptability and propagation.	**Carefully select a site of degraded land within the reach of the local community, with clear land tenure and with a manageable size.**	**Restoration starts well before planting; activities need to be planned well in advance so that planting can start as soon as the first rains have settled.**

PREPARATION OF SEEDS FOR DIRECT SOWING, AAD PROJECT, DJIBO, BURKINA FASO

2 Mobilizing quality restoration seeds

The origin and quality of the propagation material used (seeds, cuttings or seedlings) are key factors that require close attention for a successful outcome of degraded land restoration. Indeed, failure to mobilize and use quality seeds can jeopardize the entire restoration project or program. Mobilizing large quantities of quality seeds for restoration planting of thousands hectares of land can be difficult. While forest seed handling should be done by specialized seed centres, cascade training of community technicians on wild seed collection is recommended, as they live next to the natural stands. This process is an investment for a longer term but a good exit strategy when external funds phase out.

Determining the right quantity of seeds needed and planning seed collection

Seed quantity is a key variable of any plantation initiative that should not be underestimated and must be determined as soon as possible to allow for the timely mobilization of quality seeds. The quantity of the seeds is determined by the weight (and not by number of seeds) as this variable is easier to use whether the seeds be collected or purchased. An estimated amount is determined for each species once both the surface area to restore, as well as the planting and seeding density are known. In addition, it is important to take into account the following variables so as to determine the weight of the seeds required:

- 1 000 seed weight (i.e. the weight of 1 000 seeds of a given species);
- germination response (i.e. the percentage of seeds of a given seedlot likely to germinate over a given period).

Examples of these two variables can be found in the table in the annex, or through an online database such as the Seed Information Database (SID) of Royal Botanic Gardens, in Kew (UK). Table. 1 provides an example of the calculation of the quantity of seeds needed based on a mix of three tree species (acacia, baobab and balanites). In practice, however, trees should be combined with herbaceous seeds of 3-4 species and, due to the fact that grasses generally produce smaller seeds (thousands in 1 kg), it is recommended to plant about 5 kg per hectare.

Furthermore, appropriate training of the seed collectors is important and requires careful planning as seed collection requires specific skills and practice. Botanical skills, knowledge on seed physiology and tree climbing skills are some of the qualifications required. In addition, due to the fact that seeds are a forest resource, the legal aspects regarding seed collection rights (national regulations, permits, local rights, etc.) should be taken into consideration when planning seed collection, especially in protected areas and private properties.

TABLE 1. Tree seed quantity calculation for large-scale restoration (seedlings plantation)

EXAMPLE: What is the quantity of seeds needed to restore a 100 ha village woodlot (planting density of 1 000 woody seedlings per hectare) using the following species: 70% of *Acacia senegal*, 20% of *Balanites aegyptiaca* and 10% of *Adansonia digitata*? What is the minimum quantity of seeds to collect on wild stands of *A. senegal* (population of 75 trees), *B. aegyptiaca* (population of 210 trees) and *A. digitata* (population of 90 trees)?

Determine the germination response and 1 000 seed weight of each species

Species	Germination response	1 000 seed weight (g)	Seed weight (g)
Acacia senegal	100%	46	0.046
Balanites aegyptiaca	100%	3 000	3.000
Adansonia digitata	80%	399	0.399

Calculate the weight of seeds to mobilize

Species	Number of seedlings per hectare	Total number of seedlings (100 ha)	Weight of seeds needed (g)
Acacia senegal	0.70 x 1 000 = 700	70 000	70 000 x 0.046 = 3 220
Balanites aegyptiaca	0.20 x 1 000 = 200	20 000	20 000 x 3.000 = 60 000
Adansonia digitata	0.10 x 1 000 = 100	10 000	(10 000 x 0.399)/0.80 = 4 987

Determine the minimum number of trees where the seeds will be collected, and the quantity of seeds to collect per tree

Species	Minimum number of trees for seed collection (1/3)	Minimum weight of seeds to collect per tree (g)
Acacia senegal	25	3 220 / 25 = 129
Balanites aegyptiaca	70	60 000/70 = 857
Adansonia digitata	30	4 987/30 = 166

Collecting quality seeds for restoration

The propagation material should match the current and expected climate and environmental conditions in the desired restoration site as closely as possible (Bozzano *et al.*, 2014), which is why local (native) species are preferred to exotic species. Generally, seeds are collected from the wild plant populations near the restoration site in order to minimize the need for transportation and in addition, because the site conditions are similar in terms of climate, altitude and soil type.

Genetic diversity is an important aspect of climate and environmental change, as it can widen the range of opportunity and provide solutions that will increase the resilience of the restored area. Genetically eroded or fragmented stands should be avoided, therefore, maintaining the appropriate distance (i.e. 50-100m between trees or grass patches) where seeds are collected is strongly advisable. The constraints associated with low genetic diversity include a higher risk of diseases and a reduced adaptation capacity to environmental change, such as drought.

In a natural forest, seed collection (table 2) is recommended in different areas and from as many trees as possible, that is at least 25-30 trees. Although collection seeds from a smaller number of trees or from more accessible trees (e.g. near a road) could seem more tempting, collecting seeds from a larger plant population ensures much better seed quality with a broader genetic base.

Whether in a natural forest, grassland or in a cultivated area, seed collection is carried out on plants growing in the same environment as the target site (including soil, altitude, and rainfall). Plus trees are chosen according to the desired characteristics (tree height, straight stem, foliage density, etc.) irrespective of site conditions. For example, a tree that is taller than others may be so because it is growing in better site conditions, and not necessarily because of its genetic predisposition. The best period to collect seeds is when trees reach a peak in seed production and most of the fruit has reached maturity (i.e. min 60 per cent mature fruit). Seed collection should be carried out close to the time of their natural dispersion period in order to maximize quality.

It is important to consistently keep track of the seed provenances for performance monitoring and information input in the country forestry seed center database, provided one exists. Record-keeping is essential to evaluate the quality of the material used, as well as to provide information for future decisions on where to collect seeds. Adoption of the OECD[1] forest scheme is recommended to ensure systematic record-keeping.

[1] The OECD Scheme for the Certification of Forest Reproductive Material - http://www.oecd.org/agriculture/forest

TABLE 2. Seed collection in practice

TREE SEEDS	GRASS SEEDS
→ Collect seeds from a minimum of 25-30 trees, with a distance of 50-100 mm and take seeds from different branches of the tree. → Only undamaged normal seeds are to be collected. Avoid amassing seeds already dropped or found on the ground or old seeds. → Fruits/seeds are usually collected by hand, after clearing them or by placing recipients or a tarp on the ground, and shaking the tree by hand or with a tool or rope.	→ Grass seeds are usually collected and husked by hand, using similar techniques as for cereal harvesting. → Seed collection should be carried out at maximum maturity or close to the time of their natural dispersion period. In the Sahel, the best period is usually from September-November. → Always carry out seed collection in non-fragmented populations, and in the largest populations possible.

Seed handling and storage for restoration

Depending on the species, tree seeds need to be extracted from the fruit (depulping) after drying when necessary, before cleaning (avoid mechanical cleaning that can damage the seeds) and sorting out (through filtering, flotation, sifting, etc.).

It is important to understand the parameters that affect initial seed quality, as this will determine viability, germination, response, longevity and long-term conservation. In each population the proportion of viable seeds after storage in given conditions depends on mainly two variables: moisture content and temperature. In sum, a higher initial viability will ensure a higher germination response and seed longevity.

Seed longevity potential is affected by environmental parameters during development as well as by post-harvest conditions; for example, immature seeds dried too quickly will have a reduced longevity. The period during which seeds can be stored varies considerably between species, provenances of the same species and storing conditions (see box 2) and need to be stored in the appropriate conditions corresponding to the type of seed (recalcitrant, intermediate, orthodox). Recalcitrant seeds cannot be stored for long periods and should be planted as soon as possible.

Generally, grass seeds are orthodox and can be stored after being properly dried in a cold room for many years, but infrastructure and maintenance is costly and not necessarily required for short term use of restoration collections. In fact, under ambient conditions these seeds maintain their germination capacity for several years.

BOX 2. Classes of seed storage behavior and how to store seeds short term

	What they are	How to store them	How long they can be stored	Examples
Orthodox seeds	Can be dried to a low moisture content and are resistant to low temperatures for long periods (dry seeds)	Need to be dried (<5% humidity content) and stored in clean and sealed containers. The containers need to be stored in a cool, dark, dry and ventilated place, and preferably above ground to avoid humidity	One to two years, but up to more than five years	*Panicum laetum* Most *Acacia* sp.
Intermediate seeds	Survive drying but cannot survive at low temperature	Need to be dried and stored in normal temperatures	Up to a year in ideal storage conditions	*Khaya seneglensis Balanites aegyptiaca*
Recalcitrant seeds	Cannot survive drying below a relatively high moisture content and low temperatures (moist seeds)	Need to be kept in a relatively humid environment (humid sawdust or vermiculite) and sowed as soon as possible	One to two weeks in ideal storage conditions	*Boscia senegalensis Detarium microcarpum*

Source: Royal Botanic Gardens Kew, 2019 (Sacande, Sanogo and Beentje, 2016).

KEY RECOMMENDATIONS
CHAPTER 2

Estimate the quantity (in weight) of seeds needed for each species to cover the entire restoration site and identify where and how to mobilize these seeds.

Plan seed collection carefully and maximize genetic diversity within collected seeds by collecting seeds from large populations and from a large number of trees within the population.

Pay attention to the specific seed characteristics that will determine how and for how long the seeds can be stored before being planted in a nursery or directly in the field.

NURSERY, AAD PROJECT, OUEDRAOGO SALIF, DJIBO, BURKINA FASO

3 Producing quality nursery seedlings

Nurseries are structures where seedlings are grown from seeds before being planted out in the field for site restoration. The production of seedlings is more costly and labor-intensive than seeds that are sown directly. However, planted at the right period, the chances of survival are greater only in the first years because they have been monitored in a nursery where they have been given the appropriate amount of water, shade, and protection from browsing. In the AAD project, results show that for most of the species after three rainy seasons, there is hardly any growth difference in the field between a direct sown seedling and a nursery planted seedling.

Establishing and managing a nursery

If a nursery needs to be established, it is important to define its exact role and production capacity, as well as the dimensions and location respectively for the restoration site. The nursery should be kept as close to the plantation site as possible to reduce the need for transportation, as it can be very costly to transport thousands of seedlings across long distances (1 potted seedling weighs about 1 kg!) The establishment of a temporary nursery on the restoration site or in a nearby vicinity, to be removed once the seedlings have been planted, is also a feasible option.

Firstly, the establishment of a village nursery near the settlements would allow easier access to both water and for the working force. A local nursery could prove to be more effective as it would reduce the need to transport seeds being collected in stands close to the restoration site.

Secondly, nursery management would focus on the organization of the nursery's main areas and equipment. Specific areas are required for: seedling beds and propagators (seed-trays), substrate preparation and composting, storage of equipment (including picks, shovels, mattocks, shovels, wheel barrows ...).

Finally, sound management serves to keep detailed records of the production, deliveries, accounts, and nursery reports. Production reports record inputs (and dates) such as: seeds, compost, treatment products and outputs such as seedlings produced and their quantities, qualities, germination responses, age and information for monitoring seedlings growth. Keeping track of their performance is important to improve the quality of the seedlings produced and increase cost-effectiveness. In addition, accounting documents are needed to record the sales and/or outflows of seedlings, expenditures and revenues, as well as lists of clients and their contact details. Substrate quality is a key element that directly affects the growth of seedlings and generally consists of a mixture in variable proportions of:

- soil;
- a nutrient-rich material such as compost;
- an inert material such as sand.

Different proportions of these components will result in different soil textures, hence a different capacity for retaining water and nutrients. The ideal nursery substrate must have good cohesion and be able to retain sufficient water and nutrients without producing heaviness (should not stick to the hands), in addition, soil organic matter and fertility should be high. It is strongly advised not to re-use soil from old bags while preparing for new seedlings, so as to prevent contamination.

In order to facilitate the nursery management, the seedlings should be organized in rows, taking into account the following:

- The space between rows should allow easy access for maintenance;
- The number of seedlings per row should be constant, to facilitate counting, transport, etc.

Pre-treating seeds for germination

Each seed has a specific type of dormancy (exogenous, endogenous, both) and in order to lift dormancy it is important to follow a specific protocol, which may include: mechanical/scarification, boiling and acidification treatments.

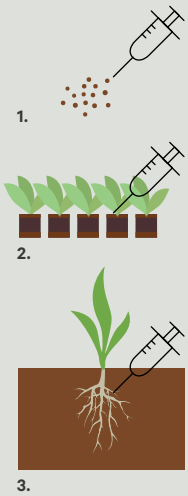
Throughout the AAD project, innovative techniques have been tested on the use of inoculation with micro-organisms to improve the establishment and performance of seedlings in the field (box 3). Such treatments can be applied at different stages for example, the coating of seeds, nursery seedling inoculation, or soil inoculation in the field. The results are very promising and these techniques are being further developed for their mainstreaming and widespread adoption.

BOX 3. Inoculation with micro-organisms applied to restoration planting (seeds and seedlings)

Some natural symbiotic associations provide mutual benefits between soil micro-organisms (bacteria and fungi) and the plants through their roots. These associations include:

- **Rhizobium** (bacteria) which facilitate nitrogen fixation through root nodules (mostly in legumes – e.g. Acacias - and pulses);
- **Mycorrhiza** (fungi) living on the plant roots and providing mutual benefits, and present in 95% of tropical plants.

Inoculation consists of integrating inoculum (i.e. living micro-organisms) into the plants by using different techniques. Experiments have shown that the inoculation of propagules in the nursery with appropriate mycorrhizal fungi or rhizobia and other seed treatments facilitates and accelerates the establishment of seedlings by increasing water and nutrient uptake, and improves the vitality of plants subject to various stressful situations. Different inoculation techniques that can be applied to restoration planting include: **1.** Coating of seeds for direct sowing. **2.** Nursery seedling inoculation. **3.** Soil inoculation in the field.



Nursery seedlings management and preparation for the field

Watering is best carried out by hand (with a hose or a watering can). Frequent watering is needed until the seeds germinate, since germination is always triggered by water. During hot conditions watering should be carried out in the evenings to minimise evaporation. Mulching and protection from strong sunlight are also effective to reduce rapid water evaporation. Weeds compete with the seedlings for water and nutrients and should therefore be removed, furthermore, they also can impede air circulation and be potential sources of pathogens.

After 3 to 6 months, seedlings of the faster growing species such as *Acacias* usually reach a height of 40 to 80 cm in height. Generally, at this stage of development their chances for survival should be good, once in the field. Slower growing species such as *Balanites aegyptiaca*, *Faidherbia albida*, and *Tamarindus indica* may need a total of 14-18 months in nursery before plantation. For this reason, it is important to plan restoration projects carefully with a timeframe that is long enough for the production of species that grow more slowly.

Two weeks before planting the water quantity can be divided into two parts, in order to facilitate adaptation to dryer conditions and the seedlings must be watered abundantly the day before planting. If using bare-root seedlings they should be extracted from the soil carefully, using a sharp knife or pruning shears to prune the roots. Some seedlings will require pruning their aerial part as well. The roots need to be protected with humid soil and placed into propylene bags for transportation to the planting site.

KEY RECOMMENDATIONS
CHAPTER 3

Prior to the establishment of a nursery, it is essential to define its precise role and include where and how many seedlings will be used. The nursery location and production capacity and size will be defined accordingly.	**Maximize nursery efficiency by carefully choosing the substrate, following the germination treatment, and care for seedlings (water, shade).**	**Continuously monitor seedlings growth for adaptive management.**

LARGE-SCALE LAND PREPARATION,
AAD PROJECT, BURKINA FASO

4 Land preparation for large-scale restoration

In degraded landscapes with a low or non-existent vegetation cover, water cannot be absorbed by the soil and is therefore lost in runoff or evaporation. Improvements to land preparation through water harvesting, retention and soil permeability are key to the success of both forestry and agricultural plantings in the Sahel. In drylands, soil and land preparation is crucial to retaining moisture and providing a better growing environment for the plants before planting. Two micro catchment systems based on the digging of microbasins to improve water retention are the most often used: (i) manual in agro-forestry or agro-ecology systems and (ii) mechanized using a tractor coupled with a special plough in wider agro- and sylvo-pastoral systems.

The traditional land preparation

Traditional micro catchment systems in the Sahel include the "half-moon", and the "Zai" or "Tassa". The traditional half-moon entails digging large planting pits (2-3 m wide) in the shape of a semi-circle and placing the excavated earth on the lower-side to form a contour bund so that during the rainy season, water does not run off the surface but soaks into the soil, thus allowing the vegetation to grow. Soil prepared in this way retains about 100 litres of rainwater per year and about 300 half-moons can be dug in one hectare of land. Organic fertilizers can also be used to improve soil by filling in the half-moon or Zaï holes with compost or manure. Such techniques are commonly used in agro-forestry or agro-ecology systems as they facilitate the restoration of degraded land and also increase soil fertility.

However, the traditional preparation of these micro-catchments by hand, with traditional machinery or animal traction is difficult, slow, and labor-intensive. Although effective, these practices are not compatible with the large-scale restoration objectives that have been set as a response to the tremendous amount of degraded land in the GGW core region, especially in the face of rapid climate change.

Mechanized land preparation

For a larger scale of land preparation (e.g. 50-200 hectares), mechanized deep ploughing is carried out using specialized Delfino ploughs, a concept inspired by the traditional methods of the Sahel described above. The plough digs deeper (50-80 cm), breaking the soil's hard crust and exposing the soil in a way that creates micro-dams/micro-catchments for better permeability and moisture retention (10 times more than the manual- about 1 000 litres per rainy season). It is pulled by a heavy-duty tractor (about 100 hp) on slopes with up to a 10 per cent inclination in areas with 200-600 mm annual precipitation.

The new generation of the Delfino ploughs facilitates the preparation of large surfaces of degraded land in a limited period of time. A tractor with a Delfino plough can work up to 15-20 hectares a day, creating about 500-700 micro catchments per hectare, comparatively, 100 workers would dig 1 hectare with about 300 micro-catchment a day.

Special training is needed for the tractor drivers so as to ensure that the half-moons are dug in the right direction (i.e. perpendicular to slopes) and that the existing vegetation is avoided and therefore not destroyed. It is equally important to plan for the maintenance of the tractor (mechanic, spare parts etc.), in fact, in addition to specialized ploughs the Delfino group has set up a specialized maintenance garage (after-sales service) as well as a training school in West Africa for mechanics and tractor drivers using this equipment. Some of the first and second generations of Delfino are still functional after 15 to 20 years in operation.

For monitoring and reporting purposes, it is important to record the polygons consistently by a GPS device in order to accurately identify/map the position and measure dimensions of the areas that have been ploughed. This will allow a follow up of biomass increases (vegetation index) after planting and to assess a success or failure of the interventions.

TABLE 3. Technical statistics/specifications of a Delfino plough unit

Land prepared per day	15 to 20 hectares
Average land prepared per year	1 000 to 1 250 hectares
Spacing between trenches	3 - 5 metres
Spacing between 2 micro-dams in a row	1 - 2 metres
Number of micro-dams in a row of 100 metres	12 half-moons in 100 metres
Dimensions of a half-moon/micro-catchment	Diametre: 0.90 - 1 metre Dept: 0.50 – 0.80 metre Long: 4 - 5 metres
Rainwater retention capacity	Up to 1 000 litres per season (remain moist up to 2 months after the rains)
Periods for ploughing	October to June (dry season before the rainfall)
Density of planting/sowing	600-1 000 nursery plants per hectare 2-3 kg of herbaceous seeds sowed directly

FIGURE 5. **Improvement of land preparation, comparing traditional and mechanised ploughing**

TRADITIONNAL	MECHANIZED
• **SLOW AND TAXING:** usually 1 hectare per day, with 100 person • **SOIL PREPARATION DEPTH:** up to 50 cm • **LOW INVESTMENT** (tools, labour) but per hectare cost is high	• **FAST:** 15 to 20 hectares per day, with a team of 2 drivers and 1 mechanic • **DEPTH:** up to 1m • **HIGH INITIAL INVESTMENT** (plough and tractor, but lower cost per hectare and cheaper in the long term)

KEY RECOMMENDATIONS
CHAPTER 4

Land preparation needs to be planned well in advance to ensure finalization before the start of the rainy season.	**Mechanized land preparation allows for the restoration of large surfaces in a shorter period of time, making it more feasible to respond to huge demands for restoration needs.**	**To be economically viable, mechanized site preparation needs to be carried out on large portions of land (e.g. 50 to 200 ha).**

WOMEN PLANTING TREE SEEDLINGS IN GARGABOULE'S RESTORATION PLOT, AAD PROJECT, DJIBO, BURKINA FASO

5 Direct sowing and planting nursery seedlings

Once the species to plant have been determined, the seeds collected, seedlings produced and the soil prepared, the planting activities can begin. Both seeds and seedlings from trees, shrubs or grasses, are directly used in restoration plantations for improvement of degraded agro-sylvo-pastoral systems. It is particularly important to pay attention to the planting period, as well as the planting density or seeding proportion per surface area.

Plantation density

Although nursery seedlings tend to have a greater survival rate, direct seeding may be more cost-effective, especially in the case of large-scale restoration where surface areas are to be covered and large quantities need to be planted. Grass seeds particularly must be sown directly, so are woody seeds; and this can be done in dry soil before the rains. As mentioned previously, it is advisable to use a mixture of a minimum of 10 species per hectare, combining annuals and perennials to maximize social and ecological functions and resilience.

In drylands a balance can be found by maximizing tree density without compromising groundwater resources; it has been demonstrated that an intermediate tree density facilitates maximizing the groundwater recharge (Ilstedt *et al.*, 2016). It is however difficult to determine the ideal tree density as this depends on the species used and the environmental factors including annual rainfall. Even in the case where the tree density of the reference ecosystem is much lower, the planting density can be much higher to compensate for possible mortality during the first years after plantation, due to factors such as drought or animal browsing, or in case of success, to revisit the spacing years later through thinning, which would provide fuelwood.

The following numbers can be used as references for tree planting density in the Sahel:

- **High density** (e.g. village woodlots, production of fuelwood): up to 1 000 seedlings per hectare;
- **Lower and intermediate density** (e.g. inter-village lands, sylvo-pastoral lands): between 625 and 1 000 seedlings per hectare;
- **Low density** (e.g. agroforestry systems, spacing for crop production): between 100 and 625 seedlings per hectare.

Tree seedlings and seeds should be combined with herbaceous fodder seeds of at least 3-4 species. Seeds are planted by direct seeding at a recommended ratio of 3-5 or 5-10 kg per hectare, depending on species.

Planting in the field

Planting activities (direct seeding and tree seedling) are labor-intensive, however, they present a greater opportunity for directly involving communities in the restoration of their landscape (even more so if land preparation has been made by machines). Therefore, the appropriate amount of time should be dedicated to providing demonstrations on planting and seeding techniques for participants, thus heightening their sensitization and part taking.

The best time for planting in drylands is when the soil has sufficient water to allow germination of seeds. It is equally important to ensure the maximum water supply during the first weeks after planting the seedlings. In the Sahel, given the increasing variability and uncertainty in rainfall patterns due to climate change, it may be unwise to plant immediately after the first rain but rather after the first rains have settled in.

The first step is to mark where each tree will be planted according to the plantation plan (e.g. three seedlings per half-moon). A hole must be dug that is large enough for each seedling and preferably immediately before the seedling is placed inside, thus minimizing the drying up of the soil. The seedling container must always be removed before planting and properly disposed of. The soil around the planted seedling should be slightly compacted to remove all empty spaces/cavities around the roots.

6 Managing the restored sites

Restored sites provide many benefits, some of which are available within a few months after restoration activities and interventions have taken place. More importantly, herbaceous species are specifically included in the planting materials for large-scale restoration to provide fodder readily within the first year of planting. Fodder planting in restored plots and harvesting it for animal feed, a very coveted resources mainly in the eight-month dry season and sometimes a source of tension, have been one the success stories with the beneficiary communities, who are combined farmers and herders in the Sahel. At the same time, controlling browsing of livestock in the restored sites has been one of the challenges. If left un-managed, the new fragile vegetation cover can rapidly be reduced or even disappear. Hence, the beneficiary communities (ownership) commit active measures that are needed for maintaining and protecting the restored plots and for reaping the benefits.

Setting up a Community management committee

In the large-scale restoration approach, surveillance and maintenance of the restored sites are more efficiently carried out through continued community mobilization, or so-called "social fencing". The installation and maintenance of physical fences is very costly and unrealistic when weighed against the magnitude of the millions of hectares to be restored throughout the GGW. Social/community mobilization requires a collective management and decision-making mechanism in order to avoid conflict and allow the equitable distribution of restoration benefits.

FODDER HARVESTING AND SEED COLLECTION, AAD PROJECT, DOUMA, NIGER

In its intervention model, the consultation and discussion framework set up by AAD actively encourages communities to establish community management committees or "COGES" (from the French "*Comité de Gestion*") for the restoration sites. The COGES are responsible for sensitizing and mobilizing community members for their active involvement in restoration and management activities. Collective decisions are also taken for their contributions to and the objectives of restoration, site surveillance and on how to use the restored areas and organize its management.

The COGES is composed of about ten members including a chairperson. Youth and women participation is at the heart of the AAD approach and their representation is required in each COGES. This has given an opportunity for many women to step forward, be considered (some as chairperson) and have their say in the restoration activities, thus enabling their empowerment.

In the AAD program, fodder production and sale (or self-consumption) was the first most direct and most important benefit to participating communities. This thus, becomes a powerful incentive for community members to take part in restoration activities. Along with other non-timber products and value chains promoted through the program (see Sacande and Parfondry, 2018), such incentives have allowed significant socio-economic impacts on communities (Part II of this manual details how to assess such impacts through household surveys), guaranteeing their continued involvement throughout the restoration process.

KEY RECOMMENDATIONS
CHAPTER 6

Continued social mobilization and the equitable share of restoration benefits is at the heart of the AAD approach for restoration governance and success, and for the sustainability of the interventions.	**The Community management committee allows collective management and decisions on the surveillance, maintenance and exploitation of the restored sites.**	**Women and youth participation and representation in restoration management committees provide a great opportunity for their empowerment.**

FORESTRY OFFICER CARRYING OUT A SURVEY ON PLANT USE, AAD PROJECT, TERA, NIGER

FODDER HARVESTING, AAD PROJECT, DOUMA, NIGER

PART II

SOCIO-ECONOMIC ASSESSMENT AND SURVEY METHODS FOR LARGE-SCALE RESTORATION IMPACT ON COMMUNITIES

Through large-scale restoration such as described in the first part of this manual, the aim of FAO's Action Against Desertification (AAD) is to improve the natural capital and therefore to have a direct and indirect impact on the livelihood of communities living near the restored areas.

Livelihood enhancement as a result of large-scale restoration is very diverse and cannot be measured based on income evels alone (see box 4). Fodder harvesting completed within the first year after planting for example, improves animal production and has a direct impact on income, food security and nutrition. Furthermore, the restoration of degraded land allows for the improvement of crop production with a similar impact as previously described. In addition, the planting of local tree species while supporting women's organisations for the production of non-timber forest products (such as gum Arabic, honey, and many other edible fruits, oil and other products) generates a positive impact on household income and food security, as well as on women's empowerment.

Monitoring and evaluation (M&E) can track progress made as well as measure the biophysical and socio-economic impacts, both key components to these interventions. Since 2015, AAD has been using household surveys to collect socio-economic data to be used for impact assessment and decision making. This approach does not consist of a new methodology *per se* - it is rather a system that was created by combining different existing frameworks that include the Sustainable Livelihoods Framework and the FAO Food Insecurity Experience Scale (FIES). Household surveys are carried out based on a questionnaire administered to households selected as representative examples from a statistical standpoint. The objective of this second part of the manual is to guide project implementers on how to take rapid, simple and cost-effective socio-economic surveys with minimum training.

This method has provided the AAD with the means to establish a project baseline for impact assessment and furthermore, to use the collected data for decision-making within the project, e.g. to support the choice of the species to be used in restoration to serve as a guide for similar projects. The results of the socio-economic baseline assessment were published in 2018 (Sacande, Parfondry and Martucci, 2018) and provide new and valuable information on the socio-economic and biophysical features of the Great Green Wall countries. As a result of these successful results

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**SEED CLEANING, AAD PROJECT,
NATIONAL TREE SEED CENTER, NIAMEY, NIGER**

the method has generated great interest outside of the project and in fact, other organizations have applied it. Moreover, several training sessions sponsored by the project have been held to promote its use both within and outside of the AAD project. This section of the manual aims to make it more widely available and adopted more extensively by other stakeholders of the Great Green Wall and beyond. Other users would include monitoring, evaluation and technical staff from governmental and non-governmental organizations, as well as international organizations.

7 Socio-economic assessments in the context of large-scale restoration

Livelihood enhancement is one of the key objectives of large-scale restoration initiatives and other projects in the context of the Great Green Wall. Household surveys are an effective way to collect socio-economic data in the area of intervention and are used to measure the actual achievement and impact of these objectives. This socio-economic information helps to better design, plan, prioritise and assess restoration interventions with communities.

Restoration projects need to monitor and evaluate in order to assess where changes have occurred and whether these changes can be linked to project activities. Impact assessment has to be understood here as an approach that helps to judge the effectiveness of the project activities by measuring the changes and long-term effects brought about by those activities. It is an integral part of M&E and as such, can be integrated into the project's logical framework and measured by impact indicators.

A clear distinction should be made between activities or outputs (directly measurable results), outcomes (specific effects which can be observed during the course of the programme), and impacts (long term effects of the programme). Indeed, while outputs can usually be assessed by a simple reporting on project activities (e.g. number of households involved in education activities), outcome and impact indicators must be chosen carefully so as to reflect medium and long-term improvements, respectively.

There are different ways to collect socio-economic data, one of most common and effective ways being through a household survey. Firstly, a household survey identifies the households as the lowest elementary unit from which data will be collected and measurements taken. Household-level surveys predominantly collect information on sources of income, land holdings, housing characteristics, coping strategies, household food production and consumption, diet quality (FAO, 2011).

Secondly, a household survey is based on a standardized set of questions (see chapter 8) generating quantitative data using statistical techniques, thus making measurements more precise. The answers to the survey questions are then used to assess pre-determined impact indicators. The information gathered from a sample (or sub-set of households) can be generalized for the entire population of interest (see chapter 9).

Ideally, the assessment design will combine the two following approaches (fig. 6):

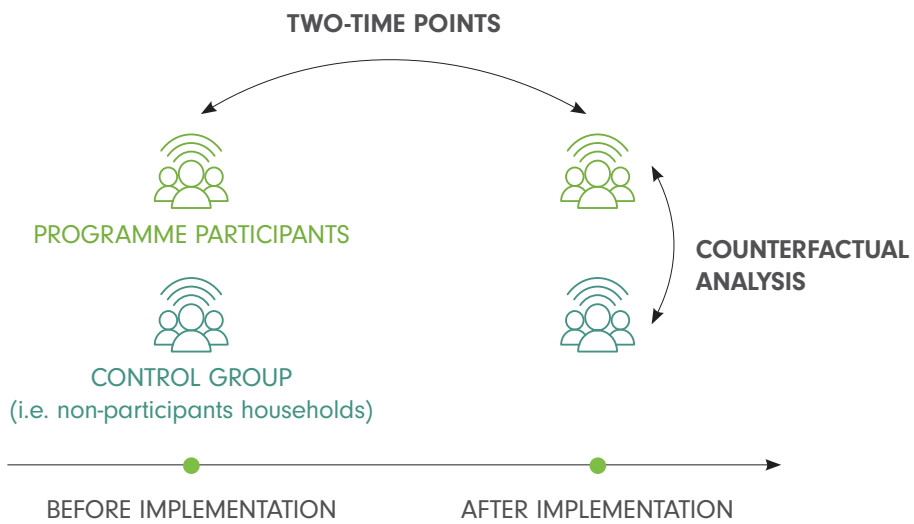
- **Two-time points:** the same questions are asked before the programme begins (providing values for the indicators at the time 0 of the project, or "baseline") and again after it has been implemented ("endline"). Comparison of indicator levels before and after the process provides quantitative evidence of changes that have occurred since the beginning of the programme.

- **Counterfactual analysis:** the same questions are asked after programme implementation in households having participated in the programme, as well as households that have not (i.e. the control group) but live in similar conditions. The comparison between the two groups is divided between the current socio-economic status of the households after the intervention, and the potential situation should the project not be implemented; the counterfactual analysis therefore verifies whether the changes observed can be attributed to the programme.

Household surveys are not only used for impact assessment but can potentially serve to collect a multitude of other useful information related to livelihoods. If carried out prior to a large-scale restoration intervention, a socio-economic assessment can provide key information for decision making, i.e. to better plan and design the intervention. The information needed has to be carefully assessed in advance, and can include:

- the plant species used by the households (which can then potentially be selected as preferred restoration species);
- the main sources of livelihoods (which for example can serve as a guide for the use of fodder or agroforestry restoration species);
- the way forests and land are used (and if conflicts exist);
- existing capacities and capacity needs;
- the identification of potential restoration sites.

FIGURE 6. Two-time points vs counterfactual analysis assessment design



8 Designing a survey questionnaire

There are several tools that can be used to gather socio-economic information on a population, including collection of statistical data, in-depth interviews and observation of people's behaviour, in addition to the questionnaires. However, the questionnaires are preferable for socio-economic assessments, especially when the target population lives in rural areas. Questionnaires can provide primary and reliable data on a significant number of households with a reasonable amount of effort in terms of time and resources.

Designing the questionnaire

Before designing the questionnaire, it is important to know exactly what information is needed. The goal of a questionnaire is to collect the required quantitative information through carefully chosen standardized questions and a well-designed questionnaire is key to the quality of the results of the household survey. It must be designed and structured in a comprehensive way so as to encompass the multiple livelihood features needed both for designing the restoration intervention and monitoring its impacts.

The proposed template questionnaire found in the Annex, currently contains a set of generic questions that have been used in the AAD project, as well as in other Great Green Wall countries. It is composed of three different sections or modules described in further detail in the following sections.

SECTION I. **Livelihoods Questionnaire**. This is the core module of the questionnaire and is composed of a set of questions based on the five capitals of the sustainable livelihood framework;

SECTION II. **Food Insecurity Experience Scale (FIES)**. This survey-based module is the standard tool developed by FAO for assessing the prevalence of moderate or severe food insecurity within a population;

SECTION III. **Plant Species Questionnaire**. This questionnaire has been developed to collect key information on plant uses and species preferences.

Depending on the purposes of the questionnaire, not all modules need to be used at the same time. For example, the plant species questionnaire is intended for use only prior to a restoration intervention so as to better design the restoration intervention, while the FIES can be used to assess the intervention's impacts on food security through a two-time points survey (i.e. before and after the intervention).

The template questionnaire also needs to be customized based on the specific features of the region of interest. The options or responses should reflect the context as accurately as possible to avoid using the "Other" option.

For example, if the question is about the main wild species, the options or responses need to be customized customized by providing a comprehensive list of the known local species (with local names). Instead, if a species is missing from the list and the "other" option selected from a close ended list, the species name will be lost, as questionnaires are not analysed individually.

It is important to avoid an overlap between the modules, for example, questions on plant use can also be part of the natural capital section of the livelihood questionnaire, while questions from FIES may also include the human capital section of the livelihood questionnaire. It is essential to keep the entire questionnaire as straightforward as possible and to focus primarily on information that reflects the purpose of the survey.

In the case of "end-line" surveys (carried out at the end of a project to assess impacts by comparing with baseline results) questionnaires should include the exact same questions (i.e. identically worded) that are used in the baseline so that changes can be more easily assessed. However, the survey can be expanded to provide additional questions that have not been asked at the baseline, such as the level of participation in the project.

In household surveys all the questions are usually closed-ended, with the following possible types of answers:

Yes/no (dummy variables)

N°	Questions	Answers	Codes
FIES1	During the last 12 MONTHS, was there a time when you or others in your household worried about not having enough food to eat because of a lack of money or other resources?	☐ No ☐ Yes ☐ Doesn't know ☐ Refused	0 1 98 99

Numbers (quantitative variables)

N°	Questions	Answers (=codes)
LI70	Number of livestock heads owned by the household	Cattle ☐ Goats ☐ Sheep ☐ Poultry ☐

List of options to select (qualitative variables)

N°	Questions	Answers	Codes
LI62	First source of livelihoods of the household	☐ Farming (staple crops)	1
		☐ Livestock	2
		☐ Fishing	3
		☐ Commerce	4
		☐ Handicraft	5
		☐ Crafts (masonry, carpentry, mechanics, etc.)	6
		☐ Salary/wage	7
		☐ Remittances	8
		☐ Traditional healer	9
		☐ Forest-based enterprise	10
		☐ Horticulture	11
		☐ Other	12

The livelihoods questionnaire

Livelihoods are complex, multi-faceted systems and are therefore not easy to conceptualize. Rather than understanding poverty as simply the lack of income, development organizations have been creating different sustainable livelihoods approaches that are more holistically inclined when dealing with poverty reduction. One of the most common frameworks used is the Sustainable Livelihoods Framework (SLF) designed by UK's Department for International Development DFID (DFID, 1999) particularly the livelihoods of the poor. It places people within a context of vulnerability (contexts and conditions in the external environment shaping livelihood systems, such as the climate, ecology or macro-economic conditions). The SLF considers the "capitals", i.e. the range of productive resources or assets that people use and combine to build livelihood strategies within this context: the human, social, natural, physical, and financial capitals (these capitals are described in figure 7).

The Sustainable Livelihoods Framework has been used here as a benchmark to structure the questionnaire. In other words, the questionnaire is divided into five sections corresponding to each of the five capitals of the sustainable livelihood framework, thus ensuring that all capitals are included in the questions. This module can be used both for impact assessment and to collect key information to be used as a guide for the restoration intervention.

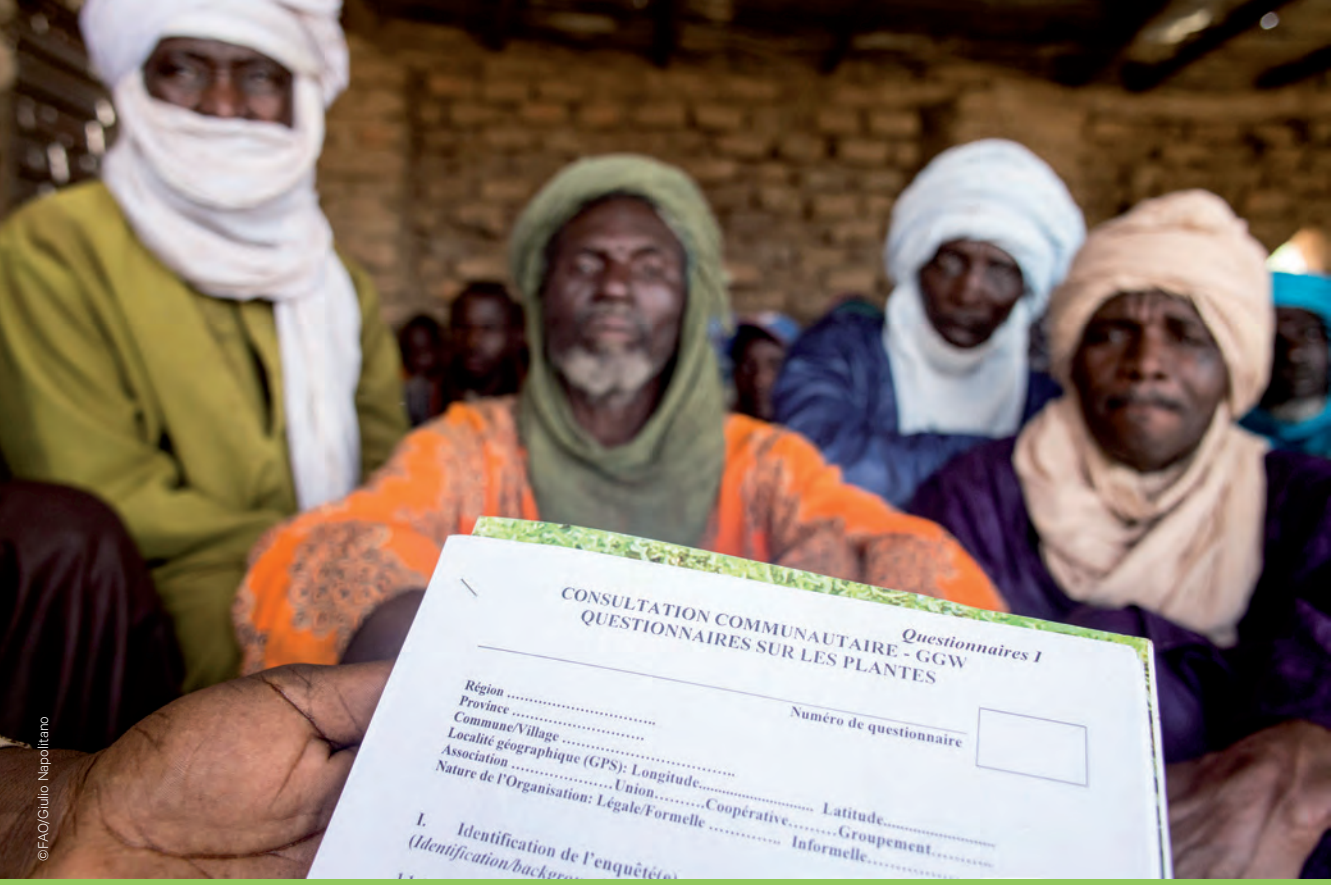


FIGURE 7. The five capitals of the Sustainable Livelihoods Framework

HUMAN CAPITAL

Skills, knowledge, ability to work and good health

SOCIAL CAPITAL

Network, groups of interest, relationships of trust, reciprocity and exchange

FINANCIAL CAPITAL

Income, credits and investments

NATURAL CAPITAL

Natural resources stocks providing useful ecosystem services for livelihoods

PHYSICAL CAPITAL

Basic infrastructures and producer goods needed to support livelihoods

BOX 4. Action Against Desertification project impacts along the five capitals of the Sustainable Livelihoods Framework

Drylands are among the ecosystems most affected by environmental degradation. The **Action Against Desertification** (AAD) project is an FAO (Food and Agriculture Organization of the United Nations) led initiative that has been carrying out large-scale restoration work in degraded lands in 12 countries, 10 of which are Great Green Wall countries in Africa, in addition to Fiji and Haiti.

Through this initiative FAO has put plant science to the service of local communities and brought 53 000 hectares of degraded land under restoration by planting no less than 25 million trees of local species, combined with diverse herbaceous fodder species, and consequently reaching 700 000 people. At the same time, given the fact that solving land degradation hinges on economic development, AAD supports five major value chains of non-timber forest products that enhance and diversify the generation of income including fodder, restoration seeds, honey, gums and resins, balanites oil and soap.

In order to fully include the diversity and measure its multiple types of socio-economic impacts, the initiative uses the five capitals of the Sustainable Livelihoods Framework to structure the questionnaires created for household surveys. Some examples of the impacts achieved are listed below under each of the five capitals:

- **Human capital**: improved food security from increased animal (fodder), crop production and forest products, increased capacities in different technical areas such as seed collection, soil preparation and restoration techniques, as well as business development;
- **Social capital**: increased community engagement through the creation of Management Committees for the management of the restored sites, increased women empowerment through the creation of women's producer groups;
- **Natural capital**: increased vegetation cover through enrichment planting of local preferred species of trees, shrubs and grasses, improved soil fertility and water quality, and greater biodiversity (return of flora and fauna wild species);
- **Physical capital**: improved access to water through the installation of water infrastructure (boreholes) to support both restoration activities (e.g. nurseries establishment) and local livelihoods;
- **Financial capital**: increased income and diversification of income generation activities through the sale of non-timber forest products such as fodder, honey, balanites oil and many others.

The Food Insecurity Experience Scale (FIES)

A prevalence of severe food insecurity is on the rise in all regions of Africa, particularly in West and East Africa (FAO, IFAD, UNICEF, 2018). **Food insecurity** is defined by FAO as "A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life." Combatting food insecurity is therefore an important objective of restoration projects in drylands in the context of the Great Green Wall, such as Action Against Desertification. Restoration reduces the effects of climate variability and climate extremes, which are among the leading causes of severe food crises (FAO, IFAD, UNICEF, 2018). In the Sahel, restoration can contribute to improving food security directly and indirectly through different means including increased availability of fodder for animals and improved crop productivity (through increased soil fertility and reduced soil erosion). In the long term, planted trees having reached maturity provide non-timber forest products that can be consumed or sold to increase income and consequently, to further contribute to food security. In this context, monitoring changes and trends in food insecurity levels over time play an essential role in assessing the success of a restoration intervention.

In 2014, FAO developed a new global tool called FIES[2] (the Food Insecurity Experience Scale) that can rapidly collect reliable information about people's access to adequate food, by asking eight simple questions (see table 4). Its main advantages are that it is simple to apply and can easily be integrated into household surveys together with other related questions. FIES is in fact increasingly being adopted by countries worldwide, its goal being to report on SDG indicator 2.1.2 [i.e. Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale].

We propose integrating this tool into our approach by integrating the brief set of questions within the household questionnaire with no changes to them or to their order, in addition to keeping the recall period of 12 months. The choice of a 12 months recall period is particularly important in the Sahel and other regions where seasonal changes (i.e. rainy vs dry seasons) strongly affect food availability and food security. A 12-month reference period therefore allows to measure access to "safe, nutritious and sufficient food all year round" (SDG Target 2.1) based on internationally-comparable estimates.

Depending on the context, other survey modules consisting of a series of questions regarding people's access to adequate food may also be used such as the HFIAS (Household Food Insecurity Access Scale for Measurement of Food Access). Both FIES and HFIAS modules are based on the same underlying concept of food insecurity and are composed of very similar sets of questions. However, HFIAS is based on a recall period of four weeks instead of twelve months and furthermore includes a subset of "frequency of occurrence" questions. HFIAS can therefore detect smaller changes in food insecurity, as well as changes occurring in more rapidly evolving situations.

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2 www.fao.org/in-action/voices-of-the-hungry/using-fies/en/

TABLE 4. Food Insecurity Experience Scale Survey Module

	Standard label	Question wording
1.	WORRIED	During the last **12 months,** was there a time when you were worried you would not have enough food to eat because of a lack of money or other resources?
2.	HEALTHY	Still thinking about the last **12 months,** was there a time when you were unable to eat healthy and nutrition food because of a lack of money or other resources?
3.	FEWFOODS	Was there a time when you ate only a few kinds of foods because of a lack of money or other resouces?
4.	SKIPPED	Was there a time when had to skip a meal because there was not enough money or other resources to get food?
5.	ATELESS	Still thinking about the last **12 months,** was there a time when you ate less then you thought you should because of a lack of money or other resources?
6.	RANOUT	Was there a time when your household ran out of foods because of a lack of money or other resouces?
7.	HUNGRY	Was there a time when you were hungry but did not eat because ther was not enough money or other resouces for food?
8.	WHOLEDAY	During the last **12 months,** was there a time when you went without food for a whole day because of a lack of money or other resources?

The plant species questionnaire

Information on traditional plant use and land management is crucial to better learn about the community's needs in terms of restoration. A key factor in the success of the approach used by the AAD project for large-scale restoration is that communities themselves determine which species (of trees, shrubs and grasses) to be used during restoration based on the purposes these species serve.

Because such traditional ecological knowledge is often poorly documented, questionnaire-based household surveys are an effective method (if not the only one) for collecting information such as the main species used by households, plant harvesting, plant products, state of plant conservation or constraints related to plant collection. Once the preferred species have been identified, a prioritization exercise is carried out by and with community members according to the restoration objectives (often, their lifestyles, well-being aspirations and opportunities for generating income from their environment.

We propose including the plant species questionnaire in the household survey, i.e. alongside the socio-economic baseline survey questionnaire used before the beginning of the intervention.

The module is divided into four sections:

- Identification of the main species and plant parts used: this section helps identify the most important species used for different purposes (food, animal feed, medicine/human health, animal health, dyes, beekeeping and other uses), as well as to rank them by preference, which can then help to select the potential species for restoration;
- Utilisation of plant products: this section gathers information on how plants are used, including the products made and how they are used or sold;
- Regulations on plant exploitation. This section identifies the regulatory framework for the utilisation of plants.
- Support, collaborations and constraints. This section captures information on the networks, groups and associations the household may be part of in relation to plant use.

Testing the questionnaire

Once a draft of the questionnaire has been completed and translated into the local language if required, it should be pre-tested to ensure that both enumerators and respondents fully understand each of the questions and answers. The questionnaire will, ideally, be administered to a small group of respondents and all questions and answers should be verified for clarity and consistency beforehand. This will also give the interviewers the opportunity to practise administrating the questionnaire. If deemed necessary, the questionnaire should be revised after the test. It is important to ensure that:

- The response options are relevant and as exhaustive as possible;
- Each response has its unique identifier/serial number;
- The language used is simple, questions are easy to understand; and
- The questionnaire has been translated (and tested) in the appropriate languages.

TABLE 5. Common mistakes will designing a survey questionnaire, and ways to overcome them

COMMON MISTAKES	HOW TO OVERCOME THEM
Complicated questions, or difficult to understand	Always use a simple language
Repetitive questions	Select only the most important questions
Questionnaire is too long	Reduce length by deleting some questions
Non-exhaustive list of answers	Revise the list of choices
Recall period not clear	Questions should be defined with a clear recall period, and be brief, if possible

9 Defining a sampling strategy

The objective of household surveys is to obtain socio-economic information on a certain population, e.g. the people living within the target area of a project. However, populations are usually too large to make it possible to efficiently administer the questionnaire to all of the households. Reliable information can be obtained by using a sample population, allowing to conduct the survey on a relatively limited number of households.

A sample is "a smaller collection of units from a population used to determine truths about that population" (Field, 2005). While planning a household survey, one of the key tasks is to choose how many households should be interviewed and where to find them. A good sampling design produces representativeness and consistency in the results, i.e. it facilitates the drawing of a conclusion about the socio-economic status of the whole population based on results gathered on the sample households.

The design of the sampling strategy is a three-step process. Firstly, it is essential to know the size of the population of interest. Secondly, the optimal size of the sample is determined by identifying the minimum number of households that allows for a generalization of the survey results. The third and final step is to decide the methodology to follow during the selection of the sample households. The latter is influenced by time and financial constraints, and several options are also available with different degrees of reliability.

Defining the population of interest

By "population of interest" the total number of households living in the area targeted by the project is usually taken into consideration. As national and regional statistics about the population are commonly expressed as the number of people living in the area, this number has to be divided by the average size of a household, provided that it is known at country level.

To proceed with the sampling strategy it is advisable to keep the figures about the population broken down into the smallest scale available. This means that the optimal information during this step of the sampling strategy includes as much as possible of the following:

- number of households living in the region(s) concerned by the project;
- number of households living in the commune(s) concerned by the project;
- number of households living in each of the villages concerned by the project.

Determining the sample size

Based on the size of the population living in the project area, the number of households to be sampled for the survey can be determined via automatic calculators available online (see www.raosoft.com/samplesize.htm as one example). In order to provide the user with the minimum size of the sample, these calculators require the following three pieces of information.

- The **population size,** as calculated in the first step of the sampling strategy and expressed as the total number of households living in the area concerned by the project;
- The desired **confidence level,** i.e. the amount of uncertainty that can be tolerated when generalizing the results of the survey to the whole population; this is generally set at 95 per cent, although 90 per cent and 99 per cent may also be used; of course, a higher confidence level requires a larger sample, resulting in a higher reliability of the results gathered through the survey;
- The **margin of error,** i.e. the amount of error that can be tolerated when generalizing the results of the survey; this is generally set at 5 per cent, but lower margins of error may be used when a higher precision of the results is needed; however, as the margin of error decreases, the minimum number of households to be interviewed greatly increases.

When the population is rather small (less than 5 000 households), the size of the sample is proportionally bigger than in the case of large populations (see table 6). In general, for any large population composed of more than 5 000 households and a confidence level of 95 per cent, the sample size remains relatively constant at about 400 units.

TABLE 6. Sample size for different populations (the margin of error is set at 5%)

Population (size)	Confidence level (90%)	Confidence level (95%)	Confidence level (99%)
2,000 households	**239** (11.9% of the total)	**323** (16.1% of the total)	**499** (24.9% of the total)
5,000 households	**257** (5.1% of the total)	**357** (7.1% of the total)	**586** (11.7% of the total)
10,000 households	**264** (2.6% of the total)	**370** (3.7% of the total)	**623** (6.2% of the total)
50,000 households	**270** (0.5% of the total)	**382** (0.8% of the total)	**655** (1.3% of the total)
200,000 households	**271** (0.1% of the total)	**384** (0.2% of the total)	**662** (0.3% of the total)

The calculated size of the sample corresponds to the minimum number of households to be surveyed. However, some households may inevitably not complete the questionnaire correctly, or may provide unreliable data that has to be eliminated from the database during the encoding or the cleaning up of the data. To ensure that the recommended size of the sample is always achieved, the final sample size is usually increased by 10 per cent with respect to the number of observations suggested by the calculator.

Defining the sampling methodology

Once the sample size has been determined, the last step of the sampling strategy involves the definition of the methodology to be followed by selection of the households to be surveyed. This exercise must be based on the available census data, i.e. total population (households) disaggregated per district or village,

and if possible the list of the households living in each village. Once this information has been gathered, several methodologies are available for selection of the sample households. The most reliable options are those ensuring that the sample is statistically representative of the total population.

To select a representative sample, a probabilistic criterion should be followed, guaranteeing that all the households of the population have the same opportunity to be selected. This can be accomplished based on three different methodologies.

- Starting from a list of all the households included in the population, the best option is to randomly select the observations. In order to do so, each household has to be assigned a numerical code and a random number generator can be used to identify the codes corresponding to the sampled households. For example, the function «RANDBETWEEN» in Microsoft Excel can be used to generate a list of random numbers within a minimum (usually 1, i.e. the code assigned to the first household of the list) and a maximum (equal to the total number of households within the population). Otherwise, online random number generators are available (e.g. www.random.org). This is the so-called **random sampling**;
- Another option is to adopt a **systematic sampling** methodology. In order to do so, the first household of the sample is randomly selected, then a fixed interval (k) is set and all the k-th households on the list are selected; this interval will roughly be equal to the ratio between the population and sample (for example, if the population is 5 000 households and the sample 500 units, the optimal interval is ten);
- When the population of the project area is broken down into several sub-groups, for example by commune or by village, the best option could be to adopt a **stratified sampling**. A limited number of sub-groups, for example villages, are first randomly selected to host the survey, and the number of households to be interviewed in each village is then determined proportionally to the total number of inhabitants. In order to assure representativeness of the final sample, the households surveyed in each village are always selected randomly or systematically. This methodology is probably more demanding in the planning phase but it can provide substantial savings in time and resources in the implementation of the survey, especially when there are many sparse villages in the project area.

Other sampling methods are not able to provide a representative sample for the survey and shall therefore be used only when more preferable options are not available. Namely, when lists of households within the areas concerned by the projects are not available, it is recommended that at least a random selection of the villages be applied.

The choice of the sampling strategy is therefore highly context-dependent. In the AAD project, every country has looked for the methodology that best suits the specificities of the project areas. As long as the sampling ensures statistical representativeness, the survey results can be compared across countries.

PASTORAL FAMILY IN TÉRA, NIGER

10 Carrying out the survey

During the administration of the questionnaire the role of the interviewers, or enumerators, is crucial. The interviewers deliver the survey to households and are therefore primarily responsible for the quality of the data collected.

Planning the survey and hiring enumerators

The field survey needs to be planned well in advance since it can be very time consuming. Let us take, for example, a questionnaire with 60 questions that can require up to 90 minutes to be administrated. About five households can be covered per day per enumerator. If the sample size is 400 households (an acceptable size for any population with a size above a few thousand households) 80 working days will be required, i.e. 16 full days for a team of five enumerators. Additional time also needs to be allowed for testing the questionnaire, training the enumerators, obtaining the required permissions (e.g. village chiefs), sensitizing communities to the purpose of the survey, as well as transporting to and from the (sometimes remote) areas where the sample households are located.

The team of enumerators should not be too large, as the larger it is the higher the risk of variability of the results will be. Although it is preferable to hire professionally trained or experienced enumerators, it is not always necessary. For example, university students can be hired as enumerators, as long as they are able to communicate with the respondents in the local language and are acquainted with the methodology and questionnaire being used. A good understanding of the local cultural environment is essential, as well as basic computer skills for data encoding (e.g. Microsoft Excel).

Thorough training of the enumerators is critical for the success of the survey. They need to be able to clearly communicate each question and must respect the administrative standards required during the survey. Pre-testing the questionnaire with the enumerators in real situations allows them to practice and receive feedback before beginning the survey.

Implementing the survey

The work of the enumerators needs to be closely supervised and coordinated. The person in charge of the assessment is responsible for the work done by the interviewers and is expected to check that the sampling scheme is consistent with the one planned for the survey, otherwise the results may lose their statistical validity. There could be a tendency for enumerators to choose the more accessible households rather than strictly follow the sampling scheme (in other words, convenience rather than probabilistic sampling).

A household can be defined in different ways, depending on the cultural context. It is usually defined as a group of people who live under the same roof and share the same source of food. However, depending on the definition applied, the composition of the household may change, thus including or excluding some people. It is therefore important that the definition be consistent throughout the said survey, and if possible, during any other surveys taking place at the national level. The person to be interviewed should be the head of the household, or someone speaking on behalf of the household who is knowledgeable of the household situation.

It is recommended that the enumerators always start the interview by introducing themselves, the organization or project they represent, and by briefly explaining the purpose of the interview. In some areas where they have previously taken part in similar surveys, respondents may express "survey fatigue" or feel disillusioned by other interventions where expectations have not been met. If the head of the household does not want to respond, the enumerator should never insist.

TABLE 7. Practical tips for carrying out household interviews

DON'T	DO
Make comments or judgements, suggest answers or do anything that could influence the responses	Keep a neutral position towards respondents
Modify the questions or change their order	Administer all questions in the order of the questionnaire, without changing them
Allow the interviewee to read the questionnaire	Read out the questions, repeat if needed, and make sure the respondent understands each question
Communicate the results of the interview, or any project related information which may create expectations	When the interview is over, thank the respondent and leave

11 Encoding and analysing the data

Encoding consists of filling in a data matrix with the information collected from the questionnaires. Once completed, the data can be checked, the data can be checked and cleaned up before being analysed through statistical tools and presented in graphs.

Filling in the data matrix

An important advantage of closed-ended questions is that answers can be easily coded and compiled in a data matrix. If possible, the interviewers should compile the results in the data matrix immediately after the daily survey (i.e. the same evening) to reduce the risk of errors, fix any problems in the questionnaire and avoid having to encode all questionnaires at the same time. The coding rules used should always be consistent with the questionnaire. We suggest using the following:

- For dummy variables, YES usually is coded with 1 and NO is coded with 0;
- For quantitative variables, numbers do not need to be coded, the figure is reported in the matrix as such;
- For qualitative variables, options can be coded with subsequent numbers;
- N/A and N/R answers can be coded with pre-determined and easily recognizable figures like 99 ("N/A" or "refused to answer"), 98 ("does not know").

In the data matrix, the data collected in one household surveyed are compiled in the same row; for each question, the code is put into a column. The final matrix will have N rows and K columns:

- N is the number of the household surveyed;
- K is the number of questions administered.

During data entry, particular attention should be paid in order to avoid adding spaces or punctuation within the cells of the matrix together with the coded answers; these small mistakes can cause various complications during the subsequent statistical analysis of the data.

After encoding each questionnaire, typos and encoding errors should be thoroughly checked to ensure that the codes entered in the matrix fully correspond to the answers of the respondent. This is usually accomplished by going through the database column after column and searching for invalid entries. For example, if a given question only allows the codes 1, 0 and 98, and a different value (for example 2 or 99) is detected in the corresponding column, the relevant household (hard copy) questionnaire needs to be re-checked to replace the incorrect entry in the matrix. The questionnaire hard copies (i.e. paper copies) should be safely kept, even after the data has been encoded into the matrix.

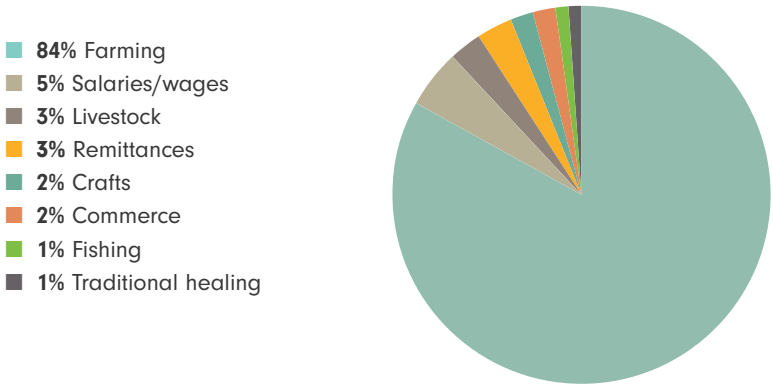
Data analysis

After the matrix has been cleaned up a descriptive analysis can be performed. The objective of descriptive statistics is to summarize the large quantity of information to better describe the data. The easiest way to deal with missing values is simply to exclude from the analysis the observations with missing values, even though statistical software can also estimate them (with the mean or by inference). In the descriptive analysis of the data, the percentage of missing values should always be determined for each variable. If a variable shows many missing values, a threshold can be set (e.g. 5 per cent or 15 per cent) to exclude from the analysis all variables having more missing values than this threshold.

For **dummy and qualitative variables**, tables can be created by reporting the figures of each option, as well as pie charts or histograms showing the quota of answers for each option. For example, in the following question:

N°	Questions	Answers	Codes
LI62	First source of livelihoods of the household	☐ Farming (staple crops)	1
		☐ Livestock	2
		☐ Fishing	3
		☐ Commerce	4
		☐ Crafts (masonry, carpentry, mechanics, etc.)	5
		☐ Salary/wage	6
		☐ Remittances	7
		☐ Traditional healing	8

A simple calculation of percentages of respondents selecting each of the respective options allows for the production of the following pie chart:



In the case of **quantitative variables**, basic descriptive statistics can be performed (average value, median, standard deviation). See the example question below:

N°	Questions	Answers (=codes)
LI70	Number of livestock heads owned by the household	Cattle ☐ Goats ☐ Sheep ☐ Poultry ☐

The answers coded as presented in the matrix below allow to easily calculate the average number of cattle, goats, sheep and poultry per household, as well as the standard deviations.

	LI70 (1)	LI70 (2)	LI70 (3)	LI70 (4)
Household 1	5	6	0	20
Household 2	1	2	2	10
Household 3	1	25	1	25
Household 4	7	5	7	10
Household 5	2	1	1	1
Household 6	2	3	0	0
Mean (± SD)	**3.00 (± 2.45)**	**7.00 (± 9.01)**	**1.83 (± 2.64)**	**11.00 (± 10.00)**

Once the data has been properly described, statistical elaborations can be performed through a statistical software. The rationale of the statistical elaborations may follow one or more of the following questions.

- *Is there a statistically significant difference between two groups of households with respect to one or more variables?*

This may be relevant for a deeper exploration of the survey data or to test whether the socio-economic situation of the households has improved after the implementation of the project. For example, it could be interesting to study whether a different perception of food security exists among households interviewed in two different regions of a country; in this case, the average FIES scores would be calculated for the two groups of households, and the difference between them is tested for statistical significance through t-tests.

➔ *Is there a relationship among the results obtained under different questions?*

Here, it may for example be relevant to investigate whether the level of a particular asset (out of the five of the SLF) is related to the level of the other assets. This elaboration can be done through a correlation analysis when the concerned variables are numerical, while chi-square and correspondence analysis shall be used for categorical variables.

➔ *What are the factors explaining the level of a certain variable?*

A regression analysis can be used to study the extent to which one or more factors can explain the value of a certain variable across the observations, and the effect of each factor on it. For example, it may be relevant to study the extent to which the level of the livelihood assets is able to influence the uptake of an improved practice of land management by the households (Ceci *et al.*, 2018). The results of the regression analysis help understand (i) the extent to which all the factors together can explain the uptake of the improved practice, (ii) whether the influence of each livelihood asset is positive or negative (i.e., it increases or decreases the uptake of the practice), and (iii) the magnitude of the effect of each factor.

Food security indicators

If the FIES module has been used within the questionnaire, its responses can be treated to calculate specific indicators related to food security[3]. The eight items should be analysed together as a scale, not as separate items.

➔ A raw score can be calculated by adding affirmative responses given to the eight FIES questions. The score is a number between zero and eight, as an indicator of food insecurity severity, with lower raw scores corresponding to less severe food insecurity. A weighted average of the scores provides the prevalence of food insecurity in the population.

Respondents can be assigned a class of food insecurity depending on a severity threshold: ATELESS (Q5) and WHLDAY (Q8), defining the moderate and severe food insecurity classes, respectively. People experiencing moderate levels of food insecurity will typically eat low quality diets and might

[3] Additional guidance on how to analyse FIES data is available at http://www.fao.org/3/a-i7835e.pdf

have also been forced, at times during the year, to reduce the quantity of food they would normally eat, while those experiencing severe levels would have gone for entire days without eating, due to lack of money or other resources to obtain food.

Two FIES-based indicators can be used for national and global monitoring purposes:

- $FI_{mod+sev}$ is the proportion of the population experiencing moderate or severe food insecurity (SDG indicator 2.1.2);
- FI_{sev} is the proportion of the population experiencing severe food insecurity.

During the interpretation of the results obtained through the FIES assessment, it should always be remembered that the FIES tool reports the perception of the respondent with respect to the level of food security of the household, which may be different from the actual level of food security. However, a full assessment would require much more complicated tools, involving a full report of the meals consumed by a family over a certain time period. The FIES scale is considered a sufficient approximation of the level of food security of households surveyed in the context of large-scale restoration projects.

Drafting the report

The socio-economic report is a summary of the analysis that has been carried out, and that presents the major findings. The report should briefly present the activities of the project or any intervention it partakes in, as well as the objectives of the study (baseline or end line study for socio-economic impact evaluation, thematic study, etc.) and methodology used, from design to analysis, providing as much detail as possible. Aggregated tables and/or figures should be provided that specifically answer the questions posed. Secondary data may also be used, including any relevant and reliable sources of information and statistics available to help understand the socio-economic context and to complement the results of the assessment in the region of interest. It is important to keep in mind that the data needs to be analysed according to the information required, and not the contrary.

In the case of impact evaluation, all impacts must be thoroughly understood. If changes are observed (for example by comparing baseline and end line indicator values) the causal relationship between them and the project activities must be identified. The following questions can serve as a guide for impact evaluation:

- *What are the changes that have occurred?*
- *How important are they?*
- *Who has been most/least affected by them?*
- *How did they occur?*
- *And most importantly, are they are a result of project activities or to external factors?*

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Conclusions

Under the ever-increasing threat of climate change, desertification calls for a response of unprecedented urgency. While traditional techniques to improve soil-fertility currently exist and can effectively restore degraded land, they can no longer be the only response to the volume of restoration required globally. Active restoration on-the-ground, which is the type of the model presented in this manual, is a key plant-based solution needed to upscale and accelerate restoration of degraded land in countries of the Sahel and the Great Green Wall, and beyond.

Sustainability is achieved through the ownership of the restoration process by the local communities and their involvement in the design, implementation and monitoring of the restoration process. At the same time, technical know-how needs to be embedded into local and traditional systems, institutions and processes. Consequently, the technical model presented in the first part of this publication should be applied jointly with a participatory approach based on well-understood livelihoods and plant uses, and by placing community-based organizations such as village management committees at its center to guarantee both ecological and developmental long-term success.

This manual is mainly built on lessons learnt and findings through the implementation of large scale restoration work on the ground with rural communities and plant scientists. During a five-year period, FAO's Action Against Desertification has brought 53 000 hectares of degraded land under restoration by planting 25 million well-adapted native trees combined with diverse herbaceous fodder species, and has reached 700 000 people. Indeed, an approach that places communities at the heart of restoration and provides support by way of plant knowledge, delivers multiple ecological and socio-economic benefits contributing to attainment of the goals of the 2030 Agenda on Sustainable Development. This approach has proved to be a powerful lever for the development of dryland communities. Clearly, its primary scope of application is the Great Green Wall core region, but it is also used in other regions such as the Caribbean and Pacific under the AAD project.

The UN Decade on Ecosystems Restoration (2021-2030) demonstrates that restoration has moved to the top of the international agenda. While pledges to global restoration initiatives abound, it has become increasingly clear that restoration efforts must still be made to reach rural communities living in fragile ecosystems, where it matters most. May this manual support and serve in achieving the dual purpose of consolidating biophysical operations and socio-economic assessments of large scale restorations in actions against desertification.

Annex 1

Major species used for restoration by communities in the Great Green Wall and their seed characteristics

Species (taxa)	Life form	Collection month	1 000 seed weight (g)	Germination response (%)
Alysicarpus ovalifolius	grass	10		
Andropogon gayanus	grass	11		
Andropogon pseudapricus	grass	10		
Aristida mustabilis	grass	9	0.65	94%
Brachiaria ramosa	grass	10	0.77	
Cenchrus biflorus	grass	10	1.73	35
Chloris pilosa	grass	10		
Chrozophoro senegalensis	grass	5		
Crotalaria macrocalyx	grass	12	3.31	100
Cymbopogon giganteus	grass	12	1.44	56
Cymbopogon schoenamthus	grass	8		
Dactyloctenium aegyptium	grass	10		
Digitaria exilis	grass	8		
Eragrostis tremula	grass	11	0.06	75
Leptadenia hastata	grass	3		
Panicum laetum	grass	11	1.1	20
Pennisetum pedicellatum	grass	11	0.98	100
Schoenefeldia gracilis	grass	9		
Senna occidentalis	grass	1		
Senna tora	grass	11		
Stylosanthes hamata	grass			
Stylosanthes fruticosa	grass	2	2.26	
Zornia glochidiata	grass	10	1.65	55

Species (taxa)	Life form	Collection month	1 000 seed weight (g)	Germination response (%)
Acacia nilotica	woody	1	16	100
Acacia senegal	woody	3	46.3	100
Acacia seyal	woody	3	42.69	95
Acacia tortilis	woody	4	26.44	100
Adansonia digitata	woody	3	399.26	80
Adenum obesum	woody		25	
Balanites aegyptiaca	woody	1	3 000	100
Bauhinia rufescens	woody	10	78.63	100
Combretum glutinosum	woody	4	78.53	95
Combretum micranthum	woody	12	28.66	100
Dalbergia melanoxylun	woody	3	105.45	100
Faidherbia albida	woody	3	51.6	100
Grewia bicolor	woody			
Guiera senegalensis	woody	11	29.1	73
Lannea microcarpa	woody	7	200	
Parkia biglobosa	woody	4	1 000	100
Piliostigma reticulatum	woody	1	102.41	100
Prosopis africana	woody	2	106.23	100
Pterocarpus lucens	woody	1	163.58	90
Sclerocarya birrea	woody	5	431.55	
Sterculia setigera	woody	12	395.6	80
Tamarindus indica	woody	3	385	100
Ziziphus mauritiana	woody	11	382.75	87

Source: (Sacande, Sanogo and Beentje, 2016).

Annex 2

Checklist for socio-economic assessments

A checklist may be useful in planning a socio-economic assessment as it lists the key activities to carry out before starting a socio-economic survey. Controlling the checklist during the planning phase can guarantee the people in charge of organizing the assessment that everything is ready before beginning the survey. Once all the items are marked with "done", the socio-economic survey may start.

ITEM	STARTED	DONE
The questionnaire has been customized, based on the context of the project area		
Each item in the questionnaire reports the encoding instructions for interviewers		
Data on the number of households living in the project area is available		
The sample size has been calculated		
The sampling methodology has been defined		
The number of interviewers and working days have been decided		
Interviewers have been recruited		
Interviewers have been trained		
Clear instructions on how many households are expected to be interviewed and how to obtain their availability for each interviewer		
Questionnaires are printed out, ready for the survey		
An Excel sheet, structured according to the items included in the questionnaire, has been created to manage the data entry operations		
The survey coordinator is acquainted with how to calculate the food insecurity score through the FIES questions		
The survey coordinator is acquainted with the basic statistical tools used to analyse survey data		
A structured word file for reporting is ready to be filled in with the results of the survey		

Annex 3

Template household survey questionnaire

Informed consent:

Hello! My name is ..... and I'm working for .....

We are conducting a survey on socio-economic situations in your community/village and I would greatly appreciate the opportunity to talk with you about your household and the household members. It should take us about 45 minutes, and the answers you provide will help us to understand the socio-economic situation of your community/village.

Are you willing to take some time to answer these questions today?

RESPONSE: **YES** **NO**

HOUSEHOLD* LOCATION

*Household definition used for the survey:
(for example: "group of people living under the same roof and sharing the same source of food")

Date:	Name of Interviewer:	
Village:	Name of interviewee:	
Region/State/Department:	Commune/District:	
Questionnaire code:	Geographic location (GPS coordinates)	
	Longitude:	Latitude:

SECTION I: LIVELIHOODS QUESTIONNAIRE

HUMAN CAPITAL			
N°	**Questions**	**Answers**	**Codes**
LI01	Gender of household head (even if the interviewee is another member of the household)	☐ M ☐ F	1 2
LI02	Household head age (even if the interviewee is another member of the household)	☐ 18 years and below ☐ 19 to 35 years ☐ 36 to 50 years ☐ 51 to 65 ☐ Above 65 years old	1 2 3 4 5
LI03	Number of household members by gender	Male ☐ Female ☐ Total ☐	
LI04	Profession	☐ Agro-producer ☐ Traditional Healer ☐ Nurseryman ☐ Horticulturalist ☐ Craftsman/sculptor ☐ Herder ☐ Herbalist ☐ Traditional midwife ☐ Dyer ☐ Plant products seller ☐ Rope maker ☐ Beekeeper ☐ Other:	1 2 3 4 5 6 7 8 9 10 11 12 13
LI05	Professional experience (years)	☐	
LI06	Household members temporarily **(maximum 6 months per year)** out of the village for seasonal job	☐ None ☐ 1-2 ☐ 3-4 ☐ More than 4	1 2 3 4
LI07	Number of household members who out-migrated for work **(more than 6 months per year)**	☐ None ☐ 1-2 ☐ 3-4 ☐ More than 4	1 2 3 4
LI08	Highest level of education attained by the household head	☐ Never been to school ☐ Primary ☐ Secondary ☐ Vocational (e.g. technical training) ☐ Tertiary (university, college)	1 2 3 4 5

LI09	Household boys between ages of **7-18** regularly go to school	☐ All of them ☐ Some of them ☐ None ☐ N/A	3 2 1 99
LI10	Household girls between ages **7-18** regularly go to school	☐ All of them ☐ Some of them ☐ None ☐ N/A	3 2 1 99
LI11	Household members **older than 18** who are literate	☐ All of them ☐ Some of them ☐ None of them	3 2 1
LI12	Forest and land management and protection practices in which household members are involved		**Yes** **No**
		☐ Restriction on tree felling	1 0
		☐ Restriction on fuelwood/fodder harvesting from live trees	1 0
		☐ Restriction on tree branch cutting (fodder, fencing material)	1 0
		☐ Eclosures – grazing control	1 0
		☐ Use of improved cooking stoves	1 0
		☐ Erosion/sedimentation control measures (sand bags, loose stone walls, live fences, dykes, riparian tree planting)	1 0
		☐ Live fences	1 0
		☐ Zaï	1 0
		☐ Half-moons	1 0
		☐ Tree planting (seedlings or direct seeding)	1 0
		☐ Direct seeding of grasses	1 0
		☐ Dune stabilization, sand encroachment	1 0
		☐ Fire breaks and fire prevention measures	1 0
		☐ Other	1 0
LI13	Agricultural practices used by household members		**Yes** **No**
		☐ Use of chemical fertilizers	1 0
		☐ Use of chemical pesticides	1 0
		☐ Aerobic compost making	1 0
		☐ Anaerobic compost making	1 0
		☐ Agroforestry practices (alley cropping, live fencing, etc.)	1 0
		☐ Intercropping (growing two or more crops in proximity)	1 0
		☐ Crop rotation	1 0
		☐ Ploughing with animal traction	1 0
		☐ Ploughing with tractor	1 0
LI14	The household practises seasonal transhumance of livestock	☐ Yes ☐ No	1 0
LI15	Household members that have received technical training		**Yes** **No**
		☐ Agricultural	1 0
		☐ Livestock grazing	1 0
		☐ Forestry	1 0
		☐ Business development	1 0
		☐ Other	1 0

LI16	Household uses traditional medicine	☐ Yes ☐ No	1 0
LI17	Adaptation strategies to climate change		**Yes** **No**
		☐ Tree planting for shade and wind break	1 0
		☐ Staggered cropping (early and late crops)	1 0
		☐ Crop rotation	1 0
		☐ Other	1 0
LI18	Technical capacity development needs of the household		**Yes** **No**
		☐ Beekeeping	1 0
		☐ Fruit tree planting	1 0
		☐ Sustainable forest management techniques	1 0
		☐ Seed collection, propagation and nursery management	1 0
		☐ Development of private forest plantations	1 0
		☐ Awareness and educational programmes on forests for climate change mitigation and adaptation	1 0
		☐ Improved cooking stoves	1 0
		☐ Fruit tree grafting	1 0
		☐ Business development skills (book keeping, marketing, strategy)	1 0
		☐ Product transformation and conservation techniques	1 0
		☐ Other	1 0
LI19	Tree/forest products which are part of the household diet		**Yes** **No**
		☐ Fruits and nuts	1 0
		☐ Leaves	1 0
		☐ Honey	1 0
		☐ Tubers	1 0
		☐ Resins and gums	1 0
		☐ Other	1 0
LI20	Period of the year in which the household has food shortage		**Yes** **No**
		☐ March – June	1 0
		☐ July – October	1 0
		☐ November – February	1 0
LI21	Coping strategy to deal with food and/or cash shortages		**Yes** **No**
		☐ Sale of livestock	1 0
		☐ Fuelwood collection and sale	1 0
		☐ Barter trade	1 0
		☐ Remittances	1 0
		☐ Reduced meals	1 0
		☐ Loans	1 0
		☐ Petty business	1 0
		☐ Gardening	1 0
		☐ Food harvesting from forests for household-consumption and/or sale	1 0
		☐ Borrowing food from family or friends	1 0
		☐ Harvesting and selling products from forests and/or grassland (incense, etc.)	1 0
		☐ Fishing	1 0
		☐ Other	1 0

SOCIAL CAPITAL			
			Yes No
LI22	Household members are involved in socio-economic interest groups (farmers' association, women support group, youth group, etc.)	☐ Gardening ☐ Dyeing ☐ Soap-making ☐ Commercial fruit tree plantations (mango, banana, orange, cashew) ☐ Commercial tree forest plantations ☐ Commercial nursery ☐ Handicraft ☐ Beekeeping ☐ Commercialization of wild fruits ☐ Community farming (groundnuts, early millet, sesame) ☐ Community forestry (nursery, tree planting) – other than Community Forest Committee ☐ Other	1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0
LI23	Household women participate in socio-economic interest groups	☐ Yes ☐ No ☐ N/A	1 0 99
LI24	Monthly number of meetings the household is involved in (all processes)	☐ None ☐ 1-2 ☐ 3-4 ☐ 5 and above	1 2 3 4
			Yes No
LI25	The household receives support from external institutions	☐ Non-governmental organizations ☐ Extension services (forestry and agriculture) ☐ Government projects ☐ Community based organisations ☐ International projects ☐ Local government administration ☐ Other	1 0 1 0 1 0 1 0 1 0 1 0 1 0
LI26	Household women participate in decision-making and other community processes	☐ Yes ☐ No ☐ N/A	1 0 99
LI27	Household members provide labour assistance to community members in case of need	☐ Yes, for free ☐ Yes, for compensation ☐ No	2 1 0
LI28	The household receives labour assistance from community members in case of need	☐ Yes, for free ☐ Yes, for compensation ☐ No	2 1 0

NATURAL CAPITAL			
LI29	Number of natural water points (springs, streams) that the household has access to for its needs	☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 and above	0 1 2 3 4
LI30	Some natural water points have dried up in the last five years	☐ Yes ☐ No ☐ N/A	1 0 99
LI31	Average temperature has increased in the last ten years	☐ Yes ☐ No ☐ Does not know	1 0 98
LI32	Rainfall patterns have shifted in the last ten years	☐ Yes ☐ No ☐ Does not know	1 0 98
LI33	Rainfall intensity has changed in the last ten years	☐ Yes ☐ No ☐ Does not know	1 0 98
LI34	Extreme weather events for which frequency has increased in the last ten years	☐ Drought ☐ Heat wave ☐ Dust or sand storms ☐ Floods/heavy rainfall ☐ High winds	1 2 3 4 5
LI35	Agricultural land where the household has access to for farming	☐ Home garden ☐ Upland ☐ Lowland	**Yes No** 1 0 1 0 1 0
LI36	The household owns the agricultural land it uses for farming	☐ Owned ☐ Borrowed (free) ☐ Rent	**Yes No** 1 0 1 0 1 0
LI37	Main land ownership types in the area	☐ State owned ☐ Municipality owned ☐ Community owned ☐ Private land (individual) ☐ Private land (corporate) ☐ Other	**Yes No** 1 0 1 0 1 0 1 0 1 0 1 0
LI38	The land used by the household has soil erosion problems	☐ Yes ☐ No	1 0

			Yes	No
LI39	Main vegetation types in the area	☐ Forest	1	0
		☐ Wood land	1	0
		☐ Sparse woodland	1	0
		☐ Shrubs	1	0
		☐ Sparse shrubs	1	0
		☐ Grassland	1	0
		☐ Cropland	1	0
		☐ Other	1	0
			Yes	**No**
LI40	Main land uses in the area	☐ Subsistence agriculture	1	0
		☐ Intensive agriculture	1	0
		☐ Livestock grazing	1	0
		☐ Forest land	1	0
		☐ Wood collection	1	0
		☐ Hunting	1	0
		☐ Mining	1	0
		☐ Waste disposal	1	0
		☐ Water reservoir (dam)	1	0
		☐ Recreational uses	1	0
		☐ Natural protection	1	0
		☐ Spiritual	1	0
		☐ Other	1	0
LI41	Forest resources in the area are degraded	☐ Heavily degraded		1
		☐ Degraded		2
		☐ Not degraded		3
LI42	Trend of tree/forest cover in the area in the last ten years	☐ Decreased		1
		☐ Stable		2
		☐ Increased		3
		☐ Does not know		98
LI43	Trend of forest fires in the area in the last five years	☐ Decreased		3
		☐ Stable		2
		☐ Increased		1
		☐ Does not know		98
LI44	Household access to and use of forest resources is satisfactory	☐ Yes		1
		☐ No		0
LI45	The household owns a private plantation	☐ None		1
		☐ Forest tree plantation		2
		☐ Fruit tree plantation		3
		☐ Mixed		4
LI46	Conflicts over the access to natural resources (forest, land, water) have occurred in the community in the last five years	☐ Yes		1
		☐ No		0
		☐ Does not know		98

			Yes	No
LI47	Encroachment between livestock, agriculture and forests has occurred in the community in the last five years	☐ Farming encroachment on forests	1	0
		☐ Livestock encroachment on farming	1	0
		☐ Livestock encroachment on forests	1	0
		☐ Wildlife encroachment on farming	1	0
		☐ Other:	1	0
LI48	Animal grazing is a current cause of land and forest degradation	☐ Both free grazing and tree branch cutting		1
		☐ Tree branch cutting		2
		☐ Free grazing		3
		☐ No		4
			Yes	**No**
LI49	Products extracted from trees besides food	☐ Fuelwood	1	0
		☐ Medicinal plants	1	0
		☐ Timber	1	0
		☐ Construction material (roofing, fencing, etc.)	1	0
		☐ Artisanal material	1	0
		☐ Ropes	1	0
		☐ Fodder	1	0
		☐ Dye	1	0
		☐ Soap	1	0
		☐ Fibers	1	0
		☐ Organic fertilizer	1	0
		☐ Other	1	0
			Yes	**No**
LI50	Parts of trees used by household members for uses other than food	☐ Leaves	1	0
		☐ Branches	1	0
		☐ Bark	1	0
		☐ Inner bark	1	0
		☐ Trunk	1	0
		☐ Roots	1	0
		☐ Resin	1	0
		☐ Deadwood	1	0
		☐ Litter	1	0
		☐ Other	1	0
LI51	Household women are actively involved in forest management and protection	☐ Yes		1
		☐ No		0
		☐ N/A		99
LI52	What kind of fuel is used by the household for cooking	☐ Charcoal		1
		☐ Fuelwood that is collected in the surroundings		2
		☐ Fuelwood that is purchased		3
		☐ Gas		4
		☐ Other		5

PHYSICAL CAPITAL			
LI53	Number of houses the household occupied	☐ 1-2 ☐ 3-4 ☐ 5 and above	1 2 3
LI54	Housing typology of the household	☐ Modern (metallic roof, clay bricks or concrete) ☐ Both modern and traditional ☐ Traditional (straw roof, mud bricks)	3 2 1
LI55	Important goods and tools owned by the household	☐ Power generator ☐ Television ☐ Bicycle ☐ Motorbike ☐ Car ☐ Plough ☐ Cart ☐ Traditional farming tools ☐ Tractor ☐ Crop processing machine ☐ Wood processing tools ☐ Other	**Yes No** 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0
LI56	The household owns animals (donkeys, cattle, horses, etc.) for farming activities	☐ None ☐ 1-2 ☐ 3-4 ☐ 5 and above	1 2 3 4
LI57	The household has access to artificial water points for its needs	☐ Tap ☐ Borehole ☐ Covered well ☐ Open Well	**Yes No** 1 0 1 0 1 0 1 0
LI58	In the village there is a primary health care centre	☐ Yes ☐ No	1 0
LI59	In the village there is a school	☐ Secondary school ☐ Primary school ☐ Nursery school	**Yes No** 1 0 1 0 1 0
LI60	Rural roads are sufficiently developed and maintained in the area	☐ Yes ☐ No	1 0
LI61	There are enough markets in the area for buying and selling products	☐ Yes ☐ No	1 0

FINANCIAL CAPITAL			
LI62	First source of livelihoods of the household	☐ Farming (staple crops) ☐ Livestock ☐ Fishing ☐ Commerce ☐ Handicraft ☐ Crafts (masonry, carpentry, mechanics, etc.) ☐ Salary/wage ☐ Remittances ☐ Traditional healer ☐ Forest-based enterprise ☐ Horticulture ☐ Other	1 2 3 4 5 6 7 8 9 10 11 12
LI63	Second source of livelihoods of the household	☐ Farming (staple crops) ☐ Livestock ☐ Fishing ☐ Commerce ☐ Handicraft ☐ Crafts (masonry, carpentry, mechanics, etc.) ☐ Salary/wage ☐ Remittances ☐ Traditional healer ☐ Forest-based enterprise ☐ Horticulture ☐ Other	1 2 3 4 5 6 7 8 9 10 11 12
LI64	Trend of household income in the last two years	☐ Increased ☐ Constant ☐ Decreased	3 2 1
LI65	The household practises off-season agriculture	☐ Yes ☐ No	1 0
LI66	The household produces cash crops	☐ Yes ☐ No	1 0
LI67	The household receives monetary remittances from out-migrated members	☐ Yes ☐ No	1 0
LI68	The household buys fuelwood	☐ Yes ☐ No	1 0
LI69	The household is engaged in a small forest-based enterprise	☐ Non-wood forest products enterprise ☐ Timber enterprise ☐ Fuelwood ☐ None	4 3 2 1

LI70	Number of livestock heads owned by the household	Cattle ☐ Goats ☐ Sheep ☐ Poultry ☐	
LI71	The household experiences value chain problems and products are not marketed enough	☐ Yes ☐ No ☐ N/A	1 0 99
LI72	The household keeps **private** cash savings in banks, community funds or other forms	☐ Yes ☐ No	1 0
LI73	The household benefits from community development funds established in the village for common purposes	☐ Yes ☐ No	1 0
LI74	The household has access to reasonable micro-credit and loan schemes	☐ Community/CBO loan ☐ Government loan ☐ Development project loan ☐ Private bank loan ☐ None ☐ Does not know	5 4 3 2 1 98

SECTION II: GLOBAL FOOD INSECURITY EXPERIENCE SCALE (Household Referenced)

FIES01	During the last 12 MONTHS, was there a time when you or others in your household worried about not having enough food to eat because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES02	During the last 12 MONTHS, was there a time when you or others in your household were unable to eat healthy and nutritious food because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES03	During the last 12 MONTHS, was there a time when you or others in your household ate only a few kinds of foods because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES04	During the last 12 MONTHS, was there a time when you or others in your household had to skip a meal because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES05	During the last 12 MONTHS, was there a time when you or others in your household ate less than you thought you should because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES06	During the last 12 MONTHS, was there a time when you or others in your household ran out of food because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES07	During the last 12 MONTHS, was there a time when you or others in your household were hungry but did not eat because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99
FIES08	During the last 12 MONTHS, was there a time when you or others in your household went without eating for a whole day because of a lack of money or other resources?	☐ No ☐ Yes ☐ Don't know ☐ Refused	0 1 98 99

SECTION III: PLANT SPECIES

1. IDENTIFICATION OF THE MAIN SPECIES AND PLANT PARTS USED

Please repeat this section (comprising seven questions numbered SP01 to SP07) for each of the following relevant plant use categories: food, animal feed, medicine (human health), animal health, dyes, beekeeping and other uses. Only the three most important plants used per category should be reported here.

SP01	What are the main wild species used for food/ animal feed/ medicine (human health)/ animal health/ dyes/ beekeeping/ other uses?	Name of species 1	Name of species 2	Name of species 3	
SP02	What organs are collected from these plants?	☐ Root ☐ Bark ☐ Leaves ☐ Flowers ☐ Fruit ☐ Seeds ☐ Sap ☐ Tuber ☐ Rhizome	☐ Root ☐ Bark ☐ Leaves ☐ Flowers ☐ Fruit ☐ Seeds ☐ Sap ☐ Tuber ☐ Rhizome	☐ Root ☐ Bark ☐ Leaves ☐ Flowers ☐ Fruit ☐ Seeds ☐ Sap ☐ Tuber ☐ Rhizome	1 2 3 4 5 6 7 8 9
SP03	Current conservation status	☐ Abundant ☐ Threatened ☐ Rare ☐ Disappeared	☐ Abundant ☐ Threatened ☐ Rare ☐ Disappeared	☐ Abundant ☐ Threatened ☐ Rare ☐ Disappeared	1 2 3 4
SP04	At which periods these useful species (and organs) are available?	☐ January-February ☐ March-April ☐ May-June ☐ July-August ☐ September-October ☐ November-December	☐ January-February ☐ March-April ☐ May-June ☐ July-August ☐ September-October ☐ November-December	☐ January-February ☐ March-April ☐ May-June ☐ July-August ☐ September-October ☐ November-December	1 2 3 4 5 6
SP05	How do you harvest the plant parts?	☐ Branch cutting ☐ Stem cutting ☐ Use of machete/ secators ☐ Uprooting ☐ Slashing barks ☐ Digging roots out ☐ Other:	☐ Branch cutting ☐ Stem cutting ☐ Use of machete/ secators ☐ Uprooting ☐ Slashing barks ☐ Digging roots out ☐ Other:	☐ Branch cutting ☐ Stem cutting ☐ Use of machete/ secators ☐ Uprooting ☐ Slashing barks ☐ Digging roots out ☐ Other:	1 2 3 4 5 6 7

SP06	How do you source your useful plants / plant parts?	☐ Use of Own exploitation /supply ☐ Order (herbalists) ☐ Buying ☐ Other:	☐ Use of Own exploitation /supply ☐ Order (herbalists) ☐ Buying ☐ Other:	☐ Use of Own exploitation /supply ☐ Order (herbalists) ☐ Buying ☐ Other:	1 2 3 4
SP07	What products are made of collected species?	☐ Raw organs ☐ Powder ☐ Liquid extracts ☐ Other:	☐ Raw organs ☐ Powder ☐ Liquid extracts ☐ Other:	☐ Raw organs ☐ Powder ☐ Liquid extracts ☐ Other:	1 2 3 4
SP08	Top ten (10) most important **tree species** (currently abundant or not) for your livelihoods Note: please add local name next to the scientific names (+ the language)	☐ Acacia senegal ☐ Acacia nilotica ☐ Acacia seyal ☐ Acacia tortilis ☐ Adansonia digitata ☐ Adenum obesum ☐ Balanites aegyptiaca ☐ Bauhinia rufescens ☐ Combretum glutinosum ☐ Combretum micranthum ☐ Dalbergia melanoxylon ☐ Faidherbia albida ☐ Grewia bicolor ☐ Guiera senegalensis ☐ Hyphaene thebaica ☐ Lannea microcarpa ☐ Mangifera indica ☐ Parkia biglobosa ☐ Piliostigma reticulatum ☐ Prosopis africana ☐ Pterocarpus lucens ☐ Sclerocarya birrea ☐ Sterculia setigera ☐ Tamarindus indica ☐ Zizyphus mauritiana ☐ Other:		**Rank (1-10)** _____	

SP09	Top ten (10) most important **non-tree species** (currently abundant or not) for your livelihoods Note: please add local name next to the scientific names (+ the language)	☐ Alysicarpus ovalifolius ☐ Andropogon gayanus ☐ Andropogon pseudapricus ☐ Aristida mustabilis ☐ Brachiaria ramosa ☐ Cenchrus biflorus ☐ Chloris pilosa ☐ Chrozophoro senegalensis ☐ Crotalaria macrocalyx ☐ Cymbopogon giganteus ☐ Cymbopogon schoenamthus ☐ Dactyloctenium aegyptium ☐ Digitaria exilis ☐ Eragrostis tremula ☐ Leptadenia hastate ☐ Panicum laetum ☐ Pennisetum pedicellatum ☐ Schoenefeldia gracilis ☐ Senna occidentalis ☐ Senna tora ☐ Stylosantes amata ☐ Waltheria indica ☐ Zornia glochidiata ☐ Other:		**Rank (1-10)** _____	
SP10	Where do you find plants that you often use currently?	☐ Everywhere ☐ Around compounds ☐ In plains/valleys ☐ In forest galleries ☐ In bushes ☐ Neighbourhood ☐ In other districts ☐ Other habitats (specify)			1 2 3 4 5 6 7 8
SP11	What are the important species not available anymore in your surroundings?	Name of species 1	Name of species 2	Name of species 3	
SP12	Where do you get those species from currently?				

2. UTILISATIONS OF PLANT PRODUCTS					
SP13	Where do the products go?	☐ Used within the household ☐ Sold ☐ For rituals ☐ For exports ☐ Other:			1 2 3 4 5
SP14	Do you store/stock the products?	☐ Yes ☐ No			1 0
SP15	Who are your clients/buyers of your plant products?	☐ Other households from the village/community ☐ Buyers at a local market ☐ Middle-men or wholesalers ☐ International buyers ☐ Other:			1 2 3 4 5
SP16	Which products are the most wanted?	Product 1	Product 2	Product 3	
SP17	What estimated quantities of plant products do you sell per year? (In bags or kg if possible).				

3. REGULATIONS ON PLANT EXPLOITATION					
SP18	Which species exploitation is forbidden / protected in your environment?	Name of species 1	Name of specie 2	Name of specie 3	
SP19	Who protects them?	☐ Forestry Services ☐ Plot owners ☐ Other:			1 2 3
SP20	What are the reasons of protecting these species?	☐ Forest code/other national legislation ☐ Protected area ☐ Threatened species with international protection status (i.e. IUCN red list) ☐ Sacred species/spiritual value ☐ Local level regulation ☐ Species provides key ecosystem functions (pest control, seed dispersal, erosion control etc.) ☐ Species provides key products ☐ Other:			1 2 3 4 5 6 7 8
SP21	Do you have any agreement on plant exploitation?	☐ Yes ☐ No			1 0
SP22	If yes, please specify	☐ Local ☐ Traditional ☐ Other:			1 2 3
SP23	What can you do to protect and conserve these useful species?	☐ Reduce harvested quantity ☐ Harvest only at certain periods of the year ☐ Stop harvesting until the species regenerates ☐ Protect from livestock (fences, etc.) ☐ Collect and store seeds for propagation ☐ Change harvesting/management practices ☐ Other:			1 2 3 4 5 6 7

4. SUPPORT, COLLABORATIONS AND CONSTRAINTS			
SP24	Do you have/benefit from any supports?	☐ Yes ☐ No	1 0
SP25	If yes, what sort and by whom/which partners)	☐ Technical support, from: ☐ Financial support, from: ☐ Institutional support, from:	1 2 3
SP26	Are you (or your association/group) supported by a network or by some type of collaboration?	☐ No ☐ Union ☐ Federation/cooperative ☐ Community network ☐ Regional network ☐ National network ☐ International network	0 1 2 3 4 5 6
SP27	What are the main constraints related to plant exploitation and management?	☐ No organised institutions ☐ Lack of existing rules and regulations ☐ Disappearance and degradation of plant resources ☐ Poverty ☐ Lack of supervising institutions for plant users ☐ Uncontrolled exploitation of plants ☐ Other:	1 2 3 4 5 6 7
Any other suggestions – Remarks (exploitation, supply, protection, propagation, regulation, etc.)			
Land/Farm available for restoration (ha)		☐ Communal/Village land	Number of hectares:
		☐ Family land	Number of hectares:

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