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Participatory research extension approach: N₂Africa extension method

Hakeem A. Ajeigbe and
Kenton Dashiell

Putting nitrogen
fixation to work for
smallholder farmers
in Africa (N₂Africa)



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For more information on the N₂Africa Project, contact the Project Leader at k.dashiell@cgiar.org or visit our website www.N2Africa.org



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Acronyms and abbreviations

ACIAR	Australian Centre for International Agricultural Research
AGRA	Alliance for Green Revolution in Africa
BNF	biological nitrogen fixation
CBO	community-based organization
CIAT	Centro Internacional de Agricultura Tropical
EA	extension agent
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
GO	governmental organization
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IITA	International Institute of Tropical Agriculture
IP	innovation platform
NARES	national agricultural research and extension systems
NGO	nongovernmental organization
M & E	monitoring and evaluation
MRR	marginal rate of return
PREA	Participatory Research and Extension Approach
SSA	sub-Saharan Africa
T & V	training and visit
TL11	Tropical Legume II
TSBF – CIAT	Tropical Soil Biology and Fertility Institute of the Centre for Tropical Agriculture

Legumes mentioned in this manual

Bush bean	<i>Phaseolus vulgaris</i>
Climbing bean	<i>Phaseolus vulgaris</i>
Common bean	<i>Phaseolus vulgaris</i>
Cowpea	<i>Vigna unguiculata</i>
Groundnut	<i>Arachis hypogaea</i>
Soybean	<i>Glycine max</i>



About N₂Africa

Putting nitrogen fixation to work for smallholder farmers in Africa (N₂Africa) is a research and development partnership project that is developing, disseminating, and promoting appropriate N₂-fixation technologies for smallholder farmers, focusing on four major grain legumes. The project is operating in eight African countries (DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, and Zimbabwe) and three subregions over 4 years. Partner institutions involved in the project include national agricultural research and extension systems (NARES) of countries in West, East, and Southern Africa, AGRA, TSBF-CIAT, IITA, ICRISAT, EMBRAPA, ACIAR, and TLII.

The project is using legumes as a basis for improving cropping systems and households' well-being, and increasing inputs from biological nitrogen fixation (BNF). This will link a family's protein supply and farm nitrogen inputs directly to the atmosphere, improve soil health, and increase household incomes. The expected project outcomes include the following.

- Diversification of N₂-fixing legume species that are integrated into smallholder farming systems in sub-Saharan Africa (SSA);
- Expansion in cultivation of grain legumes, greater productivity in legume-based farming systems, and enhanced family incomes;
- Selection of efficient rhizobial inoculant strains and improved grain legume varieties with enhanced BNF capacities adapted to various environmental stresses;
- Establishment of a state-of-the-art laboratory and culture collection of elite strains of rhizobia for target legumes; and
- Establishment of rhizobial inoculant production in countries of West, East, and Southern Africa, through partnership with the private sector.



The large body of research results on BNF and nitrogen dynamics in smallholder farming systems in SSA is being used, together with adaptive on-farm research to improve existing legume-based technologies, develop new ones, and support extension campaigns. The project will explore the research-and-development continuum from laboratory testing to collaboration and dissemination with farmers' groups in West, East, and Southern Africa. The number of direct beneficiaries will be 225,000 households or 1,800,000 people in the whole area. The project will target mainly the smallholder farming systems of SSA but will also work with small and large-scale producers.

Vision of success (5–10 year time frame)

Within 5 years, N-fixation inputs will be increased from the current amounts of 35 kg ha⁻¹ to 93 kg ha⁻¹ across the whole area of 225,000 farms within the target smallholder farming systems of SSA. These nitrogen inputs exceed the goal of the Abuja summit on increased fertilizer use solely through BNF and permit greater attention to be given towards delivering other needed fertilizer nutrient inputs, such as phosphorus and potassium. This target will be achieved through (a) improved adoption and utilization of legume-based technologies tailored to specific niches; (b) greater use of high quality inoculants for legume seeds; (c) strengthened partnerships for sustainable agriculture and soil health in key countries of SSA; (d) enhanced capacity for research, teaching, and agricultural extension in BNF and legume-based farm enterprises. The resulting improvement of crop yields will lead to the significant betterment of human nutrition and farm income for smallholder farmers in the target regions. The project is organized into the following five objectives.

1. Establish a baseline of the current status of BNF, identify farm enterprises and niches for targeting N₂-fixing legumes in the impact zones, and establish mechanisms for monitoring and evaluation (M & E) and impact assessment.



2. Select multipurpose legumes (food, fodder, stakes, and soil fertility management) for enhanced BNF and their integration into farming systems.
3. Select superior rhizobial strains for enhanced BNF and develop inoculum production capacity in SSA through collaboration with private sector partners.
4. Deliver legume and inoculant technologies to farmers throughout SSA.
5. Develop and strengthen the capacity for BNF research, technology development, and application.

The project will seek to develop strong partnerships along the entire value chain of the mandate crops by engaging with existing development programs, legume seed production and marketing activities, farm inputs, commodity marketing and processing initiatives, and household and children's nutrition programs operating in the country.



Introduction

The introduction of the participatory research and extension approach (PREA) is a key component in promoting improved agricultural technologies to farmers. The PREA focuses on encouraging the active participation of local leaders, farmers, researchers, extension agents (EAs), and the private sector in identifying the problems of local communities and their possible solutions. It involves communities in analyzing their situation, planning, trying, monitoring, and evaluating new technologies. This will result in the widespread adoption of identified/relevant new practices and new varieties as a result of farmer-to-farmer extension. This has been of great benefit to the lives of communities in the areas where the International Institute of Tropical Agriculture (IITA) and several partners had implemented agricultural projects in West Africa and is expected to benefit the impact zones of N₂Africa in the next 4 years. The PREA is designed to ensure the farmer's involvement in every aspect of the planning and implementation of any intervention through frequent interaction among farmers, researchers, extension workers, and the private sector, working as a team. It has been shown to promote farmer-to-farmer extension and when gender issues are given due considerations, agricultural productivities can be increased substantially.

Within the framework of the N₂Africa project, interventions will consist of activities to improve the productions, productivities, and contributions of major leguminous crops (soybean, cowpea, groundnut, and common bean) in the farming systems on a sustainable basis and encourage an improved policy environment. Underpinning many of the field activities will be a strong extension/dissemination objective in a PREA setup involving a wide range of stakeholders, including research institutes, governmental organizations (GOs), non-governmental organizations (NGOs), business communities, community-based organizations (CBOs), farmers' groups, and



the media. Over a 4-year period (October 2009 to September 2013), N₂Africa will work in eight countries (Ghana, Nigeria, Kenya, DR Congo, Rwanda, Malawi, Mozambique and Zimbabwe) grouped into three hubs (West, East/Central, and Southern Africa). This will involve over 225,000 households by the end of the project. PREA will play a major role, not only in the widespread adoption of the new technologies disseminated by N₂Africa, but also by increasing the capacity of local communities to identify and resolve their own problems.

Since N₂Africa plans to use PREA in most of its extension/ dissemination activities, and PREA is designed to ensure the participation of farmers, researchers, extension workers, and others working as partners in finding sustainable solutions to problems, there is a need for the project to facilitate effective implementation by the provision of tools and reference materials in addition to practical trainings of the implementation partners.



This guide is one of several reference materials that would be produced by the project.

As such this guideline is intended to achieve the following:

- Provide an overview of PREA in facilitating the involvement of groups and individual farmers in the implementation of N₂Africa's extension/dissemination activities.
- Describe the participatory process, including the use of some participatory tools which are important in raising awareness amongst farmers, EAs, and researchers about problems faced by farmers and how these can be overcome.
- Reinforce changes in moving from traditional to participatory research and the development approaches which will be used in the N₂Africa project.
- Provide a resource that can be used by EAs, training and research institutions, and other partners in ensuring that the extension activities of the N₂Africa project address farmers' priority legume and other agricultural problems.

Although this guide is intended to provide a guideline to the extension method to be used in the implementation of N₂Africa's activities, it is hoped that local conditions would be looked into and adaptation would be made as needed during field implementation since the project is covering diverse areas with multiple partners.

The evolution of participatory approaches

In the past, the approach used in development activities in rural Africa often consisted of farmers and communities being told what to do. Participatory approaches have evolved from past poor experience with these approaches, where farmers were often instructed while their views about research needs and extension activities were not sought. The failure or slow pace of change compared with investments has fueled the search for alternative, participatory approaches for technology



development and dissemination. Within the Training and Visit (T&V) extension system introduced by the World Bank during the 1980s and 1990s there was often a hierarchical structure where local extension workers were backed by subject matter specialists relying on strong technical messages. This “old style extension” assumed that its primary task was to convey superior technologies into local practices with farmers being seen as the recipients or as the adopters or rejecters of innovations without local knowledge or indigenous practices being taken into account. Participatory approaches, on the other hand, are now widely accepted in development practice as being concerned not only with improving farming practices but also with issues of empowerment and giving a “voice” to the farmers. Participatory approaches recognize the importance of all stakeholders in the generation and dissemination of knowledge and in removing systems constraints (Table 1). This is contrary to the hitherto existing situation where the main beneficiaries, the farmers, were often overlooked in the process of searching for new knowledge, despite their rich indigenous capability.



Participatory research and extension approach: the process

The process of PREA requires an interaction among stakeholders that is fundamentally different from conveying standard messages from the top down. This requires processes that must be carefully managed, facilitated, and stimulated with partners contributing, particularly where they have a unique role to play. Table 2 highlights the changing roles of partners in PREA and the expected contributions from the different partnership sectors.

Table 1. Changes from the use of conventional to participatory approaches to development.

Conventional approach (T&V)	Participatory approach (PREA)
Telling farmers what to do	Discussing with farmers
Making farmers change	Working with farmers to effect change
Extension workers and researchers know best	Learning from farmers
Modern methods are better than traditional ones	Building on local traditional knowledge
Teaching	Providing feedback to communities
Use of contact farmers and demonstrations	Promoting farmer- to-farmer extension

Table 2. Changing roles for partners in PREA.

Partners	Role changes	Unique contributions
Farmers	From passive recipients of messages to active participants in their own development process	Knowledge of their own natural, financial, economic and social environment
Extension agents	From providers of messages to facilitators of learning processes	Facilitation skills
Researchers	From detached scientists to facilitators and participants in on-farm research	Experimental design, knowledge
Private sector	From pushing inputs and buying produce at prices unfavorable to farmers to supporting farmers in more efficient market related production	Information provision specific to the products they buy and sell
NGOs	From organizing production means to facilitating conditions conducive to participatory development	Process management and facilitation skills
Governments and donors	From implementing projects defined in time and space to supporting long-term development processes	Resources Enabling policies Resources



Purpose and benefits

- To facilitate local farmers in their identification of problems and the search for solutions.
- To build strong linkages among local communities, extension agents, and researchers.
- To encourage the transfer of new and appropriate technologies from farmer to farmer.

Participatory research entails involving farmers in the research process at all stages—in the definition of the research agenda, the conduct of research, the evaluation of the results, and the dissemination of the findings. The benefits of this approach are as follows:

- Ensures indigenous technical knowledge is understood and utilized where appropriate,
- Positively influences farmers' motivation with an improved response to researchers' ideas, when farmers' own views are respected,
- Allows the development of new technologies suitable to farmers' circumstances and practices,
- Allows further local adaptation to the wide diversity of socioeconomic and natural environments through further experimentation by farmers, and
- Increases farmers' role in knowledge generation and farmer-to-farmer transfer of new technologies and farming practices.

Gender dimensions of PREA

Gender equality is essential to the elimination of poverty and is addressed by the N₂Africa project where women will be given special attention and constitute over 50% of the target farmers. Gender equality does not necessarily mean equal numbers of men and women in all activities or even the provision of the same treatment. In many cases, men and women may be better suited to or prefer to undertake different tasks. This must be considered in the dissemination exercise.



PREA allows the mainstreaming of gender, providing an opportunity for encouraging gender equity through the inclusion of women as participants and promoting equal access to resources with benefits for both men and women. This does, however, require commitment from implementing partners to ensure that gender issues are given appropriate consideration.

Some considerations for mainstreaming gender.

- Discussion among partners on gender issues and development constraints.
- Capacity building for partners on gender interventions.
- Disaggregation and evaluation of project data according to gender.
- Assessment of progress on lowering gender barriers.
- Commitment for gender mainstreaming from policymakers and decision takers, where applicable.
- Policy changes towards the adoption of gender-sensitive approaches, where applicable.



Gender analysis explores the norm of male and female behaviors and experience, and the implications of the different ways that men and women contribute to and benefit from the development processes. The introduction of any intervention needs to be negotiated and integrated by both male and female farmers for it to be sustainable

The Gender Equality Wheel is a tool which identifies four stages of the progress toward gender equality (Fig.1). This tool, described below, would be used in gender mainstreaming by the project.

- **Empowerment** refers to resources such as ideas, knowledge, and skills that become available to the community as a result of collaboration with the project. Such resources are the cornerstone of social capital, building self-confidence in women and men as they explore new ways of seeing and acting.
- **Engagement** refers to the stage at which people (especially women) come out of isolation, discover new possibilities for their lives, and begin to build mutual

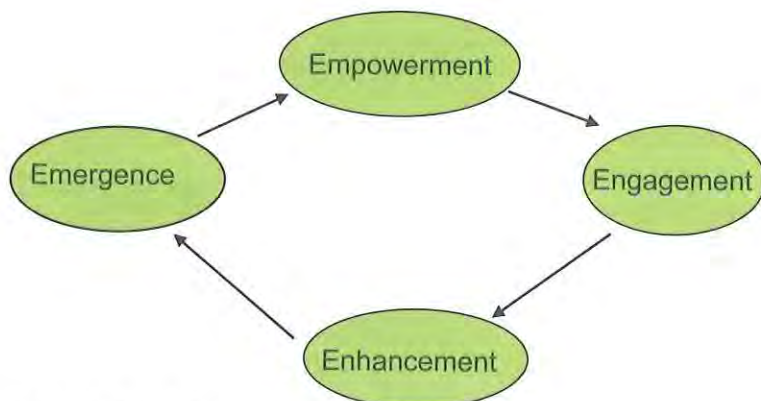


Figure 1. Gender equality wheel.



support. In N₂Africa, attention will be paid to the composition of lead farmers as well as to farmers' groups to ensure gender balance during the selection of participants.

- **Enhancement** refers to the process when women and men begin to apply the new ideas, knowledge, and skills to enhance the lives of family and community members and to provide household and community gains. Trainings will be given to all farmers including special trainings for women farmers and some women collaborators on processing to enhance income generation and improve household nutrition and health.

- **Emergence** refers to the process when women and men move onto the public stage, to take social and political action that transforms their social, cultural, and political environment. Field days and mid-season evaluations would be conducted on women farmers' fields to voice their experience to fellow women farmers and the larger populace.

Building platforms (innovation platform)

As part of the PREA and the dissemination strategy, N₂Africa will work with several partners. This entails the formation of platforms at different levels for the execution of project activities. As the project will be disseminating improved legume technologies and innovations, the platform so formed is an innovation platform (IP). An IP consists of a set of stakeholders who are bound together by their individual interests in a shared issue, objective, challenge, or opportunity, with the potential to improve livelihoods, businesses, and/or other interests. An IP refers both to the emergent properties of groupings of players and their processes, practices, and habits, as well as to the formal structures that might give operational focus to activities and interactions. This platform will be at different levels of operation, with overlapping interests. At the project level, it would be made up of all the partners that interact to influence project activities in all eight countries as well as in





activities outside those countries. At the country level, it would be composed of those partners whose effect is limited to that country. At the action site, the platform would be made up of groups and individuals who implement or facilitate project activities to achieve set objectives there. A complete IP for the N₂Africa project is made up of the researchers, extension groups, farmers' groups, input/output marketers, NGOs, GOs, and leaders at various levels, all of whom have a vested interest in the outcome of the project's activities.

Enhancing communication and facilitation

Some key basic principles are required in implementing the process of PREA, which in turn require improved communication and facilitation skills.

These are some principles of using participatory methodologies.

- *Learn from the farmers:* this means starting with both male and female farmers in their knowledge, awareness, attitude, belief, feelings, and practical habits.
- *Discuss and share experiences:* as a facilitator, speak less and listen more.
- *Involve all groups in the community:* male, female, the youth, rich and poor must be included.
- *Facilitate, don't lecture:* create a learning environment for everybody by communicating in an open and constructive manner, based on mutual trust, respect, and confidence.
- *Aim at practical orientation:* adult learning is life- or work-centered.
- *Triangulate information:* use information from different sources. Use different tools to collect information. Triangulation is used for cross-checking information.
- *Avoid biases:* Fit your objectives into the local situations. Biases, such as those for a special crop, a time (season), people, and project, can adversely affect the effectiveness of agricultural programs. Though N₂Africa's objective is biased towards specific legumes, in whatever situation we



find ourselves, we will work on the specific legumes as they relate to the systems and seek to improve the productivity not only of the legumes but also of the whole system.

- *Learn from mistakes:* adapt and develop tools/ techniques in the field.
- Activities should be sustainable and continue after donor support has ceased.

The extension worker becomes a facilitator, easing a process of change. Such a process involves farmers in identifying key problems, then testing and evaluating alternative solutions which are more likely to ensure the adoption of appropriate technologies and management practices. As the role of the extension worker changes from that of a teacher to that of a facilitator, specialized skills are required which include listening, questioning, giving and receiving feedback, summarizing; and (when working with community members) using verbal and non-verbal signals.

Facilitators' tasks and responsibilities

A facilitator has important roles to play in the community, the main task and responsibility being to assist local communities and groups to achieve the following.

- Analyze their situation, identify problems, and seek alternative solutions.
- Try out, monitor, and evaluate these alternatives.
- Establish links with other groups and institutions that may be able to provide support.

The four stages of PREA

PREA involves a four-stage process usually undertaken over a 12-month period.

This can be repeated annually as new problems and issues emerge. Each stage and the activities required are shown (Fig. 2)

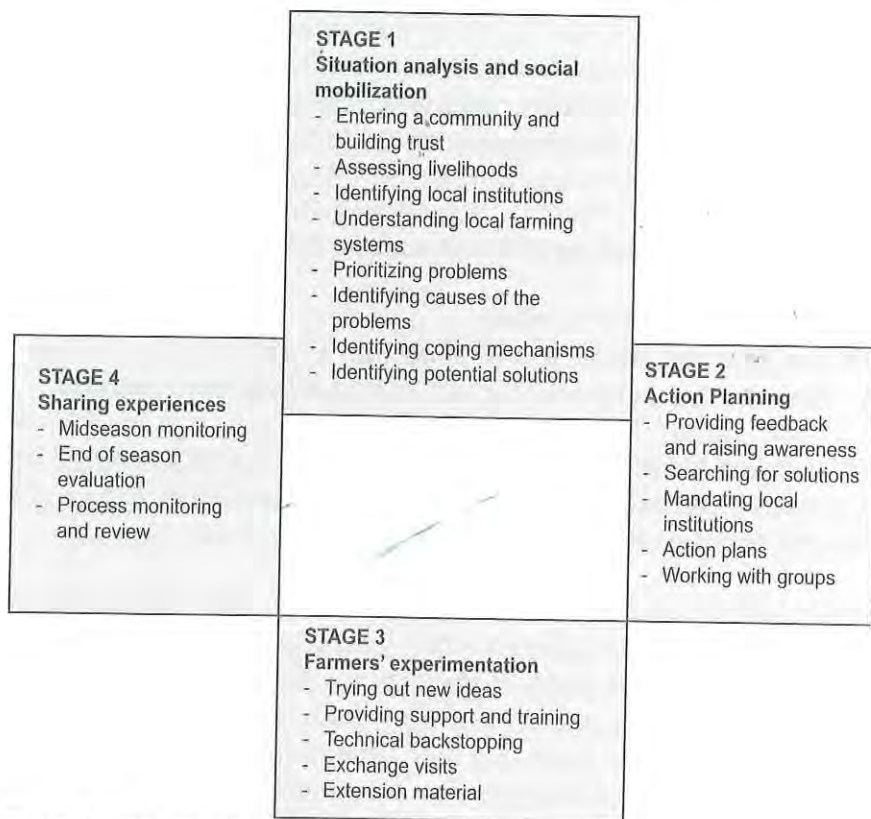


Figure 2. Participatory research and extension stages.

1. Situation analysis and social mobilization

This stage consists of encouraging and mobilizing the communities to undertake the analysis of their own situation and start thinking about how they can deal with their farming and livelihood constraints. The rationale for situation analysis is based on the fact that a good understanding of farmers' circumstances and problems is critical for sustainable solutions to the constraints faced by male and female farmers. The dominant trend in development thinking now is to give increased attention to what small-scale farmers say they need, to obtain a good understanding of their situation, and to attach less importance to what research scientists and extension workers say they should have. The rationale for



people's mobilization, therefore, would be to stimulate the community to be aware of their potential and to become willing to take initiatives and accept the risks and responsibilities to convert this potential into organized action in order to effectively resolve their own problems.

We should be guided by three important questions:

1. What do we have to offer?
2. Where are we likely to have most impact?
3. Who are the partners that will contribute most to impact?

What do we have to offer is answered in the N₂Africa project documents. It can be summarized as "We have improved legume technologies to offer."

Where are we likely to have most impact? Though the action sites have been fairly chosen, the choice is not rigid and we will take opportunities as they come. The communities have not been chosen and we should endeavor to work in communities where there is a high potential for widespread impact from the technologies we have to offer. Always ask how many families in this place and nearby communities will benefit from this work.





Is a market available? If not, can we forge market linkages? Are there reliable partners and organizations to collaborate with or who will actively support the work, bringing in their own resources as well as continuing when N₂Africa ends?

For our research and development activities to be owned by the participating communities, two key conditions need to be in place:

- Real motivation and enthusiasm within the communities to resolve their problems.
- Effective community institutions to support the process and take it forward. (This includes relevant partners that are in place or created by us, as well as the provision of linkages and capacity building by the project.)

The first step for an EA or researcher to build trust among community members is to arrange a meeting with community leaders to explain, discuss, and gain their support for the process of PREA. Such meetings are intended to provide information about:

- The community and their livelihood strategies (how the households meet their needs and earn a living), the different types of households in the community, segregated based on wealth or access to resources, local institutions, and the crops that people grow and the livestock they keep.
- The natural resource problems with which they are faced (water resources, soil fertility, erosion, fuel wood, grazing, wild fruits and animals, etc.,) and existing coping mechanisms.
- The biotic constraints (crop diseases, insect pests, *Striga*, etc.)
- The social/infrastructural constraints (input/output markets, access to finance, roads, government policies as these affect agriculture, etc.)



Participants at such meetings should capture the diversity of the community and should include community leaders, men, women, and young people. It is important to create conditions where it will be possible for all to express their views and thus contribute effectively to find solutions to the problems. But there are sometimes difficulties in this regard. For example, does the local and religious setting allow the women to speak before the men or elders? These are important issues to be considered in the different countries and regions where we will be operating. Sometimes the meetings may be conducted separately for the men, women, and the youth so as to be able to capture the different views of these groups or where local custom and tradition do not allow the men and women to mix freely.

The timing of meetings is critical for success. It is important to select times when people are not otherwise busy, such as planting and harvesting times, and to avoid market days and times when the community has other priorities. Also, keep an eye on what would be the most convenient time for women to attend the meeting. Remember that women may also have critical household activities for attention at specific times. Failure to give allowance for this will limit their effective participation and contributions.

Assessing livelihoods

Assessing livelihoods provides an understanding of the different ways in which people derive a living; who in the community is involved; the relative importance of each in providing either food or cash; the numbers or percentage involved in the community; the trends over the years, and the reasons for these trends.

Identifying and prioritizing farming enterprises and problems

Initially, ask people to identify the range of crops grown and livestock kept and prioritize these in order of importance for providing food security and cash from sales. Asking men,



women, and younger people to undertake the activities separately should also identify different gender and age perspectives. A farming systems analysis can then be undertaken by preparing a cropping or livestock production calendar. Take note of when each operation is undertaken for each crop or livestock enterprise, and if any crops are intercropped. The same should be done for identifying and prioritizing problems relating to crops, livestock, and natural resource management. In the N₂Africa project, most of this information is being generated in the baseline gathering by the M & E group.

It is important to determine the actual root cause and effects of the problems identified earlier in order to systematically deal with the underlying causes. Trying to address the problems without knowing the actual causes is like treating the symptoms rather than the disease.

Identifying coping mechanisms

In seeking how to resolve problems, people need to build on their local knowledge and existing practices. To explore practical solutions to problems, ask the following questions with regard to coping mechanisms:



- What methods do people use for resolving the problem?
- Where did the knowledge come from?
- Who in the community is using these methods? Gender differentiation of who is responsible for deciding which methods are to be used and who does the work would also be appropriate.
- What are the advantages and disadvantages of each method?
- What are the trends in the use of such practices and the reasons for this?

The above are standard practices when implementing PREA in new areas or in communities where the researchers and other implementing partners have had no previous knowledge or interactions. The N₂Africa project will start implementation mostly in areas where knowledge of most of the above is available, even if not in detail. Despite this, it is important to document them as they will be not only useful for project reports but also valuable in the interpretation of results and feedback.

2. Action planning

This is planning by the community which helps in motivating the people and giving an opportunity to male and female farmers and disadvantaged groups to express their views.

The findings from the initial situation analysis are important and help outsiders to know the community but the results are even more important for the community members. Provide them with time to think about possible solutions and which local institutions can play a role in resolving these problems. Because of their involvement from the beginning, the community will:

- Motivate people to become more involved in an action research and development process that can improve their livelihoods, and
- Give an opportunity for the poorer and disadvantaged groups to express their views.

Once household and community issues have been explored, it is necessary to:

- Feed back to the rest of the community the issues and needs identified in the situation analysis,
- Analyze with the community the underlying causes of the problems identified and identify possible solutions,
- Identify possible local institutions to help take forward some of these solutions.

This is best achieved in community workshops by nominated members of each group who provide reports from each of their groups. After this it is important to:

- Agree on a schedule of work to be undertaken in addressing those needs,
- Agree on the criteria and indicators which enable the community to see whether their work is really leading to an improved situation.
- Collective decision-making and local ownership are essential for success.





Searching for solutions

We will start evaluating options with farmers as soon as possible. Once the root causes of the priority problems are better known, it is easier to identify possible solutions. For example, poor quality or a poor response to inoculants may entail an investigation of the value chain to identify the source of the poor quality or the cause of the poor response. High quality rhizobia may leave the producers and end up as low quality when they reach the farmers/end users because of poor handling. On the other hand, a weak strain or dead rhizobia may be marketed by producers. The strategies to solve the problems in the two examples above will be different. Fresh solutions to old problems need to be generated by blending suggestions from community members with those from people from outside the area. It is here that the roles of researchers and extension agents (EAs) become increasingly important. The use of appropriate extension material will assist in creating a better understanding. Outside help may be needed. For example, access to input and output markets



may form part of a solution coupled with the adoption of an improved technology which gives increased productivity with some investment. Farmers would not want to invest in the new technology if a market is not guaranteed. However, the search for solutions should focus initially on people's own knowledge. There may be traditional knowledge which may have been forgotten. However, the search is not limited to existing knowledge. Another approach is the use of a mother, daughter, and granddaughter approach (sometimes called mother-baby trials) in the research process to raise awareness and encourage farmers to test those research options applicable to their own environments and management conditions. In the context of N₂Africa's extension strategy this will be a very important approach. This will be discussed later.

Local groups and lead farmers

Our main approach is to work with local groups and lead farmers selected by the community-based organizations that they represent. They should undertake the piloting and testing of new technologies. Regular feedback from the lead farmers to the groups will ensure the groups' involvement in planning and implementation, and encourage a process of further farmer-to-farmer testing and adaptation (and diffusion). The lead farmer is not a title but a role to be played by the actor with specific reference to the current activities. In certain situations or by some other organizations, the lead farmer is called a master/volunteer/demo farmer. Whatever the nomenclature, the roles are fairly similar. As usual, we must undertake to have female lead farmers who should be not less than 50% in number. The responsibilities of lead farmers and the groups also need to be agreed.

Potential role of local groups

- To formally adopt the program into their activities.
- To appoint a person or persons responsible for reporting on progress and identifying issues/problems that affect the program. This is likely to be the lead farmer.



- To encourage participation by other farmers in trying out the new techniques.
- To invite the extension worker to attend meetings on a regular basis.
- To arrange field days that cover all farmers.
- To evaluate the new methods at the end of the season and plan for the new season.

Potential responsibilities of lead farmers

- To motivate other farmers to try out new technologies.
- To assist with the project planning process using participatory methods.
- To assist the EA in training the group and other farmers.
- Host mid- and end-of-season evaluations of the test plots and demonstrations.
- To ensure that information is disseminated to the community at large.
- To hold regular meetings with other farmers and present concerns to the group and the EA.
- To facilitate coordination between the group and the EA.

The lead farmer needs to be all of the following.

- *A group advisor*—helping to strengthen the group's leadership, organizational, and planning capacities.
- *A participatory trainer*—teaching basic technical skills to group members through a Farmer Field School Approach.
- *A link person*—facilitating communication between the group and the EA.

In addition to working with groups and lead farmers, it is essential that we visit individual farms to get a better understanding of the variations in needs, constraints, and opportunities among farmers.



reduce *Striga* infestation, improve soil fertility, increase income, improve human nutrition, and others. The EAs will facilitate and encourage the groups and farmers to experiment with the new ideas, guiding farmers to conduct simple comparisons between local practices and new techniques. Researchers will also be able to use the same plots to measure yields and growth parameters and undertake a more detailed statistical analysis.

Trial types

Mother trials

These include all options selected by researchers with input from farmers.

They are conducted on-station and are researcher-managed.

Mother trials are the first step in the technology generation process. These are researcher- managed to test new technologies before further testing by farmers and before dissemination to the wider farming community. The mother trials provided a basket of options from which farmers will be able to select promising technologies for inclusion in on-farm testing. Farmers' field days will be conducted to assess farmers' perception of the basket of options, during which farmers and extension workers from adjoining areas will also visit the trials.

In the context of the N₂Africa project, mother trials are conducted under objectives 2 and 3. All the varietal, agronomic, and inoculants trials which are managed more than 50% by researchers and with the collection of a full range of data will be categorized as mother trials. They will contain relevant treatments based on researchers' experiences as well as interactions with farmers and others on specific constraints and the options available to counter the constraints. A full range of data as directed by researchers would be collected on the mother trials. These trials would be visited by farmers and extension workers from adjoining areas who will select those options they consider best for their circumstances and



subsequently establish daughter trials with the support of an EA (objective 4) on their own farms. Midseason evaluations involving many farmers and facilitated by the EAs would be conducted on many of them. This will give early feedback to the researchers about farmers' interests and the important criteria that should be considered in selections. The mother trials are the main source of new technology options for demonstration to the farmers.

Daughter trials

These are best-bet options and local innovations selected by farmers.

They are conducted on-farm and are farmer-managed with significant input from researchers and EAs.

The daughter trials are the selection from the mother trials with input from farmers; they are supposed to be conducted in the second year. However, in the context of N₂Africa, certain best-bet options (technologies) would be demonstrated in daughter trials in many locations in the first year. These technologies/ treatments would however be included in the relevant mother trials. Mid- and end-of-season evaluations involving many other farmers and facilitated by the EAs would also be conducted on the daughter trials. These trials are the demonstration plots on lead farmers' fields or where available on group farms (refer to the roles of lead farmers and local groups, above). During strategic agronomic activities (inoculation, spraying, etc.), the EAs and lead farmers are expected to invite other farmers to the fields for training and demonstration. With their in-depth knowledge of the farming systems, farmers will quickly decide about the information and technologies that are likely to provide substantial benefits.

Daughter trials are crop specific or crop directed technologies. For example, in a daughter trial we will not compare cowpea and soybean; instead we could compare different management



options of the different legumes, taking each legume as a daughter trial. Two or more daughter trials could be located in same field or next to each other. This will increase the number of technologies on display to farmers. In Kenya, for example in 2010, our demonstrations contain one demonstration each of three crops (soybean, bush bean, and climbing bean) arranged side by side with similar management options. Each crop has three management options on display. Normally daughter trials should have two treatments compared against a traditional control; however it is possible to display up to five options in the N₂Africa project. For example, the following five treatments are possible in a daughter trial: inoculated, inoculated + P, P only, high population, and control. Each farmer and farm is different and farmers are expected to adopt and possibly adapt relevant technologies. Therefore we will offer a broad range of options that are relevant to the issues and identified constraints. When crops are grown with two different techniques, side by side, the differences are easily visible. Measurements such as yield are needed to quantify differences between the technology options. A minimum set of data (grain yield, N₂-fixation where relevant) would be collected from the daughter trials. The data collection is necessary to monitor the performance of different options on-farm and in farmer-managed plots. In some cases and as directed by researchers, a more detailed set of data may be required from the daughter trials. This may be needed to compare the performance of certain technologies on-farm and in researchers' plots. Each daughter trial would be accompanied by a protocol.

A daughter trial/demonstration will be an average of 600 m² (0.06 ha) in size, made up of two new treatments and a control (200 m² per treatment) or just two treatments (300 m² per treatment). The project will provide the input on credit in the first year. The N₂Africa project will mainly target smallholder farmers but will also work with medium and large- scale farmers wherever available. These groups of farmers, however, will receive only technical backstopping. A demonstration on a



medium or large-scale farmer's field mostly will be one best-bet treatment against the current practice and plot size will range from 0.4 ha to 1 ha. This treatment may include the demonstration of inoculants, a new improved variety, or cereal-legume rotation. The farmer will pay for all the necessary inputs.

It is necessary to make sure that management methods of the different practices are similar. This requires the following.

- Using soils of similar type (unless different soil types are being tested).
- Using the same seeds and the same plant spacing (unless varieties or spacings are being compared).
- Planting both or more areas of land on the same day (unless planting dates are being compared).
- Applying the same amount of fertilizer (unless different fertilizer treatments are being compared).
- Weeding in the same way (unless different types or times of weeding are being compared).
- Harvesting at the same time

Granddaughter trials

Here the options are selected by farmers.

Trials are on-farm and farmer-managed with no input from researchers.

All lead farmers are expected to have 15 to 20 other farmers associated with them. Each of these farmers will also have one of the management/technology options from the daughter trial (demonstration) planted on-farm. These plots are the granddaughter trials; they are entirely managed by the farmers with training from EAs and lead farmers. The farmers are expected to follow standard practices as demonstrated to them by EAs and lead farmers on the demonstration plots; they will then compare the results with their traditional practices. The diagram below (Fig. 3) illustrates the relationship between the mother, daughter, and granddaughter trials in the context of the N₂Africa project.



When farmers have started testing the technologies, N₂Africa and other members of the platform will support them by providing or facilitating the following:

- supplying materials needed for technology options (seeds, fertilizer, inoculants)
- helping farmers to establish trials
- providing technical information and backup trainings
- making visits soon after establishment

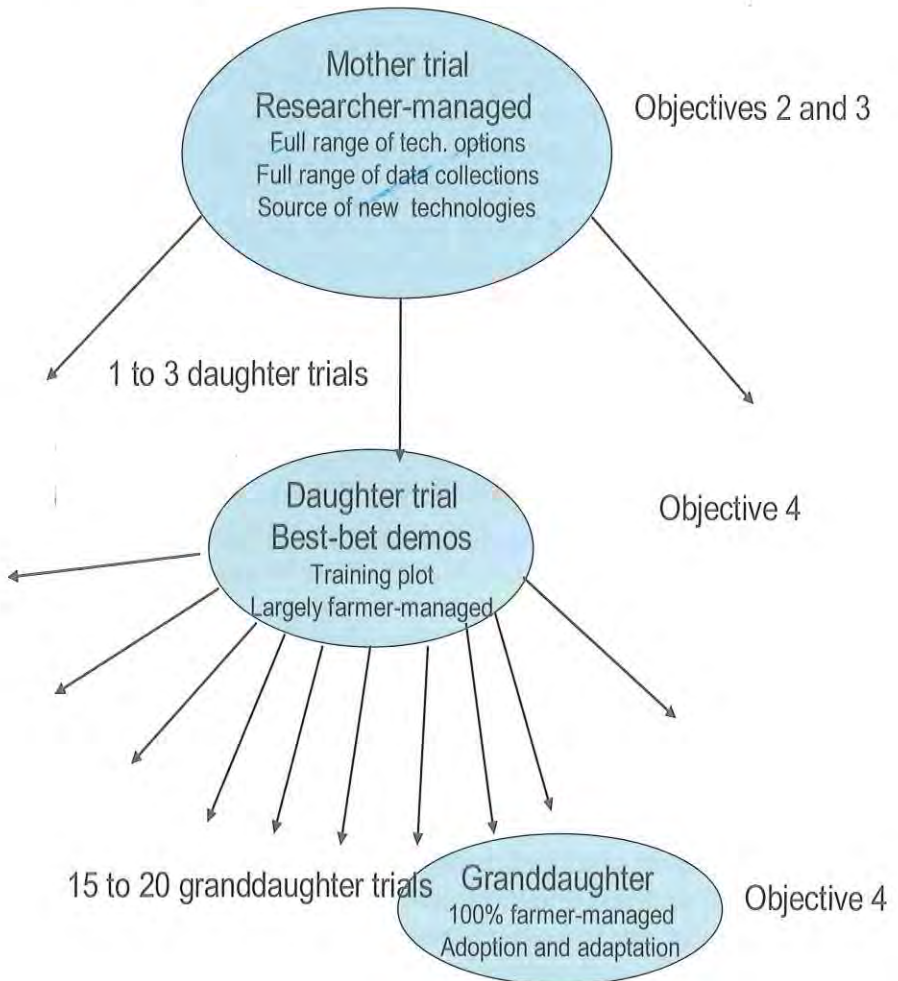


Figure. 3. Relationship between mother, daughter, and granddaughter trials.



- making regular follow-up visits to discuss progress and help solve simple problems. (Each time you visit a community, make sure you visit at least one or two farmers you did not visit the last time.)
- providing special activities designed for women farmers
- providing linkages to appropriate organizations for other support (marketing, processing, finance, etc.)

4. Participatory monitoring and evaluation

Sharing experiences, self-evaluation, and planning for the next season

Exchange visits, field days, and crop evaluations will provide opportunities for farmers to learn and share; these will result in an increase in awareness among lead and secondary farmers and the adoption of new technologies. Monitoring and evaluation (M & E) forms an integral part of the PREA process and the earlier it is incorporated into program activities the better. M & E allows farmers, researchers, and EAs to ensure that Stages 1–3 in the PREA



are addressing identified problems and concerns and the project objectives. This requires two more formal steps.

- A midseason evaluation and monitoring of the new practices being tested
- An end-of-season evaluation where the whole process can be evaluated and plans made for the coming season

Midseason evaluation of demonstrated technologies and farmers' field days

The lead farmer must be compelled to bring other farmers to the demonstration plot from time to time, especially during major agronomic activities or treatment applications. The aim is to allow participants to assess different treatments during a field-day, when the differences between the treatments are visually most apparent. A participatory technology evaluation would be undertaken during the cropping season at full podding (midseason evaluation) to establish farmers' preferences in comparison with new technologies and to establish which criteria farmers used in their evaluations. This should involve (a) establishing the advantages and disadvantages of the technologies being tested, (b) undertaking a pair-wise and/or matrix ranking for farmers to select the best. This assessment can be used not only for farmers' trials but also for any mother trials that farmers may visit. This will help to share knowledge, build confidence through presentation, as well as encouraging farmer-to-farmer extension. After everyone has had a chance to look at the different technologies, the findings would be analyzed and provide feedback to researchers, the community, and the larger public as well. As far as possible, these activities will be conducted with men, women, and young people separately so that any differences in perspective may be captured.



Criteria would be identified and used by farmers in their preference ranking: these criteria would include grain and fodder yield, grain color and size, maturity, resistance to pest including *Striga*, growth habit, etc. Hypothetical examples are given in Tables 3 to 6. The tables below would be filled in by each community to identify important criteria in selecting technologies and also to determine the farmers' preferred technology.

Table 3. Criteria used by farmers in their evaluations*.

	Criteria	Number of times mentioned		Total
		Men	Women	
1	High grain yield			
2	High fodder yield			
3	Big seed size			
4	Seed color			
5	Early maturity			
6	Resistance to diseases			
7	Resistance to <i>Striga</i>			
8	Insect tolerance			
9	Drought tolerance			
10	Growth habit			

*The above is a template for crop varieties it may be different for other technologies, e.g., for inoculants it may include plant coloration, survival, etc. These criteria are to be determined by farmers.

Table 4. Pair-wise ranking of criteria.

Criteria	Criteria										Total Score	Rank
	1	2	3	4	5	6	7	8	9	10		
1 High grain yield	x	1	1	1	1	1	1	1	1	1	9	1
2 High fodder yield	x	x	3	4	2	6	2	8	2	2	3	6
3 Big seed size	x	x	x	3	3	6	7	8	9	3	4	5
4 Seed color	x	x	x	x	4	6	7	8	4	10	3	6
5 Early maturity	x	x	x	x	x	5	7	5	5	10	3	6
6 Resist. to diseases	x	x	x	x	x	x	6	6	6	6	7	2
7 Resist. to <i>Striga</i>	x	x	x	x	x	x	x	7	7	7	6	3
8 Insect tolerance	x	x	x	x	x	x	x	x	8	8	5	4
9 Drought tolerance	x	x	x	x	x	x	x	x	x	9	2	9
10 Growth habit	x	x	x	x	x	x	x	x	x	x	2	9

Table 5. Pair-wise ranking of three technologies on display.

	Technology	1	2	3	Total	Rank
1	Option 1	x	1	1	2	1
2	Control	x	x	3	0	3
3	Option 2	x	x	x	1	2

Table 6. Pair-wise ranking of treatments.

	Treatments	1	2	3	4	Total	Rank
1	+P + In	x	1	1	1	3	1
2	+ P – In	x	x	2	2	2	2
3	–P + In.	x	x	x	4	0	4
4	–P –In Control	x	x	x	x	1	3

Based on the criteria, farmers will be asked to rank the technologies according to their preference. The criteria will be compared in pairs and any one preferred will be recorded in the box. The score is the number of times the criteria is recorded.

The higher the score, the more preferred the trait/criterion or in the case of technologies, the better the technology. The above (Table 4) shows that the most important criteria selected by this group of farmers are high grain yield and followed by resistance to diseases.

End-of-season evaluations

Once the trial crops have been harvested and the yields are known, conclusions can be reached about the technologies under observation for the past season. During end-of-season evaluations, the lead farmers will narrate their experiences to the participants. Results from the midseason monitoring, namely, the advantages and disadvantages and the ranking identified during the midseason field-days, can be referred to and modified in the light of any subsequent information. However, the main aim is to assist participants to look at the costs and benefits of the new technologies. This is best achieved through developing a participatory budget that compares each of the technologies being tested.



End-of-season evaluations should be conducted after harvest. This exercise will provide the opportunity for farmers, researchers, and EAs to confirm midseason assessments and undertake a participatory cost-benefit analysis. Learning in this way is critical to the success of PREA and lends itself towards using the test and demonstration plots for training. Observing the trials will help to identify the reasons why one technique performs better or worse than another.

Steps for undertaking an end-of-season evaluation

1. Agree a date, time, and place in advance.
2. Visit the plot with as many members of the group as possible to remind them what has been tested. Let the lead farmer explain what has been done. Have available the results of the midseason evaluations as well as any records that the farmer may have kept.
3. Confirm the findings of the midseason evaluations of the alternative treatments, but **do not repeat** the exercise.
 - Advantages (benefits) and disadvantages (costs)
 - Ranking of treatments
4. Agree which advantages or disadvantages can be quantified in monetary terms and how it can be done (usually yields, seeds, fertilizer, and labor costs, even if some of these are supplied by the household and not purchased).
5. Use local units of measurement that everyone can understand. This includes the land area (usually the actual plot itself), the crop harvested (grain and crop residues), seeds, fertilizer, labor, and (if necessary) draft animal or tractor costs.
6. Agree local prices of inputs and outputs.
7. Facilitate the production of a **partial budget**. This means that when treatments incurred by management practice are the same, these do not need to be included. We are interested in measuring differences between each new treatment and the farmers' normal practice.
8. Use farm-gate price: the farm-gate price of an input is the total cost of the input to the farmer, i.e., the market price

Table 7. Hypothetical partial budgeting of cowpea inoculants and fertilizer demonstration.

	Improved seeds + inoculant + P	Traditional	Improved seeds + inoculant + higher population
Variable cost			
Labor cost			
Land preparation	1520	1200	1520
Planting	400	400	500
Fertilizer application	300	0	0
Insecticide spraying	360	120	360
Harvesting	400	250	450
Threshing	320	250	320
Transporting	120	80	120
Inputs			
Fertilizer	1400	0	0
Insecticides	600	200	600
Inoculants	240	0	240
Seeds	600	500	800
Total variable cost (A)	6260	3000	4910
Benefit			
Output			
Grain output (kg)	240	80	180
Grain value (₦)	19200	6400	14400
Stover	360	150	260
Total (B)	19200	6400	14400
Net benefit (B-A)	12940	3400	9490
Change in net benefit between improved and control	12940-3400 = 9540		9490-3400 = 6090
Change in total variable input cost between improved and control	6260-3000 = 3260		4910-3000 = 1910
Marginal rate of return (MRR)	(9540/3260) = 2.93		(6090/1910) = 3.19



plus transportation costs. The farm-gate price for an output is the value (price) farmers receive or can receive for their harvested crops. It is the price farmers receive at the end of the production process. The transportation, packaging, and other costs are deducted except where they are included in the variable cost.

9. After the meeting, summarize the information, leave the farmer with a copy and keep one

An example of a treatment partial budget drawn up using participatory methods is shown in Table 7. The valuation of the crop harvested and the inputs supplied must be based on the farmers' valuations.

The above illustration implies the first option (improved seeds + inoculants + P) is more profitable, based on the farmer's supplied information. Note that the values are the real monetary cost of each activity/input. The net benefit is the difference between gross farm-gate benefit and the total variable cost. A conclusion can normally be drawn with the calculation of the net benefit. However, if time permits, other variables can be calculated. The change in net benefit is the difference between the net benefit of the new technologies and that of the control. The marginal rate of return (MRR) is a ratio of the change in the net benefit and total variable cost. Before the adoption of new technologies, especially those with implications of extra cost, farmers will consider many factors, such as compatibility with other farming activities, the opportunity cost, availability of required additional production resources, the additional cost, the benefit of adoption (income, nutrition, environment, etc.), and the outlet for produce (market opportunity). While the partial budget analysis shows the level of profitability and identifies the additional cost, problem priority pair-wise ranking will identify possible constraints to final adoption.



Problem priority pair-wise ranking

The aim is to assist the participants to identify and rank the problems that they are facing with their farming activities or in implementing the project's activities as well as in the adoption of new agricultural technologies. Pair-wise ranking is a useful technique to find out about the reasons for a particular choice, but it can be used only when there are not too many options (a maximum of 6–7).

Steps for undertaking a problem pair-wise ranking

This can be done in mixed groups or in gender/age specific groups. However, we recommend that it should be conducted separately for men, women, and young people.

1. Make sure everyone knows the purpose of the exercise.
2. List all the problems. It may be necessary to limit these to natural resource problems.
3. Ask the participants to decide which is the most important, limiting these to no more than 6 or 7 through mutual agreement, hand, or stone voting.
4. Prepare a blank matrix.
5. Compare each problem with all the others, in pairs, going through each pair in turn.
This gives the participants two options to discuss and agree which is the more serious.
6. Make comparisons of all the possible pairs (starting with weeds and fertilizer availability), recording the greater problem for each comparison.
7. Add the number of times each problem each is scored and then rank (in the same way as in pair-wise ranking, illustrated above).

Capacity building for implementing PREA

To successfully implement PREA requires new skills, knowledge, and attitudes, not only for extension workers but also for the farmers who are used to working with conventional approaches. PREA is a process learning cycle which requires flexibility in its



implementation. The complexities of rural situations require that capacity is developed and the institutional approach is changed to create an environment, conducive for the process to be accepted. It may mean a change for EAs away from being technical advisors to being process leaders and facilitators. Participatory development processes are not blueprints and cannot be predicted in terms of output.

The N₂Africa project has allocated resources for trainings at different levels. Dissemination begins within the project through a series of training activities. Training-of-Trainers in BNF technology and extension will be conducted and attended by at least two cooperators from each of the eight countries and two BNF specialists from each of three project hubs. These specialists will return to their respective hubs and countries and organize workshops of national cooperators, particularly the representatives of large farmers' associations and NGOs active within each country. This will result in the training of 132 trainers over 4 years, 50% of whom will be women. Project staff will provide technical and logistic backstopping for these national cooperator workshops. Finally, each trainer will schedule a series of stakeholder workshops within the project action sites where specific project activities and cooperators' responsibilities are discussed, technologies demonstrated, and the use of project dissemination tools explained. This will result in a grassroots cadre of 1320 lead or master farmers, 50% of whom will be women. These master farmers will, in turn, recruit and backstop the participation of 225,000 farm households over 4 years. The above are the minimum numbers expected; it is hoped that these numbers would be surpassed as the implementation exercise continues.

Documentation

Record keeping and documentation are very important. The researchers, EAs, as well as the lead farmers should endeavor to document every activity, whether major or minor. The number of participants present during meetings, field-days,



etc., should be recorded with a note of the number of males and females present. During visits to the field, record anything abnormal or outstanding you noticed; these details are very important in PREA as they will ultimately help in interpreting results. Records should be kept of all meetings, stating the decisions and recommendations made as well as the follow-up activities. During field days and other meetings or when interacting with farmers, ask open-ended and probing questions to fully understand their opinions and experience. Technicians, EAs, and lead farmers should report successes to their superiors who should publicize them. They should be reported to other partners, farmers, neighboring communities, projects, etc., to appreciate and share experiences.

Conclusion

The introduction of PREA is a key component in promoting improved agricultural technologies to farmers in N2Africa. The PREA focuses on encouraging the active participation of local leaders, farmers, researchers, extension agents (EAs), and the private sector in identifying the problems of local communities and their possible solutions. It involves communities in analyzing their situation, planning, trying, monitoring, and evaluating new technologies. This will result in the widespread adoption of identified/relevant new practices and new varieties as a result of farmer-to-farmer extension.

N2Africa is working in eight African Countries and several different partners are implementing extension activities in each country. Many of our partners have already been successful disseminating technologies before they joined N2Africa and we encourage them to continue using extension methods that have worked well for them in the past and possibly incorporate some of the PREA concepts. We also expect some of our partners to use PREA. The diversity of dissemination approaches used in N2Africa should make it possible to compare the efficiency and impact of the different methods.



Suggestions for further reading

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