Monitoring & Evaluation of Natural Resource Management (NRM) Interventions in Niger:

M&E Tool kit for Local Interventions

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Background to the Toolkit

The Monitoring and Evaluation of project progress and impacts have often been seen as difficult tasks to be accomplished as infrequently as possible, and usually left to project donors to carry out punctual assessments, typically at mid-term and at the end of project life. These punctual checks which seek to ensure that the project has spent its budget correctly and is proceeding as the project document states are more correctly termed project **Evaluation**. When carried out during the life of the project they also offer one of the few opportunities for the readjustment of project activities. The **Monitoring** side of the equation is an activity usually associated with the project itself, and, to be efficient, should be carried out at regular intervals so as to produce a more or less continual record of the projects progress and impact. Unfortunately, many small projects (and some larger ones too) are unable to conduct appropriate impact monitoring programs due to lack of resources and adequately trained personnel.

ASDG II is a project funded by USAID which has as one of its primary components the supply of funds to support Non-Government Organizations (NGOs) and Local Community Organizations (LCOs) proposing to work in the area of natural resource management, in its broadest sense. ASDG II has helped to put in place a NRM Grants Supervisory Committee composed of independent members from a broad NRM background. One of the committees first actions was to develop a series of criteria to be used in judging the standard and applicability of grant requests, and to judge the competence of the requesting group to carry out their project's proposed activities. To date, ASDG II has received many requests and, unfortunately, the vast majority have been rejected by the committee for failing to meet the established criteria. Although not the only area of rejection, too many proposals are failing to develop adequate proposals for carrying out future impact monitoring activities. Realizing the organizational constraints that have led to this problem and in order to help overcome it, ASDG II has put into place two levels of assistance. Firstly, an M&E specialist has been appointed to the project staff with terms of reference that include assisting NGOs and LCOs to develop adequate impact monitoring plans. Secondly, following the recommendations of DeCosse (1995), ASDG II is to initiate an M&E training program; established with the intention of improving the impact monitoring of local-level NRM projects. As part of the training initiative, this Toolkit has been developed and it seeks to provide solid support for field-based NGOs and LCOs in the carrying out of impact monitoring at the village level.

Following discussions with a number of grant-providing organizations, it has become clear that the problem of lack of experience in impact monitoring is widespread. Thus several organizations have agreed to support the ASDG II initiative by providing cooperative support and feed-back at all stages of the Toolkit development. One of the key elements to come out of this multilateral cooperation is the development of a set of common NRM objectives (long-term) and associated indicators of project impact. These have been put together in Tool 01 under the "General Framework for the Monitoring and Evaluation of the Impacts of NRM Interventions at Village-Level". Without exaggeration,

it has been the development of consensus about objectives and indicators that has allowed the Toolkit to develop from an idea to reality. Without the input and constructive commentary of many colleagues, it would have been impossible to have developed these foundation stones on which the Toolkit has been developed. Thus we appreciate all the help that we have received from a disperse NRM community in Niger, and especially from USAID, the PGRN and its World Bank Consultants, ASDG II staff, and many individuals from a variety of departments and organizations.

Although this Toolkit was developed in the first instance for organizations seeking or receiving ASDG II grants, it is also hoped that since such wide consensus has been reached from the NRM community, other non-recipients may consider to make use of the Toolkit in their own impact monitoring work. ASDG II is prepared to support such organizations by arranging training sessions, providing the Toolkit, and follow-up assistance from their M&E specialist.

Basic NRM Objectives

A fuller discussion of the broad-based objectives that have been retained as to include the most likely goals for most NRM projects is to be found in Tool 01. However, by way of introduction to the Toolkit, they are reproduced below:

- To Improved Capacity of Communities in the Use of NRM Techniques,
- To Bring about a Sustainable Improvement of Living Conditions, and
- To Assist in the Reconstitution of the Productive Capital

Each objective is provided with a series of anticipated results, while each of the latter has been allocated a set of impact indicators and precision on the type of data required to measure that impact (see Tables 1-3 in Tool 01). Looking through the details of data requirements, it has been possible to identify the most convenient means of collecting the desired information. These methods have been developed into individual tools and form the basis of the M&E Toolkit.

It is clear that few local-level projects will cover all three objectives, nor is it even likely that they will be involved in all the areas contained within any one of the objectives. Instead the general framework has been conceived as a way of covering all likely participation in the broad area of NRM interventions.

Toolkit Structure and Contents

Broadly, the Toolkit can be considered in two halves; the first half contains those modules or tools that will be of use to all projects working at the village-level. These tools provide guidance in all aspects of impact monitoring; starting with an explanation of the process of impact monitoring, passing via check-lists for the planning and carrying out of monitoring campaigns, and ending with suggestions on how to present impact data and prepare monitoring reports. In is considered that projects will wish to make use of all these modules.

The second half of the Toolkit contains a variety of methodologies that projects can use either in the field, to collect the impact data required (and contained in the General Framework), or that can be used in the office to interpret visually or statistically the accumulated data. This second half contains sufficient methods to allow the collection of all data sets mentioned in the General Framework. Given the fact that few projects will require all of the data sets indicated in the Framework, projects should feel free to pick and choose only those tools that are relevant to the collection of their particular data needs.

As a final word of introduction, we have developed the Toolkit with care and have tried out in field conditions, the majority of the data collection tools. Therefore it is hoped that they do not contain any errors or unforeseen difficulties. Nonetheless, we imagine that with the first time of use, certain problems will arise. We would appreciate a feed-back from the field so that we may correct or adapt the Toolkit as necessary. Contact should be made with the M&E Specialist at the ASDG II project in Niamey.

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Tool 01

General Framework for the M & E of Impacts of NRM Interventions at Village Level

Introduction

This framework regroups Indicators and methods of Monitoring and Evaluation which will produce the defined categories of results, required to help measure progress towards achieving the three principle Objectives of NRM interventions, at village level. The objectives retained are:

- To Improved Capacity of Communities in the Use of NRM Techniques
- To Bring about a Sustainable Improvement of Living Conditions
- To Assist in the Reconstitution of the Productive Capital

Each of the M&E Objectives has been translated into a set of anticipated results (or impacts). Progress towards achieving these results will be measurable by village-level collection of relevant quantitative and qualitative values that can be attributed to groups of project impact indicators. Level of impact is to be determined by the collection of relevant data sets using a series of M&E tools; and responsibility will lie with the relevant village-based projects.

Briefly the rationale for the different Objectives is as follows:

Objective 1 seeks an improvement in the functionality and cooperative structure of the project village, and in the development of the community as a whole. Much of the information required here is easily quantifiable either by the Enquêteur alone or by talking with a village official.

Objective 2 is to bring about a sustainable improvement in living conditions. This will of course have a direct influence on the purchasing power of the village community. However, the key word in this objective must be "sustainable". Careful harvesting of a forest is sustainable since the resources are renewable while mining of a coal seam is not. However, experience around the world has shown that renewable resources can rapidly become non-renewable if the resource is exploited at a faster rate than it is naturally regenerated. Therefore in measuring this objective it is essential to consider not only project impact on revenue but also to look back on Objective 3, and the level of the underlying natural resource base.

Finally, therefore, Objective 3 seeks to bring about improvements in the quantity and quality of the three major components of the community's natural resources base (the soil, the water, and the vegetation). The aim here is to determine project impact, which may of course be positive, negative, or absent; and to determine qualitative and quantitative measures of

progress towards achieving the stated objective.

Given that project objectives are usually for the long-term, it is necessary to develop a set of intermediate determinants of project progress; to ask the question "is the project moving towards the specified objectives?" and to provide the necessary answer. In order to determine the project's contributions to development it is first necessary to develop a mechanism which can determine whether or not progress is indeed occurring. It is generally considered that the vast majority of NRM interventions; be they via large-scale projects, NGO assistance or through local community-based organization will, during their own reflections, arrive at one, two or all of the objective that have been produced here.

The real difficulty for projects comes in determining the methods to illustrate that they are indeed on the right track to achieve their objectives. To this end considerable reflection has been undertaken by a host of organizations under the guidance of C/GRN assisted by representatives of the ASDG II Project (USAID/Niger). This has led to the development of a series of anticipated mid- and long-term results which encapture the logic of the three broad objectives. Once more, these anticipated results require the adoption of means to determine or indicate (hence: **Indicators**) project progress. In the accompanying Table, Indicators have been developed that will show progress towards achieving the three Objectives and their component Anticipated Results. Further, Data Requirements to be used in the Indicators to measure impact are proposed as our the different Methodologies that should be used for collecting the relevant data sets.

The Toolkit, as it develops after this first Tool in the series, will aim at providing assistance to the M&E specialist at the village level in obtaining the required information and with it, determine progress towards anticipated results and objectives.

Relevance of the Different Tools in the Toolkit

The Toolkit has been developed to provide a logical progression of data collection techniques for each of the three NRM Objectives. The information that may be gleaned from the Toolkit's complete use, should provide all that any locally-based NRM project might require in order to measure project progress towards achieving the stated objectives and allow a complete response to project M&E requirements.

However, it is quite obvious that not all community based projects will have the full spectrum of activities that the M&E tools are seeking to measure. For example, a project interested only in improving the availabilty of water to a village might have little interest in determining project impact on soil fertility or change in vegetation cover. If this is the case, the officer responsible for M&E at project level should cross off those sections of the Questionnaire that he/she is sure have no relevance to the project. Similarly, the indicators for regeneration in natural forests, or improvement to village pastures should be ignored (as should be the accompanying tools) if the project has neither of the components in their intervention.

General Framework for the Monitoring and Evaluation of the Impacts of Natural Resource Management Interventions at Vilage-Level

NRM Objective 1	Anticipated Results	Impact Indicators	Data Required	Methodology/Toolkit
Improved Capacity of Communities in the Use of NRM Techniques (organization, literacy, collaboration, competence)	Strengthened organizational capacity at the local level	1. Status of community organizations and degree of functionality	No. and type established	Interview
			% households with members	Questionnaire
			Number of literate members	Interview
			Existence of rules respected by the population	Questionnaire
		2. Presence of financial schemes	No./type of credit facilities	Interview
			Level of financial contributions	Interview/Questionnaire cf. Indicator 13
	Strengthened local NRM competence	3. Reduction/rapid resolution of land-use conflicts	No./type of land-use conflicts versus resolution	Interview with responsible and questionnaire with population
		4. No./type of NRM training activities	No. of training sessions and participants	Interview
		5. Recognition of livestock corridors	No. and location of corridors established or displaced	Interview
		6. No. of requests for assistance received by project	No./type of requests coming from non-project villages	Project records

NRM Objective 2	Anticipated Results	Impact Indicators	Data Required	Methodology/Toolkit
Sustainable Improvement of Living Conditions (Increases in the productivity of natural resources, of the buying power, work conditions, services and infrastructure of local communities)	Increased production (crop, wood and fodder yields) of natural resources	7. Type and number of NRM techniques adopted	See Indicator 17, 20, 24	Questionnaire
		8. Annual crop production	Estimates for the production of all crops	Questionnaire with possibility of using (Tool 11)
		9. Herd size/composition	Village livestock (herd size and species composition)	Questionnaire to calculate estimated village herd size
		10. Pasture productivity	Estimation of end of rainy season pasture biomass	Methods described by Tools 07, 08, 09, 11, 21
	Increased household incomes	11. Sources of revenue	No./types of sources	Questionnaire
			Level of revenue/expenditure	Questionnaire
			Level of credit given/received	Questionnaire
		12. Level of migration	No. of family members and duration	Questionnaire
		13. Value of goods coming from NRM destined for markets outside the village	Level of financial transactions with external clients	Questionnaire
	Increased access for women to natural resources	14. Modification in Women's use of time	% time spent on different occupations	Questionnaire
	Increased basic services	15. No./type of Services	Presence of basic infrastructure (cereal banks, health care, school, boutique)	Interview or direct counts
		16. Use of carts and other forms of animal traction	No. of functional oxen/donkey carts	Questionnaire or Direct count

NRM Objective 3	Anticipated Results	Impact Indicators	Data Required	Methodology/Toolkit
3. Sustainable reconstitution of Productive Capital (soil, vegetation, water)	Improvements in soil fertility and moisture content	17. Adoption rate of NRM techniques aimed at improving soil fertility and soil-water conservation	No. of households using recognized NRM techniques	Questionnaire (Tool 13)
			Type of practices used	Questionnaire
		18. % of land in different uses	Partition between cultivated, fallow, range/forest, community forests	Mapping from the ground or from aerial photograph
		19. Soil fertility assessment	Farmer assessment	Questionnaire
			Chemical measures of NPK and organic matter, pH	Use testing lab. but try correlating with farmer's assessment as well
			Presence of indicator species	Questionnaire
	Improved vegetation cover and quality	20. Adoption of measures to improve natural forest regeneration	No. households using recognized regeneration and forest/range management protection measures	Questionnaire
			Volume of wood harvested	Method? Interview (Tool 12)
			No. of established saplings	Ground counts (Tools 07/08/09)
			Area of managed forests	Interview
		21. Amount of reforested land	No. of nurseries producing seedlings on a regular basis	Interview or village survey
			No. persons raising trees or collecting seeds	Questionnaire
			No. hectares planted	Questionnaire and Indicator 18
			Amount of land reforested	Questionnaire/Interview
		22. Pasture quality	Herder's assessment	Questionnaire. Note: species check requires specialist skills
	Improved availability of water; better control and use of surface water	23. Availability of permanent water	No. of village wells and average distance apart	Count and measure

continued

NRM Objective 3	Anticipated Results	Impact Indicators	Data Required	Methodology/Toolkit
3. Sustainable reconstitution of Productive Capital (soil, vegetation, water)	Improved availability of water; better control and use of surface water	23. Availability of permanent water	No. of village wells and average distance apart	Count and measure
			Position of wells relative to livestock corridors	Map (see Indicator 18)
		24. Adoption of techniques for the better use of surface water	No. of households using established measures	Questionnaire
			List of measures being used and estimates of effectiveness	Questionnaire

Tool 02

Recognized NRM Practices

Introduction

This tool seeks to collect together as wide a range of recognized NRM practices as possible; both as a check list for projects seeking to develop further in this field and as a reference list. The authors are well aware that the list is not comprehensive, that many practices go under a variety of different names, both technical and vernacular, and that there is considerable debate on what represents actually represents a valid practice. Furthermore, some individuals state that certain of the practices listed are merely variations on a theme while others will state that they are validly different being used in differing situations and locations to tackle varying problems. Finally, certain "practices" listed may not be considered NRM Practices at all. However, when included it indicates that the communities themselves have stated to us, or to one of our reference sources, that they (the farming community) consider them valid; who are we to argue? We are not interested in entering into all these debates here. Thus the Tool has been developed to serve as a guide, an *aide memoire*, and as a means of assisting M&E Officers in filling replies to Questions 18, 21, 27 of the Questionnaire (Tool 19).

The list composition and the sub-divisions which follow have been produced with the Questionnaire in mind. However, some additional categories have been added for sake of interest and completion. Two documents in particular have been the keys to the development of our lists (Manou & Zakou, 1996; McCormac-Wild & Wild, 1996). We appreciate greatly all the background work that the two sets of authors have accomplished, and would appreciate receiving any comments or details of additional practices that could be added to the lists.

List 1

NRM Practices which Aim to Enhance Soil Fertility and Moisture-Holding Capacity

1. Protection of Natural Regeneration
2. Improved Pruning and Spacing of Trees in Fields/Plantations
3. Use of organic Matter in Fields
4. Composting
5. Use of Manure
4. Zai Holes
5. Small-scale Check Dams
6. Demi-Lunes/Microcatchments
7. Mulching
8. Leaving Crop/Tree Residue in Fields
9. Dune Stabilization
10. Rock Bunds
11. Cart Purchase for Manure Transport
12. Tranchées
13. Diguettes
14. Cordon de Pierres
15. Gabions
16. Use of Fire Ash

List 2

NRM Practices which Aim to Enhance Forest Regeneration and Increased Wood Production

1. Protection from Grazing
2. Use of Improved Cooking Stove
3. Banquettes
4. Demi-lunes
5. Digues Filtrant
6. Cordon de Pierres
7. Defrichement Amelioré

List 3

NRM Practices which Aim to Enhance Tree Planting and Plantations

1. Tree Production/Nurseries
2. Windbreaks
3. Planting Trees on Borders
4. Live fencing
5. Woodlots/Plantations
6. Protection from Grazing

List 4

NRM Practices which Aim to Enhance Water Usage/Reduce Water Erosion

1. Banquettes
2. Demi-lunes
3. Tranchées
4. Diguettes
5. Fossés
6. Cordon de Pierres
7. Gabions
8. Barrage en Pierre Sèches
9. Digue de Protection des Berges
10. Seuil Longitudinal
11. Perrés
12. Talutage des Berges
13. Epis
14. Zai Holes

List 5

NRM Practices which Aim to Enhance Livestock Production

1. Cutting/Storing of Hay
2. Livestock Fattening
3. Establishment of Cattle Corridors
4. Creating Pastoral Zones/Units
5. Provision of Salt Licks
6. Banquettes
7. Demi-lunes

List 6

NRM Practices which Aim to Enhance Agricultural Production/Diversification

See also List 1

1. Gardening
2. Transformation of Agricultural Products
3. Fruit Tree Production
4. Improved Seeds
5. Village Storage Facilties
6. Banquettes
7. Digues Filtrant
8. Digue de Protection des Berges
9. Seuil Longitudinal
10. Perrés
11. Talutage des Berges
12. Epis
13. Zai Holes

List 7

NRM Practices which Aim to Enhance Human Resource/Organizational Development

1. Community-based Organizations and Meetings
2. Adult Literacy
3. Locally-controlled Credit

Tool 03

Definitions Check-list

Area Frame: An organized collection of all individuals in a population in which organization is based on geographic areas. Thus a population of fields around a village, the departments of a country. See List Frame

Biomass: or Standing Crop, is the quantity of vegetation (usually measured in gm or Kg of dry weight) per unit area (usually per m^2 or hectare). Of interest in the Toolkit is the biomass of herbaceous vegetation in local pastures

Carrying Capacity: A measure of the ability of pastures to support livestock. The calculation uses the biomass present, the biomass available and the feed requirements of a Tropical Livestock Unit (= 250 Kg live-weight), to determine the number of head (in TLUs) that the pastures can support. Thus data is usually presented as TLU/hectare. However, when feed is scarce the level of TLU may fall below one meaning that each would require more than a hectare of grazing in order to satisfy its requirements.

Census: A type of survey in which all members of the population are sampled, ie. the coverage is total and the sampling effort = 100%

Chi-square Test: A statistical test of association between data

Confidence Limits: or C. Intervals are values calculated that represent measures of the variability of data around the mean as calculated from a stated sample. With a given level of variability, the size of the CL changes with the level of confidence selected. Throughout the Toolkit we have used 95% (or $p = 0.05$) as a standard. The confidence limits are calculated to determine the probable value of the true population mean. Thus, assuming the use of $p = 0.05$, the true population mean has a 95% (95 out of 100) chance of falling within the upper and lower limits of the C.L.

Control: A population were a given treatment has not been applied. This population is used for comparaison with the target population. Therefore the impact of a project on a target village could be compared to the situation at a village where the project is not involved.

Correlation: A measure of the relationship between individuals or populations. A correlation may be positive: an increase in one leads to an increase in the other (eg. rainfall and vegetation biomass); or negative: the increase of one leads to a decrease in the other (eg. vaccination level and the incidence of disease).

Estimate: A value that is thought to lie close to the real value. This may be an estimate of tree height or an estimate of the population mean, as can be calculated for example, during sampling.

Evaluation: The summing-up of an effect. When used in the M&E context, it refers to defining population impact at defined periods in the project life, eg. mid-project or end-project evaluation. These are punctial events and not ongoing processes (cf. Monitoring)

Frequency: The chance of finding a given variable or character in a population. Usually measured as a proportion or as a percentage.

Hectare: A measure of land area being equal to 10,000 m^2.

Individual: A member of the population of interest. Eg. households in a village, trees in a forest, zai holes in a field

Land Use: The manner in which the land is being used. A list of different land-use categories should be developed and each unit of land assigned to a single category. This will be for use in developing land-use maps (Tool 13; Indicator 18).

List Frame: A collection of all individuals in a population arranged into a list. The list is usually alphabetical (as in a telephone directory). Thus a list of all villages in the country or all households in a village would constitute a List Frame (see Area Frame).

Mean: or average, is a value to be calculated from the sums of all observation divided by the number of observations. When we talk of a mean value we usually refer either to the mean value of a population (population mean) or to the "sample" mean. To calculate the population mean, the selected feature is measured from <u>all</u> individuals and the mean determined in the usual way. In calculating the sample mean, a given number of individuals are drawn from the population and the mean calculated. It is assumed that the mean of the sample will approach closely that of the population mean.

Median: The median is the mid-value of a range of values listed in order from the smallest to the largest (or vica versa). When the range consists of an odd number, the median is found simply at the mid-way point; when the range contains an even number, the median is obtained by taking the to middle numbers and averaging them.

Mode: The mode is the most frequent or common number in a series.

Monitoring: A process - usually internal to a project - in which impact is followed over time (cf. Evaluation and its punctial nature)

pH: A chemical term meaning the concentration of hydrogen ions in the soil, measured on the log scale. For use in the Toolkit, pH is simply a measure of the acidity or alkalinity of a soil.

Population: A collection of individuals with common characteristics. Eg. a forest (collection of trees), a village (collection of households), a household (collection of individuals)

Quadrat: A square, rectangular or circular frame used commonly by ecologists to delimit an area of ground for sampling

Random: Occurring in a manner with no defined order (see Random Sampling)

Random Sampling: Individuals are drawn from the population with each individual having an equal chance of selection

Sample: A collection of individuals that are assumed to represent the population from which they have been drawn

Sample Size: The number of individuals included in a sample

Sampling: The process of selecting a sample (see Random Sampling)

Sampling Effort: The size of the sample relative to the size of the population from which it is drawn. Usually represented as a %. Thus a sample size of 10 from a population of 100 is a 10% effort

Sampling Frame: An organized collection of all members of the population of interest (See Area Frame and List frame

Significance: Literally, the validity of your results measured against a statistical standard. In simple terms, the significance is the a measure of the likelihood that a calculated result has occurred purely by chance and not as a result of some action that has been taken. The level of significance is usually measured as a percentage (between 0 and 100%) or as a proportion (between 0.0 and 1.0). Proportions and percentages are interchangeable by multiplying or dividing by 100. In statistics the usually accepted level of significance is 95% ($p = 0.95$). This means that the result has a 95% (ie. 95 out of 100) chance of being a real result and only a 5% (5 out of 100) chance of being by chance alone. Statistical Tables give the percentage or proportion across the top of the columns. Throughout the Toolkit we have adopted 95% as our level of significance. Above this level (ie. going towards 100%) it becomes harder to get a valid result but, if you do, you can be sure that the result has very little element of chance in it.

Standard Error: A measure of the variability of data around their mean (see Variance). It is calculated from the square root of the variance.

Student t-Test: A statistical test of difference between sets of 2 sets of data (you should rarely use it to compare pairs of data from a series of results). The calculation reveals how significant is the result that you have witnessed (see Significance).

Stratum: Literally a layer, but used in the meaning of Stratified Sampling to indicate a discrete sub-division of the population in which all members share a common characteristic. This characteristic is not found in members of other strata.

Survey: The process of collecting information from the defined sample of the population under study (see Census)

Target Village: The village or villages in which a project is active.

Variable: A characteristic of a population that may differ from individual to individual. Usually something that can be measured eg. height, eye color, etc.

Variance: A measure of the variability of data around their mean. It is calculated by accumulating the differences between the observed values of the sample and their calculated sample mean.

Videography: A (new) method of remote sensing involving the use of a video camera carried in a small aircraft for recording pre-selected information over large areas. The height of the aircraft and adjustments to the focal length of the camera can be adjusted so as to obtain more or less land surface in frames of the film. The method has been tried in Niger with success, and the coordinating unit is based at the UTA.

Tool 04

Monitoring & Evaluation Check-list
Data Needs and Responsibilities

Introduction

This Tool has been developed to help in the planning and carrying-out of the M&E functions of the project. It is intended more as a "Aide Memoire" than a Work Plan but it does have all the elements necessary for this function although in less detail than would generally be required. As far as possible all the processes, from the start to the finish, involved in M&E are covered here.

Data Needs

Donors: Senior officials of village-based projects (be they CBOs/NGOs/other structures) should appreciate that if they accept to receive support of any form, they are also undertaking an obligation to provide relevant and pertinent information to the donor. This information may come in various forms: financial, project implementation, project impact. Where your project forms part of a larger program, as is the case with large donors such as the World Bank, USAID, European Community, etc. these donors rely heavily on the receipt of your village-based information in order to develop their own Impact Monitoring Reports. Thus if certain measures of impact seem to be of little value to your understanding of the project, do not forget that you are also working as part of a much larger picture. Furthermore, you must appreciate that aid sponsorship, be it from the National Government or from overseas has a duty to report back to its contributors (mostly tax payers; i.e. you and me): how the money is being spent, the impact that the contribution is having on the target populations and on the environment.

Grant Projects: Currently ASDG II (USAID) has, as one of its key activities, to support the development of community projects in the field of NRM. Further initiatives are already present in Niger and others will follow eg. as being developed within the framework of the Projet National de Gestion des Ressources Naturelles. This long-term program is being supported by the World bank under the auspices of the C/GRN of the PGRN. These organization, also have very real data needs, much of which can only come from the village level. They need to know for example how well the projects being funded are developing, what impact their work is having on the environment and on the livelihoods at the village level; and whether such impacts that exist are positive or negative. They also need to show to their own donors that their work is progressing as anticipated.

Local -level Projects: The largest need for access to pertinent information is actually at the local level; i.e. you. You must be aware of what effects project actions are having on the target population, and such information must come in a timely fashion. It is not good enough to realize three years down the road that a certain action in force since project start-up has actually been having a totally contrary effect to that anticipated. Apart from on the purely activity front, there is also an enormous linkage between ground-based actions and financial management of a project. The financial controller needs to know whether more finance will be required in an expanding (positive) sector, or whether savings can be made by reducing or changing activities where impacts has not been as great as was previously anticipated.

Staffing and the Sharing of Responsibilities

Who is ultimately responsible for carrying out impact monitoring: the donor, the project director, M&E officer, the statistician, the field data collectors, the village organizing committee, the farmer? In reality, the responsibility lies with just about all those people listed. The donor's responsibility will be minimal since clear terms of reference will have been signed with the project. The donor will therefore be more likely to remind the project that the M&E information required by the project agreement is well overdue. Such a reminder will come to the Director desk who in turn will ask his M&E Officer for an explanation, and the buck will be passed down the line until the farmer in the field is to blame. **Note:** the farmer, in such a scenario, will be the only innocent party and the responsibility becomes more pressing as the chain is climbed upwards to project director-level.

Director: Overall responsibility for ensuring that all pertinent information on project impact is received by higher office (Government, Donors, etc.) by the due dates. A time-table will have been developed with the M&E Officer and the project Accountant, forward plans to ensure that the necessary financial/material resources will have been allocated, and that equipment/material is in working order. The Director should also set up a project notebook in which relevant details for the M&E program will be listed. In the General Framework (Tool 01), Indicator 6 (number of requests for assistance) is an important detail for the Director to record. See also "Village Associations".

M&E Officer: Will be responsible for overall development of the M&E plan. This will not have been done in isolation but considerable inputs from donors, umbrella projects, the director, technical experts at the project, field assistants and village organizations. Nothing should be left to chance; planning is essential. You must accept that during every M&E program something unforeseen is bound to go wrong. Do not add to that list by negligence or oversight. Make sure that at any time of the year you are aware of what training is needed, which data will be required, when it is programmed to be collected and which method will be used. Produce lists of things to be done well in advance, make sure that your field assistants are well aware of plans and have received adequate training, that the computer expert (if one exists) has

booked time for the treatment of your data, that the secretary will be available to carry out all the photocopying of field sheets, etc. Do not leave the planning to the last minute. After the field campaign starts, be ready to begin the data management and treatment processes immediately they arrives at the office. Do not procrastinate on these tasks. Ensure that you know the types of documents to be produced and to whom they are destined. Finally, you should know that once the director has handed over to you the impact monitoring, you are responsible in his eyes. See also "Village Associations".

Field Assistants: will be responsible for setting up interviews, carrying out field data collection, ensuring that information gets from field level to M&E officer-level as well as ensuring they know what they are supposed to do. Be concerned with the quality of information collected. No excuses should be accepted that "I did not know". This level will have received adequate training and should be up to the tasks assigned them.

Village Associations: will probably have been asked to collect together pertinent information. For example, in projects with a community forestry component they will be the best source of information for the quantity of wood harvested, the amount exported for sale outside the village, qualitative assessments on how the forests are developing. They will also be responsible for maintaining accurate records on credit, also on land and other disputes. However, the M&E Officer should not assume that the Associations will know which information they should provide in advance. This is something that should be agreed before project start-up and contained in the formal signed document. That it is included in the document in the first place is the responsibility of the Project Director on advice from the M&E Officer. See also "Farmer".

Farmers: There is a responsibility on the behalf of the farmer to assist the project field assistants in carrying out their work. He should know that in the act of accepting technical assistance/finance that he is contracting to help the project achieve its aims. Thus he should be available for interviews as necessary (but see Tool 19 and Tool 20), he should be prepared to divulge information that the project will ask (in turn his confidentiality must be respected) and above all he must answer questions honestly. It is better to have no answer at all than one that is blatantly false. Particularly he will not appreciate having to divulge actual revenue levels (thus we do not use this directly as an indicator for Objective 2).

Tool 05

Monitoring & Evaluation Check-list
Calendar of Activities

Introduction

During the implementation of M&E activites, proper respect for the organization, timing and carry-out of activites is essential. Tool 01 identifies the data that requires collection, Tool 04 developes the idea of responsibility, this Tool develops the idea of "When" and "How".

The Timing of Impact Monitoring

In developing this Toolkit it has become clear that in order to obtain the information that provides the indicators of project impact it will be necessary to collect relevant data during four types of campaign:

- project start-up,
- each trimester,
- annually
- project completion

Before each campaign it will be necessary to organize and clarify particular sets of requirements. These are developed here in chronological order.

Project Start-up

This is an absolutely critical phase in the M&E process since it provides base-line or starting point data against which <u>all</u> future impact will have to be measured. Without this data, it will be almost impossible to quantify project effects over time. Unfortunately, many interventions forget or ignore these needs and discover, only at a later date, how necessary base-line data is. However, it is appreciated that project start-up is exactly the wrong occasion for the project hierarchy to need to have to organize a data collection campaign. There exist many obvious reasons:

- personnel to carry-out the work may not yet have been identified
- understanding of the importance of M&E will be at a low point
- there will be too many other demands on personnel time
- there may be a lack of materials and equipment for carrying out such a campaign
- personnel may lack the training/capacity at data collection/treatment
- cooperation and trust may not yet have been developed between the project and the farmer, etc.

Unfortunately the monitoring still has to be done! This dilemma and the realization that many NGOs/CBOs are weak in impact monitoring techniques, was one of the major driving forces behind the conception of the Toolkit idea at ASDG II. In developing the theme of M&E we have tried to minimize the initial requirements but still obtain as great a monitoring impact as possible. The requirements and timing to get the initial campaign underway are presented in Table 1.

Trimestrial Campaigns

These three-monthly campaigns demand much less time and effort than either the Project Start-up or Annual or Final campaigns. They exist in effect to enable the collection of time sensitive information; meaning information that might be lost or forgotten if held over until the annual campaign. Detail of Household budgets represents a good example. Given that far less information is needs to be collected, it will be necessary to sift out from the overall data requirement matrix (Tool 01), the identity of data to be collected. As with the entire data collection exercise, most information will be collected via the Questionnaire (Tool 19) and the Interview Sheet (Tool 20). In order to help with your planning, Tool 18 has been conceived. This contains two tables that clearly indicate which questions are to be asked during the three-monthly campaign and which can wait for the annual campaigns. Since there is an annual campaign during every 12-month period, there are in reality only three trimestral campaigns per calendar year.

Annual Campaigns

The annual campaigns represent those important milestones in time when data is to be collected and analyzed and information distributed concerning project impact. This information is to be compared with that from the base-line study in order to obtain coherent indications of impact. In reality using the term "annual campaign" is a slight misnomer since there are two data types (crop production and pasture biomass) whose collection may not coincide with the physical annual campaign. These data collections will need to be programmed accordingly. Furthermore there are two cases where data are required only at two-yearly intervals following the base-line data collection. These are updates of the land-use map (see Indicator 18) and monitoring of tree regeneration in managed forests (Indicator 20).

It should be noted that the first annual campaign will occur 12 months after collection of field data for the base-line campaign. Since the latter is programmed for 3 months after project start-up, the first annual campaign will actually occur 12 months later i.e. during Month 15. Table 3 provides the approximate timing for the annual M&E campaign.

Final (Project Completion) Campaign

As a project approaches its completion date, it is necessary to plan to collect information that will show impact over the whole life of the project. Thus projects will need to extract from the General Framework all indicators relevant to their project objectives, and to carry out the end of project campaign in the usual fashion. This final collection finishes off the work of the project, and will be used to show trends of project impact over time, problems encountered and how they were resolved (a "Lessons Learned" document is frequently produced), recommendations for further work that may be necessary, as well as pointers for other projects active in the same field. This campaign will certainly be paralleled by the donors own end of project campaign. This latter is outside the scope of the toolkit.

To provide comprehensive timing for the end of project campaign is obviously impossible given that projects have different life-times. However, they should be time-tabled to occur during the last trimester of project funding. Since the ASDG II-funded projects have maximum two-year life-spans, the final campaign will begin in month 21 or 22, after project start and the final report should arrive at the donor's office in order to coincide with, or soon after, project completion. Donors should themselves organize post-project evaluations - perhaps several years later - to determine how the target villages have continued to evolve following project close-down. This will determine whether project impacts have proven sustainable or not. All these timings are timetabled in the charts given below (Tables 1-3).

However, for illustration purposes, a brief summary for the impact monitoring of a two-year (24-month) project is given:

Month		
0	-	project start-up
3	-	start of base-line study
6	-	base-line report produced
9	-	start first trimestrial campaign
10	-	first trimestrial report produced
15	-	start of annual campaign
18	-	annual report produced
18	-	second trimestrial campaign
19	-	second trimestrial report produced
21	-	start final campaign
24	-	final report delivered
later	-	project site revisited to determine evolution post-project

Note that any project of less than approximately 15 months may never undertake an annual campaign since this would coincide with the carrying-out of the end of project campaign.

Table 1: **Development and Execution of Base-line Study**

* Timing takes the date of project start-up as time=0. All timing develops from this point. Abbreviations: M&E (M&E Officer at project level); FA (Field Assistants); PD (Project Director), LCO (Local Community Organizations)

Task	Timing*	Notes	Responsibility
Determination of Project Objectives and Indicators	during project design	receive guidance from ASDG II	PD, donor, LCO
Designation of functions	before project start	M&E officer to be selected	PD
Development of data needs to be collected at the village association level	before/at project start	to include in NGO/village contract	M&E, LCO
Toolkit training of M&E officers	as organized by ASDG II	ASDG II may need to hold several courses per year	ASDG II, M&E
Pre-campaign organization	within 2 months	select Tools relevant to your project	PD, M&E
Training of field assistants	within 3 months	trial of questionnaire, quantitative data collection methods plus familiarity with Tool 06	M&E with support from ASDG II if necessary
Development of sampling frames	within 3 months	see Tool 09	M&E
Selection of samples	within 3 months	see Tool 08 and 09	M&E
Carry-out questionnaire and interview sheet	at 3 months	see Tool 19 and 20 and retain only pertinent questions	M&E, FA
Collect soil samples, dispatch to laboratory	at 3 months	see Tool 13	M&E, FA,
Prepare site map of land-use types	at 4 months	ensure that a budget line has been included for this work (if relevant)	Cartographer/M&E
Prepare estimate of number of young trees in community forests	at 4 months	see Tools 12 and 16 if relevant to your project	M&E, FA
Data centralization and treatment	within 5 months	see Tool 17	M&E
Report Production and dispatch	by 6 months	see Tool 23	PD, M&E
Preparation for first trimestral campaign	in month 7	see Table 2	M&E

Table 2: **Development and Execution 3-monthly M&E Campaigns**

* Project start-up is considered as month 0, the presentation of the Base-line Report is anticipated in Table 1 at Month 6. The first 3-monthly campaign will occur at month 9. Abbreviations: M&E (M&E Officer at project level); FA (Field Assistants); PD (Project Director), LCO (Local Community Organizations)

Task	Timing*	Notes	Responsibility
Review FA training	Month 7 or 8	Ensure problems of the initial campaign do not reoccur	M&E, FA
Pre-campaign organization	Month 8	planning and collection of materials (Tool 06)	PD, M&E
Know data needs	Month 8 at latest	select relevant tools	M&E
Arrange interviews	Month 8	check with LCO on their data collection	M&E, LCO, Farmers
Arrange Questionnaire and Interview Sheet	Month 8	select pertinent questions for interviews	
Campaign	Month 9	Tool 06	M&E, FA
Data centralization and treatment	End Month 9	see Tool 17	M&E
Report Production	Start month 10	internal distribution only (Tool 23)	PD, M&E
Preparation for next trimestral campaign	in month 11	Follow this table	M&E

Table 3: **Development and Execution of Annual M&E Campaign**

* Timing takes the date of project start-up as time=0. All timing develops from this point for the first annual campaign. For subsequent ones add on 12 months to the timing indications. Abbreviations: M&E (M&E Officer at project level); FA (Field Assistants); PD (Project Director), LCO (Local Community Organizations)

Task	Timing*	Notes	Responsibility
Collection of data for annual crop production	*At end of harvest*	*likely to occur outside of annual campaign*	*M&E, FA, LCO, Farmers*
Determination of pasture biomass	*At end of hivernage*	*as last and see Tool 11*	*M&A, FA*
Review training of FA	Month 13/14	Go over annual collection techniques	M&E, FA
Reminder to LCO of project data needs	Month 14		M&E, LCO
Pre-campaign organization	Month 14	select Tools relevant to your project needs	PD, M&E
Update sampling frames	Month 14	see Tool 09	M&E
Arrange interview dates/times	Late Month 14		FA
Carry-out questionnaire and interview sheet	Month 15	see Tool 19 and 20 and retain pertinent questions	M&E, FA
Collect soil samples, dispatch to laboratory	Month 15	see Tool 13	M&E, FA,
Count/locate livestock corridors, wells; update village map	Month 15	update map produced during the base-line study	M&E
Determine response to Indicator 6	Month 15	(request for project assistance from other villages)	PD
Data centralization and treatment	Month 16	see Tools 06 and 17	M&E
Report Production and dispatch	mid-Month 17	see Tool 23	PD, M&E
Preparation for next trimestral campaign	During Month 17	see Table 2	M&E

Tool 06

Data Collection Methods and Procedures

Terms used in this Tool: Qualitative, quantitative, stere

Introduction

This is one of the "General Information" Tools which will therefore be of relevance to all projects working in the field of natural resource management. The tool describes the key methodologies used during typical M&E programs and outlines those proposed to be used for measuring the impact indicators contained in the General Framework for Impact Monitoring at Village-Level (Tool 01).

In the Toolkit there are contained several different data/information collection methods; each with its own place and logic for use. They fall conveniently into one of two general categories:

Quantitative Methods

These methods involve the actual measurement of attributes in recognized units of measure. Thus the height of a tree (in cm); the weight of millet spikes (in gm); the distance between village wells (in m); the number of NRM practices (in numbers) or pasture production (in Kg of dry weight per hectare), etc. Ecologists tend to veer towards this type of data collection since the values have a real "feel" to them, and can be treated statistically by one of several different statistical tests. Furthermore, these type of data lend themselves well to the different methods for data presentation, for example in the form of tables, graphs, histograms, pie charts and so forth. Some of the more common collection methods are developed in detail later in the toolkit as are the relevant statistical tests, and the different ways that the data may be presented.

Frequently, however, the results may appear empty, even when presented in a pleasing visual format such as a graph. Often they appear to be difficult to understand or the results themselves seem bland. This is because we may very well be able to see that a change has occurred over time simply by comparing two sets of data, but usually this does not allow us to understand why or how the changes have occurred. Quantitative measures are often considered as providing a strong framework on which to build impact monitoring but which still require the use of other methods to fill in the spaces between the individual strands of the frame. Ways that can directly provide the explanation, or give a compliment of information, that allows a phenomenum to be understood. This is one area in which qualitative methods are used.

Qualitative Methods

Qualitative (sometimes called subjective) methods are those in which a feature of interest is not measured in recognized units; rather they are ways in which opinions, and observations can be collected. Thus a farmer can be asked whether his field is more fertile since he has added manure. He would certainly reply that it was (and he would probably be correct) although no physical (thus quantitative) measures of soil fertility would have been obtained. Alternatively, if an individual is shown two piles of millet spikes, with one pile originating from a field with Zai holes and the other from an equal-sized field that lacks this practice, he will be able to indicate which field has produced the most millet.

However, where this type of information falls down is when we require to show with firm figures what impacts have occurred. Thus a project may wish to identify the relative effects on millet production of using Zai holes without manure; Zai holes with manure and Zai holes with manure and fire ash. Simply to say qualitatively that it would appear that production rose as the farmer added more nutrients to the soil is of interest but we cannot be sure that the additions have had a significant effect. This can only be determined by measuring. For example, by counting the number of spikes produced in order to determine the number per unit area; then weighing the millet seeds from a sample of spikes and finally to determine the production of millet per unit area. This, therefore, requires use of quantitative methods.

Common and popular methods for collecting information are the different types of Rapid Rural Appraisal/Participatory Rural Appraisal (RRA/PRA). They are used extensively in village situations and are capable of generating a lot of relevant information rapidly. In the development of this Toolkit a lot of discussion was entered into between the pro-RRA/PRAs, the anti lobby, and those who were not sure. After much discussion it was finally decided that PRAs and RRAs were not the best tool for use during M&E campaigns. Rather they would have their place far more in the planning and research phases for selection of target villages and of project approach; than during impact monitoring. Thus although we consider that RRAs and PRAs are highly useful and adaptable tools, they do not warrant a place in the Toolkit. We are sure that the debate has not finished yet!

Data Collection Methods Used in the Toolkit

In order to cover the potential data requirements of the widest range of NRM projects as possible, it has been necessary in turn to develop a broad spectrum of indicators with differing data requirements. Thus it has also been necessary to look at several different data collection methodologies. However, knowing, the multitude of problems that NGOs may often face with collecting good data, we have sought throughout to introduce a minimum number of data collecting methods and keep selection of statistical tests to those that are the most versatile and easy to use.

1. Questionnaires

A brief look at the General Framework (Tool 01) will show that some measures for most indicators can be obtained via a questionnaire. What a questionnaires seeks to do is to record information emanating from a number of individuals in a short period of time. Depending on the way that individual questions are constructed, the questionnaire may provide either qualitative or quantitative data, or a mixture of the two. The questionnaires supplied in the Toolkit, will produce quantitative data (that can be subjected to simple statistical analysis and be displayed in graph or tabular from) as well qualitative information that will help you to gain a better understanding of factors that underlie the results, and improve your analysis of information when writing up the M&E reports.

The main Questionnaire (Tool 19) has been chosen as the prime vehicle for data collection throughout the impact monitoring processes. For many projects there will be far more questions present (the same goes for the list of indicators) than a given project may need to ask of its target population. The surplus questions can simply be crossed out. The replies to questions that provide quantitative data can be included in the Results Grids (Tool 21) that have been developed to accompany the questionnaire and interview sheets. The Grids will also lay data out in a format that will make statistical analysis and testing easier to carry out.

At the end of the main questionnaire is an important question that is to be directed solely to women. This questions will provide data for a very important indicator as it seeks to discover whether improved NRM practices are altering the pressure of chores on women's daily lives, and whether women are gaining greater access to the village's natural resources. For example, if community forests are now producing sufficient wood for village needs, are women spending less time and having to walk shorter distances in collecting fuel-wood? Similarly, if the owners of a market garden now have a well closer to their concessions, how are they spending the time saved in collecting water from more distant sources. Also of interest is to discover whether women are arranging their working day to cope with any potentially greater access to the villages natural resources.

The questionnaire has been produced so that valuable information can be collected from a restricted samples of individuals within the target village (see Tool 07 and 08). This means that projects will not have to carry out total village censuses to produce the details they require.

The main questionnaire is to be supplemented by Tool 20 which is called the "Interview Sheet" as a means of distinguishing it from Tool 19. However, the construction of the two is very similar. The only real difference is that the questionnaire has been designed so that data/information can be collected from a sample of villager answering the questions in isolation from their fellows, while the Interview Sheet is constructed to be answered by one or more senior village representatives providing verifiable data.

The important part of all questionnaires is that we are relying on the observations of others. As this is the case, there may be the need to verify certain aspects; there may be the need to cull out obviously erroneous answers, and there may be the need to modify answers so that they fit into the results sheet that you are developing. For example if you are

collecting information on the wood production of community forests and you are provided measures in wagon-loads by one wood-cutter and in steres by another, you may wish to convert them into common units.

2. Administrative Registers

The collection of data for measuring indicators of NRM projects calls for two types of administrative registrars to be kept. The first is that to be maintained by the village organizations and the second by the project administration. Tool 22 has developed a standard village administrative registrar that one individual should be shown how to fill in and encouraged to complete as necessary. This will allow valuable information to be noted on a timely basis and will prevent the loss of data as it slips from the memory. If the organization already keeps a log of events, this will certainly contain information that can be accessed by the project. If it does not, the committee should be encouraged to do so.

The project administrators will have their own way of keeping project records and this will not be developed here. However, one important indicator that requires careful monitoring is that of the increase in demand over time for project assistance and coming from villages outside of the project's sphere of intervention. If demands occur it will show that non-project villages are becoming increasingly aware that certain NRM practices can lead to an increase in production and to improved living standards. Further, increased demands will indicate that villages are becoming sufficiently organized to be able to put a request for assistance in place. If they do so it will also indicate that they have become aware of the positive impacts of project intervention for which they now wish to be benefit from.

3. Field Data Collection

The Toolkit allows for three different sets of quantitative data to be collected by project personnel in more experimental field conditions. These are the measurements of pasture biomass and crop production (Tool 11) and of young tree populations (Tool 12). Of course if a project does not operate in one or more of these domains the tool should be ignored. The methods described have been adapted for inclusion in the Toolkit from standard techniques used elsewhere in the Sahel. Statistical methods for analyzing results have also been developed and worked on (fabricated) data sets.

4. Other Data Collection

Two final groups of information will also be required by most NRM projects. These are firstly to develop a land use map of the village, and secondly to measure the change in soil fertility in agricultural lands. Both are considered important components of the whole M&E plan and so they are developed further elsewhere (Tool 13).

Tool 07

Random versus Non-random Sampling

Terms used in this Tool: census, estimate, individual, population, random, sample, sample size, sampling, sampling effort, sampling frame, survey

Introduction

Frequently the number of individuals in a population of interest is too large to permit all individuals to be included in a census and therefore it would be better to carry out a survey. For example, if you are interested in determining how many families in the project village have adopted given NRM practices since the start-up of the project it would be very time-consuming to visit each household for this information. Usually, a sufficiently accurate estimate can be obtained by carrying out a survey in which a restricted number of household (the sample) are visited, and from replies received the percentage or total number that have adopted the NRM practices can be calculated.

Worked Example:

In a project village there are a total of 72 households. A sample of 12 were visited and 9 admitted that they had began to use 1 or more of the NRM practices being promoted by the project. Thus:

$$\frac{9}{12} \times 72 = 54 \text{ households}$$

and we can estimate that 54 out of 72 households have began to use the NRM practices under consideration. Alternatively this can be presented as 54/72 x 100% = 75% adoption rate.

Selecting a Sample

However, considerable care must be taken in the manner that the sample is selected otherwise bias will inevitably enter the sample population. If for example you decide to select the first 12 homes at the entrance to the village, you may well encounter several members of the same extended family and it is likely that they will have collectively decided to adopt or not to adopt the NRM practices. If you had selected the last 12 households, the reverse effect might well have been encountered. Similarly, allowing for chance encounters by wondering around the fields surrounding the village and talking to any farmers you might meet would again introduce considerably more bias.

Sampling Methods

The different methods for sampling a population are explained fully in Tool 08. However, the basic approach is to develop a "Sampling Frame" (see Tool 09), decide the level of sampling effort to be applied or the number of individuals to included in the sample, and then to select that number from the components of the sample frame. These individuals (be they households, fields, zai holes, or whatever) will then be surveyed following the methods chosen. The manner in which the sample is extracted from the sample frame is frequently debated. However, generally speaking, selecting the sample at random usually provides a good estimation of what the population is doing and, giving its very nature, it is totally free of sampling bias.

Random Samples

Most of us have used random sampling at some time or other in the past. Anyone that has bought a raffle ticket, drawn a name out of a hat or taken a sweet out of a bag without looking has indulged in random sampling. The crux of the method is that every individual in the population (each raffle ticket, each name in the hat, each sweet in the bag) has the same chance as all the others of being drawn.

Obtaining a random sample for use in an M&E survey is almost as simple. However, to remove the last vestige of possible bias, we usually use a conventional method involving Random Number Tables. You will find elsewhere in the Toolkit a collection of random number tables that will be sufficient for all your future needs.

How to select a Random Sample

Example:

At a target village the project has been working with the women's group to encourage the addition of animal manure to zai holes. As one component of a periodic evaluation the project wishes to discover what percentage of women have now started to add manure.

Procedure:

1. Produce a list of names of <u>all</u> members of the women's group. The list can be developed as you choose eg. alphabetically or by age,
2. Assign each a unique identity number from 1 up to the number of names on the list,
3. Decide on the size of your sample (the larger the size, the more time it will take to interview each individual; the smaller it is the less representative of the women's group as a whole it is likely to be),
4. From the list of random numbers, select as many consecutive numbers (or pairs of numbers if there are more than 10 women involved) to give you the pre-

determined sample size,

5. Mark on the list and then interview those individuals that fall in your sample.
6. One point to note is that if you have for example 70 women in the group, by taking pairs of random numbers you may logically find numbers above 70 to which of course there is no matching name. Such numbers can simply be ignored. Similar, if a number comes up twice, ignore the second occasion (although not all people do this) and take the next pair of random numbers.

Non-Random Sample

In situations where you wish to obtain information of a specific type that could best be collected by approaching one or more selected individuals rather than looking for a sample, it is perfectly valid to select a non-random sample. However, do note that this way of sampling does not allow the use of standard statistical tests.

One Tool in which non-random selection will be carried out is in the filling of the Interview Sheet (Tool 20). Here information is required on the project village generally, and further, it is information that cannot have more than one possible answer, such as how many boutiques in the village.

Tool 08

Sampling Methods

Terms used in this Tool: census, individual, population, random, sample, sample size, sampling, sampling effort, sampling frame, survey

Introduction

Tool 07 has already dealt with the reasons why during an impact monitoring program it is necessary to use a sample (in a survey) rather than all individuals (in a census). Furthermore, the manner in which we should determine the identity of the members of the sample by either random or non-random means was discussed. Assuming therefore that the logic behind the two points has been accepted, we will now look into the more common methods of obtaining the sample of individuals (be they people, fields, trees, etc.) to be included in the impact monitoring program.

Sampling Methods

Although the literature contains many different means, we will introduce here 4 methods, all of which you may need to use during future impact monitoring:

- personal choice

- simple random sampling
- stratified sampling
- systematic sampling

1. Personal Choice

Personal choice of a sample stands apart from the other methods since for an individual within the population to be selected it is an "all or nothing" process. Either you will choose that individual based on your selection criteria or you will ignore it. There is no element of chance in the process. Such a selection process will be used, for example, in the selection of the individual (senior member of the village organization or village chief) to reply to the Interview Sheet (Tool 20). This collection of information will occur at the start of the project/monitoring process (collection of base data), at three monthly or annual intervals throughout the life of the project (collection of project impact data), and at the final project evaluation.

2. Simple Random Sampling

This process gives every member of the population (be it field, household, farmer, etc.) the same chance of being included in the sample for use in the monitoring process. The enquêteur can have absolutely no influence over the individuals to be selected.

3. Stratified Sampling

This system uses the same process (see below) and theory as simple random sampling, except that the population is first split up into homogenous groupings, and sampling is carried out randomly within each of the different groups. To give a simple example. In the Questionnaire (Tool 19) there are certain questions reserved exclusively for women and others to be answered by either men or women. In this case you will use stratified sampling to determine your two homogenous groups (Men and Women) and then individuals for inclusion in the survey will be chosen from the two discrete groups by random sampling.

4. Systematic Sampling

Systematic sampling differs considerably from the other means. In this method you sample every n^{th} member of the population. Therefore this process is not random, although a measure of randomness can be brought to the data by selecting the start point randomly. An example of where this method might be used is to determine people to interview for the Questionnaire. Here you could decide to take every 5th household on the List Frame (Tool 09) and speak to the representative of each household. However, it is just as simple to make the selection totally at random from the list frame. Alternatively, if you wish to know the increase in size of a plantation of trees over time you could decide to select every tenth tree for measurement. Such a use of systematic sampling would be perfectly acceptable. Although the method is very simple to use once you have a Sampling Frame it is far less frequently used than the other three methods.

Using Simple Random Sampling

1. Take the prepared List or Area Frame making sure that every member of your population is included and that each has a reference number starting at "1" and going up to the total number of members of the population. Ensure also that no-one who should be included has been omitted by error and that no-one appears twice.

   You may have for example the following frames already developed:

   - the households in a village (list frame)
   - the fields belonging to women (area frame)
   - the charrettes in a village (list frame), etc.

2. Choose the sample size that will give you a valid estimation of the population parameter being studied (Tool 19a). Remember that the ideal sample size will be sufficiently large to provide an estimate that is close to the real situation but not so large that extra effort is spent without a corresponding increase in result accuracy.

3. Take from the Random Number tables sufficient numbers to give you the sample size required and use them to identify the individuals from your Sampling Frame.

4. Visit the sample and carry out the relevant study

Note: this method can be used equally well for selecting households for the Questionnaire, trees in a plantation, plots in a field, etc. Only first you must ensure that all possible individuals are included in your frame (in practice this is generally very easy to ensure).

Using Stratified Sampling

1. Divide the population into the different categories (or strata) determined, ensuring that every individual occurs in only one category and that no individual is excluded (basically you are developing two or more parallel sampling frames).

2. In this manner all individuals included in the same category will share certain common characteristics while differing in these characteristics from the other groups.

   Select the individuals for sampling at random

   Note: Frequently you will use stratified sampling without really thinking about it! Selecting samples from the population of Men and Women of the village; fields containing different crops or having had different treatments; and, households targeted by the project in comparison with those not targeted, are all valid examples.

Using Systematic Sampling

1. Taking the Sampling Frame of the population you wish to sample, decide the number of samples you require and divide the number of individuals on the frame by this number (example: 70 individuals on the frame; 10 to be sampled. Thus 70/10 = 7).

2. Choose a starting point on your frame between 1 and the calculated number (in this case "7"). Choice is usually at random. Take this individual and every (in our case 7th individual) until you reach the end of the Frame. These individuals are now identified as your sample population

   Note: The method is simple but must be used with care. You could use it for example if you wish to measure the difference in the size of millet spikes grown in or out of Zai holes. Here you might measure every tenth spike cut from the two different situations.

Tool 09

Designing and Installing Sampling Frames

Terms used in this Tool: area frame, list frame, quadrat, random, sampling frame,

Introduction

In order to select an unbiased sample from a population it is necessary to identify all elements (members) of the population under study. Otherwise, if an individual is ignored, that member would then have no possible chance of taking part in the survey and so the selection is biased against it.

Why? because (as was seen in Tool 07) during a random selection of a population sample all elements of the population must have an equal chance of selection.

However, frequently ensuring that all elements of a population are present can be troublesome but nonetheless the sampling frames must be as accurate as possible. You will need to develop one or more Sampling Frames which must contain all members of the population under study. To serve their desired functions they should be updated periodically and members added or deleted as necessary.

What is a Sampling Frame?

> "A series of individuals representing the total population; each individual being distinct, clearly defined and exclusive".

This means that for a given population, each individual member must be present and no individual should be present more than once.

Types of Sampling Frame

There are two main types although advanced users have the tendency to modify these and so produce many variations. The two are "List Frame" and "Area Frame". In this Tool we will see how to set up a List Frame based on village households and a (very simple) Area frame based on a farmer's field.

List Frame

This is the simpler of the two frames and, perhaps without realizing it, you are already very familiar with some examples because in reality a telephone directory, a payroll list and an electoral register are all examples of list frames. It is obvious that these frames are frequently out of date or contain errors. Problems often associated with sampling frames.

There can often be frames within frames. For example, Health Authorities use a list frame to list villages in a given zone. Each village then has a list of households in the village and, it is even possible that list frames may exist for all individuals in households as well.

Setting up a List Frame

All projects involved in the introduction of NRM practices will require to develop at the very least a list frame of households at their project site. The process to follow is:

1. identify the population (all households in the project village)
2. assign a unique number to each distinct element in the population
3. update the frame periodically

The frame can then be used during future surveys by selecting the number of samples required (by random sampling: see Tool07). Following the selection of the households, the survey can then take place.

This type of frame of course has innate advantages and disadvantages:

Advantages

- usually easy to set up and use
- relatively inexpensive to produce and use
- once established the frame can be used for a number of different surveys

Disadvantages

- with a potentially large frame it is relatively easy to omit or duplicate members of the population
- the frame can quickly become out of date since the population that it represents may be subject to rapid change (unlikely at the village level)

Area Frame

The area frames that receive the most publicity are complex and cover large geographic areas. For example, a standard map is an area frame in which the population members can be identified by their grid references. Obviously at the local level you will have no need to develop a complex area sampling frame. However, on occasions, simple area sampling frames can be of importance in impact monitoring and so an explanation of how to develop a simple one is provided.

Setting up an Area Frame

Example:

It is well known that leguminous plants help to increase soil fertility in fields since they add useful nitrogen compounds to the soil. Of special importance in the Sahel is the presence of *Acacia* species. Not only do they improve soil fertility but also their leaves and fruits are a valuable source of dry season feed for livestock. At the start of the project a number of fields were noted that had no *Acacia* seedlings. Therefore farmers were asked to leave where ever possible any Acacia seedlings they found. These fields are now to be sampled to determine how many seedlings have become established.

Method:

Measure the perimeter of the selected field (use the tape measure or pace it out) and draw a scale representation on graph paper. Enclose this totally with a second rectangle. Starting from the bottom left corner of the second rectangle, subdivide it into one metre square units. Then assign numbers to the individual 1 m^2. (See Tool 12 for a similar use of a frame). You have now constructed a simple Area Frame where the members of the population are distinct squares of the larger rectangle. Select randomly 10 squares and find their locations on your area frame map. At this stage it would be better to ignore any squares which do not contain a whole metre square of field otherwise the mathematics becomes a little more complex! If this means that you have rejected some of your population, add more randomly selected members to bring the number back up to 10.

Again by measuring or pacing locate each of the selected squares in the field and at each location trace the outline of a box 1 m^2 in the soil. You have now defined your sample unit by using a sampling tool called a "quadrat" to outline the sample unit. Count and note the number of *Acacia* seedlings in each of the 10 samples. From this information you can calculate mean density of *Acacia* seedlings per 1 m^2 and any other valid statistical procedures that allow you to understand your results better (see Module 12 in the M&E Guide and use the different Tools indicated). Repeating the exercise using the same boxes or different ones will provide information on the increase/decrease of the *Acacia* population in the fields at the project village over time.

As with the list frame, the area sampling frame also has a number of advantages and disadvantages. However, most of these relate to frames which are far more complex than the simple ones you will need to develop at project level.

Advantages

- will include 100% of the population and since we are dealing with geographic space as our sampling units, it is difficult to omit a member of the population
- if the frame is well constructed it will need little updating since this type of frame changes little over time (unlike most list frames)
- once constructed the frame can be used to monitor many different NRM practices (eg. crop production, soil fertility, pest numbers, land occupation changes, and so on)

Disadvantages

- building very large frames can be excessively expensive. A recent estimate for developing a frame covering the whole of Niger was for a cost of up to $1,000,000.
- sometimes it is difficult to define boundaries between different units, eg. in our case field boundaries. If this does occur when you are building a frame at village level, try marking the corners with painted stones or blocks.
- must be updated from time to time.

Tool 10

Adoption/Non-Adoption of NRM Techniques: A Method for Statistical Analysis

Terms Used in this Tool: chi-square, control, target village, significance

Introduction and Methodology

The basis for the majority of NRM projects is to persuade local farmers to adopt recognized NRM techniques as the means to improve production, safeguard the village resources base, and make improve uses of natural resources. How can adoption be measured and how can we be sure that a project is being successful in persuading target villages to adopt recommended processes? The answer to the first part of the question is simple. The project can simply count the number of different practices and the number of times each is being used at the start of the project, and at pre-determined intervals thereafter. However, are any changes witnessed real changes or did they arrive by chance? The second question is more difficult to answer. This is because frequently results coming out of surveys (in this case for example, at project start and one year later) seem to give rise to apparent differences that are not actually real or significant, but instead arise as vagaries of the sampling process used.

Fortunately there is a method that we can use to look at data sets and to determine whether changes are really occurring. This requires the collection of information at project start-up and again at pre-determined intervals over time (eg. each year).

Information to Collect from Project Village

Collect the information at the start of the project and at annual intervals thereafter

1. Number of households in the village

2. Number using recognized NRM practices (see Tool 02 for a wide range of techniques)

3. Number of different Techniques being used regularly

4 Numbers of households using each type regularly

This information can be collected during a survey, or if the village is sufficiently small, by census.

Statistical Analysis

Use here the Chi-Square Test of Significance. Tool 15 provides all the necessary information to walk you through the process, and gives examples (concerning adoption of practices) to help you with your own data analysis during impact monitoring.

At the start of the project, in the example concerning adoption/non-adoption in a target village, you would be checking how much local competence in NRM practices already exists. A year later, at the first annual M&E campaign you will collect the same data and we might expect that more households would have started to use NRM methods, and that each household would use more of the available methods being promoted by the project. The chi-square test will tell us whether firstly, more households are starting to use one or more methods; and secondly, whether certain defined methods (such as Zai Holes) are being adopted more readily. All the information you will need will be collected during the annual use of the Questionnaire (Tool 19).

If the project is having a positive impact over time (as everyone would hope), we would expect that adoption of practices by different households to increase. Applying the Chi-Square Test would reveal whether this effect is statistically real (significant). You should adopt the use of the chi-square test in similar situation since purely by looking at differences in figures from one year to the next without statistical analysis can be misleading and lead to erroneous conclusions being reached. Again Tool 15 leads you through simple examples. In the future, after collecting field data of this type, all you will need to do in order to discover the significance of your data is to take the model outlined in Tool 15 and insert your own figures before recalculating the data following the formula presented.

Tool 11

Estimating: Pasture Biomass and Crop Production

Terms Used in this Tool: Biomass, carrying capacity, confidence limits, mean, quadrat, significance, standard error, Student t-test, variance

Introduction

When local villagers are asked to define their most important revenue sources, the vast majority cite livestock-rearing followed by agricultural activities. Furthermore, if the cost replacement value of a household's food that is derived from their own agriculture and livestock efforts is added to actual revenue, it can be determined that crop and livestock production are of overwhelming importance in most village economies.

Thus, although good indicators of annual crop production can be obtained from the type of question "how many bags of millet, maize, tomatoes, etc. did you produce this year?" more quantitative measures would add far more value to the information that projects will put into their annual reports. Unfortunately, accurate measures of crop production are difficult to obtain (discussed below). Similarly, a reasonable indicator of pasture production can be obtained by asking herders the question "are your habitual pastures better/the same/worse than last year?" This will generally give a very good correlation to reality at the end of the rainy season, less good three months later, and little correlation after six months or more. In most years pasture resources run out before the end of the dry season and herders invariably blame the "sécheresse" and do not add that the feed also ran out the previous year. Also they will rarely blame increased herd sizes or livestock densities.

The level of pasture biomass (or standing crop) at the end of the rainy season is an extremely important measure since the quantity present has to be capable of sustaining resident livestock throughout the next approximate 9-month period before pastures regenerate during the following year's rains. Fortunately it is less complicated to measure than crop production.

Livestock specialists have determined that a standard unit of livestock (termed a Tropical Livestock Unit or TLU = 250 Kg live weight) requires to eat approximately 7 Kg dry weight of food per day. Since a good-sized bull weighs about 250 Kg (ie. equates to one TLU) he would need approximately 2 tons of foodstuff during the dry season (7 x 280 days). Given that a good proportion of a pasture's production is unavailable or lost to the herds, for example by: trampling, decay, eaten by insects and other herbivores, is unappetizing to livestock, etc., little more than half of the grass present at the end of the rainy season will end up inside the livestock. Measures of end of rainy season biomass when taken together with the size of resident livestock herds can soon allow an appreciation of whether pasture resources will be overstretched during the upcoming dry season. Such measures determined annually will provide excellent information on whether management practices are having desired results.

Therefore this tool has been conceived to provide real (quantitative) measures of pasture biomass in *selected areas* by the use of a methodology which, with a little practice, is relatively simple to apply. Of course, if the project area contains no rangeland this data cannot be collected. In order to collect measures of crop production almost the same method can be used (see below).

Estimation of Pasture Biomass

The method presented here has been inspired by the one used since 1986 at the Ecological Monitoring Centre (Centre de Suivi Ecologique or CSE), Dakar. While the CSE has used the method to determine pasture production as a tool in the calibration of satellite-based information for the whole of Senegal, the method as used here will provide valid estimations of local rangeland productivity.

Sample Period:

Immediately after the end of the rainy season and no more than 2-weeks after the rains have ended. Choose a dry day and start as early as possible in the morning.

Time required:

Count a whole day in the field for two people although with practice and an early start you can be finished in the field by midday. A total of half-a-day will required after the field work for weighing and calculations.

Materials:

Area of rangeland, 4 straight marker poles (longer than the grass), 20 cloth bags (of approximately standard plastic bag size; never use plastic bags). However, please note that if you are to sample an area which has large amounts of biomass it would be a good idea to take several spare bags, by preference a small sickle (une faucille) or, as second best, medium-sized scissors, 4 one meter-long batons of wood (2 cm x 2 cm) by preference nailed into a square (= a 1 m^2 quadrat[1]), spring balance (1 Kg load), area sampling frame (provided), results sheet (provided), random number tables (optional),

[1] if you decide to construct a quadrat ensure that the inside diameters of the frame are exactly 1 m long.

Method:

1. Select a typical area of rangeland away from the village and which is not bisected by large animal trails or roads. Do not select an atypical area such as a ridge or a depression.

2. Using one of the marker poles, establish a starting point. By the pacing method, walk 20 meters (paces) in a straight line, away from the starting point. Mark this point with a second pole. Going at right angles to the two poles, establish the other two corners of a square and again mark them. Thus you have established your sample area which covers 400 m^2. A diagrammatic representation is provided in this tool.

3. You are going to sample 20 of the possible 400 meter square areas that make up your total sample site. In producing this tool we have taken 20 pairs of numbers (going from 01 to 20) from standard random number tables. These 20 pairs have been used to establish the (random) sites for sampling pasture biomass on the grid. If you prefer to select your own sample sites randomly, there is no restriction.

4. Find each sample in turn by pacing along the bottom boundary until you arrive at the first correct coordinate and then pacing at 90^0 until you arrive at the second. Using this point as a corner, place the four meter long batons to form a square (or better still use a quadrat as indicated above). You have defined your sample.

5. Use the sickle or scissors to clip at ground-level all herbaceous vegetation inside the quadrat (but nothing that is rooted outside) and place the vegetation into one of the sacks. Make sure that you do not put in wood or sand as they weigh heavy relative to herbs and so will ruin your results. Tie the bags with string.

6. Repeat stages 4 and 5 for all twenty samples, and then with a marker pen label them from 1 to 20. Weigh and record the weight of all 20 sacks. When finished take the bags back to the office.

7. Place the tied cloth bags in a sunny place to dry, and weigh and record their weights at daily intervals in the attached Data Results Sheet (Table 2). You will note that the Data Results Sheet allows for a 10-day drying period; you will probably not require so long if the sacks are left in the sun during the day and brought under cover at night. When a sack's weight has been constant for two consecutive days, note its final weight ("a" in the Results Sheet) empty the contents, weigh the empty sack (b), take this weight from that of the full sack (a-b) and thus you will obtain the dry weight (c) in grams of the herbaceous vegetation from a square meter of pasture.

8. We will then measure the mean dry weight (per square meter) and attach confidence intervals (Tool 16 will walk you through the process). You can then calculate by extrapolation the pasture production per hectare.

Value of the data:

Firstly, why use dry weight and not the fresh weight of the plants as they are cut in the field? Actually, a green plant is over 80% water and as it dries out over the course of the dry season this will fall to 10-20%. Therefore, in order to eradicate the degree of "wetness" of the plant from real differences in plant production (as measured by dry weight), it is first necessary to remove as much water as possible; hence drying. Also, in the discussion about livestock daily feed requirements we mentioned the amounts required in Kg of dry weight. By measuring pasture biomass in dry weight units it will be possible for projects to take their investigations further if so required and also to compare year on year changes.

This result, compared with future values from the same pasture, will provide very valuable information on the food availability for livestock in an upcoming dry season and help to avoid over-grazing. Taken over time it will also show whether the productivity of the pastures are improving, and given some data on livestock numbers, an estimate of the carrying capacity of the pasture can be calculated. Of course it must not be forgotten that livestock can obtain a reasonable proportion of their food requirements from "browse" or tree/bush leaves. However, measuring annual tree production is rather complex, and in the dryer regions of the Sahel, tree browse only becomes really important when the pastures have been denuded.

Table 1: Sampling Grid or Frame
For Estimating Pasture Production

Note: The individual 1 m^2 sites for sampling have been found randomly. They are numbered 1-20 withi the grid. The numbers along the bottom of the grid and up the left-hand side are the number of paces c meters that you should go from the starting pole (bottom left corner) to be able to carry out the samplin

20																				
19																18	12			
18																19				
17			09			11											03			
16																				
15																	04			
14																	06			
13									02											
12																				
11																				
10					05															
9																				
8																				
7																10				
6																		14		
5								20												
4																				
3				13								01								
2											16							08	17	
1						07								15						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Meters (paces) from Starting Point ------->

Table 2: Data Results sheet

Sample number	Herbs + sack (gm) during days:										Dry weight herb+sack (gm) weight a	Weight of sack (gm) weight b	Dry weight of herbs alone (gm) (a-b)
	1	2	3	4	5	6	7	8	9	10			
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
Mean dry weight (gm) of herb samples =													gm

Estimating Pasture Biomass and Attaching Confidence Limits

Notes

The data collected is in sample units of "dry weight" (in grams) present on a square meter of pasture. We will continue to use these units to collect the Mean dry weight (Tool 14 provides the theory); Variance (Tool 14) and Confidence Limits (Tool 16). Many people are worried about the use of statistics and particularly that they will not be able to handle the mathematics involved. For this reason, Tools 14 through 17 have been designed to provide a "walk-through" of each technique to be used in the Toolkit. In several of these tools, simple examples are used and all the stages and mathematics involved are demonstrated using the figures provided. If you feel that you cannot calculate the results and statistics from your own field data collection, try working through the examples first. All that will be needed is a simple calculator.

Calculating the Mean Pasture Biomass

The mean or average is a mathematical concept with which everyone should be familiar. It is found by adding all the individual dry weights to provide a total dry weight and then dividing by the number of samples, in this case 20.

Thus dry weight of pasture biomass = *** gm/m^2 (for you to calculate)

Confidence Intervals

The idea of confidence intervals is very important since it will help you to compare this year's results with future years and determine whether there is a real (termed significant) change in pasture biomass over time. Once again you are referred to Tool 14 and 16 for further help. The stages involved in calculating the confidence intervals are as follows:

1. Know the mean weight ($\bar{x}$) of your samples and the sample size (n). In this case we know that you cut and recorded 20 quadrats (so n = 20). The line across the top of the "x" indicates that it is a mean calculated from the x or sample values (dry weights)

2. Calculate the variance (v) by using 2 stages

1. $$\frac{S(x^2) - (Sx)^2}{n} = Y$$

2. $$\frac{Y}{n-1} = \text{Variance } (V_1)$$

Stage 1: has the following steps to arrive at the variance

Step 1: $S(x^2)$ asks you to take each individual dry weight (x) and to square it, and add up all the squares. This can be done using a calculator and adding up in the memory.

Step 2: Calculate $S(x)^2$ which requires you to add up all the dry weights from the 20 samples (this you have done already to calculate the mean) and then to square the total.

Step 3: Divide this number by the size of your sample (n) in this case 20.

Step 4: Subtract the answer from step 3 from that of step one. You have now calculate an intermediate value (we will call it Y).

Stage 2: is simpler. Take Y and divide it by n-1 (ie. 19). You have now calculated the **Sample Variance**

3. Next calculate the value that we call the Standard Error by a simple two stage process.

Stage 1: Divide the variance by n (20) and then

Stage 2: Calculate the "Square Root" of the answer from stage 1 (calculator will do this). You have now calculated the standard error.

4. The intervals of confidence can now be calculated by multiplying the standard error by the relevant value of "Student t" available from the t-tables supplied with the Toolkit. For consistency in the use of the Tables use a 95% level of confidence with, in this case, 19 Degrees of Freedom (n-1). This provides a t-value of approximately 2.0. Multiply the calculated standard error by this value and you have produced the confidence intervals for your mean value. Display the results as follows:

$$\bar{x} \pm \text{ confidence interval (CI)}$$

5. In statistical terms this means that the real mean dry weight of biomass almost certainly lies between the values:

$$\bar{x} + CI \quad \text{and} \quad \bar{x} - CI$$

What does this show?

In future years if your calculations provide an answer with confidence intervals that overlap with the range that you have calculated, you can say with confidence that there is no apparent difference in pasture biomass between the two years. However, if in the second year the range is below that of the first year, then biomass has fallen; and if it is above, biomass has risen.

6. To calculate the pasture biomass per hectare of land simply multiply the mean dry weight per m^2 by 10,000 (there are 10,000 m^2 in one hectare). Just by way of example, if the mean dry weight from 1 m^2 is 300 gm, the biomass per hectare will be 3 tonnes. If you get any value that is not in this order (if not between say 1-5 tonnes per hectare) either you did not dry the plants sufficiently, or you have made an error somewhere in the calculation.

Final Notes

Pasture biomass is very much influenced by the amount of rainfall. Researchers at ILCA/CIPEA in Mali have calculated that in dryer regions of the Sahel, for each mm of rain approximately 1 Kg of dry weight per hectare will be produced (*grosso modo*). However, projects must take much care in using simple biomass data since there is the effect of pasture quality to consider as well. Anyone who goes to an isolated borehole in the rainy season will note a profuse vegetation (the soil is well manured) unfortunately these plants are not often appetizing to livestock. Similarly, in zones of high rainfall, the herbs, especially grasses, tend to be thick and tough and not as nutritive as the finer grass species of the Sahel.

Estimations of Annual Crop Production

Although a similar method to that described above is used to estimate annual crop production, technically, obtaining good estimates is much more complicated. This is because there are enormous variations within agriculture fields that must be taken into consideration. Here we can include the adoption of NRM practices, soil type, seed variety, and so on. The Nigerien Agricultural Services are very well accustomed to carrying out this type of measurement and, if the project desires to measure crop production, they should contact the nearest competent services for advice/assistance.

Methods

Even given the complexity of estimating crop production, a methodology is included here since agriculture is so important in the lives of rural communities and it is the area of natural resource intervention in which many projects operate.

Time of Year

At the time of harvesting

Choice of Site

Obviously permission must be sought from farmers before beginning the sampling process. The example will be developed using fields in which millet is being grown in Zai holes, although you can design a similar sampling process around any field or crop. The method used for measuring pasture biomass could also be applied.

Sampling Details

1. Mark on a piece of paper the pattern of Zai holes in the chosen field. Provide each with a unique reference number starting from 1 and going up to the number of holes present. You have developed a simple Area Frame.

2. Using random number tables, select 20 holes and count and note the number of formed millet spikes present in each hole (use Table 3).

3. Randomly select 10 batches of 10 spikes from the field, remove <u>all</u> grain and weigh the total grain obtained from each batch. Record the weights (use Table 4).

4. Determine the area of the selected field (you can use one or other of the two methods provided below.

Thus you will have recorded the following details (data sheets appear at the end of the exercise):

- the number of Zai holes in the field
- the number of millet spikes in 20 individual Zais holes
- the weight of grain (gm) from batches of 10 millet spikes
- the area of the field (m^2)

Obtaining the Area of a Field

By the pacing method, or using a tape, measure the boundaries of the selected field and calculate its area in square meters. Depending on the field shape, use one of the two suggested methods:

1. If the field is close to being a square or rectangle, you can calculate the area by multiplying field length by width.

2. If it is of a more complex shape you should measure the boundaries and draw the shape to scale on graph paper. Use one small square on the paper to equal a meter (square) on the ground. The area of the field will be equal to the number of small squares enclosed by the boundaries - simply count them. Where a square is cut in two by the boundary, ignore all squares where less than half the square is enclosed but treat all squares where more than half is enclosed as a whole square.

Calculating Grain Production

1. Add up the number of spikes present in the 20 Zai holes and then calculate the mean number of spikes per hole by dividing the total by n (the number of samples = 20).

2. Calculate the total number of spikes in the field by multiplying the mean number of spikes per hole by the total number of holes in the field.

3. Calculate the mean weight of grain from the batches of 10 spikes.

4. Calculate the mean grain production per spike by dividing the mean weight from number 3 (above) by 10.

5. Calculate the total grain production in the field by multiplying the mean grain production per spike (from 4 above) by the total number of spikes in the field (from 2 above).

6. Calculate grain production per hectare by using the following formula:

$$\frac{\text{Total Grain Production (from 5)} \quad \text{x} \quad 10{,}000}{\text{Area of the field } (m^2)}$$

For clarification: 10,000 is used since their are that many square meters in a hectare. The result should be presented as Kg/ha.

Village Production

If you wish to determine the production for the entire village it will be necessary to stratify fields into different categories (see Tool 08) based on the NRM practices used. Estimates of grain production per hectare should then be carried out in sample fields of each stratum. This will prove a long process and should not be undertaken lightly.

Table 3: Results Sheet for Recording Millet Spike Numbers

Location of Field:
Field Owner:
Date of Field Work:

Zai Hole Sample Number	Millet Spikes (Number)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
Total Millet Spikes =	
Mean Number of Spikes/Zai =	

Table 4: Results Sheet for Recording Millet Grain Weights

Location of Field:
Field Owner:
Date of Field Work:

Batch Number (Groups of 10 Spikes)	Grain Weight (gm) (per 10 Spikes)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Total Weight of Grain (gm) =	
Mean Weight (gm)/10 Spikes =	
Mean weight (gm)/Spike =	

Tool 12

Estimation of Young Tree Populations

Terms Used in this Tool: hectare, mean, population, quadrat, sample, variance

Introduction

Indicator 20 (Adoption of Measures Aimed at Improving Natural Forest Regeneration) requires four data sets to provide satisfactory measures of impact. One of these is the presence of young saplings which will form the next generation of trees. It will also serve to indicate to the project/village community whether regeneration is being successful or whether over-grazing or other hazards are preventing forest renewal. In the sampling exercise we will be measuring and recording only small tress with stems between 1 and 5 cm in circumference; measured at a height of 10 cm above the ground. Although the size class to be counted has been selected arbitrarily it should ensure that trees included are established but not very old. The 10 cm height above ground for measuring although also arbitrary will bring consistency to your measuring.

Given that tree regeneration is relatively slow, this exercise should be performed at the start of the project and at 2-year intervals thereafter. The results you produce will prove of exceptional value.

Sample Period:

During the dry season when the grass has died down. This will facilitate location of the saplings.

Estimating the population is relatively straight forward and has much in common with parts of the pasture biomass technique. However, there are a few additional points that should be added.

Time required:

Count a whole day in the field for two people although with practice and an early start you can be finished in the field by midday. Two hours will be required afterwards for data analysis.

Materials:

Area of managed or community forest, 8 marker poles (longer than the grass), a 1-meter tape (tailors tape), area sampling frame (provided), results sheet (provided), random number tables (optional), 10 m of string.

Method:

1. Select a typical area of forest away from the village and which is not bisected by large animal trails or roads. Do not select an atypical area such as a ridge or depression.

2. Using one of the marker poles, establish a starting point. By the pacing method, walk 40 meters (paces) in a straight line, away from the starting point. Mark this point with a second pole. Going at right angles to the two poles, establish the other two corners of a square and again mark them. Thus you have established your sample area which covers 1,600 m^2. A diagrammatic representation is provided in this tool.

3. You are going to sample 20 of the possible 400 sampling units that make up your total sample site. In producing this tool we have taken 20 pairs of numbers (going from 01 to 20) from standard random number tables. These 20 pairs have been used to establish the (random) sites for sampling the young tree population on the grid. If you prefer to select randomly your own sample sites, there is no restriction.

4. Find each sample in turn by pacing along the bottom boundary until you arrive at the first correct coordinate and then pacing at 90^0 until you arrive at the second. Using this point as a corner stick the four, meter long batons into the ground to form a square with sides 2 m long. You have now defined your first sample area (which is 4 m^2). To delimit the sample area with more accuracy, you can tie string from post to post and so outline the edges more accurately.

5. Look at small trees and bushes within the quadrat and count all that have stem circumferences of between 1 and 5 cm. Measure the stems at a height of 10 cm from the ground (this is important). Should you find a tree or bush that has many stems, select the biggest. If its circumference is within the range, count that plant only once. If the fattest stem is bigger, the plant should be ignored. Note the number of trees within the range provided.

6. Repeat the process with the other 19 quadrats and return to the office.

7. We will then calculate the mean number of young trees (per 4 m^2) and attach confidence intervals (Tool 15 walks you through the process in more detail). We will also estimate the number of young trees per hectare.

Table 1: Sampling Grid or Frame
For Estimating Young Tree Populations

Note: The individual 4 m^2 sites for sampling have been found randomly. They are numbered 1-20 within the grid. The numbers along the bottom of the grid and up the left-hand side are the number of paces or meters that you should go from the starting pole (bottom left corner) in order to carry out the sampling

40																				
38																18	12			
36																19				
34			09			11											03			
32																				
30																	04			
28																	06			
26									02											
24																				
22																				
20					05															
18																				
16																				
14																10				
12																		14		
10								20												
8																				
6				13								01								
4											16							08	17	
2						07								15						
0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40

Table 2: **Results Grid for Young Tree Population**

Sample Number	Tree Population/4 m^2	Sample Number	Tree Population/4 m^2
01		11	
02		12	
03		13	
04		14	
05		15	
06		16	
07		17	
08		18	
09		19	
10		20	
Total Tree Population (sum of 20 samples) =			
Mean number/4 M^2 =			

Estimating Tree Population Size and Attaching Confidence Limits

Notes

The data collected has been in sample units of "number of trees" present in 4-square meters of community forest. We will continue to use these units to collect the Mean young tree population (Tool 14 provides the theory); Variance (Tool 14) and Confidence Limits (Tool 16).

Calculating the Mean Young Tree Population

The mean or average is a mathematical concept with which everyone should be familiar. Here it is found by adding all the individual tree densities (populations) to provide a total populations from all the samples and then dividing it by the number of samples; in this case 20.

Thus Young Tree Populations = ??? /4 m^2 (for you to calculate)

Confidence Intervals

The idea of confidence intervals is very important since it will help you to compare this year's results with future years and determine whether there is a real (termed significative) change in tree population at the community forests over time. Once again you are referred to Tool 14 and 16 for further help. The stages involved in calculating the confidence intervals are as follows:

1. Know the mean population size ($\bar{x}$) of your samples (in 4 m^2) and the sample size (n). In this case we know that you recorded trees in 20 quadrats. The line across the top of the "x" indicates that it is a mean calculated from the x values (tree populations)

2. Calculate the variance (v) by using 2 stages

1. $$\frac{S(x^2) - (Sx)^2}{n} = Y$$

2. $$\frac{Y}{n-1} = \text{Variance } (V_1)$$

Stage 1: has the following steps to arrive at the variance

Step 1: $S(x^2)$ asks you to take each sample's tree population (x) and to square it, and add up all the squares. This can be done using a calculator and adding up in the memory.

Step 2: Calculate $S(x)^2$ which requires you to find the total tree populations from the 20 samples (this you have done already to calculate the mean) and then to square the total.

Step 3: Divide this number by the size of your sample (n) in this case 20.

Step 4: Subtract the answer from step 3 from that of step one. You have now calculate an intermediate value (we will call it Y).

Stage 2: is simpler. Take Y and divide it by n-1 (ie. 19). You have now calculated the **Sample Variance.**

3. Calculate the value that we call the Standard Error by a simple two stage process.

Stage 1: Divide the variance by n (20) and then

Stage 2: Determine the "Square Root" of the result (your calculator will do this). You have now calculated the standard error.

4. The intervals of confidence can then be calculated by multiplying the standard error by the relevant value of "Student t" available from the t-tables supplied with the Toolkit. For consistency in the use of the Tables use a 95% level of confidence with 19 Degrees of Freedom (n-1). This provides a t-value of approximately 2.0. Multiply the calculated standard error by this value and you have produced the confidence intervals for your mean value. Display the results as follows:

$$\bar{x} \pm \text{ confidence interval}$$

5. In statistical terms this means that the real mean tree population per unit of 4 m^2 almost certainly lies between the values:

$$\bar{x} + CI \quad \text{and} \quad \bar{x} - CI$$

What does this show?

In future years if your calculations provide an answer with confidence intervals that overlap with the range that you have calculated, you can say with confidence that there is no apparent difference in tree population (therefore no apparent increase in regeneration rate) between the two years. However, if after the second measurement, the range is below that of the first year's, then regeneration rate has fallen; and if it is above, regeneration has risen.

6. Finally, to obtain an estimate for the number of young trees per hectare, multiply the mean value per 4 m^2 (from the bottom of Table 2) by 2,500.
Just in case this step was not clear: 1 ha = 10,000 m^2 since your measures were in units of 4 m^2, you need to multiply by 10,000 and divide by 4; hence 2,500.

Tool 13

Developing Land Occupation Maps and Measuring Soil Fertility

Terms used in this Tool: Land-use, pH, videography,

Introduction

Two very different but extremely important data collections methods are brought together here. The first methodology provides suggestions on how to develop land-use maps for use at project villages. Maps will be required for example in the completion of Indicator 18. The second methodology provides suggestions on how to obtain measures of soil fertility at selected village sites. These will be required for measuring Indicator 19. They share the same tool only because neither requires sufficient space to warrant the development of two distinct tools.

Land Mapping

As a project begins to make an impact on the target village, rapid changes may well occur. Certain of these changes can be described through the data collection processes outlined in various tools. Others may be less easy to define. For example, if NRM practices are introduced that increase crop production and allow the reclamation of abandoned land, will the village be able to allow more land to stay fallow for longer periods? How much village land is dedicated to different usages (community forests, pastures, agricultural fields, fallow, market gardens. habitation)? If cattle corridors are to be installed, where is the best placement and whose fields will they pass by? If a new well is to be installed, where should it be placed to provide the maximum impact? All these questions, and many more, can be addressed if a sufficient information base is developed. A trace map will prove very useful in enabling the project to define a number of different information sets.

There are several ways of producing village maps: from aerial photographs or videography; by a trained cartographer; or by someone on the project itself. All can produce good results. The first method sounds incredibly expensive but did you know that a videography unit has been established in Niger, coordinated by UTA (the Unité Technique d'Appui) of the Department of the Environment? This unit has received the support of several projects and donors, and village based projects may be able to gain mapping assistance.

Also there are aerial photographs available for large sections of the country. The C/GRN will know whether photos exist for the zone where your village is located, and how up to date they are. Even with a relatively old photo it may be found that the basic outlines remain the same and it is only the land-utilization type that has changed.

Alternatively, projects can gain assistance from a cartographer attached to one of the technical services. A good cartographer can produce a land-use map rapidly and accurately. If it is traced onto graph paper (see for example Tool 11 for measuring crop production), the area of different land-use categories can be calculated rapidly.

Finally, an attempt at a valid land-use map could be made by the project using standard pacing (approximately one meter) or better still with a tape measure, to obtain distances, and a compass for direction. Drawing will be much simpler if it is done directly onto graph paper and by scaling (for example 1 small square = 1 meter) it will be easy to calculate the area occupied by each land-use category.

The map should be updated as and when important new events occur such as the installation of a well or the ploughing of fallow. A general update should be carried out every two years or at project end, which ever is the soonest, and changes in area under each land category determined.

Soil Fertility Measures

Indicator 19 requires that the change in fertility of soils be followed at selected village sites. The whole field of soil chemistry and the measure of soil quality and fertility is complex and outside of the scope of village-level impact monitoring. However, even the smallest of projects are able to develop a usable database of soil quality. Firstly, the farmer can provide a sound opinion of the way his soil is changing under varies NRM regimes. His opinion is sought in the questionnaire. Also many farmers will be able to pinpoint certain wild species of plant as being excellent indicators of changing soil conditions, the questionnaire also covers this information. Both methods are of course providing qualitative data. However, it is also possible to obtain quantitative measures of soil fertility by a range of methods. For these the project should seek the help of the competent national services. The Indicator 19 for determining soil fertility suggests that the levels of nitrogen, potassium and phosphorus, three important plant nutrients, be measured, as should the amount of organic matter in the soil. Organic matter is important not only because its decay releases nutrients to the soil but also because its sponge-like structure improves the water-holding capacity of the soil. The pH is a measure of soil acidity and soils which fall within certain pH ranges will have different qualities and problems. Measurement of pH will provide information on the best soil treatments. All measurements are simple for soil laboratories to carry out, and they will not prove highly expensive. It is worth noting that the PGRN is negotiating with soil laboratories to try to fix some standard charge rates. Projects may find it worthwhile to approach the C/GRN for information.

Where finances are very tight, the best test to have carried out is the organic matter content of the soil. If you are to take soil samples into a testing laboratory, get their advise on how to take the samples. Simply shoveling soil and manure into a bag will not be sufficient. It is recommended that you select five sites (fields) for annual monitoring over the life of the project.

Tool 14

Some Basic Statistics for M&E Programs

Terms Used in this Tool: mean, median, mode, variance, population, standard error,

Introduction

Monitoring and Evaluation requires the use from time to time of various statistical terms and key statistical tests. Sadly, technicians are frequently uncomfortable with statistics, and mathematics generally. Unfortunately, they are both necessary evils of M&E and so must be encountered occasionally. In order to carry out the relatively simple statistics required in a small NRM project, the M&E officer does not have to keep all the formulae and definitions in his/her head. Rather he should know which tests to use, when to use them, what sort of data must be collected in the field, how to arrange that data in a logical format, and finally where to find the formulae necessary. The Toolkit has been designed around the belief that more M&E officers will be uncomfortable with statistics than will be comfortable. In this Tool the idea of basic statistics is introduced, some of the more frequently used terms and concepts are explained and some of the common tests introduced. In subsequent Tools the way to use the 2 or 3 more common tests is demonstrated by way of worked examples using fictitious data. When faced with data to analyze it will be necessary for the M&E Officer simply to select the most appropriate test and substitute project figures in to the calculation.

Why Bother with Statistics?

In an indirect way, if you are not bothered with statistics, you should not be bothered with impact monitoring. Just as a reminder, impact monitoring is carried out to determine what effects the project is producing with its activities at the project sites. This information may then be used at a number of levels from the villagers upwards to the donors. If you wish to persuade villagers to adopt new techniques, do not imagine that they will be easily persuaded; they will require to be convinced by the project that the techniques being proposed will provide a positive impact. Perhaps they will not understand any of the statistical tests you will use but they will understand very well that such techniques as demi-lunes can lead to a doubling of grain production. Similarly, the donors will require evidence that an impact is occurring, and the evidence provided will carry much more weight if it is shown to be significantly viable. Just reporting that production appears to be rising will not usually be sufficient, they will require accurate figures such as millet production in the village is up this year by 57 bags, equivalent to an increase of 73% over last year. Getting these figures on paper requires the use of some simple statistics, and the vast majority will not be difficult. Finally, proper use of statistical techniques can lead to important discoveries; for example that a practice being promoted has in fact negligible impact (see the second worked example in Tool 15 for example). Surely it is better to be aware quickly that a practice which may be time consuming and expensive to install is actually having no impact. Now it can be modified, or discontinued and a different one introduced.

What are Statistics?

In their simplest form they are sets of data arranged in a logical manner. For example, listing tree size from the smallest to the largest. Adding a level of complexity we can work out the average tree size, we can subdivide the population into classes based on height, we can determine whether trees grown on two different plots of land differ in their heights, and so forth. Statistics do not need to be difficult.

Statistics are a way of producing information out of data (sets of numbers). They are a way of comparing two or more data sets and then determining whether apparent differences are real. And they are also ways of informing fellow technicians how confident or wary he should be with the data and information in front of him.

The Mean, Mode and Median

Three terms you have certainly encountered many times, although the mean probably the most frequently. They are, all three, measures of the general tendency of a set of figures; they describe in their own way three different measures. Firstly, the mean or average has to be determined mathematically by summing all the measures in a data set to provide the total and then dividing this by the number of observations. The Mode is the most frequent (most often present) number in the data set, while the Median is the middle number in a group of observations arranged in order from the smallest to the largest. However, if there are an even number of observations (and therefore no middle number) you must take the middle two numbers and obtain the average. This number is then the median number.

Worked Example: Data set: 1 3 5 5 5 6 6 7 8 9

1. The Mean: Number of observations = 10;
   Total = 55; Therefore 55/10
   = Mean of 5.5

2. The Mode: The number "5" occurs three times; it is the most frequent number and therefore the Mode

3. The Median: There are an even number of observations and so no direct median. Therefore take the middle two numbers (ie the fifth and sixth numbers) = 5 and 6. Now take their average = 5.5 Thus the median is 5.5

The mean is on most occasions the first statistic to be developed from a set of data obtained from a census or a sample. It is an extremely useful measure although it should be appreciated that it can also hide a lot of information about the data set. Imagine the following situations where we went to two villages to carry out a survey into household wealth and used herd size as a valid indicator. In each place we asked four villagers how many sheep they possessed.

The answers were:

Village 1: 52, 58, 60, 50 sheep. Therefore a mean of 55 sheep

Village 2: 6, 8, 102 and 104 sheep. Therefore a mean of 55 sheep

Conclusion: (at first sight) since the means were the same in both villages, they therefore possessed the same herd sizes and household wealth. However, you can see that a false impression has definitely been given by the mean. In the first village the mean calculated was very near to all the four herd sizes, and so provided us with a good representation of household value. However, in the second village the mean gave absolutely no true indication of household wealth since the data differed (or varied) so considerably from each other. Thus we need a way to determine the degree of variability of data and therefore the accuracy of the mean.

In statistics we have various ways of describing the amount of variation around the mean that exists in a data set. The most frequent, and to which all the others are linked are: the Variance and the Standard Error.

Variance: the variation that exists within a sample and which is expresses in relation to the mean

Standard Error: the square root of the Variance

These two measures are particularly important components of several statistical tests. In the Tool 16 we will look at two related ones: the Student t-Test; and the calculation of Confidence Intervals (sometimes called Confidence Limits). Worked examples are supplied to help with understanding and using them.

Tool 15

The Chi-Square Test: Model Examples To Measure Adoption/Non-adoption of NRM Techniques

Terms Used in this Tool: chi-square, control, target village, significance

Introduction

Situations in which you might reasonably expect to use the Chi-Square Test have been outlined in Tool 10. It was seen that the test can be used to compare two populations in which the information collected is of the yes/no type. Does your household use a certain NRM practice? The answer can only be yes or no. By adding together the responses from a set of sample households or from the whole village (in a census), we arrive at an indication of utilization rate. However, this does not tell us with any certitude whether for example a project village has adopted more NRM practices than a non-project village. Neither does it tell us whether the number of households within the village accepting to use a given practice is increasing with time. The Chi-Square test enables us to take relevant data and to test whether the effects we see are real (significant) or whether they arise purely by chance.

The Chi-Square Test

The test makes use of a structure called a "2 by 2 Contingency Table" in order to arrange data for testing. Fortunately such a table also simplifies the writing of the statistical formula to be used and the "walk through" demonstration of using the test with (manufactured) data.

2x2 Contingency Table

Structure and Cell Labels

Note: below is the typical form of a 2x2 contingency table that is so structured to facilitate the entry of data and the application of the correct formula to that data. The individual boxes (or cells) are labelled with letters so that we can differentiate between them.

	"yes"	"no"	
Included	a	b	a+b
Excluded	c	d	c+d
	a+c	b+d	a+b+c+d (=n)

Using this basic structure we can substitute in our data to the cells marked a through d, and we can modify the column and row headings as necessary. For example the columns can become households adopting practices/not adopting practices; and the rows: project start-up and one year later.

Chi-Square Formula

The letters inside the formula come from the 2x2 table and in using the test we will simply substitute in relevant numbers. By using a calculator we can easily obtain the value for chi-square.

$$\text{Chi-square} = \frac{(ad - bc)^2 \cdot n}{(a+b)(c+d)(a+c)(b+d)}$$

Meaning of the Result

What does a given value for chi-square mean? Simply it measures,the variation present between the different sets of figures that you have entered into the table. If the data entered into the table were all the same, ie. no variation, the result would be = 0.

In order to determine whether the difference between the figures is significant statisticians have developed the so-called "Chi-Square Table". The table contains several hundred entries but fortunately the key value for all your uses is ??3.84??. This value is a limit that must be <u>exceeded</u> before we can say with confidence that a real difference exists between the sets of data. There is a final step after calculation of chi-square and the determination of whether an effect exists. That is to decide whether any impact that has been determined is positive or negative. This step we will encounter later in an example which will make it easier to understand.

Worked Example 1

At the start of a project during the collection of base-line data, a census was held in which all households were asked the same question "do you currently use any of the following practices on a regular basis?". The household representatives were then read a list of recognized NRM practices (as found for example in Tool 02). The results were noted: out of 52 households, 12 households agreed that they did use one or more of the techniques; while the rest (40) said they did not. One year later during the annual M&E campaign, the same question was asked. The replies this time were: 35 households now use one or more techniques, and 21 still do not (total 56 households). Note that there were an additional 4 households established in the village during the first year of the project. Chi-square can absorb changes like this.

Apparently the project has had a positive impact (if it had been negative the numbers would have fallen by the end of the first year) but is the difference statistically significant? Use the chi-square test to determine:

(i) whether the project has had a real (significant) impact in the village during its first year

(ii) if it has had a significant impact, has the impact been positive or negative

Using the 2x2 Contingency Table

	Use NRM Practice(s)	Do not Use NRM Practices	
Project Start	12	40	52
After one year	35	21	56
	47	61	108

If you have difficulty in understanding how the above cells have been filled, check back to the original 2 x 2 contingency table and to the data provided in the first paragraph of Example 1.

Calculating chi-square

By inserting the correct figures in the cells we obtain:

$$\text{Chi-square} = \frac{(12x21 - 40x35)^2 \,.\, 108}{(12+40)(35+21)(12+35)(40+21)}$$

Rather than calculating all these figures in one go, we will take them bit by bit and simplify down the equation.

Thus 12 x 21 = 252; 40 x 35 = 1400; 252 - 1400 = -1148 (minus 1148).

However by squaring a negative number it becomes positive thus $-1148^2 = 1317904$.

This must then be multiplied by 108, = 142333630. This is the top line taken care of.

The bottom line becomes (52)(56)(47)(61). The adjoining brackets mean that the numbers inside should be multiplied.

Thus in turn: 52 x 56 = 2912; 2912 x 47 = 136864; 136864 x 61 = 8348704.

Finally we need to divide the top line by the bottom one:

$$\frac{142{,}333{,}630}{8{,}348{,}704} = \text{Chi-Square} = 17.0$$

The Result

The chi-square value calculated here is 17.0 (to one decimal place) while the value from the chi-square tables that had to be exceeded was 3.84. Given that our calculated value is much greater than 3.84, we can state with enormous confidence that the project has had a large impact during the first year.

However, has the impact been positive or negative? Looking at the results in the 2 x 2 Contingency Table, we can see that the number of household adopting the various practices has increased (from 12 to 35) and the numbers not using these practices has fallen from 40 to 21. Both sets of figures show clearly that the impact has been positive.

Worked Example 2

This example seeks to determine whether a particular NRM practice (the use of Zai holes) is catching on in the village. During the first annual M&E campaign in 1994 (after 12-months of project life) the villagers were asked whether or not they were using Zai holes. The same question was asked one year later during the campaign of 1995. These were the replies:

1994: 23 households using Zai holes; 32 not using them (total 55 households)
1995: 25 households using Zai holes; 31 not using them (total 56 households)

Note: The total number of households had increased from 55 to 56 between the two censuses; the number of households using Zai holes had increased (from 23 to 25); and the numbers not using them had fallen (from 32 to 31). Immediate reaction? The project has had a positive impact, albeit small, on promoting the use of Zai holes in the village. But has it really? We need to use the chi-square test to determine the truth.

Using the 2x2 Contingency Table

	Use Zai Holes	Not Using Zai Holes	
In 1994	23	32	55
In 1995	25	31	56
	48	63	111

Calculating chi-square

By inserting the correct figures in the formula we obtain:

$$\text{Chi-square} = \frac{(23\text{x}31 - 32\text{x}25)^2 \,.\, 111}{(23+32)(25+31)(23+25)(32+31)}$$

Again working through the figures slowly: we will take them in order.

Thus 23 x 31 = 713; 32 x 25 = 800; 713 - 800 = - 87 (minus 87).

$- 87^2 = 7569$. This can then be multiplied by 111, = 840,159.

Thus the answer to the top line is 804,159.

The bottom line becomes (55)(56)(48)(63).

Tool 16

Two Statistical Tests:
Student t-Test and Confidence Intervals

Model Examples to Measure Differences in Sample Means

Terms Used in this Tool: Mean, quantitative (data), significance, variance

Introduction

Tool 14 has already introduced some very basic statistical concepts of the mean, variance and so on. Tool 15 showed the way to use the Chi-Square Test for determining changes in adoption patterns of NRM techniques. The present tool has been developed to help M&E Officers determine whether quantitative field data from two or more sources or years are really different from each other. Two related tests are introduced here (Student T-Test and Confidence Intervals). Both require a little statistical work, but nothing you cannot handle on a small calculator (indeed the worked examples produced below were calculated on a very cheap model).

If you are unfamiliar with the two tests shown, work through the examples to see how the formulae function. They have all been simplified enormously, and a lot of running information has been added, and reminders given, so that inexperienced users do not get lost. If you compare these formulae with standard statistical text books, you will find that the symbols and letters used will not always be the same. This is because the text books use internationally accepted symbols while we have used more common-sense or long-hand methods. However, the result will end up the same!

Student t-Test

Despite much speculation, this test is not for students; it was actually developed by a Mr. Student! It is an excellent method to compare two sets of data and to determine whether these sets are different or not (in statistical terms we can test whether the two sets of data are "significantly" different. The test is based on comparing the means and associated variance of two data sets. You can use this test to compare for example, the number of young trees in a number of samples taken at the community forests in the years 1992 and 1996, or the weight of millet harvested from fields using demi-lunes or not.

Worked Example:

At project start-up in 1992 we determined the number of young trees (1-5 cm circumference) that occurred in 10 randomly positioned quadrats. Each quadrat covered 4 m^2. Immediately after sampling the project village decided to place the forest under its management control, which excluded heavy dry season grazing. The same count was repeated in 1996 after four years of management. We now wish to determine whether the management regime has led to a significant increase in young trees (and therefore regeneration). Results were as follows:

Number of Saplings (1-5 cm circumference) per quadrat (4 m^2)

1992: 5, 8, 3, 2, 4, 5, 6, 2, 2, 7 Total trees = 44; Mean = 4.4

1996: 2, 6, 8, 5, 9, 8, 10, 7, 10, 9 Total trees = 74; Mean = 7.4

At first sight comparing means there were obviously more saplings present in 1996 than in 1992. However, a closer look at the data shows that the lowest number in a quadrat found in 1996 was 2; the same as in 1992. Furthermore, in the majority of quadrats in 1992 there were more trees than in the quadrat with the least in 1996. Therefore we must ask ourselves whether the difference that we observe between the two means is "real" or whether it has occurred purely by chance. To do this we can apply the Student t-Test.

Stages in the Formula:

Stage 1 - Calculate the variances of the two data sets. The variance for each of the two data sets is calculated separately using the following 2-step formula:

Step 1:

$$S(x)^2 - \frac{(Sx)^2}{n} = Y$$

Step 2:

$$\frac{Y}{n-1} = \text{Variance}$$

Before going further we should see what the formula is saying and what the letters mean:

x = the individual numbers in the data set; S = the sum of;
n = the number of samples (here it is 10); Y = an intermediate value;

It will be noted that in order to calculate Y we must determine the two sides of the formula. The left side asks that all the values of x be squared, and then added up. The right side is that all x should be added up (to give the total) and then the total squared before being divided by n (the number of observations). When Y has been calculated it is simple to find the variance by dividing Y by n-1 (= 9 in our case).

Follow the calculations through on a calculator:

Variance of data from 1992:

Step 1:

a). The sum of the squares of individual observations = 236

b). The sum of all observations is 44; this squared is 1936; and then divided by n (10) = 193.6

c). 236 - 193.6 = 42.4 = Y (1992 data)

Step 2:

d). The Variance (1992) = Y divided by n-1 (= 9); 42.4 / 9 = 4.71 = V

Variance of data from 1996:

Step 1:

a). The sum of the squares of individual observations = 594

b). The sum of all observations is 74; this squared is 5476; and then divided by n (10) = 547.6

c). 594 - 547.6 = 46.4 = Y (1996 data)

Step 2:

d). The Variance (1996) = Y divided by n-1 (=9); 46.4 / 9 = 5.16 = V

Stage 2 - Calculate the Variance for all the data combined (ie. 1992 + 1996 data). This is easy if there are the same number of samples in both sets as in our case (10 in each). If this is the case you simply take the mean of the two variances to obtain the variance of all the data, ie. 4.71 + 5.16 = 9.87 divided by 2 = 4.93

However, you may find that there are different numbers of samples and if so you should use the formula:

$$\text{Variance of total data} = \frac{Y(1992) + Y(1996)}{n(1992) + n(1996) - 2}$$

With our data this is:

$$\frac{42.4 + 46.4}{(10+10)-2} = \frac{88.8}{18} = 4.93$$

Stage 3 - Calculate the Standard Error of all the data by using the following formula and then taking the square root of the answer:

(use the V for all data)

$$V\left(\frac{1}{n} + \frac{1}{n}\right)$$

Putting real figures to the formula gives:

$$4.93\left(\frac{1}{10} + \frac{1}{10}\right) = \frac{4.93}{5} = 0.986$$

and it's square root = 0.993 = standard error

Stage 4 - Finally, to calculate "t" we use the following formula:

$$t = \frac{\text{Mean (1996)} - \text{Mean (1992)}}{\text{standard error}}$$

Substituting our figures gives:

$$t = \frac{7.4 - 4.4}{0.993} = 3.02$$

Stage 5 - Leads us to the Student t-tables. These are a set of tables that have been established to determine the significance of differences between data sets. If we look in the tables (a copy is included with the Toolkit). We see across the top is a series of Probability Levels. Use the one headed 95% or p=0.05 (they mean the same thing). Now down the left hand side we have "degrees of freedom". Here we look under n (1992) + n (1996) - 2. or 18 (as we saw above). Check where the selected column and row cross, and note the value it actually equals *.**

The t-test says that if the calculated value (ie. 3.02) exceeds the table value, then the difference that we saw between the two means (from 1992 and 1996) is a real difference. However, if it is less than the table value then we cannot claim that the two data sets are different. Are the two data sets significantly different and has regeneration improved since the forest was put under management?

Additional Uses

There are many situations in which the t-test can be employed but never use it with straight percentages or proportions (see note at the end of this tool). However, you could for example compare pasture production at the end of two rainy seasons; or crop productions at two sites under different management regimes. Equally, crop production figures can be compared by this method. You could use for example, number of millet spikes per square meter, or millet weight in grams per square meter and so on. Again results can be compared between years or between different treatments such as grown in fields with Zai holes and in fields without.

Confidence Intervals

Confidence intervals or limits have a lot in common with the t-test. For each data set we calculate the mean value and, from the variance, is determined the confidence intervals. The intervals are presented as follows:

Mean $\pm$ CL as an example, 6 ± 2

What does this mean? When we take a sample of observations from out of the whole population (as we did in our example of young trees in which 10 quadrats from the whole forest were measured), we are actually trying to estimate from a sample, what the real mean value for the whole population should be. Obviously to count every tree in a forest in order to determine the mean density of trees would be an enormous task. By sampling we cut down the effort but of course lose accuracy because we cannot hope to get an exact measure. Confidence limits tell us how close our sample value has come to the real value for the population as a whole. The smaller the confidence intervals, the more exact we have been. This can be said in another way: with a mean of 6 ± 2, we are confident that the mean of the entire population actually lies somewhere between 4 and 8.

Now if we determine confidence limits for two sets of data that we are comparing and if their confidence limits overlap, we would say that the two sets of data are not significantly different. We can work through an example, using for ease the data on the young tree population provided above.

Worked Example: as above (the data is duplicated here)

Number of Saplings (1-5 cm circumference) per quadrat (4 m^2)

1992: 5, 8, 3, 2, 4, 5, 6, 2, 2, 7 Total trees = 44; Mean = 4.4

1996: 2, 6, 8, 5, 9, 8, 10, 7, 10, 9 Total trees = 74; Mean = 7.4

Stages in the Formula to Determine Confidence Intervals:

Stage 1: Taking one data set at a time, calculate the variance (see above stage 1; steps 1 and 2)

we know that these are:

1992 = 4.71
1996 = 5.16

Stage 2: Calculate the standard error of each. Remember that this is obtained by two steps:

Step 1: divide the variance by the number of samples (10) and
Step 2: take the square root of the result

Thus standard error is:

1992: = 0.686
1996: = 0.718

Stage 3: Look in the t-tables. Take the column headed p=0.05 or 95%; and the row for Degrees of Freedom = (n-1) = 9 in our case. The value found will be *.**. The value for the confidence limits is found by:

standard error x t-value

and thus:

1992 = 0.686 x *.**
1996 = 0.718 x *.**

Now finally, if we attached the confidence limits to the means we obtain

1992 = 4.4 ± which gives a mean value for the population of between *.** and *.**
1996 = 7.4 ± which gives a mean value for the population of between *.** and *.**

Therefore by calculating the confidence intervals we must say that .....

Relative Size of Mean and Confidence Intervels

Another important point to be made is the relative size of the confidence interval to the mean. Thus taking two values of

10 ± 2 and 100 ± 2

the CI for 10 is equal to 20% of the mean, while for 100 it is only 2%.

Value of the Two Statistical Tests

If you have only two data sets to compare you should use the T-test, it is more sensitive to detecting differences than confidence limits. However, if you have more than two data sets, use confidence intervals. Do not be tempted, for example if you have four sets of data to compare, to try the T-test between pairs of data. With four sets you would have to use the test 6 times and this brings in a statistical complexity that would tend to negate your findings.

Final Note:

Do try out the T-test and Confidence Intervals with your quantitative data sets, they are well recognized techniques, sensitive to differences, and easy to use. However, do not use with data that is in the form of percentages; the tests, for very good statistical reasons cannot unfortunately handle them in that condition. There are techniques called "transformations" (eg. the arc-sine transformation) that can be used to convert percentages into a state to which the t-test and confidence intervals can be applied. However, discussion of the methodology falls

outside the level of the Toolkit. If you are interested in taking the subject further, most standard statistics books provide a description of how to transform data as well as providing tables for doing so.

Tool 17

Organizing and Analyzing Results

Terms used in this Tool: Correlation, frequency, variable

Introduction

Following the field collection of impact monitoring data and their statistical analysis, the hardest part of the process has ben completed. However, two critical stages still remain: extracting and displaying information from the raw data; and drawing valid conclusions in order to write the different M&E reports that are required. The first stage is treated in this tool and the second and final part in Tool 23.

Organizing and analyzing results involves a series of processes which are introduced here in a step-by-step fashion.

Immediately after Field Data Collection

This is a critical stage since it is a time that data sheets may frequently be lost. It is a time for centralized of data and the first opportunity that the M&E Officer and other senior project officials will have to view the collected data sheets. The processes to follow are:

Broad Data Analysis

Several stages are relevant here including: data manipulation, descriptive data analysis and statistical data analysis.

1. Data manipulation

Centralization of Field Data

This stage begins immediately the field campaign ends and starts with the physical centralization of data and data sheets. It continues into the revision and edition of data (as may be necessary), the control of data quality, and the elimination of any obvious mistakes/fabrications. Many of the points raised in this section will sound so obvious and basic that it may be thought almost insulting to raise them in a document such as this. Our excuses to any one who believes this to be so. However, why do so many M&E campaigns go wrong? Quite a few because of silly confusion in routine procedures, and clumsiness of key personnel.

Projects for whom the M&E campaign spreads over an extended period (mostly large projects covering many communities) should attempt to centralize field data as the campaign proceeds; and at the latest the day after data collection. This will permit for example, answers from the batch of questionnaires to be transcribed on to the Questionnaire Results Grid (Tool 21), a process which will facilitate later data treatment. Do not allow completed questionnaires and data collection sheets to remain uncentralized for extended periods otherwise pages will go astray and you will end up with an incomplete data set. This may not sound too critical since a farmer could always be revisited but supposing the data lost was from the crop production or pasture biomass campaign? Here projects have only a very reduced window of time to carry out their data collection. Once that window has closed, you would be obliged to wait until the following year, and so would have a hole in the project data set.

Who should be responsible for collecting data sheets and completed questionnaires and ensuring their centralization? The naming of the agents responsible is something that should be carried out before the campaign starts (see activities calendars - Tool 05), and all field enquêteur should know the identity of the individual to whom they should turn-over their results. He in turn should check carefully that he has received the full batch of data sheets, questionnaires, etc., that they have been properly completed and that they carry the correct identification (such as enquêteur name, village, farmer interviewed, date, and so on).

Care should also be taken in transporting the data sheets back from the field to the office. Ensure that they are delivered to the right person (who is this to be?) and ensure as well that they are not left lying on the secretaries desk where sheets may be lost, scribbled on, or have coffee spilt on. We will hope that the sheets have arrived without mishap in the bureau of the M&E officer.

Preparation and Manipulation of Data

These related tasks should be performed by the M&E Officer immediately he/she has received the field data. The processes involved are to check that all data sheets have been centralized and that there are no outstanding results to arrive. If there are, the field assistant responsible for handling the data sheets should explain the omission (remember that he was supposed to have controlled the receipt of field sheets before bringing them to the office). If need be he will have to go back to the enquêteur for further information. What if data has been lost? We will deal with this later.

The second stage here is to control the data for obvious errors where a lack of concentration have led to an enquêteur writing (usually) a number which does not tally with the rest of the data set. Usual he will be able to provide the correct figure from memory. If not there are some alternative actions (again to be dealt with in a moment. Far more problematic and distressing is the situation where an enquêteur has fabricated results. To find out whether results have been fabricated you must be prepared to do some random spot checks. Try speaking to the village chief to find whether the agent was at the village on the days claimed; casually ask one or two of the farmers that were supposed to have been interviewed. Also look for strange coincidences on the results sheet. If all measures end in a 0, or if a certain other number crops up with particular frequency then you should begin to get suspicious. Finally, if at the end of calculating data you find that results are far away from

that expected you may have reason to be suspicious.

Why do people cheat? This may occur because the agent was not properly briefed on the work to be performed, or it may have been because the day was too hot to go out and count trees, or simply because the agent could not be bothered to do the work and did not care much about the M&E campaign. If the first is the case, the project should look firmly at its own pre-campaign organization and ask why the agent did not know. What line of discipline will be taken should be according to project policy. However, if the agent had received a field allowance for the work (which was not performed), the allowance should be recovered.

Much more serious to the project's well-being is where data is fabricated through laziness. Should such an agent who is happy to receive a salary for work that he has no intention of doing remain employed by the project? Probably in such a situation the project would be wise to make an example by dismissing the agent. This may be harsh on him but it should prevent such cheating occurring in the future. Whatever reasons an agent might have for producing fabricated data, the reality is that the project is now lacking the required data sets. If this should be responses to questionnaires, the information can be gathered from the sample. If it is figures crop production or pasture biomass, attempt to see whether the information can still be collected. If it can, make a note in the M&E Report to describe any changes in data collection that had been necessary. If the data can be replaced you will have to attempt to fill the gap with some qualitative information.

Missing Data

These are always a problem for a project and care must be taken in your response to the problem. Imagine a set of numbers which should read:

2 4 6 8 10

while you receive from the field the list:

2 _ 6 8 10

What should you do? Really you have several options with the gap: replace it with the number before it in the sequence (2), with the number after it in the sequence (6), with a zero (0), with the most obvious number (4), or ignore it and keep just 4 replicates rather than 5.

With as clear a sequence as this, there is little argument that a 4 would be the best one to use. However, usually field data does not keep in such neat patterns. Where you really cannot see the identity of the missing number, it is better to omit it altogether and use a sample of 4 rather than the anticipated five.

Data Reception Sheets

These are convenient ways of stocking data and a number of results sheets and grids have been included in the Toolkit. They are convenient because they allow all data from a question or field measure to be viewed at once and they require far less space than keeping all the individual field sheets together. Also when carrying out descriptive or statistical analysis, the tasks is simplified by having all data in a set together on the same page. Of course it is far easier to stock figures such as number of NRM practices being used by farmers than it is to stock sentences of the farmers opinion on the efficiency of the different practices that he uses.

Data Inclusion

During the transfer of data from field sheets/questionnaires to the data summary sheets provides an ideal time to recheck the validity of results and answers. Do not be afraid to call into doubt the validity of figures and statements that you are seeing. Do not forget the M&E Officer is responsible in the eyes of his Director to ensure that the M&E Reports are as accurate as is possible.

2. Descriptive analysis of data

Descriptive or exploratory analysis of results involves the appreciation of the overall data set (a first perfunctory look) and the use of relevant processes. This stage follows on immediately after the manipulation of field data and the controls for errors and fabrications

Objectives

This is a key stage in M&E and is really the beginning of the critical analysis of data. It is a time when all data sets can be seen together and allows an overview of the campaigns results. It is also the moment to begin to use the other tools in the Toolkit that are relevant, in order to begin to detect trends and relationships. Thus this stage allows an overall appreciation of the key elements of the data sets and also to begin starts to bring out any major problems of project impact. Unlike using statistics to analyze results, descriptive analysis does not contain a set of rules or a standard sequence to be followed. However, useful tools to use are visual ones such as tables and graphs (lines, histograms, pie charts). Remember that you are trying to bring out trends in the data, their overall structures, as well as relationships between and within data sets. This stage also is one of preparation for the use of statistical tests. Note: frequently it is not clear when the descriptive analysis ends and statistical analysis begins. In this document it has been decided that wherever any mathematical applications are applied to the data analysis, this will be treated under statistical analysis. Thus descriptive analysis will be reserved for visual displays of data and data sorting techniques.

Some Techniques to Use

1. Classify the data in order so as to give an idea of trends and the distribution of data collected

2. Representation of data in graphical form such as Bar Charts of the adoption of NRM practices amongst different households in a village

3. Representations where there is a single variable under inspection eg. household credit; or where there are two or more variables being considered together such as the yield of millet between use or non-use of zai holes and between years

4. the graphic representation of cumulative measures over a village

On the accompanying page, a few examples of graph types are presented which may help projects in illustrating their reports with good visual tools.

3. Statistical analysis of data

Following on from the descriptive analysis of results, this stage seeks both to test the pre-campaign hypotheses of project impact and to determine the degree of significance of the data sets collected. In this section of the tool we will review the most common statistical tools and see in which circumstances they should be used. However, details of methods of use and worked examples are covered elsewhere in this document and you should therefore refer to the relevant tool. Since each data set will probably require a different approach in order to bring out its full compliment of information, it will not be possible here to develop a plan that projects can follow as they work through their data. However, several general treatments of data are suggested, and Tools 06 through 16 cover the analysis of almost all data types that you are likely to collect during the M&E of an NRM project.

Measures of the Central Tendency of Data

- calculate the mean, median and mode (Tool 14)
- calculate the dispersion of data around the mean (variance, standard error, etc.)

Transformation of Data

- to percentages or to frequencies
- logarithmic transformations (often to produce straight line graphs from curves)
- development of normal distributions (eg. by arc-sine transformations)

Tests of Differences between Data Sets

- for example looking for differences between the yield of maize from fields treated with or without fertilizer. We can use:

    - Student t-test
    - calculate confidence intervals

Detecting Links between Data Sets

- correlation/regression (relationships between two or more variables). The links can be of two types:

    - negative: one variable becomes reduced as the other increases and vica versa. Therefore they have an inverse relationship. Eg. the percentage of children vaccinated and the incidence of a contagious disease
    - positive: the increase of one variable is associated with the increase of the other; and vice versa (therefore they increase and decrease together. Eg. rainfall and biomass production, income and life expectancy

These relationships can be easily shown using a graphical representation, a so-called regression line. Examples of a positive and a negative correlation are provided on the next pages.

- Testing for association between two variables

    - use the Chi square Test

Graphical Representations

Some Simple Examples

The next three pages carry simple examples of graphs that can be used to illustrate project results. They are in order

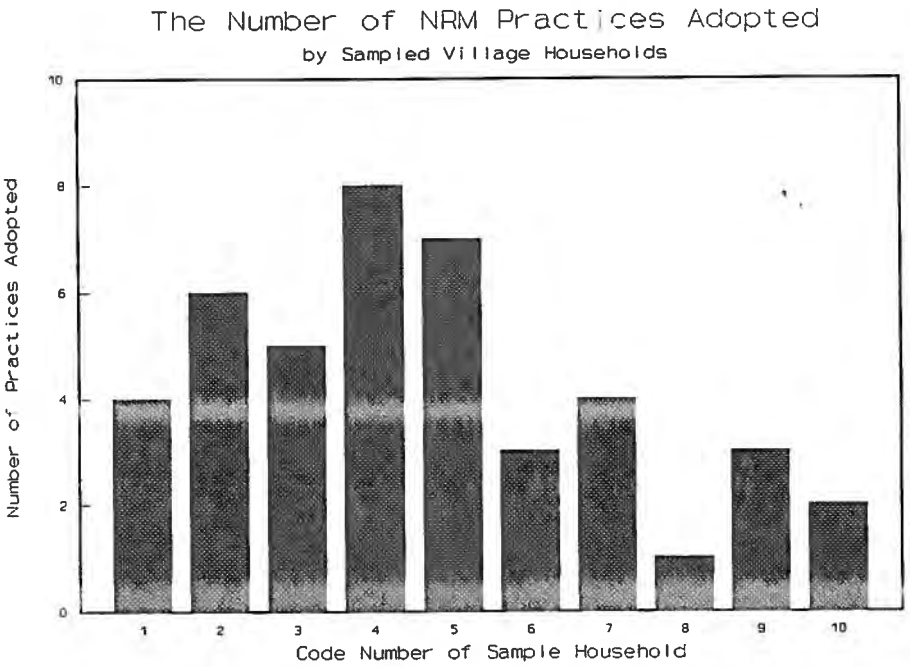
- a simple Bar Chart showing the different adoption level of NRM practices by farmers within the project village. Your project will certainly be able to produce a graph such as this from data collected in the questionnaire.

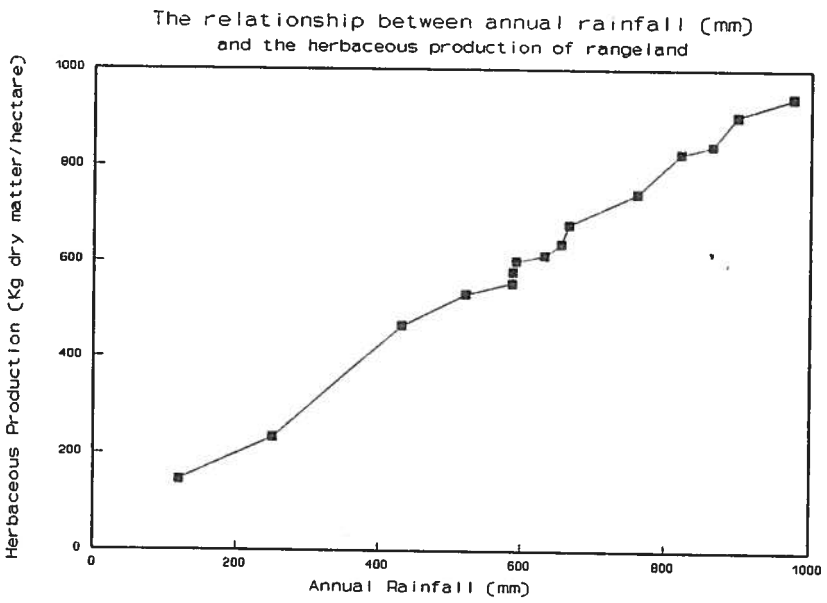
- the second graph provides an example of a positive relationship between two variables (rainfall and herbaceous vegetation production). It can be seen that as rainfall goes up so does the production.

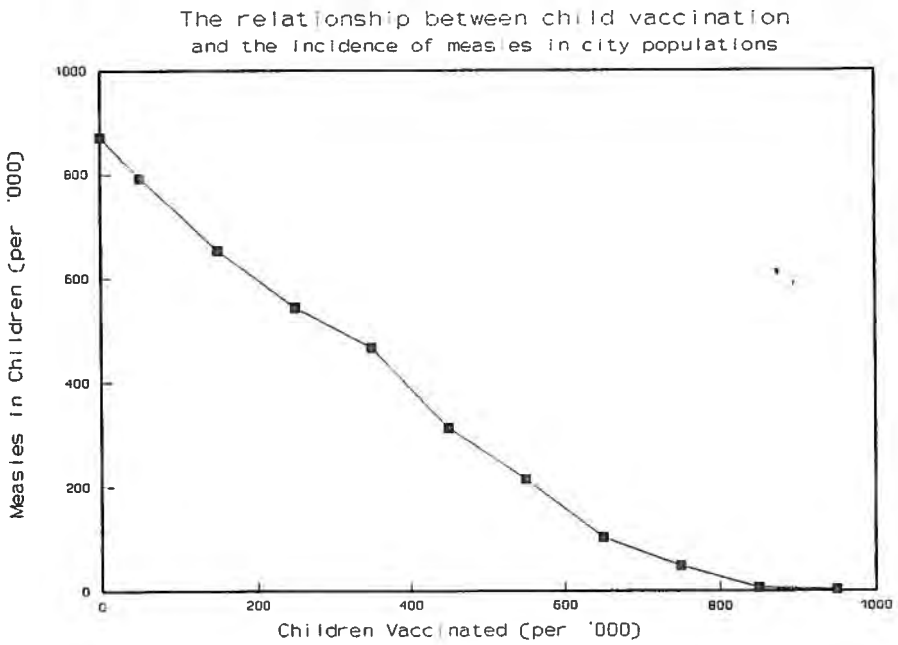
- the third graph provides an example of a negative relationship between two variables (incidence of measles and vaccination levels). It can be seen that as more children in city populations are vaccinated against measles so the incidence of the disease falls.

Notes: 1. These results were fabricated to provide the graphs illustrated. They do not represent actual results.

2. For those people with access to a computer, the graphs reproduced here were developed using Lotus 123. The files were saved as .cgm files, and then imported into Word Perfect (5.1). After modifying such components as graph size, page positions, and deletion of graph frames, the modified files were inserted into this Word Perfect text.


The Number of NRM Practices Adopted
by Sampled Village Households
Number of Practices Adopted
0
2
4
6
8
10
1
2
3
4
5
6
7
8
9
10
Code Number of Sample Household


The relationship between annual rainfall (mm)
and the herbaceous production of rangeland
Herbaceous Production (Kg dry matter/hectare)
1000
800
600
400
200
0
0
200
400
600
800
1000
Annual Rainfall (mm)


The relationship between child vaccination
and the incidence of measles in city populations
Measles in Children (per '000)
1000
800
600
400
200
0
0
200
400
600
800
1000
Children Vaccinated (per '000)

Tool 18

The Use and Timing of Questionnaires and Interviews plus Keeping a "Cahier de Projet"

Introduction

Questionnaires and interviews are tools that allow a considerable amount of quantitative and qualitative information to be collected rapidly and comprehensively. However, it is unlikely that they can provide all the information that is needed to monitor project impact. In this plan there is the need to use other measuring and defining techniques to obtain a compliment of information. However, it is fair to say that approximately 75% of future information requirements can be obtained using one or other of these methods.

In this Toolkit, a Questionnaire (Tool 19) is taken as being a structured series of questions that is to be presented to a sample of villagers and will enable the collection of both qualitative and quantitative information on project impact and progress towards achieving the main objectives of most (all?) NRM interventions. Individuals in the sample will provide information based on their personal experience; be it the number of seedlings that they have produced to plant as windbreaks around their fields or the use of a range of recognized NRM practices as a way of increasing crop production. They may also indicate how they feel their soil fertility is changing under given NRM practices, and so forth.

An interview (Tool 20), on the other hand, is a type of questionnaire that is aimed at a single, responsible individual (or collective group) and in which the questions should only have a single possible result. For example, how many recognized livestock corridors does the village possess or how many village organizations operate? Since these figures should not vary at a single point in time there is no need to put such questions into the full Questionnaire and collect the same answer from a number of different individuals.

"Cahier de Projet"

It is important that the Project Director and the M&E Officer keep a project notebook in which they must note interesting events as they occur which may have a bearing on the monitoring of project impact. Of special note here is the recording of requests for project assistance coming from non-project villages. Remember that this is required to measure Indicator 6. Perhaps the **most important indicator** of all those in the general framework list.

Furthermore you must enable the local community organizing committee to set up a notebook for recording relevant data needed by the project for impact monitoring. Tool 22 deals with this more fully.

Frequency of Data Collection

It is crucial to realies that two very different groupings of information must be obtained in order that a viable impact monitoring program can be installed and developed. Firstly, at or soon after, project start-up there must be the collection of a set of base data which will provide measures of reality at time = 0 against which all future progress/impact will be compared. Without such data, impact monitoring will be realize difficult. Secondly, there will need to be the collection of data sets throughout (and indeed after) the life of the project. The question "when should M&E be performed?" is frequently asked and there is no single answer. In effect impact monitoring occurs all year round although there are bursts of activity at pre-defined times. Thus if we are seeking to estimate millet production, logically the information will be collected during only one limited period of the year (at harvest). On the other hand if we wish to monitor the balance of household revenue against expenditure, data should be collected relatively regularly in order to increase accuracy.

The Questionnaire and the Interview Sheet have been designed so as to provide all the questions that will need to be asked at any stage throughout the entire M&E life of the project. This method of producing "global" questionnaires has been adopted rather than the alternative of having a number of slightly different questionnaires in the Toolkit. In order to help the project officer to know when to collect different types of information, a time-table has been established. This is in tabular form (see attached) and lists the questions numbers as they appear in the Questionnaire and the Interview Sheet as well as providing the frequency, and where relevant the timing, for information collection. It is assumed that in preparation for a questionnaire campaign, the M&E Officer will simply note on the questionnaire which of the questions should be asked on that occasion.

Table 1: Questionnaire Time-Table

Question numbers are the same as those listed in the comprehensive Questionnaire (Tool 19). The presence of *** indicates the frequency of information collection. Obviously if a data set is to be collected every three months it will be collected automatically during the annual data collection.

Question Number	At Project Start-up	3-Monthly	Annually	Notes
Q1	***	***		
Q2	***	***		
Q3	***	***		
Q4	***	***		
Q5	***	***		
Q6	***		***	
Q7	***		***	
Q8	***		***	to collect at end of harvest
Q9	***	***		
Q10	***		***	
Q11	***		***	
Q12	***		***	
Q13	***		***	
Q14	***		***	
Q15	***	***		
Q16	***		***	
Q17	***		***	
Q18	***		***	
Q19	***		***	
Q20	***		***	The answer to this question will probably not change much over time
Q21	***		***	
Q22	***		***	
Q23	***		***	
Q24	***		***	

Table 1: Questionnaire Time-Table

Continued...

Question Number	At Project Start-up	3-Monthly	Annually	Notes
Q25	***		***	
Q26	***		***	The answer to this question will probably not change much over time
Q27	***		***	
Q28	***		***	
Q29	***		***	Women only question

Table 2: Interview Sheet Time-Table

Question numbers are the same as those listed in the Interview Sheet (Tool 20). The presence of *** indicates the frequency of information collection. Obviously if a data set is to be collected every three months it will be collected automatically during the annual monitoring campaign.

Question Number	At Project Start-up	3-Monthly	Annually	Notes
Q1	***		***	
Q2	***		***	
Q3	***		***	
Q4	***		***	
Q5	***		***	
Q6	***		***	
Q7	***	***		
Q8	***	***		
Q9	***		***	
Q10	***		***	
Q11	***		***	
Q12	***	***		This questions is to be asked only when the village has a community-based forestry program. If the committee keeps good records of wood extraction, the survey can be conducted annually
Q13	***		***	
Q14	***		***	

Tool 19

Questionnaire: Estimating NRM Impacts

Project Name/Code:
Village:
Name of Interviewee:
Occupation:

Name of Enquêteur:
Date:
Age/Sex:
Size of Household:

Objective 1/Indicator 1:

Households with members of Community Organizations:

Q1. Are you or someone in your household members of a community organization?

Yes / No (circle the reply)

Number and Details:

Q2. Have these organizations established rules controlling the use of the villages natural resources?

Yes / No (circle the reply)

Details:

Q3. Have these organizations established a set of penalties/fines for punishing rule breakers?

Yes / No (circle the reply)

Do not collect details here (Note 1)

Q4. Do you think that the population respects the regulations?

Great deal / little / No (circle the reply)

Details:

Q5. Does the population pay the fines?

Yes / No (circle the reply)

Objective 3/Indicator 3:

Land-Use Conflicts: (Note 2)

Q6. Has a member of your household been involved in a land conflict during the past 12-months?

Yes / No (circle the reply)

Details:

Q7. Was it resolved satisfactorily?

Yes / No (circle the reply)

Details:

Objective 2/Indicator 8:

Q8. Can you provide an estimate of your agricultural production during the season that has just ended? (Note 3)

Millet:
Others (provide details)

Objective 2/Indicator 9:

Livestock: Herd Size and Species Composition

Q9. How many head of livestock does your household own?

Cattle	_____	Dromedaries	_____
Sheep	_____	Goats	_____
Donkeys	_____	Horses	_____
Chicken	_____	Others	_____

State whether these figures were exact of estimates _____

Objective 2/Indicator 11:

Sources of Household Income (Note 4)

Q10. From which sources did your household income derive during the last 12 months?

1.
2.
3.
4.
others

Q11. During the last year did the income of your household exceed that of the 12 months before? (Note 5)

Yes / No (circle the reply)

Q12. Have you received credit this year?

Yes / No (circle the reply)

Details:

Q13. Have you provided credit this year?

Yes / No (circle the reply)

Details:

Objective 2/Indicator 12:

Migration of Family Members:

Q14. During the past year has one or more members of your household travelled away from the village to work?

Yes / No (circle the reply)

Details:

Objective 2/Indicator 13:

Financial Affairs outside of the Village:

Q15. Have you sold or exchanged your products coming from NRM practices to clients from outside of the village?

Yes / No (circle the reply)

If yes, which type of products and give an approximate value:

Objective 2/Indicator 16:

Ownership of Wagons and the use of Animal Traction:

Q16. Do you own an animal-drawn wagon? (Note 6)

Yes / No (circle the reply)

Numbers and details:

Q17. Do you use animal traction for any other reasons (for example: ploughs)

Yes / No (circle the reply)

Numbers and details:

Objective 1/Indicator 17:

Households adopting Recognized NRM Practices:

Q18. *See list 1 attached and mark the relevant boxes.* Do you use one or more of the following NRM practices for improving the fertility of soil and the water-holding capacity of the soil (note 7)

Objective 1/Indicator 19:

Farmers Evaluate of their Soil's Fertility:

Q19. Has the fertility of the soil in your fields changed after you began to use NRM practices?

It is improving rapidly/slowly/not changed/diminished slowly/rapidly

(circle the reply)

Q20. Can you recognize certain wild species which serve to indicate that the fertility of your soil is changing?

Local Name(s):

Latin Name(s): (if available)

For each species mention which situation they indicate (note 8).

Objective 1/Indicator 20:

Households Adopting Recognized NRM Practices:

Q21. *Refer to List 2 (attached) and mark the relevant boxes.* Do you use one or more of the following NRM practices recognized to improve the natural regeneration of forests and the management of forest resources? (Note 7)

Objective 1/Indicator 21:

Area of Land Reforested

Q22. Have you or someone else in your household collected seeds or produced plants to be used in reforestation/replanting? (note 9)

Yes / No (circle the reply)

Q23. Give an estimate of the area reforested by your family during the past 12 months

None / 0.25 ha 0.5 ha 1.0 ha 2.0 ha >2.0 ha (circle the nearest reply)

Use the following space to write any relevant information (note 9)

Q24. How much of the land reforested by your household has been successful? (note 10)

Objective 1/Indicator 22:

Evaluation of Pasture Quality:

Q25. Has the quality of your pastures changed in comparison with previous years?

Improving rapidly/slowly/no change/declining slowly/rapidly

(circle the reply)

Why?

Q26. Are there are pasture species that indicate to you that the quality of the pastures is changing?

Local Names:

Latin Names:

Provide information on which conditions each species are indicating (note 8).

Objective 1/Indicator 24:

Households Adopting Recognized NRM Practices:

Q27. *Refer to List 3 attached and mark the relevant boxes.* Do you use one or more of the following practices recognized to promote more efficient use of surface water?

Q28. Are they Efficient? (Note 7).
Use the following space to develop their ideas of the efficiency of each technique

Question only for Women
(Note 11)

Project Name/Code:
Village:
Interviewee's Name:
Occupation(s):

Enquêteur Name:
Date:
Age/Sex:
Household Size:

Objective 2/Indicator 14:

Time Spent on Different Activities:

Q29. Estimate the average time you spend each day on your different chores:

Chore	Time Spent
1.	
2.	
3.	
4.	
5.	
6.	

Total =

(Make sure that the total of hours is reasonable!)

List 1: NRM Practices which Aim to Enhance Soil Fertility and Moisture-Holding Capacity

For use with Question 18: Use the numbered spaces to record the answers for each of your questionnaires

NRM Technique	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Protect Natural Regeneration															
Improved Pruning and Spacing of Trees in Fields/Plantations															
Use of organic Matter in Fields															
Composting															
Use of Manure															
Zai Holes															
Small-scale Check Dams															
Demi-Lunes															
Mulching															
Leaving Plant Residue in Fields															
Dune Stabilization															
Rock Bunds															
Buy Cart for Manure Transport															
Tranchées															
Diguettes															
Cordon de Pierres															
Gabions															
Others															

List 2: NRM Practices which Aim to Enhance Forest Regeneration and Increased Wood Production

For use with Question 21: Use the numbered spaces to record the answers for each of your questionnaires

NRM Technique	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Protect Natural Regeneration															
Protection from Grazing															
Use Improved Cooking Stove															
Banquettes															
Demi-lunes															
Digues Filtrant															
Small-scale Check Dams															
Cordon de Pierres															
Defrichement Amelioré															
Others															

List 3: NRM Practices which Aim to Enhance Water Usage/Reduce Water Erosion

For use with Question 27: Use the numbered spaces to record the answers for each of your questionnaires

NRM Technique	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Banquettes															
Tranchées															
Fossés															
Epis															
Talutage des Berges															
Zai Holes															
Gabions															
Demi-Lunes															
Barrage en Pierre Sèches															
Digue de Protection des Berges															
Seuil Longitudinal															
Cordon de Pierres															
Perrés															
Tranchées															
Diguettes															
Others															

Tool 19a

ASDG II Monitoring & Evaluation Questionnaire
Notes to Accompanying the Questionnaire

Introduction

Much data required by NR projects can be collected in the convenient manner of recording responses from a selection of farmers during the use of a questionnaire. We calculate that this one questionnaire developed in Tool 19 will in effect allow approximately 70 % of indicators to be measured. Thus questionnaires are highly useful tools. This does not make them simple to conceive. At is fair to say that we have spent more time on developing the questionnaire than any other part of the Toolkit; and we received far more feedback. Questionnaire are not simple to produce because they have to be usable by project field assistant who will have to translate them into the local languages. Thus if questions are ambiguous in English or French, they will be doubly so when translated into one or other of the village languages. We took the prototype of the questionnaire to the field for testing, and requested two M&E officers to carry out the questionnaire without any assistance from us. The first time through, many problem areas were located and corrected; mostly due to questions being too complicated or offering too much information to the interviewee. After detailed correction, our M&E officers found the questionnaire easy to use and that it generated the type of information necessary to measure their relevant indicators.

Relevance of the Questionnaire to Different Projects

The Questionnaire has been developed to provide a logical progression of data collection for each of the three NRM Objectives. The information that may be gleaned from a completed questionnaire, when complimented by the other data collection techniques offered by the Toolkit, should provide all that is required to measure project progress towards achieving the stated objectives and allow a complete response to project M&E requirements.

However, it is quite obvious that not all community based projects will have the full spectrum of activities that the Questionnaire and the other M&E tools are seeking to measure. For example, a project interested only in improving the availability of water to a village might have little interest in determining project impact on soil fertility or change in vegetation cover. If this is the case, the officer responsible for M&E at project level should cross off those sections of the Questionnaire that he/she is sure have no relevance to the project. Extreme care must be exercised in undertaking this action since project activities can frequently have extensive knock-on effects that may not initially have been considered relevant. Taking the example of enhanced water access further, what could be some of the possible knock-on effects? An increased resident population, larger herds, development of small scale market gardens, etc. With such outcomes the project impact will start to effect other components of the village's resource base such as vegetation cover, availability of firewood, soil fertility and water-holding capacity, as well as increasing demand for basic services, transport, etc.

Similarly, projects lacking a pasture or community forest component can ignore the questions based on those indicators. By looking at the general framework in Tool 01 and cross-checking with the different sections of the questionnaire, it will be a relatively simple manner to exclude questions that are irrelevant to your particular project.

The contents of the Questionnaire are to be determined on regular intervals. A time frequency for determining the answers to the different questions is proposed in a set of tables within Tool 18 (**The Use and Timing of Questionnaires and Interviews**):

- All questions should be asked at the start of the project. This is essential in order to provide a complete set of base data against which we will compare future results.
- Several questions are to be repeated at three-month intervals after the start-up of the project. This information is frequently of the sort that the farmer may forget if you allow longer intervals between questionnaires.
- Many questions are to be determined on an annual basis, recommended to be at the end of December/beginning of January
- All details will need to be assessed at project end.

Pre-Survey Tasks

Candidates Selection and Sample Size

The choice here is between a full census or a more restricted survey. In a small village of (say) less than 15 households, a member from each could be questioned thus giving a census. However, as villages increase in size, a complete census becomes less practicable and more time consuming; as well as being less necessary for obtaining accurate data (Effort/Results curve). Thus with a village containing more than 15 households we should start to use one of the sampling techniques (Tool 08) to determine the number and the identity of the households to be included in the survey (it is now termed a survey because we will now be using a population sample). Thus before starting to fill in the Questionnaire it is first necessary to produce a List Frame (Tool 09) of households. Once this has been correctly established, find the identity of the population for the Questionnaire by selecting members from the list using the Simple Random Sampling Technique (Tool 08).

Determining the optimum number of households to reply to the Questionnaire is a statistically complex science, that goes beyond the scope of this Toolkit. However, as a general rule to try to ensure that you obtain good estimates of the data required, it will be necessary to ensure that approximately 15 Questionnaires are filled when working in small/medium villages and at least 10% of households when involved with significantly larger communities.

Furthermore, if within the project village there are specific households that have been selected for the introduction and adoption of improved NRM practices, these target households represent your population to be sampled. However, it is also valuable to include a replicate

sample of non-target households (the so-called "Control Group"). The replies given by this second group should prove very revealing. Firstly, they provide a group against which you can compare the project's direct impact on the target population, and secondly they will show the extent to which the NRM practices being introduced to the target population are being adopted by the non-target population. This will therefore give one measure of your project's indirect impact, and prove an excellent indicator in its own right of the effectiveness of project intervention.

Setting-up Interviews

You are about to ask a busy person to provide you with a host of personal information that will take up perhaps an hour of his/her time. Thus you should not treat the completion of the Questionnaire as a casual occupation to be fitted in when next you see the selected person. Instead, arrange a mutually convenient time and place. Choose one when it is not too hot or when either of you are likely to be over busy or rushed. Do not arrange an interview just before mealtimes.

Familiarity with the Questionnaire and the accompanying notes

Before sitting down with the selected interviewees ensure that you are familiar with all the contents of the Questionnaire. That means that you should have read carefully the notes that have been written to accompany the Questionnaire and that you take them with you; that you have available for use during the interview the check-lists of NRM Project Objectives and Indicators (Tool 01) and the different NRM practices (Tool 02). This latter also contains a set of supplementary "tick" sheets for recording answers to Questions: 17, 20, 26 dealing with identifying NRM practices that have been adopted by the interviewees household.

Undertaking the Interview

There is only one essential attitude to undertake the completion of the Questionnaire: relaxation. If you show your nervousness or lack of familiarity with the Questionnaire, the interviewee is likely to feel uncomfortable. If you find that he/she is reticent about a certain topic, leave it and come back towards the end of the session. Try to keep the interviewee at ease and assure him/her that the information being provided is confidential. Furthermore, having tested the Questionnaire rigorously we have a few complimentary points to make:

1. You should talk to the selected individual on his/her own. Do not encourage a group to gather or else they will join in and create a general conversation. Further you will be seeking information on the person's wealth by such questions as sources of income and number of livestock that are owned. Quite rightly this is information he will not wish to divulge to a crowd. Finally, the more people around when you carry out the questionnaire, the longer it will take to complete.

2. Ensure that you stay on the topic of the questionnaire and do not deviate away from the defined questions. On occasions you may have to use tact to bring the subject back to the question! However, if you hear something of relevant interest that does not appear to have a place in the questionnaire, make notes on a spare sheet. This information may prove of use when writing the M&E Report. However, do not alter the content of questions.

3. In trials with uninitiated user of the questionnaire we noted that the first example can take up to 90 minutes to perform. From then on you must count between 30 - 45 minutes to complete. If you find that you are considerably slower or faster than this, you need to recheck your questionnaire technique.

Tool 19b

Notes for Completing the Questionnaire

Note 1: Details should be collected during an interview (Tool 20) with a village responsible

Note 2: Try to be open-minded in this section. Here we are trying to determine whether villages are getting to grips with the land conflict issues that arise from time-to-time. As NRM practices begin to bear fruit issues of competition will build-up. It will be interesting to determine how well adapted the village organizations become in handling conflicts in a manner satisfactory to all. Chief amongst the issues is likely to be competition for land between agriculturalists and herders; between men and women; between different households. Also look out for conflicts arising from some individuals being perceived as over-exploiting common or communal resources. Is Mr. X cutting wood at a rate that Mr. Y thinks the local forests are incapable of maintaining?

Note 3: Measuring agricultural production is difficult to organize and time-consuming to carry-out. Tool 11 does provide a usable methodology. However, we have found that good estimates can be obtained from the farmers themselves. If you ask how many bags of millet were produced, sacks of onions, bowls of tomatoes, etc., you will obtain very useful information. In future years try to get the same "units" of measurement.

Note 4: As with most individuals, the villagers may not be too keen to reveal this type of information. If you start to sense some reticence, assure the interviewee that the information will be strictly confidential within the bounds of the M&E program, and that you will not disclose the sums nor the individual's name to any authority. You should list all sources of income here, including monies sent from migrating family members.

Note 5: Q11 is the minimum information that we need. If there is an increase in revenue obviously the family is reaping some gains in there work. However, it would be beneficial to have more detail and figures. Indicator 11 calls for data on the level of income versus the level of expenditure. This is not easy to obtain because the farmers are always suspicious of this type of question. If possible obtain approximate figures (do YOU know exactly how much you earned and spent last year?). Accuracy of data serving this indicator could be enhanced by the project producing simple sheets of income/expenditure and persuading sample families to keep/help you keep more accurate records.

Note 6: Gives figures as well as noting other forms of carts such as horse or oxen-drawn.

Note 7: Use copies of the list of "NRM Practices Recognized as having Positive Impacts" to record the responses (see under Tool 02). Add relevant practices as they arise.

Note 8: Many farmers are adept at identifying native species that indicate trends in soil fertility. For example the milkweed (*Calatropis procera*) is said to indicate that soils have poor fertility; *Gueira senegalensis* is said to signify areas of soil degradation and desertification. Building up a list of these indicator species could prove an extremely valuable method of simplifying several aspects of impact monitoring, especially those related to measuring changes in soil fertility.

Note 9: You should be very loose in your interpretation of the word "reforestation". In this category we can include classic replanting of degraded lands, windbreaks, woodlots, and so on. The Questionnaire provides you with space to embellish the answer.

Two words of care are required here: First, any extensive replanting will likely have been performed in cooperation with other households. Therefore, when you come to estimate the area reforested, be careful not to count more than once an area that has been planted by more than one household. Second, a villager's estimation of area is likely to be inexact and not in a scientific measuring unit. Therefore follow-up the questionnaire by measuring in square meters the area reforested (simple pacing will suffice). Also see Tool 01 for other means of obtaining information for this impact indicator (21).

Note 10: Two points here. First it should not be forgotten that the planting success rate is typically low in the dry sahelian climate. This question will help us to understand how successful the intervention has been. If mortality is high, villagers will be discouraged from continuing. Are there any more NRM practices that your project could get the villagers to adopt in order to increase survival rate? Secondly, "success" is relative, and in the case of tree planting very much a factor of time. If trees were planted a month ago can we speak of success? Obviously this is one information type that requires monitoring over an extended period.

Note 11: There now follows a question that is to be asked of women in the selected households. The reply is considered very important and should not be influenced by male members. If need be, try to get the respondent slightly apart.

Tool 20

Interview Sheet: Measuring NRM Impact

Project Name/Number:
Village:
Name(s) of Respondents(s):

Name of Interviewer:
Date:
Age/Sex:

Occupation(s):

Household Size:

Objective 1/Indicator 1

Presence of Community-based Organizations

Q1. Which community organizations function in the village?

Provide Numbers and Details:

Q2. Have the organizations established rules for the use of the village's natural resources?

Yes / No

Details:

Q3. Have the organizations established penalties if the rules are broken?

Yes / No

Provide Details (Note 1):

Q4. In general terms does the population respect the rules established by the organization? are penalties paid? (Note 2)

Rules Respected Yes / No

Penalties Paid: Yes / No

Objective 1/Indicator 2:

Presence of Credit Systems:

Q5. Are there any formal or informal systems for credit available in the village, either through the village organizations or through individuals? If so provide numbers, details and the length of time operating:

Number

Details

Q6. What level of financial contributions do members make to the village organizations/credit systems? (Note 3)

Details:

Objective 1/Indicator 3:

Resolution of Land-Use conflicts: (Note 4)

Q7. Can you provide details on village land-use conflicts that have occurred during the past three months.

Types of Conflict

Number of Each

Result

Tool 20

Interview Sheet: Measuring NRM Impact

Project Name/Number:
Village:
Name(s) of Respondents(s):

Name of Interviewer:
Date:
Age/Sex:

Occupation(s):

Household Size:

Objective 1/Indicator 1

Presence of Community-based Organizations

Q1. Which community organizations function in the village?

Provide Numbers and Details:

Q2. Have the organizations established rules for the use of the village's natural resources?

Yes / No

Details:

Q3. Have the organizations established penalties if the rules are broken?

Yes / No

Provide Details (Note 1):

Objective 2/Indicator 15:

Availability of Basic Services:

Q11. Which services and basic infrastructure are currently available in the village? Provide exact numbers of each.

- Health care
- School
- Boutiques
- Cereal Banks
- Others (mention)

Objective 3/Indicator 20:

Volume of wood harvested: (Note 7)

Q12. Can you provide a figure for the quantity of wood that has been harvested from the community forest(s) during the last 3-months?

Reply and units of measure:

Q13. Has any community forest been developed during the last year? If Yes, how much?

Objective 3/Indicator 21:

Increase in Tree Planting

Q14. In the village, how many nurseries are producing trees on a regular basis? (Note 8)

Do not forget to thank the Respondent warmly

Tool 20a

ASDG II Monitoring & Evaluation Interview Questions
Notes to Accompanying the Interview Sheet

Introduction

Consensus has now been reached by several of the major players in the field of natural resource management as to the overall and common objectives of community-based NRM interventions:

- Reconstitution of Productive Capital
- Sustainable Improvement of Living Conditions
- Improved Capacity of Communities in the Use of NRM Techniques

Each Objective has been translated into a set of anticipated results (or impacts), and in turn progress towards achieving these results will be shown by the quantitative and qualitative values that can be attributed to groups of project impact indicators. Level of impact can be determined by the collection of relevant data sets using a series of M&E tools. The most consistently used of these being the M&E Questionnaire (Tool 19), which is used repetitively with a randomly selected sample of interviewees. However, there are certain categories of question that have only one possible reply and which do not need to be aimed at every individual in your sample. For example, "how many boutiques are operating in the village?" should have only one possible answer and thus you would be wasting your time, and that of the interviewees, if you ask everyone the same question. However, this by no means reduces the importance of knowing the correct answer so the question still needs to be asked. This Tool has therefore been developed to bring together all these one-answer questions in what we will call an "Interview Sheet". You will note from the structure of this tool that it is in effect another form of questionnaire, this time destined for a single individual (or if you prefer, a group working together).

For background details on the prime objectives and indicators that have lead to the development of this tool, please refer to Tools 01 and 19 and their accompanying notes (Tool 19a). The main value of the Interview Sheet (Tool 20) in the present M&E program relates to Objective 1 (Improved Capacity of Communities in the Use of NRM Techniques). In simpler terms this objective seeks to improve the functionality and cooperative structure of the project village and bring about development of the community as a whole. Much of the information required here is easily quantifiable either by the Enquêteur alone or by talking to a single or group of village officials, and so does not need a place in the Questionnaire. Thus the Interview Sheet is a complimentary document to the Questionnaire and has been developed to allow collection of the additional data required.

Relevance of the Interview Sheet to Different Projects

The Interview Sheet has been developed to provide a logical progression of data collection for each of the three NRM Objectives, but with particular emphasis on Objective 3. The information that may be gleaned from a completed Interview Sheet, when complimented by the other data collection techniques offered by the Toolkit, should provide all that is required to measure project progress towards achieving the stated objectives and allow a complete response to project M&E requirements.

However, it is obvious that not all community based projects will have the full spectrum of activities that the Interview Sheet and the other M&E tools are seeking to measure. If this is the case, the officer responsible for M&E at project level should cross off those sections of the Interview Sheet that he/she is sure have no relevance to the project.

Pre-Survey Tasks

Candidate(s) Selection

With the Interview Sheet the only sampling process involved is in the selection of a suitable individual or group of individuals who can answer accurately the questions you will ask. I would suggest that you approach the leader of the Village Association (if such exists) or the village Chief.

Setting-up the Interview

You are about to ask a busy person to provide you with considerable information that will take up perhaps an hour or more of his/her time. Thus you should not treat the completion of the Interview Sheet as a casual occupation to be fitted in when next you see the selected person. Instead, arrange a mutually convenient time and place. Choose one when it is not too hot or when either of you are likely to be over-busy or rushed. Do not arrange an interview just before mealtimes.

Familiarity with the Interview Sheet and the Accompanying Notes

Before sitting down with the selected interviewees ensure that you are familiar with all the contents of the Interview Sheet. That means that you should have read carefully the notes that have been written to accompany the sheet and that you take them with you for reference.

Undertaking the Interview

There is only one essential attitude to undertake the completion of the Interview: relaxation. If you show your nervousness or lack of familiarity with the Interview Sheet, the interviewee is likely to feel uncomfortable. If you find that he/she is reticent about a certain topic, leave it and come back towards the end of the session. Try to keep the interviewee at ease and assure him/her that the information being provided is confidential.

Tool 20b

Notes for Completing the Interview Sheet

Note 1: Provide as accurate details as possible. Is there a written charter for the organizations? does a list of rules exist?

Note 2: Try to get a feeling from your conversation on how well the committee is functioning. Does it frequently turn a "blind eye" to rule breakers, is it totally ignored by certain farmers, or is it generally well respected. Similar questions posed to individual farmers in the Questionnaire will also provide more clarity on the value of the village NR organizations.

Note 3: If no credit facilities exist (from Q5) simply state "Not Relevant"

Note 4: Obtain as much information as possible in this section. We are seeking to find out whether village committees are up and functioning, whether they have the support of the populace, whether they require assistance from the project, and in which directions they are developing. Try to be open-minded in this section. Here we are trying to determine whether villages are getting to grips with the land conflict issues that arise from time-to-time. As NRM practices begin to bear fruit issues of competition will build-up. We need to know how well adapted village organizations are to handle conflicts in a satisfactory manner? Chief amongst the issues is likely to be competition for land but also look out for conflicts arising from perceived over-exploiting common or communal resources. Resolution of the conflicts may be simple a matter of bringing the two parties together, it may require a village effort for example delimiting Livestock Corridors or imposing realistic limits on exploitation levels.

Note 5: Take the term "Natural Resources" in its larger sense as being all areas covered by the three project Objectives. Thus training programs may be aimed at individuals, general groups, defined groups (eg. women) as well as concentrating on developing skills in field techniques, alphabetization, skills in organizing village committees (including financial skills, resolving land conflicts, etc.). Finally, do not overlook the training of trainers, the development of extension services, visits to other villages, and so on.

Note 6: The route of corridors could be traced onto a rough village map (Indicator 18). It would also be of interest to plot the locations of land-use conflicts which might provide some interesting insights.

Note 7: This question will probably be the one that is the hardest to obtain an accurate or convincing answer. If you are lucky enough to get an answer it may not be given in any conventional units. However, be content with a measure such as "wagon load" or "stere". Note as well that you may get a straight reply of "no idea". In this case you should add the question to the Questionnaire and ask it of the individuals in your sample.

Note 8: The figure to record here should be a total number producing tree seedlings on a regular basis both for sale and for personal planting programs.

Tool 21

Questionnaire Results Grid

Introduction

The following pages contain a grid to receive data from the questionnaires. The grid has been designed to take quantitative values and some short qualitative ones. They cannot be designed to accomodate lengthy replies. These should be paraphrased for inclusion in the grid or reproduced elsewhere. The grid will pull together results and answers from all the completed questionnaires thus facilitating an overall view and allowing easier use of data in statistical tests.

Each questionnaire grid is composed of 8 columns:

Column 1	=	question number (refer to the questionnaire)
Column 2	=	brief description of question
Column 3	=	the type of answer to provide
Columns 4-8	=	space for replies from 5 interviewees. If you interview more individuals, simply photocopy the sheet and add in the interviewee's code number

Do not forget to use these sheets together with Tool 18 which provides the calendar for asking the different questions of the questionnaire and the interview sheet.

Table 1: Questionnaire Results Grid

Q	Description of Question	Response Type	Interviewee Code Number				
			1	2	3	4	5
1	member of organization	Y/N					
	number of members	figure					
2	rules established	Y/N					
3	fines established	Y/N					
4	rules respected	Much/Little/No					
5	penalties paid	Y/N					
6	in land conflict	Y/N					
7	land conflict resolves	Y/N					
8	agricultural production state crop in next column use figures and measures						
9	herd size state animal and numbers						
10	sources of revenue state in the next column marks those interviewees who state them						
11	more income this year?	Y/N					
12	received credit this year	Y/N					
13	given credit this year	Y/N					
14	how many migrated	numbers					
15	sales products outside	Y/N					
		value					

Table 1: Questionnaire Results Grid

continued ....

Q	Description of Question	Response Type	Interviewee Code Number				
			1	2	3	4	5
16	animal traction: wagon	Y/N					
17	others	numbers					
18	NRM practices for soil fertility	numbers					
19	fertility changing - increase or decrease	see question IQ,IS,No,DS,DR					
20	recognized indicators	Y/N					
21	NRM practices for forests	numbers					
22	collects seeds	Y/N					
	grows trees sedling	Y/N					
23	area reforested	hectares					
24	successfully established	hectares					
25	quality of pasture - increase or decrease	see question IQ,IS,No,DS,DR					
26	recognized indicators	Y/N					
27	NRM Practices for Water	numbers					
28	are they good overall?	Y/N					
29	Time given to each activity (note activity in the next column and hours in the relevant box						

Tool 22

Data Collection Sheets for Village Committees

Introduction

It has been seen that village communities organizations are themselves extremely important sources of information for measuring project impact. In order to aid village communities to collect data on a continuous basis, a data collection sheet has been developed and is provided on the following page.

Where project activity excludes certain indicators, any data grids that prove irrelevant need not be given to the village organization.

Village Committee: Data Collection Sheet

Project:
Village Responsible:
Period covered:

Penalties/Fines Imposed

Date	Name of offender	Offense	Fine Imposed	Fine Paid

Village Committee: Data Collection Sheet

Project:
Village Responsible:
Period covered:

Land-Use Conflicts

Date	Name Protanganists	Problem	Decision Reached

Village Committee: Data Collection Sheet

Project:
Village Responsible:
Period covered:

Wood Exploitation from Community Forests

Date	Volume of Wood	Destination	Descriptive Notes**

** Under the heading of "descriptive notes" provide any relvant details about the wood cut. If it was live or dead; if there was a particular species harvested; if the cut was part of the exploitation plan or whether forced by necessity, etc.

Tool 23

Producing M&E Reports

Introduction

All the fruits of the M&E campaign are to be revealed in the report or reports that the project will produce. A badly structured or written annual report may negate all the good effort that has been expended by the project during the previous 12 months. Very good project impact can be made to look innocuous if the report is not presented in a logical manner and if the important points are not pulled out and clearly displayed. Thus this final stage of the impact monitoring process is a critical one. Luckily, it is possible to obtain some considerable guidance in the way that reports can be conceived and produced by both reference to this tool and to the useful texts listed in the bibliography. This Tool seeks to guide the persons responsible for producing the M&E reports (probably the Director and the M&E Officer) through the various production stages and choices of layout and contents.

The necessary first steps can be summed up in a single word "preparation". As mentioned in the introduction, the quality of the written report can promote or damn the fruits of an M&E campaign. Therefore it is essential to begin the report writing stage in the correct manner. What needs to be done in order to prepare for report writing? There are several items of preparation:

- centralization and analysis of data: you must have all relevant data; preferably analyzed, in front of you at the moment that you plan the structure of the report. Be sure that all the necessary information has been collected and delivered to you. If any is missing, track it down,
- report destination: know to whom the report is destined. If you are about to produce a report recording details of a three-monthly campaign, it is likely to be for internal consumption only. Therefore, it must be short and concise. You will not need, for example, to go into great detail about the project sites. (The subject of different reports for different destination will be dealt with later),
- once the decision has been made as to the recipient, develop plans for the overall structure of the report as well as its major contents,
- develop your ideas for each chapter of the report into more concise details and make (an informal) presentation to project staff. This will provide you with considerable feed-back, including areas that are unclear, require strengthening, need abridging, expansion, or inclusion/exclusion

Different Types of M&E Reports

A project will probably produce four types of report during its lifetime. These are: the Base-Line Study; Quarterly Reports; Annual Reports, and Final (end of project) Report. These reports will likely be sent to several different destinations: internal to the project; to the village committee, to the organizations providing the finance (if it comes from an umbrella project such as ASDG II); to the donors, and to an overseeing Government body such as the C/GRN. Each of these four destinations will have differing levels of interest in the fine details of the project; as well as differing amounts of time available to wade through thick tomes of information. Thus is it important to style reports to match the level of information required by the recipients, and to consider the amount of time that they will have available. Just consider that there are several hundred small, medium and large NRM projects operating in Niger, and from which the C/GRN requires punctual information. With on average, one report per day arriving at their offices, if they must read through one hundred pages to obtain the information required, there will be little time for anything else!

Report Production

It is a fact of life that many M&E reports are never published for a whole basket of reasons: sometimes they are too controversial, or their importance has faded with time, or publishing resources have run-out. Mostly, however, the report writer comes across an insurmountable blockage of one form or another, and is obliged to abandon the process. In order to avoid this problem it is necessary to conceive a valid production plan and time-frame.

Informal or Preliminary Report

As the name suggests these reports are frequently presented to a small, invited audience and are not for general distribution. Often they are presented verbally, using where possible audio-visual aids such as overhead transparencies or an epidioscope. Feed-back should be solicited, notes taken and useful comments integrated into the plan for the formal report. Make sure that the formal report is developed soon after the informal presentation. Two or three days after the presentation, your ideas presented to the audience will still be fresh in your mind. If you delay longer, the ideas will fade.

Contents for the Preliminary Report

1. Description of the Project site
2. Description of Project aims
3. Methods employed during the data collection processes
4. Results obtained from the village population (this will be mostly through questionnaires)
5. Project results (this will be mostly through field collection efforts)
6. Conclusions to be drawn from the data: project impact
7. Recommendations for future efforts (small changes, major reorientations)
8. Summary of the report

The Definitive Report

Contents for the Definitive Report

The major parts of a technical report are presented below as indications of a report structure that could be adopted. However, the final structure to be used by the project will rest very much on the information that the project considers should be included, and the identity of the recipient.

1. Title Page - should include the name and code number of the project, the period covered, the date of preparation, the author(s), and the donor.
2. Executive Summary: major details in summary form. Not to exceed two pages
3. Preliminary details: acknowledgements, Tables of Contents, List of Tables and Figures
4. Introduction: including objectives of the study and descriptions of the project
5. Methods: conception of the study; methods used; methods of data analysis; descriptions of the level of significance of data, and information on any problems encountered
6. Results and their interpretation
7. Conclusions and recommendations
8. Bibliography (if included)
9. Annexes (if included)

The Next Steps

1. Review closely the reasons behind the development of the report and ensure that the report takes these into account. Ensure that the report does not include unnecessary information
2. Develop the main themes of the report
3. Review the document structure, and the two points just mentioned
4. Produce outline contents of each chapter and spent as much time as necessary determining which data is to be included and how it is to be displayed
5. Be rigorous in applying a basic commandment: if data or particular comments are not necessary, exclude them!

Individual Sections of the Report

Here we refer to the 9 individual sections of the definitive report provided above. Sections 1, 3, 8, and 9 are self-explanatory and do not require further development here. The remaining sections will receive some individual attention.

Executive Summary

The first section of a report read by the majority of individuals not directly related to the project will be the Executive Summary. This section plays an important role in providing the readers with a rapid synthesis of the report's main details and contents. Additionally, it will indicate to them whether the main contents appear to be of particularly interest and whether they should spend more time in reading other chapters of the report. For these reasons the executive summary must be the best written part of the whole report. It is also one of the hardest to do well and will probably be the last section to be written. Given its function for displaying pertinent details rapidly, it should not exceed two pages wherever possible, and certainly no more than three. Its contents should not include methods used, unless these were particularly innovative, and of value on their own. However, you should mention major project impact; citing figures are percentages that are particularly revealing. Also the major recommendations for the project's future directions should be included in abridged format.

Introduction to the Report

The introduction is the only opportunity offered by the M&E document for setting the project into the context of its ambitions and relationships with its donors, on the one hand, and the village communities, on the other. The main objectives of the project should be displayed in this section as should the results that are anticipated and the indicators selected to determine progress towards the stated objectives. Historical information should also be included here as should any interesting background details with reference either to the project, to the donors or to the village communities.

Impact Monitoring Methods

Details to be included here should be to explain to the external reader how the monitoring program was conceived and why; which features the project wished to measure in response to the stated impact indicators; which methods were employed, and if they are innovative or unusual, why they were selected over more traditional reasons (if you have followed the guidance of the Toolkit, much of logic for using the different methodologies is explained in the relevant tools). You should then proceed to explain the methods of data analysis, describe the level of significance adopted, and provide information on any problems encountered during the data collection or data analysis phases.

Results and their Interpretation

The major part of the effort involved in impact monitoring has been directed at the collection and interpretation of data. Therefore it is highly important that this section is used to bring out (to present) the full content and relevance of the collected information. Data can be presented in a host of different formats: tables, charts, graphs of many types, as well as written (prose). Selecting the appropriate manner to display your results is highly important. As a general rule visual displays are the best since the eye catches many details rapidly. When selecting between tables and one or other of the graphical representations, it is usual to opt for the latter, although there are many situations where graphs are inappropriate and therefore tables should be used. Given the importance of this section, we will dwell on techniques in some detail. Note also that Tool 17 is dedicated to data analysis and presentation.

Principles for Data Presentation

Take care with the following details:

- how you define variables and the populations from which they were drawn.
- the titles of tables and graphs and their positions in the text
- care when using mathematical terms and study methods since the reader may not always be familiar with them (note how we have developed the Toolkit by explaining terms and processes)
- do not lose your readers with complex statistical terms. Do not be afraid to explain them either in the main body of the text or in an annex
- when using tables and graphs, explain the main points in words, do not expect the reader to interpret them automatically in the same manner that you have
- use graphs, tables and diagrams as a means of concentrating reader interest on the text and as a means of enhancing their comprehension of the information presented

Producing Clear Tables and Figures

- Reduce to a minimum the number of figures presented in tables, do not be tempted to add too many numbers after the decimal point (really the fewer the better)
- ensure a logical order in the placement and labelling (titles) of columns and rows
- Transform data into percentages, etc. when this improves the understanding of the data
- use whenever possible the mean, median and mode to highlight events. Do not forget to explain them during first usage or in the chapter on methods
- try to compare data from this campaign with those from earlier collections. Bring out the main changes and the importance of these changes
- use freely the different forms of visual aids such as pie charts (or camembert as the French call them!), histograms, as well as simple line graphs and curves
- use tables to summarize groups or sets of results

Stating Data Precision and Relative Importance

- do not be afraid to present clearly weaknesses in your data collection methods or results. Bring out errors in sampling techniques and make them clear to the readers

Conclusions and Recommendations

Use this section to expand your ideas on how the project has developed during the period covered by the report, and describe clearly how efforts should be directed/redirected during the next planning period. Ensure that your recommendations are brought to the attention of the Director, of the Financial Officer, and of the team charged with developing the next "Calendar of Activities" for the project. By talking with all these people, you can help to ensure that your suggestions have a greater chance of being acted upon.

After Report Completion

Send it to the relevant members of the project for comments and constructive criticism. This feed-back will help you to revise the report, if it should be thought necessary. It can also provide pointers to be borne in mind for future document production. Use this period then for edition, correction of errors and for distribution.

Failure for Reports to Appear

Why, so frequently, do reports fail to appear? There are a number of possible reasons but key amongst them are:

- poor initial planning of the data collection processes (fault of the M&E Officer)
- the poor quality of collected data (lack of training; fault of the Field Assistants)
- the choice of an inopportune moment to carry out the sampling (bad timing: M&E Officer)
- lack of clear objectives or the need for information was poorly conceived (Director/M&E Officer)
- unforeseen incidence (they happen but could they have been avoided with a little more care?)
- political conflicts (depending on the origin, they are hard to foresee)
- lack of collaboration on the part of the target village or poor quality of the enquêteurs (if the project has bad relations with the villagers this is serious. Director, look at the role that your field staff have been playing. If the enquêteurs are at fault, this may be due to inadequate training, or poor control of their work)
- too many leaders in the team! (Director to ensure that this does not occur)
- the original needs for the results collected no longer exist (was the report too long in appearing; was the campaign poorly planned?)

Introduction

During the production of this Toolkit, we have frequently referred to a number of documents both produced by the Government of Niger and by a number of projects/donors active in the area of Natural resource Management. We list below in part 1, a number which will provide useful material if you should wish to read more deeply about M&E. Furthermore, we have had the opportunity to make use of several excellent commercial texts. Our main sources are also listed below (in part 2).

Finally, two M&E training possibilities are provided which would be useful compliments to this Toolkit. Details follow in part 3.

Bibliography and Further Reading

Part 1 - Texts from Niger

Adelski, E. & P. DeCosse (1995): A Monitoring and Evaluation Plan for USAID/Niger's Strategic Objective Three. Chemonics/IRG/USAID-Niger.

Ba, I. (1996): Organisation du Système de Suivi et Evaluation au Sein du Programme SDSA II. IRG/USAID/Government of Niger.

CARE (1992): Mise en Place du Dispositif Interne de Suivi Evaluation du "Projet d'Amélioration des Productions Agricoles - Projet Agroforestier de Maradi". CARE, Niamey, Niger.

DeCosse, P.J. (1995): Monitoring & Evaluation of Natural Resource Management (NRM) Interventions in Niger: Strategy and Workplan for ASDG II. International Resources Group/ASDG II/USAID.

Lachance, A., Kalala, M., Pineau, M. & A. Schwartz (1995): Suivi-Evaluation Document Technique (Version Préliminaire). PGRN/Université Laval/Banque Mondiale.

Manou, Y. & Zakou, M. (1996): Manuel sur la CES/DRS. Ministère du Développement Rural, de l'Hydraulique et de l'Environnement, Niamey, Niger.

McCormac-Wild, C. & P. Wild (1996): *******title**********

Samba, I. (1992): Intervention GRN à Gouré (683-0278): Plan Communautaire de Suivi, d'Evaluation et d'Attenuation Environnemental. Prepared for USAID/Niamey

Part 2 - Commercial/Semi-commercial Texts

Casley, D.J. & K. Kumar (1987): Suivi et Evaluation des Projets Agricoles. Publication de la Banque Mondiale, ECONOMICA, Paris France. (in English and French).

Casley, D.J. & K. Kumar (1987): Collecte, Analyse et Emploi des Données de Suivi et d'Evaluation. Publication de la Banque Mondiale, Washington DC, USA. (in English and French).

Johnson, A.C. jnr. & J.S. Rowe (1987): Agricultural Statistics for Developing Countries. University of Wisconsin-Madison, USA. (only in English)

Rowe, J.S., DeCosse, P.J. & M.K. Marks (1995): Guide au Suivi et Evaluation des Projets Agricoles et de Ressources Naturelles, University de Wisconsin & International Resources Group Publication, Washington DC, USA. (in English and French).

Part 3 - M&E Training Opportunities

ASDG II-sponsored M&E Training Program: Introduction to M&E of Village-level projects and to the M&E Toolkit. Training course destined for recipients of an ASDG II-funded NRM project grant and for other M&E Officers of other interested organizations. Contact: Mr. Ibrahim Ba, M&E Specialist, ASDG II Project (USAID), Niamey, Niger.

International Resources Group & University of Wisconsin M&E Course: Le Suivi et Evaluation des Projets Agricoles et de Ressources Naturelles. Three-week residential courses (English and French) held annually. contact: Mme. Maribeth Malecki, IRG, 1211 Connecticut Ave., Washington DC 20036, USA.

Attachments

- Student t-Tables
- Chi-Square Tables
- Random Number Tables