Enhancing water productivity in Crop-Livestock systems of The Nile Basin: Improving systems and livelihoods

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Abstract

The Nile Basin countries, particularly Ethiopia and Sudan, own the highest number of livestock in Africa. About half of all the cattle and more than a third of all sheep and goats in Africa are found in this basin. Besides direct contribution of livestock to the national economy and household livelihoods, they perform multiple socio-economic functions for small scale farmers. They produce food, provide security, enhance crop production, generate cash income and produce value added goods which can have multiplier effects and create a need for services. Different livestock production systems have evolved as the results of spatial and temporal diversity in climate; population density, economic opportunities and cultural practices. Those evolutions in livestock production system are highly associated with amount, distribution and access to water resources. The mixed crop-livestock systems are the most apparent systems in the Nile basin. Despite these important roles, the livelihood strategy of livestock-dependent farmers and communities is endangered by declining the resource-base and water scarcity, which is unable to support the increased demand for livestock feed and human food. This is aggravated by increasing human population, land degradation and increased demand for more cereal production through expanding crop fields to grazing areas, hillsides, wetlands and protected forests. This expansion is also putting a huge pressure on the livestock systems by competing for labour, water and land resources. As a result of this competition, there is now an increased global concern on the potentially negative effect of livestock on the environment, particularly in terms of livestock-related water depletion. Livestock-environment interaction varies with production systems and stages of intensification. When thinking about livestock and water, most people visualize the voluntary intake. Drinking water is small compared to the water required to produce feed for animal. Evidences suggest that voluntary water

intake ranges between 25-50 liter TLU^{-1} day^{-1}. Volume wise, the most important interaction of water and livestock is through transpiration process in producing animal feed, which is up to 100X more than drinking water.

This paper will display proven and potential interventions developed by collaborative work of the International Livestock Research Institute (ILRI) and International Water Management Institute (IWMI) that would help communities to improve water productivity, minimize the negative impacts and magnify the economic and social values of livestock. These interventions include targeting models that would help development actors at local, national, regional scales to disseminate livestock, water and land management interventions across production systems and socio-economic niches, forage technologies that would increase feed availability without competing with crop lands, water management strategies enhancing water productivity and minimizing water depletion through livestock, collective action schemes for enabling improved governance of livestock and water resources and policy suggestion for creating incentive mechanisms for livestock-keeping communities to invest in natural resources management. These interventions will be exemplified by case studies from Ethiopia, Kenya, Uganda and Tanzania.

Flood Hazard and Risk Assessment in Fogera Woreda using GIS & Remote Sensing

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Abstract

Fogera Woreda is one of the most severely flood affected areas in Northwest Ethiopia in general and Ribb-Gumara Catchment in particular. Therefore, an attempt has been made to apply modern techniques like GIS and Remote Sensing for the assessment of flood hazard and risk in this Woreda. The flood causative factors were developed in the GIS and Remote Sensing environment and weighted and overplayed in the principle of pair wise comparison and Multicriteria Evaluation (MCE) technique in order to arrive at flood hazard and risk mapping. Landuse/cover change detection was done for the catchment using the 1985 and 1999 Landsat images. Comparison between long year (1974-2006) annual maximum daily rainfall and annual maximum daily gauge levels (1971-2005) data of Ribb and Gumara rivers showed that rainfall slightly decreases while gauge level increases, and this can be attributed to landcover removal especially in the upper catchment. Flood frequency analysis was done using Ribb and Gumara rivers annual maximum daily gauge levels by Gumbel's and Log-Pearson Type III methods, and the likely flood levels in different return periods were found. CHI square test showed that Gumbel's method was best fitted with observed data and therefore, DEM and the 100 year return period base flood from Gumbel's method were combined in the GIS environment in order to produce flood inundation maps. The major findings of the study revealed that most of the Peasant Associations (PAs) in the down stream part of the catchment and the different landuses in these areas are within high to very high flood hazard and risk level. The presence of risk assessment mapping will help the concerned authorities to formulate their development strategies according to the available risk to the area.

Key words: Flood Risk, MCE, GIS, Remote Sensing, Flood Frequency, Landuse/cover Dynamics

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IMPACTS OF IRRIGATION ON SOIL CHARACTERISTICS IN SELECTED IRRIGATION SCHEMES IN THE UPPER BLUE-NILE BASIN

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ABSTRACT

The study was conducted in five selected irrigation schemes which have been constructed before 20 years in the Upper Blue Nile Basin. Farmers' perception of changes in crop yield as a result of changes in soil characteristics and water logging problems were compared with soil physical and chemical analyses. Results were also interpreted along with irrigation water quality data. Soil profile pits were opened from selected representative sites in the respective irrigation command areas and from non-irrigated fields adjacent to the irrigated area for the purpose of comparison. Soil infiltration tests, soil pH, electrical conductivity, texture, different plant nutrient contents, CEC, base saturation, sodium etc were analyzed.

Preliminary findings show that the soil pH at Mendel and Tikurit schemes ranges mildly alkaline to moderately alkaline in both irrigated and non-irrigated sites and increased with depth due to the corresponding increase in carbonates. Moreover; the pH in water at Jedeb, Fetam and Mendel were generally higher than in other sites, therefore, potential impacts on crop yields may result from the exceedence of this irrigation guideline. However, Water quality analysis showing that low ranges of electrical conductivity values of irrigation water according to FAO guidelines. Obviously, irrigation water coming from the highlands of Western Amhara in the Upper Blue Nile Basin which are dominated by basaltic rocks is not carrying salts that might cause soil salinity. Measured infiltration rate and bulk densities in all schemes showed some variation between irrigated and non-irrigated sites.

Farmers perceive changes in land productivity as a result of irrigation activities compared with non irrigated plots especially onion crops decreased from time to times. Furthermore, seasonal water logging was observed in some of the schemes during the rainy season as a result of flat topography and vertic nature of the soils of the command area. Total nitrogen, organic carbon and to some extent available phosphorus contents are generally found to be in the range of low to very low status while potassium is found to be more or less enough for the current low yield levels.

Key Words: soil salinity, water quality, irrigation schemes, command area

Technical and Institutional Evaluation of Geray Irrigation Scheme in West Gojjam Zone, Amhara Region

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Abstract

The technical and institutional performance evaluation of Geray Irrigation Scheme was made in order to identify management practices that should be implemented to improve the system operation and the general health of the irrigation system. The technical evaluation was made by looking into the selected performance indicators such as conveyance efficiency, application efficiency, water delivery performance, and maintenance indicators. Moreover, availability of institutional and support services were also investigated through a questionnaire administered to beneficiary farmers and other stakeholders.

The results obtained showed that the main and tertiary canal conveyance efficiencies were 92 and 82 percent, respectively. Many of the secondary and tertiary canals are poorly maintained and many of the structures are dysfunctional. Application efficiency monitored on three farmers' plot located at different ends of a given secondary canal ranges from 44 to 57 percent.

Water delivery performance was only 71 percent showing a very substantial reduction from the design of the canal capacity. Maintenance indicator evaluated in terms of water level change (31.9%) and effectiveness of the infrastructures shows that the scheme management was in a very poor shape. Dependability of the scheme evaluated in terms of duration and irrigation interval shows that the scheme is performing below the intended level.

The 47 percent of the land initially planned is currently under irrigation while there was no change in the water supply indicating that the sustainability of the scheme is in doubt. The scheme was managed by four year old WUA despite the fact that it was commissioned 27 years ago. The overall rating of the WUA in terms of managing the scheme was very poor.

Support services rendered to the beneficiaries were minimal. There were very few indicators that production was market oriented. Ironically, farmers didn't recognize market as their problem. Conflict resolution has been the duty of the *Kebele* Council, and WUA has no legal authority to enforce its bylaws.

In conclusion, the overall technical adequacy of the scheme is rated as very poor requiring tremendous mobilization of community to sustainably manage it. Proper institutional setup need to be in place and WUA need to be empowered more in order to enforce its bylaws.

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The Blue Nile PUB Knowledge gaps in the Blue Nile hydrology

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Abstract

The Abbay/Blue Nile Basin with a catchment of 330,000 km^2 at the White Nile confluence has an average flow of 50 km^3 per year, constituting approximately 60% of the total Nile flow. The river water originates from the Ethiopian Plateau with, intensive rainfed agriculture. Large irrigation and hydropower dams have been built on the Blue Nile and Main Nile downstream of the Ethiopian Sudan border. Ambitious development plans for dams exist in Ethiopia but none has been built on the Abbay/Blue Nile yet.

The identification of research questions pertinent to the Blue Nile hydrology and water resources is part of ongoing efforts of the Blue Nile PUB committee (Prediction in Ungauged Basins) with the task to characterize the hydrology of the Blue Nile. The PUB committee is specifically interested in predicting the seasonal and long term variability in discharge and associated constituents (sediments, nutrients, etc) in un-gauged catchments in the upper parts of the basin where hydrological data are extremely scarce. In addition the group is concerned about the implications of natural and anthropogenic land use changes on water and sediment fluxes at different spatio-temporal scales. An added complication is that the water use and demand are not accurately identified. All these pose significant challenges for water resources management.

In the paper we will address the ongoing work on identification of the hydrology of the Abbay/Blue Nile. Specifically we will address innovative methods for data generation (remote sensing, isotopes, data assimilation, etc) to fill in the data/knowledge gaps and to review existing and new methods and models to predict the hydrology and sediment fluxes in ungauged watersheds. Current research efforts in the Abbay/Blue Nile in which the authors are involved will be summarized briefly (i.e. integrated research project, hydrological modeling studies). The presentation will conclude discussing optimal paths to implement hydrological studies in the Blue Nile Basin to validate the existing models.

Keywords: Blue Nile; PUB; hydrology; research questions

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WIND POWER-WATER EQUIVALENCY FOR THE WESTERN US REGION[1]

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ABSTRACT

This paper describes a screening study performed in 2007 to identify the potential equivalency of wind power and water resources in the 14-state Western Electric Coordinating Council (WECC). The WECC comprises the entire electric Western Interconnection. With a footprint of 1.8 million square miles within the US, two Canadian provinces, and Baja Norte, Mexico, WECC offers significant but widely dispersed potential for farming wind resources. Provided that power produced in either the areas of abundant water resources or using generation technologies that are inherently low water consumers (wind, solar, dry cooled thermal), it can be efficiently transported to areas with limited water resources and substitute for locally produced power. Hence, local water demand may be decreased by improving the ability to reliably import electricity into water constrained areas. Using resource maps of greatest wind potential, electric generation is incrementally increased to reach a regional 25% penetration target. This approach allows overloaded transmission corridors to be identified and investments made to reliably ship power to the areas of greatest demand growth. Explicit consideration is given to reserve transmission capacity to estimate WECC's ability to move power from remote sites. Wind resource assumptions are based on National Renewable Energy Laboratory wind maps, Class 3 or higher (mean annual wind speeds = 6.9 m/s at 80 m). Limits are placed on distance to load centers to avoid transmission congestion and to implicitly acknowledge an economic break-even towards lower speeds and closer distance.

This presentation will be placed in the context of energy-water issues relevant to East Africa, specifically Ethiopia and the Upper Nile Basin.

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Potential and Reliability of Small Hydropower in the Nile Basin

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Abstract

The Nile River is a potentially significant source of renewable energy in the form of hydropower. Several countries in the basin have initiated efforts to develop this resource through the construction of hydropower dams. Small hydropower plants with minimal capabilities to store water are generally less harmful to the environmental than larger plants. However, smaller plants are also less reliable since they are more susceptible to climatic variability and associated impacts on river flow. In this paper, an assessment of small hydropower potential in the Nile basin is carried out. Daily streamflow on each river reach is computed over a 10 year period from 1998 to 2007 using a geospatial hydrologic model. The potential head along each river reach is also computed using high resolution elevation data from the Shuttle Radar Topography Mission (SRTM). By combining the flows and head, hydropower potential is computed for a specified length of penstock running over the land surface. A power generation reliability analysis is conducted over the 10 year period for different scenarios of installed plant capacities. The results of the analysis are expressed in terms of estimates of the optimal run-of-river hydropower plant capacity that could be adopted for river reach if it a specified reliability of power generation. The results are also aggregated to show the small hydropower potential by administrative units.

Key words: Nile, streamflow, hydroelectric, SRTM, geospatial hydrological model