

# **Integration of Geographic Information System (GIS) into Monitoring and Evaluation of Sustainable Agricultural Projects in the Cemac Region**

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## **Abstract**

According to Catherman (2013), Monitoring and Evaluation (M&E) is a powerful management tool that can be used to improve the way governments and organizations achieve results. Just as governments and organizations need financial, human resource, and audit systems, they also need good performance feedback systems. GIS is a computer system capable of assembling, storing, manipulating and displaying geographically referenced information, i.e. data identified according to their locations. This training will present a practical guide for using a geographic information system (GIS) integrated with Monitoring and Evaluation. The five days training is aimed at helping development partners to monitor and evaluate the activities of specific projects intended to support M&E systems for sustainable programs and projects. The use of GIS in monitoring and Evaluation improves the effectiveness and communications of results to management, funding partners, and beneficiaries. The integration of GIS in monitoring and Evaluation makes it possible to link, or integrate information that is difficult to associate through any other means. With GIS M&E/Researchers are able to use combinations of mapped variables to build and analyze new variables. Presenting data in the form of a map helps to understand the significance of where, when, and by whom. By using the GIS to link data from multiple programs the training will make it possible to understand the individual programs better but also better understand the relationship between the programs. Spatial analysis techniques will also help with driving outcomes measures.

This paper has three parts.

The first part answers the question of how does M&E work. The paper explains that M&E is an important tool targeting two key elements to any development project – effectiveness and sustainability. In the ideal situation, M&E should span the life cycle of the project providing a continuing stream of data and feedback. In the initial stages of the project, M&E can aid in developing and clarifying the goals and objectives. Once the project reaches operational status, M&E can promote greater transparency and accountability within organizations.

Feedback from M&E during project execution means adjustments can be made to improve the prospect of sustaining successful outcomes. And, finally, using M&E techniques means that determining a project's success or failure does not have to wait until project completion and final reporting.

The second part analyses some ideas for creating an effective M&E system. In this second part, it is argued that there is no consensus on how many steps are necessary to build an effective M&E system. Kusek and Rist (2004), in *Ten Steps to a Results-based Monitoring and Evaluation System*, 2004 describe a step-by-step approach that has been used in a number of developing countries in the design and construct of M&E systems.

The third part of paper gives an overview on the linkages between GIS and M&E. The authors posit that A Geographic Information System (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data. In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology. Maps have been used in monitoring and evaluation systems long before computers and technical names for processes were developed. Therefore, how can M&E and GIS work together? M&E and GIS have a fundamental difference: M&E is temporally focused – measuring changes and outcomes occurring over time and GIS is spatially oriented – identifying where the outcomes are occurring. The challenge is to merge these two different views into one tool that will display useful information in support of a successful outcome for the project. How this mixture is accomplished depends heavily on selecting appropriate, meaningful data for monitoring the project.

This paper is an attempt to present the usefulness of GIS and Maps as a compact and elegant method of communicating information especially during heavy rains and bad weathers. With, a well-designed map, a reader should be able to quickly interpret the displayed information without assistance. The paper argued that today, the most efficient and effective method of producing maps that communicate message is with a computer-based Geographic Information System.

**Keywords:** Integration of geographic information system (GIS), Monitoring and Evaluation, sustainable agricultural projects, CEMAC.

## **MONITORING AND EVALUATION**

**Monitoring** is the collection and analysis of information about a project or programme, undertaken while the project/programme is ongoing. **Evaluation** is the periodic, retrospective assessment of an organisation, project or programme that might be conducted internally or by external independent evaluators.

**Figure 1: Monitoring and Evaluation process.**



**The first step** is to be clear about why you want to do M&E and the benefits it can offer. Community volunteers and activists often want to make the world a better place, making them action-orientated and often under-resourced. Monitoring and evaluation can sometimes seem like an unaffordable luxury, an administrative burden, or an unwelcome instrument of external oversight. But if used well, M&E can become a powerful tool for social and political change. Doing M&E (figure 1) can help you assess what difference you are making and can provide vital intelligence, for example to help you:

- **Assess** and demonstrate your effectiveness in achieving your objectives and/or impacts on people's lives;
- **Improve** internal learning and decision making about project design, how the group operates, and implementation i.e. about success factors, barriers, which approaches work/don't work etc;
- **Empower** and motivate volunteers and supporters;
- **Ensure accountability** to key stakeholders (e.g. your community, your members/supporters, the wider movement, funders, supporters);
- **Influence** government policy;
- **Share** learning with other communities and the wider movement;
- **Contribute** to the evidence base about effectiveness and limits of community action.

**The second step** is to develop some guiding principles to ensure that your M&E is relevant, useful, timely, and credible. Some examples might include making sure the M&E and/or information you collect is:

- **Focused and feasible** in relation to your available resources so that it supports rather than diverts resources from action (i.e. make sure you focus information collection on what you 'need to know', not on what would be 'nice to know');
- **Useful and timely** information to improve group learning, group decision making, and project design;
- **Useable** by, and/or comparable to, data collected by other stakeholders so it contributes to the wider evidence base;
- **Credible, valid and reliable** to the extent possible within your available resources;
- **sensitive** to unequal power relations when you collect information (i.e. ensure that you listen to people who might be marginalised in the community or do not have a strong voice);
- **Ethical** e.g. in relation to data consent and protection.

**The third step** is to decide and prioritise the programmes or projects you will monitor as it is unlikely you will have the resources to monitor all your interventions at the same time. So you will need to think about which programmes or projects you want to assess; over what time period; and whether it is an on-going activity which requires monitoring or a completed activity which requires evaluation.

**The fourth step** is to ensure that M & E is relevant to the project/programme stakeholders. Therefore, it is important to consider the information needs. One will therefore need to identify the key internal and external stakeholders, and decide how to involve them in the design, implementation, analysis and/or communication of findings. Examples of people you might want to include are (a) people directly involved in your projects (b) stakeholders in your wider community (geographic or community of interest) such as specific groups of residents, specific networks, community groups, the wider movement, and/or (c) external stakeholders e.g. funders, local and national policy makers. It might also be possible to work in partnership University departments.

**The fifth key step** is to identify the issues and questions you wish to learn about, and hence monitor. These often include issues and questions internal to the evaluator group (Organisational capacity/group processes – how well are you working together in relation to the following? ; needed resources (human, financial, technical); leadership and vision, management (e.g. clarity about aims, objectives, roles & responsibility; adaptability) cost effectiveness; sustainability (e.g. finance and/or volunteer burn out); Joint working or how well are you working with others, for example in relation to partnerships, the wider movement, alliances, coalitions, and the disseminating or sharing good practice and techniques.

**The sixth step** is to clarify the project/programme aims, objectives, activities and pathways to change. In order to assess progress needed to know what the project is trying to achieve and how: that is, the aims, objectives and planned activities.

### ***The Pathway to change***

Although change can be complex it can be helpful to present your programme and strategy in the form of a change pathway, or an impact chain. This describes how your project activities will contribute to your desired outcomes (your objectives); which will in turn contribute to final impacts (your aims). A simplified impact chain looks like this:



In practice the impact chain is unlikely to be linear: there may be multiple outcomes and impacts and there may be interactions and feedback loops between different parts of the pathway.

### ***Change Assumptions***

A change pathway/ impact chain can be useful because it reveals the interrelationships between activities, outcomes and impacts and therefore also your change assumptions or theory about how you think change will be achieved. These assumptions are often implicit rather than explicit so you may not even be aware of them. If you haven't already done so it's worth taking time in the group to discuss them to see whether you are all in agreement,

whether they seem plausible, and/or whether you might need to investigate them more. You could test them against existing theories of change, evidence and/or your practical experience or the experience of other groups. The more well-founded your change assumptions at the start the greater your impact is likely to be.

**The seventh step** is to identifying what information the evaluator needs to collect. Generally you are likely to need information to track and assess what has changed (both intended and unintended); understand the reasons for changes - i.e. what factors/organisations/individuals have facilitated/constrained change (including your contribution); to interpret the changes i.e. people's perceptions and experiences of change. Further, the information collected might either be quantitative information expressed in numerical terms as numbers and ratios for example. This information will allow the evaluator to answer 'what', 'how many' and 'when' questions. The information may also be qualitative, expressed through descriptive prose and can address questions about 'why' and 'how', as well as perceptions, attitudes and beliefs.

**The eighth step** is deciding how the information will be collected. There is internal monitoring where for each indicator one need to work out how the information will be collected. During this step, the evaluator can either conduct his own evaluations or commission an independent external person to do it for you. External evaluations can be more useful as interviewees may be more likely to talk openly to them, however they can be expensive unless they are conducted by funded academic researchers (see the Transition Research Network, and the Transition Research Primer). External evaluators can use the information collected by the internal monitoring system but may also need to supplement this with other information collected from a range of internal and external stakeholders e.g. from group workshops, semi structured interviews and/or surveys.

**Last steps** may include depending on the purpose of the M&E to communicate the data to relevant stakeholders. This might involve deciding key audiences e.g. community group, community, donors, policy makers and the media; tailoring and packaging the data to key stakeholders/audiences; converting data into graphs, pie charts etc, and drawing out key lessons for key stakeholders/audiences. The information could then be incorporated into Annual reports (see the links below for examples), or provide a useful background document to give people who want to know what your group does.

To this last, it is important that the evaluator gain informed consent from research respondents/participants, ensure their anonymity in the communication of research findings, and respect data protection laws.

Developing an M&E system must involve cooperation between stakeholders in the project. The evaluator must keep in mind the M&E-GIS methodology and advocate for features that will be needed to create a successful M&E-GIS system. Advocate for collecting spatial data such as location coordinates as an important attribute of the data collection task. The model to use in developing the M&E-GIS system follows a "past, present, future" format.

## **GEOGRAPHIC INFORMATION SYSTEMS (GIS)**

When evaluating which GIS software will work for your organization, some important factors to consider include: cost, ease of learning, as well as capabilities of the GIS software application to meet the evaluator needs. Developing a useful M&E-GIS system will require the services of a knowledgeable GIS technician. Although it is possible for many people with

some information technology experience to learn to use GIS, your time and availability requirements may require finding a person who already has well-developed GIS skills.

Powerful commercially available GIS systems are available after paying a licensing fee which can be quite expensive. The most popular GIS software in the US is ArcGIS from Esri. A down-loadable trial version is available for evaluation. In other regions of the world (Cameroon in this case), different GIS software applications are “local favorites”. Check with the geography department of a local college or university to see what commercial GIS software is most commonly used in your area. If high licensing costs are a barrier to an organization's use of GIS software, a variety of open-source (free) GIS software is available for download from the internet. One of the most popular, powerful and easy-to-learn open-source GIS applications is Quantum GIS (QGIS) which provides data viewing, editing, and analysis capabilities. The field of on-line GIS software is presently undergoing significant development and advancement. At this time, the two most prominent sources of free versions of online GIS (open systems) are both provided by commercial GIS software suppliers - probably introducing their product with a free version with limited capabilities in hopes that users will eventually upgrade to their fee-based versions with full capabilities.

The two companies that offer free on-line GIS capabilities are:

- a. Esri at <http://www.arcgis.com/home/index.html> and
- b. GeoCommons at <http://www.geocommons.com/>.

Expect more vendors to provide free, limited capability versions of their on-line GIS software. The expectation of open-source versions of on-line GIS software is limited because of the cost and support requirements of maintaining a cloud-computing environment without an income revenue stream.

### **M&E-GIS IMPLEMENTATION**

The M&E-GIS process is a series of three maps:

1. A “current” map showing the current status of each reporting entity. e.g., school, health clinic, well, food distribution center, etc.
2. A “past” map, that illustrates the work completed since the last report
3. A “future” map showing the work to be done before the next report is due, e.g., repairs, new installations, training, etc.

This 3-stage model has many similarities to an accounting model:

1. The current map is a balance sheet showing the current level of accounts at a specific moment in time
2. The past map is similar to a financial statement of revenues and expenses for activities during the prior reporting period
3. The future map is similar to a budget which is the plan for activity in the upcoming accounting period

Persons who are familiar with standard accounting reports should find this model of an M&E-GIS map-based reporting system easy to understand. Other conceptual models may be a better fit for your project. The most important principle to remember is that you are using key indicators to map outcomes that tell a story -- the map model is only the method of displaying the outcomes.

## **CONCLUSION**

This paper is not intended to be a comprehensive article on either M&E or GIS. It is just an excellent source of information and instruction on both topics. The intent of this paper is to provide a step-by-step guide to developing a combined M&E-GIS system and to emphasize some key points that apply to reaching this goal.

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