Water Related Indicators for Sustainable Crop-Livestock Intensification Planning in Ethiopia

Report of a Regional Workshop (North), Bahir Dar, 11 August 2012

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The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

Introduction

This report addresses the output of the feedback workshop for Africa Rising Quick Water Project held at Bahir Dar. The workshop was organized by School of Civil and Water Resources Engineering of Bahir Dar University. A general comment is first presented on the document and trajectories followed by a discussion on each trajectory and indicator. This is then followed by a brief look at the thresholds. Additional trajectories were suggested together with their corresponding indicators and thresholds. Some of the existing indicators were also modified based on experience. The procedures followed to accomplish the workshop are presented at last.

Overview on the document and the trajectories

The following were the most important points raised by almost all participants of the workshop regarding the discussion on trajectories.

A general comment on the document was raised by the participants. It was indicated more clearly by participants that the document does not clearly indicate the approach followed to identify the eight (8) trajectories, the way the indicators are identified and grouped and the thresholds are fixed. Overall, the document lacks clarity on the above issues, although the document is appreciated by the way it revises the literature and tried to show the gap. For a reader the document does not show the scale (appears to be very coarse) and results are not described well. Therefore, it is suggested that the 8 trajectories shall be defined and described in terms of production system, man power or energy requirements, physiological requirements, conservation requirements etc at different level of management. The same description shall also be given for the indicators and thresholds.

In the discussions, it was stressed that one development intervention related to environmental conservation appears to be missed. Based on this the group had discussed whether to add environment as a separate trajectory or include it as an indicator on each trajectory would be better alternative. The issue of mainstreaming environmental issues in every trajectory is very important. More weight has been then given to include environment related indicator on each trajectory. This is believed to enhance the sustainability of the intensification strategy.

In order to alleviate the current land degradation and to improve the crop and livestock production, agro-forestry as an intervention has to be considered. However, some argued that agro-forestry can be taken as a component under soil and water conservation in crop-livestock systems, although they are convinced on the validity of it.

Discussions on each trajectory and indicator

Trajectory 1-Soil and water management in crop livestock systems

It is believed that all indicators for trajectory 1 are valid and appropriate. However, a question was raised if gully formation were taken into account when calculating erosion as this phenomenon is very common in Ethiopia. Moreover, it was suggested to modify the name of the trajectory to Soil and Water Management in Crop-Livestock system.

Additional indicators were also suggested for this trajectory. Those are soil salinity and soil acidity. Soil salinity limits plant growth due to the presence of soluble salts in soils which hold water more tightly than the plants can extract it and soil erosion does not necessarily include salinity or acidity. Soil acidity is also among the important environmental factors which can influence plant growth, and can seriously limit crop production.

Trajectory 2-small scale irrigation in crop livestock systems

Existing indicators are found to be good and well defined. It is also widely used in our region. However, the indicator "potential small scale irrigation density" is found ambiguous and needs elaboration as it includes both the water (river) and land component. It shall be downgraded to other indicators which can be used to determine potential irrigable area. For instance soil suitability method for irrigation land evaluation (for this reference should be made to Sys and Verhaye (1974) titled as "Land evaluation for Irrigation of arid regions by the use of parametric method".

Trajectory 3-rainfed small holder intensification in crop livestock systems or agro-pastoralist systems

An idea was raised on the appropriateness of the terms minimum and maximum rainfall without considering the Length of growing period (LGP). It was pointed out that as far as rain fed agriculture is concerned, rainfall should be continuous throughout the growing period of the specific crop.

Modification of the existing indicators were then suggested which are thought to be inclusive. One indicator is the rainfall amount during the length of growing period. The minimum annual rainfall and maximum annual rainfall should then be taken out as both of them are inside the LGP. Extreme temperatures are not suitable for cropping. i.e., there are some crops that do not give good yield in extreme temperatures. Consequently, temperature is added as additional indicator as T_{max} and T_{min}.

Trajectory 4-large scale irrigation

In this case existing indicators are found to be well defined and descriptive. They are also used in our region. However, there are some concerns about sediment load. We hope that all the concerns can be avoided by appropriate technology. Similar comments were also given as trajectory 2 in using the indicator "potential large scale irrigation".

Trajectory 5-livestock based intensification

In this case existing indicators are found to be well defined and descriptive. They are also used in our region. However, aridity index does not appear to indicate availability of feed or pasture land. Consequently, feed availability is taken as additional indicator.

Trajectory 6-urban agriculture

There are two points raised here. One is the fact that urban diary can be taken as a subset of livestock based intensification. The second is urban diary excludes other forms of urban agriculture. Consequently, urban agriculture is found to be a good replacement of urban diary to address the issue of intensive water usage and include poultry, bee keeping and vegetable production. Additional indicators were also suggested that includes proximity to growth centers replacing the existing addis neighborhood; where it can consider growth centers other than Addis Ababa.

Trajectory 7-vertisol

In this trajectory a clear definition appears to be missing for vertisols. Some vertisol areas in Ethiopia are either wetlands or grazing lands and these areas should be preserved. It is thought that simply saying vertisol management might victimize the wetlands and grazing lands. Existing indicators are believed to be descriptive and good.

Trajectory 8-Rainfed commercial farming intensification

An idea was raised to merge trajectories 3 and 8 together, however it has been agreed to keep these things separately as both of them have distinct characteristics. Other than those mentioned in the document, additional indicators were also suggested. Those include access to road, rainfall in the growing period (LGP) and temperature extremes.

Trajectory 9 (new trajectory)-Agro-forestry

Agroforestry is an integrated approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock. It combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy, and sustainable land-use systems. A narrow definition of agroforestry is "trees on farms.

This trajectory is added by considering the fact that concern is mounting that swidden (an area cleared for temporary cultivation by cutting and burning the vegetation) agriculture is increasingly “unsustainable” because of the onrush of settlers into forests and other development pressures. One way to curtail rampant deforestation is to find alternatives to the practice of shifting fields every few years, such as by planting perennial crops instead of allowing the land to revert to second growth. There is also a trend towards tree farming in the Brazilian Amazon, which is being propelled primarily by smallholders taking advantage of market opportunities; although most of them do not even have access to credit and technical assistance (Smith *et al,* 1996). Smith *et al.* (1996) analyzed 136 polycultural fields with perennials in widely scattered locations in the Brazilian Amazon, 108 agroforestry configurations were noted involving 72 crops, ranging from fruit production to timber harvests. Small-scale entrepreneurs are clearly experimenting with a wide array of perennial crops, mostly on their own initiative. Major constraints to further intensification include inadequate development of agro industries, absence of credit, and luck of inexpensive irrigation systems and insufficient planting materials of commercially desirable varieties. If the above issues can be thought of to a certain extent, agroforestry can be a better alternative to boost farm income, while minimizing environmental damage and hence can be carried too far.

The following indicators are thought for agro-forestry based intensification.

- Forest cover
- Population density
- Livestock density

A discussion again emerged to include nature (resources) conservation as one trajectory. It was stressed that all development initiatives and alternatives should go hand-in-hand with the environment. In the past environmentally protected areas have been undergoing several transformations due to the growth of urban areas, tourism and other development intensifications. Environmental degradation is becoming much like the depreciation of physical capital but with two big differences: damages are frequently hard to reverse and ecological processes tend to be non-linear, so that ecosystem can collapse abruptly, without much prior warning. Having seen this, a need will arise either to include this as a trajectory or include it in some way in every trajectory. The planned indicators (if it can be considered as a trajectory) include presence of endemic species (yes or no) and presence of priority areas (e.g., wetlands, national parks) with a yes or no threshold.

Discussion on Thresholds

The team of experts participated in the workshop agreed by the fact that setting threshold requires data and should be based on research. Otherwise it may mislead development strategies. This is what we have seen in this document and toolbox and due to this the team was unable to make detail discussions about the thresholds. Even though it is difficult to set a threshold at this workshop, experts indicated initial threshold values of some of the new indicators added based on their experiences and existing knowledge base.

The first comment that is raised by the professionals on indicator Erosion is that tolerance limit (like 11 Ton/ha/year) which is mentioned in the draft report should not be taken as threshold rather erosion should be mapped from scientific point of view. In Ethiopia, Hurni (1983) quoted by Nyssen (2003), categorized average soil formation rates based on the agro-climatic zones which are delimited based on altitude (m) and annual rainfall (mm). Accordingly the soil formation rates ranged from 1 ton/ha/year for bereha 'desert' (altitude, 500m) to 16 ton/ha/year for Wet Woina Dega (altitude: 1500-2300m; annual rainfall; 1400mm) agro-climatic zones. This suggests that the soil tolerance limit of 11 ton/ha/year is excessive. Moreover, a rule of thumb for rilling to begin is when soil loss exceeds 15 tons/ha/year, which is met by tolerance values 11 tons/ha/year. This indicates the fact that 11 tons/ha/year is a threshold for rill formation. The following approach on erosion hazard classes is suggested to be better alternative in this case (SCRP, 1996; FAO-UNDP/LUPRD, 1984)

0-5 t/ha/year – no effect
5-15 t/ha/y – Slight
15-50 t/ha/y – Moderate
50-200 t/ha/y – Severe
>200 t/ha/y- very severe

In the same trajectory "soil and water conservation and management in crop-livestock systems additional indicators are added such as:

- Soil acidity
- Soil alkalinity

From scientific point of view, the threshold for soil acidity is set to be less than 5.5 in PH whereas the soil alkalinity is set to be greater than 9.5 in PH.

In trajectory 2 (Small- scale irrigation in crop livestock systems), Market access is added as an indicator with its threshold value of less than 4 hours. The threshold is fixed based on the fact that most agricultural products are perishable if they stay more than 4 hours.

On trajectory 3 (Rainfed smallholder intensification in crop-livestock systems or agro-pastoralist systems) the indicators for rainfall should not be on the basis of maximum and minimum annual rainfall basis instead in the form of rainfall on Length of Growing Period (LGP). The threshold for this indicator is if LPG less than 40 days it is considered arid and if it is greater than 300 days it is very humid. On this trajectory temperature extremities are also included as an indicator because temperature is a very important parameter in intensifying crop-livestock systems. The threshold for the lower extremities is less than 7.5 ^{0}c which is very cold and higher extremities greater than 27.5 ^{0}c is hot.

Under trajectory 6 (Urban Agriculture) (Modified from urban diary trajectory), the indicators are market access and proximity to growth centers and the respective thresholds are 2 hr and 4 hrs respectively. This indicator is also fixed with similar reasoning as trajectory 2. For instance, milk and its products can stay unrefrigerated for 4 to 6 hours before it begins to spoil. If it is in hot area it will begin to spoil even in one hour.

Trajectory 8 (rainfed commercial farming intensification in crop-livestock systems or agro-pastoralist systems): The indicators are:

- Access to road with thresholds **1= Yes, 0= no**
- Rainfall based on LGP with thresholds < 40 days as arid
- 300 days as very humid

The new Trajectory (Trajectory 9) named as Agro-forestry. The indicators and their respective threshold are:

- Forest cover with threshold < 50%
- Population density with threshold 0.6 percentile
- Livestock density with threshold 0.6 percentile

Procedures followed for the workshop

A team of experts from different regional stakeholders were participated in the workshop. The team includes experts from ANRS Water Resources Development Bureau (WRDB), Amhara Design and Supervision Works Enterprise (ADSWE), ANRS Bureau of Agriculture (BoA), Representatives from IFAD-PASIDP, Bahir Dar University-College of Agriculture and Environmental Sciences, Bahir Dar University-School of Civil and Water Resources Engineering, Bureau of Finance and economic Development of the region and Sustainable Water Harvesting and Institutional Strengthening in Amhara (SWHISA).

At the first instance, a visit to each of the mentioned stakeholder was carried out and personal discussions were held with organizations representative to select a specialized expert who can deliver appropriate comments and feedback to the document. Representatives responsibly assigned the required personnel for the workshop and the document was then dispatched well in advance, hence participants came very well prepared for the workshop. The workshop was held on Saturday, 11th August, 2012 at Summerland Hotel, Bahir Dar starting from 2:30AM local time.

First, a presentation was given by Mr. Bitew Genet, Staff member of the school of Civil and Water Resources engineering of Bahir Dar University about overall initiation and objectives of the Africa Rising Quick Water project. This is to familiarize and refresh the participants about the project, although it is believed that participants came prepared as the document is dispatched in advance. Mr. Michael has then delivered a presentation about the approaches followed and the components of the toolbox.

A general direction was then commented from the workshop organizers regarding how to proceed with the rest of the discussion. The approach given was to do it step by step starting from the trajectories, indicators and then to the thresholds. However, participants preferred to first comment on the document itself before proceeding to detail discussions. Consequently, a general comment on the document was forwarded as described below in the trajectories part.

Participants

No	Name	Institution	Background
1	Mr. Wubneh Belete	ADSWE	Agricultural engineering and Environmental Science
2	Mr. Mastwal Ejigu	IFAD-PASIDP, Coordinator	Agricultural Engineering and Water Resources Management
3	Dr. Kefyalew Alemayehu	College of Agriculture, Asst. Prof.	Animal production
4	Dr. Belayneh Ayele	College of Agriculture, D/Dean	Natural Resources Management
5	Mr. Dagnenet Sultan	College of Agriculture, Lecturer	Agricultural and Irrigation Engineering
6	Mr. Shiferaw Solomon	BoWRD	Socio-economist
7	Mr. Alelegne Dagnaw	BoA, SLM-Senior Expert	Livestock specialist and Ecologist
8	Mr. Elias Sime	SCWRE	Watershed Hydrology
9	Mr. Chalachew Abebe	SCWRE, Director	River Basin Development
10	Mr. Bitew Genet	SCWRE, D/Director	Agricultural and Irrigation Engineering
11	Mr. Michael Mehari	SCWRE	River Basin Development
12	Mr. Ahunim Gedif	BoFED	Planning
13	Mr. Yelebe Aneley	SWISHA	Socio-economist