Baseline Report
Yala and Nzoia River Basins

Western Kenya Integrated Ecosystem Management Project
Findings from the Baseline Surveys

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TRANSFORMING LIVES AND LANDSCAPES

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1. Introduction

1.1 Aim and objectives

The first aim of the WKIEMP baseline reports are to synthesize a quantitative description of the baseline project situation along the ecological and socioeconomic dimensions that are relevant for project implementation. In this context, flexible strategies for selecting priority intervention areas and households at the landscape/population scale are proposed. The second aim is to lay a foundation for change detection that considers spatial variability explicitly.

1.2 Introduction to the Yala River Basin

The Yala River is one of the main Kenyan rivers draining into Lake Victoria Yala and its drainage basin covers an area of 3,351 km^2. Average discharge is 27.4 $m^3 s^{-1}$, with a total N delivery of about 1000 tonnes per year and total P delivery of about 102 tonnes per year. The Western Kenyan Integrated Management Project (WKIEMP) has identified three main areas in the Yala River Basin in which activities will take place. These focus areas (or "blocks") have been identified from ground surveys and satellite images and have been placed to represent the basin in terms of elevation, slope, rainfall regimes and land use: the Lower Yala block is located in an area with high population density and

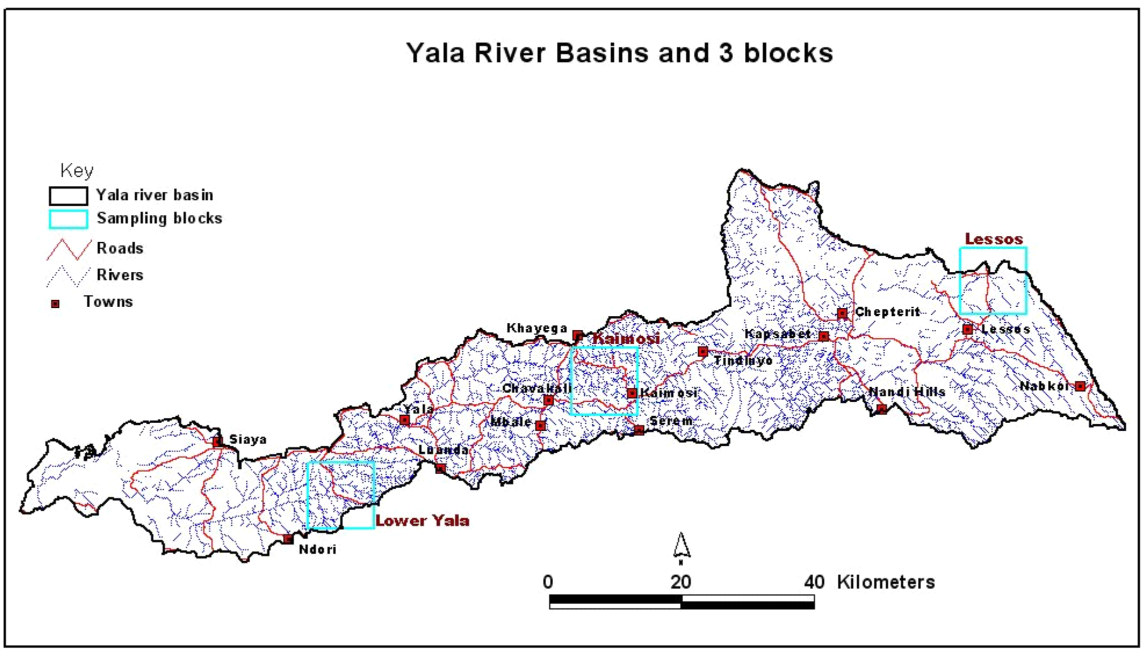

Figure 1.1 Map of the Yala River Basin showing the 3 blocks.

moderate slopes; the Middle Yala block further upslope characterized by higher elevation, moderate to steep slopes and less erratic rainfall and finally, the Upper Yala block characterized by larger farms and higher elevation.

2. Baseline data collection

Baseline data was collected for socioeconomic and biophysical parameters. Before commencing the baseline data collection, the local administration was informed of the Project and a series of meeting arranged in each of the sub-locations where sampling was to take place. KARI and ICRAF jointly hold these meetings, where the overall objectives of the Project were outlined and discussed.

2.1 Sampling design

The baseline data collection is built around the use of blocks of 10 × 10 km in size. The basic sampling unit is called a cluster. In each block, 16 centre points are generated from which 10 sampling plots that constitute the cluster are generated. Hence, in each block the sampling size is 160 plots (see map in section 3.1). The centre point of each cluster is randomly placed within each block. The sampling plots are then randomized around each cluster centre point, resulting in a spatially stratified sampling design. This sampling design ensures proportional sampling within each block and minimizes local biases. The randomization procedures are done using either customized programmes or scripts or a special Microsoft Excel spreadsheet that has been prepared for this purpose. Using these tools enables easy up-load of plot coordinates to GPS units, which are then used to navigate from sampling plot to sampling plot in the baseline data collection exercise. For more detailed information about the randomization procedure see the Biophysical and Socioeconomic Monitoring and Evaluation Plan.

2.2 Sampling methods

2.2.1 <u>Socio economic sampling methods</u>

Socioeconomic information is collected on a household level by the use of a questionnaire designed by KARI and ICRAF. The questionnaire contains 63 questions regarding various socio economic parameters such as household size and economy, livestock, soil and water conservation, agroforestry, etc. Three enumerators carry out the survey. They interview 10 households per cluster and collect one soil sample per household, (i.e. sample size is 160 households). A soil sample is collected to i) assess topsoil fertility at farm level and to ii) increase the number of soil samples collected per block to enhance the modelling of soil parameters. The soil samples are dried, crushed, and sieved through a 2mm sieve before being sent to ICRAF Nairobi for further analyses. See section below for more detailed description of analyses for soil samples. The information from the questionnaire is then entered into a Microsoft Access database created by ICRAF, which enables easy queries of data.

2.2.2 Biophysical sampling methods

Biophysical information is collected for each of the 10 sampling plots for the 16 clusters. The biophysical team collects information on soil infiltration capacity, land forms and land cover, and soil characteristics. Before sampling can begin, the sample plot needs to be laid out.

2.2.2.1 Plot lay out

Upon reaching the sampling plot, the radial arm plot method is used in setting up the plot layout as described in the Monitoring Manual. This method allows soil and vegetation to be sampled and classified for an area of $1000m^2$. After identifying the centre point (point no. 1) an additional three points are set up in the following order: sample point no. 2 is placed 12.2 m up-slope from the centre point, where point no. 3 and 4 are off-set 120^o and 240^o, respectively from the centre point in the down slope direction. Once the plot layout is set-up, sampling can begin.

2.2.2.2 Data collection

The field data recording sheet is presented in the Monitoring Manual. The recording sheet is divided into six sections, A-F:

Section A: First, the centre point location is geo-referenced using a GPS unit. Thereafter, slope is measured both up and down slope using a clinometer.

Section B: Second, the major land forms and the topographic position are described. To do this, the surrounding area is inspected and the appropriate categories, provided on the field data recording sheet, are selected.

Section C: Thereafter, the land cover for all four points is recorded using the FAO Land Cover Classification System (LCCS). This classification system recognizes 8 primary land cover types of which 5 are present in the study areas of WKIEMP: Cultivated and managed terrestrial areas, natural and semi-natural vegetation, cultivated aquatic or regularly flooded areas, natural or semi-natural aquatic or regularly flooded vegetation, and bare areas. The LCCS classification system allows the identification of different land cover types on the basis of the dominant vegetation type (tree, shrubs, herbaceous). The questions in the field data recording sheet are designed to guide one through the classification process.

Section D: In section D, we collect information regarding land use and land ownership.

Section E: Section E is for characterization of the soil surface. The first questions are on erosion and conservation. Thereafter, soil sampling at the four points is carried out. Topsoil is sampled for the 0-20 cm depth and subsoil for the 20-50 cm depth by using a soil auger. The soil samples are bulked for the two depths in separate bags. Soil depth is measured until a depth of 120 cm at 5 cm increments and the depth of restriction is indicated on the field recording sheet.

Soil texture is assessed by using the ribbon method. The method is widely used for quick assessment of texture and is also the recommended method by the Australian Gas office.

Section F: Woody vegetation is measured in this section using the T-square sampling method. This method is one of the most robust methods for sampling woody plant communities. It can be used to estimate stand parameters such as density, basal area, bio-volume, and biomass. The advantage of this method is that it is less prone to bias where plants are not randomly distributed, such as in managed landscapes. In this sampling scheme, trees and shrubs are sampled separately.

2.2.2.3 Soil infiltration capacity

Infiltration measurements are carried out at 3 of the 10 sampling plots for each of the 16 clusters. Infiltration rings measuring 12 inches in diameter are placed at the centre point (point no. 1) and infiltration rates are measured after the soil has been pre-wetted with approx. 2-3 litres of water. The data sheet is given on p. 12 in Annex 1.

The infiltration data is then entered into the Microsoft Access database designed for the biophysical baseline survey and infiltration curves are fitted using the Hortonian infiltration function.

2.2.2.4 Soil analyses

The soil samples collected from both baseline surveys are air dried for a minimum of 3 days at the ICRAF Kisumu soils laboratory. The dried soil samples are crushed and sieved through a 2mm sieve and sent to Nairobi for further analyses. Samples are first analyzed using infrared spectroscopy and a subset of samples is sent to the lab for further analysis to permit calibration of the spectral data to soil properties of interest.

After completing the data collection, data is entered into the Access database designed for the bio physical baseline survey. This data together with the entered data from the socioeconomic survey is the basis of this report.

2.3 Accessibility mapping

Spatial accessibility is determined by the geographical location in relation to target location (towns), and by the transportation facilities that are available to reach those destinations (roads). Accessibility models are derived by creating a cost surface, which establishes the impedance for crossing each individual cell.

The accessibility surface in this project was created using an extension in ArcView "Accessibility analyst" developed by CIAT staff. This extension calculates the accessibility on a friction surface, which represents a grid where each cell value represents the cost of traversing that particular cell. The data used for this friction surface include: - Roads2006.shp, Land-use (grid), and the Bounding_Box.shp for defining the limits of the analysis. The Towns dataset (towns.shp) was our target input referred to as place of interest. The aim was to come up with a general overview of the accessibility in this region, therefore the land-use dataset was customized to be a continuous grid with all the cell values having the same value of 1. Cost distance algorithms work only with grid datasets therefore, the vector datasets were converted to their respective grids with a pixel dimension of 100m.

For the cost surface modelling the gridded datasets were reclassified so that the value of each cell represents the time required to traverse the cell. Using the formula:

$$Time = cell\_size \times \left[\frac{1}{speed(km/hr) \times \left(\frac{1000}{3600} \right)} \right]$$

Assuming an average speed for each dataset, the results of the cell crossing times are shown in the Table 2.1. All the reclassified datasets (roads, land-use and bounding box) to create the friction surfaces were merged to create one grid. Thereafter the cost-distance algorithm was implemented to determine cost allocations, cost directions, and the times to target. Our map is based on time to target, which indicates the cost of travel from each cell to the nearest town. The grid output was converted to shape file for visualization.

Table 2.1 Speed and cell crossing times for the datasets used in this analysis.

Dataset	Average speed assumed (Km/h)	Cell crossing time (seconds)
Roads	60	6
Land-use	18	20
Towns	36	10
Bounding box	36	10

3. Lower Yala

The Lower Yala block is located in Kisumu and Siaya Districts and contains twelve sub-locations. This block is characterized by low to medium gradient hills, with shallow depressions and small permanent streams. The area is largely agricultural with some rangeland and thickets. The earliest land conversion from wooded grassland to agricultural land took place in 1930's and the recent conversion took place in 1980's. The forage availability is limited to the rainy season and the immediate post rainy season

The population is largely Luo, but there are areas where Luhya predominate. The area is largely subsistence farming today with a mix of crops typical of the lower elevations of western Kenya. Maize and sorghum are the major cereal crops; banana and cassava are also grown. The area is also an important producer of mangos.

A few remnant forests are left in the landscape and are used for ritual ceremonies. These forests are found in Tiriki East and they are mainly used during circumcision of boys. These areas are well protected and governed by traditional laws along side the springs. It was hard for the biophysical team to identify the tree species found in these forests because strangers are not allowed near the forest, leave alone going inside them.

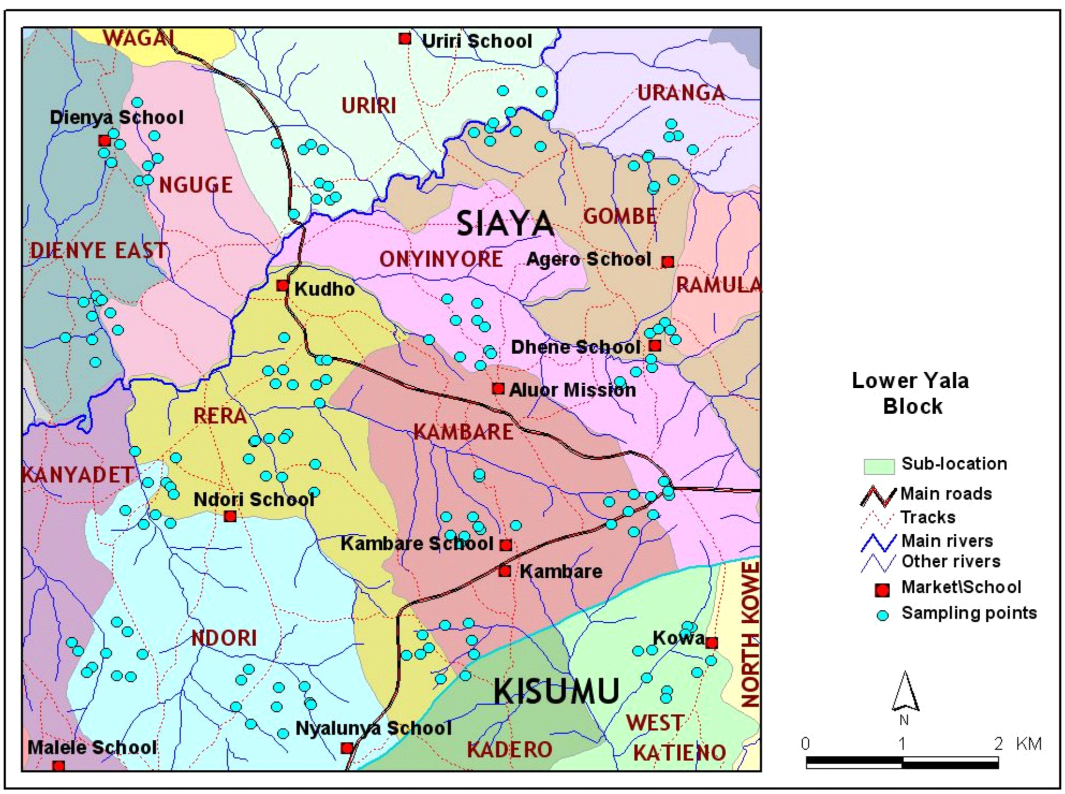

Figure 3.1. Administrative map of the Lower Yala block. The blue dots are the sampling points for the biophysical survey.

3.1 Biophysical baseline data summary

3.1.1 Topography

The area Lower Yala is generally characterized by moderately sloping terrain with slopes ranging between 1 and 35%. Moderate to steep slopes (> 10%) cover 22% of the block. Elevation ranges between 1200 and 1450 m. The northern part of the block has a few large hills (clusters 4, 12 and 16), notably Nguge Hill in the northwest corner of the block (Figure 3.2). The central and southern parts of the block have a rolling terrain. The eastern part of the block also has more sloping land with 30 to 40 percent of the plots in clusters 14 and 15 exceeding 10% slope. Around 35% of block area is flat with slopes of less than 5% (Table 3.1)

The Yala River traverses the block from the northeast to the west. The block is dissected by a number of important tributaries of the Yala, including the Ogommo Nyanyo and the Dhoneno Rivers. Cluster 8, between clusters 4 and 12 fell on the Yala River flood plain in Uriri sub-location.

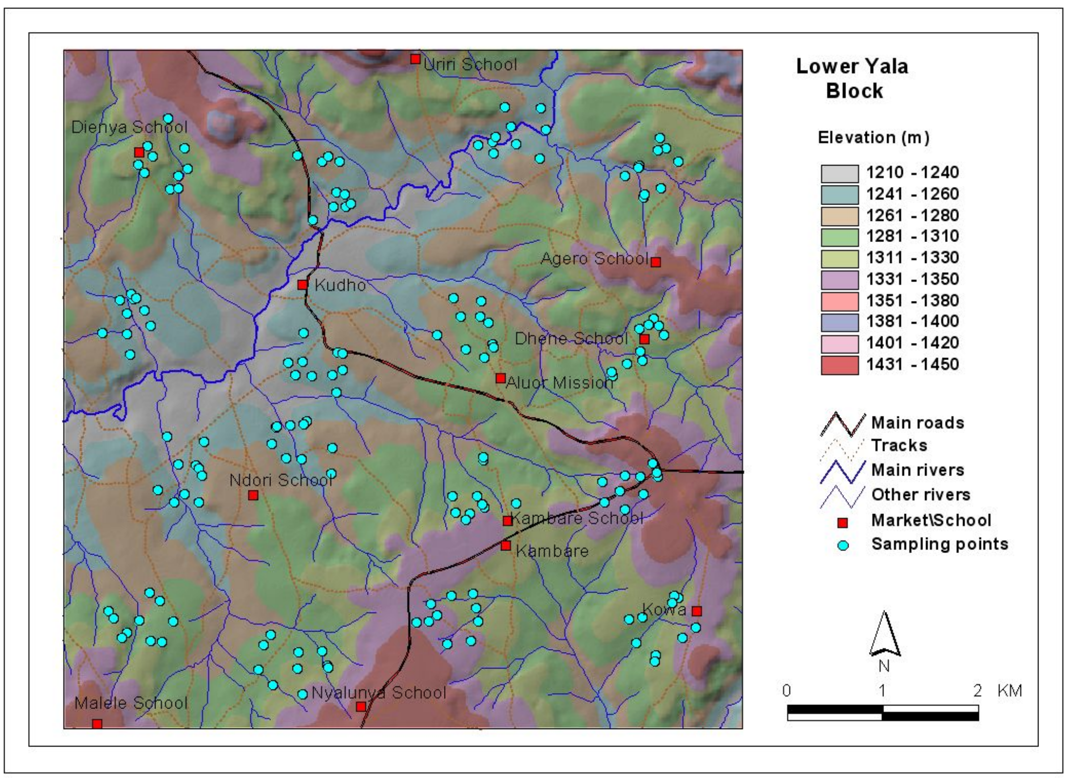

Figure 3.2. Elevation map of the Lower Yala block showing roads, streams, rivers and sampling points.

Table 3.1. Average slope, slope range and incidence of steep slopes

Cluster	Average slope (%)	Slope range (%)	No. values > 10%
1	8.71	1.7 – 19.4	3
2	3.9	0 – 12.3	1
3	6.17	3.1 – 7.9	0
4	14.06	4.4 – 34.4	6
5	4.73	3.1 – 7.0	0
6	6.47	1.7 – 11.4	2
7	5.21	2.2 – 11.4	1
8	4.97	1.7 – 10.1	1
9	6.52	3.1 – 11.4	1
10	5.83	3.1 – 12.7	1
11	6.17	1.3 – 10.5	2
12	16.65	5.2 – 30.6	8
13	6.44	2.6 – 8.3	0
14	8.9	1.7 – 18.5	4
15	8.02	1.7 – 15.8	3
16	8.55	3.9 – 21.3	2

3.1.2 Soil texture and soil depth restrictions

The soil texture in this area is mainly clay loam (Table 3.2). The soils of the eastern part of the block are somewhat lighter textured than the western part of the block, with a higher presence of sandy and silty clay loam soils. Clay soils were associated predominantly with mid-slope sites and bottomlands.

Table 3.2. Soil texture (% of samples).

Clay	Clay loam	Sandy clay loam	Sandy Loam	Silty clay	Silty clay loam	Loam	Sand
8	45	12	7	7	19	1	1

Soil depth restrictions were widespread across the block, with 39% of the subplots showing restrictions within the first 50 cm and 20% of the subplots showing restrictions within the first 20 cm. Clusters 1, 2, 11 and 14 had very high incidence of depth restriction. Clusters 3, 13 and 15 had relatively low incidence of depth restrictions.

Table 3.3. Incidence of depth restrictions per cluster (values = % of subplots per cluster with depth restrictions; n = 640).

Cluster	Shallow (≤ 20 cm)	Deep (> 20 cm)
1	40	58
2	18	56
3	10	8
4	33	20
5	15	10
6	23	8
7	15	13
8	5	25
9	28	10
10	18	10
11	48	15
12	20	18
13	5	13
14	30	30
15	5	8
16	13	0

3.1.3 Vegetation and land use

Farming is the major land-use and determines the patterns of land cover in the block (Table 3.4). Agriculture is dominated by cereal production, but there are also areas with perennial grasses for livestock grazing. There are small areas of woodland along the Yala River. Much of the land around Cluster 5 is fallow or abandoned scrub land. The project should look closely at this area for rehabilitation. The second most common vegetation type was grasslands. Natural grass species includes both perennial and annual both palatable and unpalatable for livestock. The dominant species in the area are:

1. *Cymbopogon comphanatus:* perennial grass, moderate to high forage quality;
2. *Sporobolus pyramidalis*: annual grass; low forage value;
3. *Digitaria ciliaris*: annual grass; low forage value;
4. *Digitaria gazensis*: perennial grass; high quality forage
5. *Eragrostis aspera*: annual grass; moderate forage quality;
6. *Eragrostis superba*: perennial grass; good quality forage;
7. *Hyparrhenia collina*: perennial grass; good forage, but it should be stocked in the early stages of growth.

Table 3.4. Land cover classification (N = 160)

Vegetation strata	No. points	Percentage
Fallow	28	17.5
Farm land	73	45.6
Forage land	9	5.6
Other	1	0.6
Perennial grassland	36	22.5
Shrub land	12	7.5
Woodland	1	0.6

The largest allocation of land in this block was for grazing livestock. The area used for crop production was somewhat less. Notably, food production was largely absent in clusters 4 and 11, but grazing was the dominant land use in these clusters. A small percentage of the land was used primarily for producing wood. A classification of the primary current land use showed the following:

Food / beverage:	43%	Timber / fuel wood:	12%
Forage:	55%	Other:	4%

In general there are few trees in the landscape. No woodlots or planted plantations were found during the survey. Of the 160 plots sampled only 28% or 45 plots had trees in the vicinity. This woody vegetation is mostly broadleaf and evergreen, (Table 3.5). *Markhamia lutea* was the tree most commonly encountered. *Terminalia brownii*, *Psidium guajava* and *Senna spectabilis* were also commonly seen. There was a wide variety of shrubs encountered including *Rhus vulgaris*, *R. natalensis*, *Lantana camara, Carissa indulis* and *Tithonia diversifolia*. Shrubs were widely present in the landscape and were measured on 82% of the plots. Few exotics were found on the plots sampled. *Ipomea* was widespread in this block, indicating low soil fertility.

Table 3.5. Wood vegetation type (% of plots with vegetation types present)

Broadleaf	Needle leaf	Allophytic	Evergreen	Deciduous
83.8	0.0	1.3	76.3	6.9

In this block all farms surveyed are privately owned and for 28% of the plots land use has not changed since 1990. However it was impossible to ascertain whether land use has changed for the majority of the plots (59%).

3.1.4 Soil erosion and conservation measures

Soil erosion was visible in 57% of the plots, with highest incidence in clusters 1, 4, and 6. Because of the presence of sodic soils on the lake plains in this block, presence of erosion does not always correspond with steep slopes. Clusters 10, 11 and 16 had the lowest incidence of soil erosion. The principal type of erosion is sheet erosion, but rill erosion was more common in this block than what has been seen in other blocks of the Yala River basin (especially clusters 4 and 11). Table 3.6 indicates on a cluster basis, the percentage of points showing visible signs of erosion.

Soil and water conservation is practiced in this block, but needs to be expanded. The clusters with the highest incidence of erosion were not the areas where most of the erosion control structures were encountered. Nevertheless, soil conservation structures were found in all but three clusters within the block. Therefore, the project can build on current practices and extend soil and water conservation practices. This should be done in association with tree planting should be one of the first activities undertaken in this block.

Table 3.6. Percent of plots showing erosion features for each cluster

Cluster	None	Sheet	Rill	Gulley
1	0	100	0	0
2	40	50	10	0
3	60	40	0	0
4	10	60	30	0
5	30	70	0	0
6	0	90	10	0
7	50	50	0	0
8	60	40	0	0
9	50	50	0	0
10	80	10	10	0
11	70	10	20	0
12	40	50	10	0
13	40	50	10	0
14	40	60	0	0
15	50	50	0	0
16	70	30	0	0

Table 3.7 Summary of baseline parameters

Cluster	Texture	Slope (%)	Woody vegetation cover*	Soil depth restriction (%)	Soil erosion (%)	Household size
1	Sandy clay to clay loam	8.71	Low	98	100	5
2	Clay to sandy clay	3.9	Low	74	100	5
3	Clay loam	6.17	Moderate	18	100	5.9
4	Sandy clay loam	14.06	Moderate	53	100	5.1
5	Clay loam	4.73	Moderate	25	100	8.5
6	Clay loam	6.47	Moderate	31	100	5
7	Silty clay loam	5.21	Moderate	28	100	5.4
8	Silty clay loam	4.97	Low	30	100	8.4
9	Clay loam	6.52	Moderate	38	100	5.2
10	Clay	5.83	Low	28	100	5.3
11	Clay loam	6.17	Moderate	63	100	7.2
12	Clay loam	16.65	Low	38	100	6.2
13	Silty clay	6.44	Low	18	100	7.1
14	Clay loam	8.9	Low	60	100	6.3
15	Clay loam	8.02	Low	13	100	8.9
16	Sandy clay to clay loam		Low	13	100	6.8

**** Low: <15%; Moderate: 15 to 65%, High: > 65%.***

3.2 Socio economic baseline data summary

3.2.1 Household parameters

Average household size is six people with 89% of the households having 10 members or less (Table 3.8). Only two households have more than 15 members. Population density is highest on the south side of the river (Figure 3.3). Average farm size is 3.9 acres; however, 88% of the households have farm sizes of 4 acres or less. Less than 5% of the households have farm sizes larger than 10 acres (Table 3.9). The majority of the households were male headed (70%), while the rest (25%) were female headed. One household was headed by orphans and only seven households were polygamous.

Table 3.8 Household size (N=161)

Household size	Number in sample	Percentage
3 or less	33	20.5
4	17	10.6
5	20	12.4
6	17	10.6
7 – 10	56	34.8
11- 15	16	9.9
More than 15	2	1.2

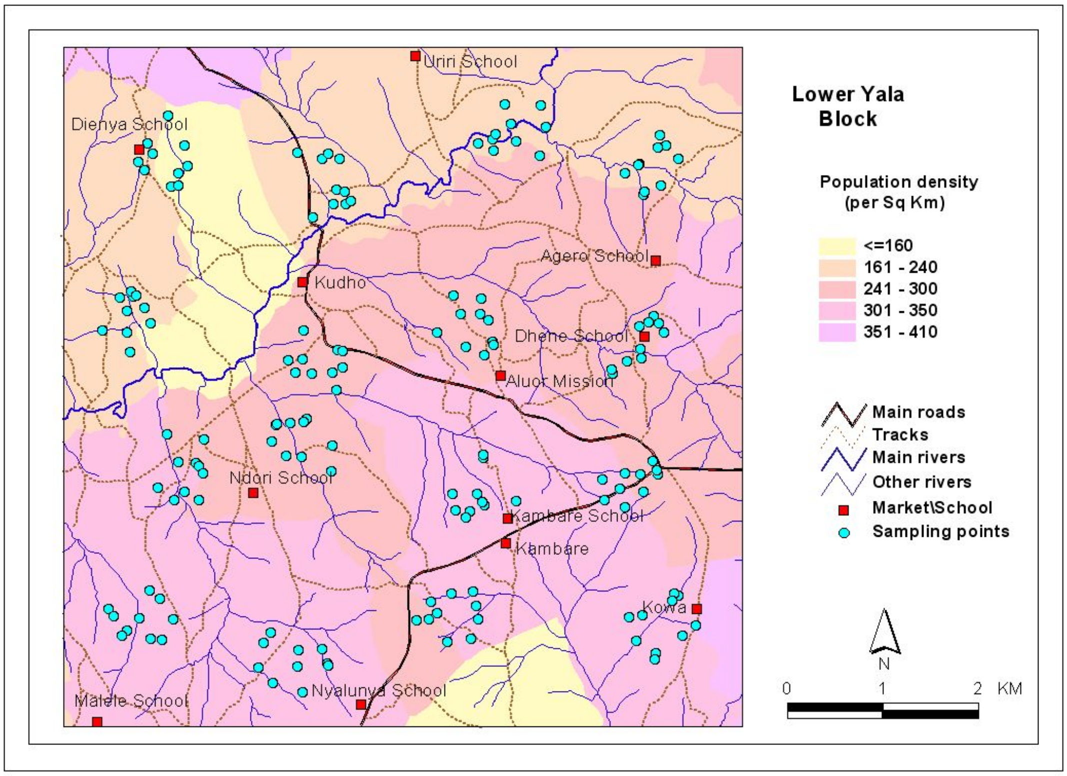

Figure 3.3 Population density in Lower Yala Block.

Table 3.9 Farm size (N=161)

Farm size	No. households	Percentage
2 acres or less	48	29.8
3 acres or less	40	24.8
4 acres or less	22	13.7
5 to 9 acres	44	27.3
10 acres or more	7	4.3

3.2.2 Land use and livestock

Of the 160 households surveyed, 156 rear livestock. Table 3.10 lists the percentage of households with different species of livestock. Only one household in the study area had pigs and seven households had donkeys. Improved breeds are not widely raised in the area. Only three households had improved breed cattle, while no improved goats or chickens were being raised in the households sampled.

Table 3.10. Livestock ownership in percentage (N=161)

No.	**Cow**		**Chicken**		**Goat**		**Bull**		**Sheep**
	Local[1]	**HB[2]**	**Local**	**HB**	**Local**	**HB**	**Local**	**HB**	**Local**
0	46.0	98.8	8.7	100.0	52.8	100.0	60.9	98.8	78.3
1	12.4	1.2	3.1	0.0	9.3	0.0	11.8	0.6	5.6
2	15.5	0.0	10.6	0.0	18.0	0.0	13.0	0.0	5.0
3	14.3	0.0	12.4	0.0	8.7	0.0	4.3	0.0	3.1
>3	11.8	0.0	65.2	0.0	11.2	0.0	9.9	0.0	8.1
Highest no.	7	1	150	0	15	0	11	1	9

[1]Local indicates local breed, [2]HB indicates improved breed

The source of fodder is mainly grasses (71%) and crop residue (56%). Average acreage used for crop residue production is 1.8 acres and livestock grazes on around 1.7 acres, on average. Grazing on communal land is common (32%) and uncommon on government land (2 cases). Commercial feed is a source of fodder for only 15 households and only 2 households buy feed at the local market. However, 83% of the households are experiencing problems with their livestock. The major problem is livestock health, with 98% of the respondents reporting problems with ticks and with disease incidence. Only 9% of the households cited fodder availability as a major problem with their livestock. However, 77% say they do not have adequate land for grazing their livestock, and 61% experience problems with free-grazing livestock from neighbours, which corresponds well with the fact that 63% of the households practice free-grazing.

3.2.3 Major constraints at the farm level

The largest constraints at the farm level are lack of financial resources and the high prices for inputs (Table 3.11). Fertilizer was often cited as a desired input. Soil related problems, particularly erosion were also important. Thus, the project should pay attention to soil erosion and fertility problems in this block. Old age and ill health were cited by a larger number of farmers than in other blocks in the river basin. Linking farm production to improved nutrition should be explored by the Project. *Striga* infestation and unpredictable weather were also seen as important constraints. Given the close relationship between *Striga* infestation and soil fertility, this is an area where the Project needs to focus some attention during the development of the PAPs.

Table 3.11. Major constrains at farm level listed by farmers

Constraints	No. 1 (N=161)	No. 2 (N=142)	No.3 (N=99)
Input costs	42	20	14
Income	34	28	11
Erosion	3	26	16
Old age/ill health	24	12	6
Striga	18	7	17
Pests	3	10	16
Weather	8	14	5
Soil fertility	10	6	4

3.2.4 Soil and water conservation

Soil erosion is being addressed by 112 of the households interviewed (71%) and the most common conservation measures are terraces (50%) and strips of grass and shrubs (16%). Here the most common species are local grass species and Napier. Of the 66 farmers using terracing as a conservation measure, three farmers have constructed 'Fanya chini' terraces. Eleven farmers have established contour lines twenty three have installed physical barriers (stones or contour ploughing).

In addition to these measures, 39 farmers are also harvesting water, mainly from the roof, for domestic use. Hence there seems to be a need to assess the soil and water conservation measures and assist the farmers in selected better measures and integrating trees and legumes in the control of runoff water and soil erosion. This would simultaneously address the low soil fertility that many farmers are mentioning as one of the largest constraints at farm level.

3.2.5 Trees & Agroforestry

The majority (75%) of the farmers are practicing agroforestry. All of the homesteads sampled have trees which are protected (Table 3.12) and 85 percent of the farmers interviewed are interested in planting more trees, which corresponds well with the farmers' response to practicing agroforestry. Only 27 farmers out of 161 are not interested in planting more trees, which is mainly due to land size (6 farmers), age and ill health (10 farmers), husband making such decisions (4 farmers) and the farmer feels that he or she has enough trees (3 farmers). Approximately 23% of the farmers interviewed are planning to cut down trees on their farm. Seven farmers mentioned cultural practices as a hindrance to tree planting.

Table 3.12. Tree species on-farm (N=161)

No.	Tree species	No. farms with the species
1	*Markhamia lutea*	100
2	*Mango*	98
3	*Eucalyptus spp.*	60
4	*Avocado*	36
5	*Cypress*	17
6	*Guava*	15
7	*Grevillea robusta*	10
8	*Jacaranda mimosifolia*	10

Reasons for growing trees include producing fruits, fuel wood, timber and to reduce the negative effects of wind (>75% for each). Thirty-eight percent of the respondents use trees grown on the farm for medicine and 60% grow trees for cash income. Less than 25% of the farmers use trees to produce fodder and address soil fertility. Therefore, the project should organize community training to raise awareness of opportunities offered by expanding the growing of trees and production of other tree products to facilitate better integration of trees into the farming system. Using farmers' answers to rank the importance of agroforestry products the top 10 uses were:

1. Fruits
2. Fuelwood
3. Timber
4. Wind breaker
5. Food
6. Cash income
7. Aesthetics
8. Medicine
9. Fodder
10. Soil fertility

3.2.6 Household energy supply

The main sources of fuel for the farming families in this block are wood and paraffin (Table 3.13). About 75% of the households are not energy self sufficient, which might explain the high number of farmers interested in more tree planting as mentioned above. More than 85% of the interviewed farmers are interested in planting more trees.

Table 3.13. Fuel use by source

Fuel source	Percentage
Wood	100
Paraffin	99
Charcoal	75
Crop residue	17
Solar	1

3.2.7 Training and group membership

The majority of the farmers interviewed have not received any training. Only 41 of the 161 farmers interviewed have received any type of training; most (35) were members of a group. Many farmers in this area (70%) are of members of groups. There are over 130 groups active in the clusters that were surveyed. Table 3.14 lists the number of croups by cluster. Therefore, there is a good base upon which to build the training program in the block for these groups.

Table 3.14. Examples of community groups in different clusters

Group name	Cluster	Main activity
Kwe gi lamo	1	Basket weaving
Kanyasiboki	5	Chicken rearing
Karabuor	6	Store cereals and sell after sometime
Nyiseme women	11	Farming
Aluor self help	11	Local chicken rearing, horticulture
Riwruok e teko	11	Vegetable farming, sell produce, saving money
Otieno Moyie	15	Agricultural production
Aluor cent	15	Saving and lending money

3.3 Market accessibility

Market accessibility is generally good throughout the block, but a few areas in the north-eastern corner, particularly around clusters 12 and 15, are relatively isolated from markets (Figure 3.4). Because the area has a reasonably good road network, market oriented activities, like growing wood for timber or fuelwood may be feasible.

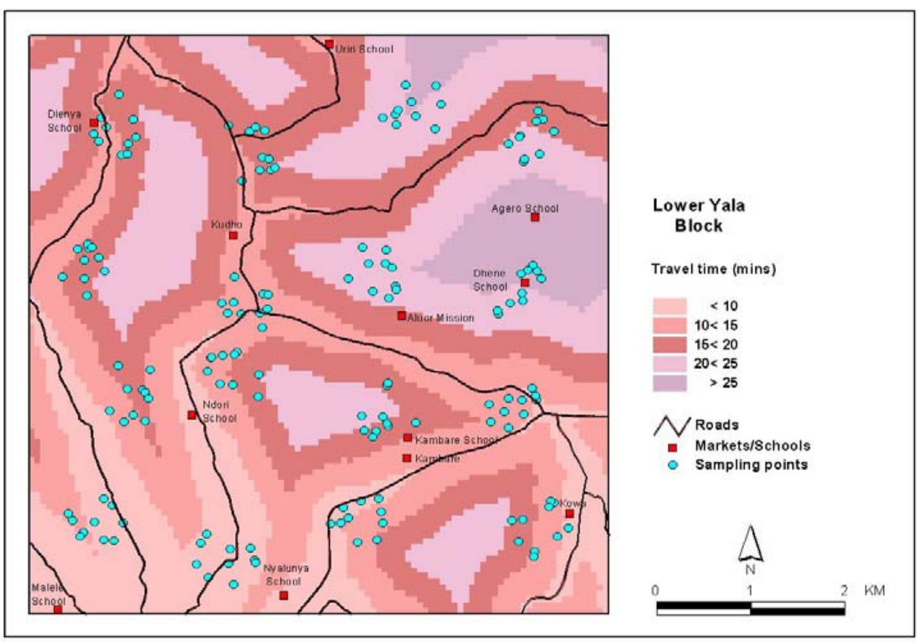

Figure 3.4 Market accessibility.

3.4 Management Recommendations

The block has a high population density the land is largely used for subsistence agriculture. Trees are not particularly common in the landscape, but are scattered across the block. The remaining woody vegetation is under high pressure and cutting for timber, charcoal, and fuelwood is common. The forage quality of the grasslands and grazing lands is low, with the exception of few areas with better quality species, which are of good to medium grazing value. Soil erosion and hard setting is a major problem in this block and baseline data shows severe land degradation in the entire block, except for the river valleys (cluster 3). Hence, activities which halt the degradation of areas that are still being cultivated should be given priority.

The greatest amount of abandoned degraded land occurs in the western portion of the Block, particularly around clusters 1, 2, and 4. This area should be the focus for land rehabilitation work. Such activities should include tree planting and control of free-grazing. Elsewhere in the block, soils are degraded, but still cultivated. Over 70% of the households practice conservation, and yet the entire block continues to experience soil erosion and large scale runoff. These areas should be targeted for soil conservation and development of agroforestry systems that maintain more permanent vegetative cover. Additional erosion and hard setting on these sites could render them unfit for cultivation.

When discussing interventions with communities, farm size and soil depth restriction need to be considered. Average farm size is 4.3 acres, which is considerably smaller than elsewhere in the river basin. More than 30% of the sampled points have soil depth restriction at 20 cm, hence it is important that soil depth is assessed before any activity is planned and implemented.

The areas adjacent to the tributaries of the Yala River need to be stabilized and interventions set up to protect the river banks. Recommended interventions are improved fallows and other leguminous cover crops such as *Dolichos lablab* and *Mucuna spp.* and planting of indigenous trees in riparian buffer zones.

In general, farmers are interested in agroforestry; however, most farmers have planted *Markhamia lutea* and *Eucalyptus spp.* and have poor knowledge of other indigenous trees and their purposes. The most common species besides these two are fruit trees, *Cupressus lusitanica*, *Grevillea robusta*, and *Jacaranda mimosifolia*, all exotics. There are a wide range of indigenous trees which are suitable for the area which should be promoted through training and meetings with community groups and extension officers. Focus should be on species suitable for timber, fuel, fodder, and soil fertility. In order to successfully increase the tree cover of this block, there is a need to focus on the purposes and benefits of indigenous trees. More than 70% of the farmers are not self sufficient with firewood and under general comments many farmers asked for more knowledge on trees and especially inquired about access to seeds. Hence, there is an interest for tree planting upon which this project should capitalize. This can be done through training of community groups, by tree planting in screening trials and degraded areas and in schools.

Many farmers cite old age and ill health as a constraint. The project should evaluate the labour requirements of improved practices and assess the appropriateness of the activities given this constraint. The project might also look at the nutrition of the population and find alternative food sources that facilitate balanced nutrient intake.

Striga infestation is an important constraint in the block, but less important than elsewhere in the river basin. *Striga* weeds grow well on poor soils with low soil fertility. Studies in Western Kenya, by Boye (2005)[1] and Gacheru and Rao (2005)[2], show that relay-cropping maize and beans with improved fallows reduce *Striga* infestation after a few rotations. At the same time, soil fertility is improved and the farmer has additional benefits from the wood produced by the fallow crop, fodder and firewood.

Many farmers listed erratic rainfall as a major constraint at the farm level. The erratic rainfall pattern of Lower Yala is likely to continue and perhaps worsening in the coming years because of climate change. Hence, interventions which increase soil cover and soil fertility, and which promote diversification should be given priority, since these interventions will buffer the variable climatic conditions. Secondly, the few but heavy rains should be harvested in ponds and dams to ensure better water availability throughout the year. Hence, establishment of ponds and dams is another priority activity to be considered by the Project team.

All households surveyed have livestock; however, 83% of the farmers are experiencing problems with their livestock. A large number of farmers report health problems and the lack of adequate veterinary services in the area. Ticks and tick-borne diseases are a problem in the area. The Livestock Officer of the Project should look into this and liaise with potential service providers to find affordable and appropriate solutions for these farmers. Fodder supply and quality is not as important a problem in this area as it is elsewhere. Free-grazing is a major problem in the entire block and is a threat to tree planting activities. The project should therefore assist the communities in setting up by-

[1] Boye, A. (2005) Effect of Short Term Fallowing on Maize Productivity and Soil Properties on a depleted Clayey Soil in Western Kenya. PhD dissertation University of Copenhagen

[2] Gacheru, E. & Rao, M.R. 2005. The potential of planted shrub fallows to combat Striga infestation on maize. *International J. Pest Management*, 51(2): 91-100.

laws to control free grazing and promote live fencing. It is imperative that free grazing be controlled for the project to have any impact in terms of tree planting and rehabilitation of degraded areas. Several Acacia species can be planted as live fences since they are tolerant to browsing. If farmers begin controlling grazing, an alternative fodder source needs to be provided. Establishment of fodder banks and the encouragement of hay production might also be considered with communities. Planting trees at wide spacing (e.g. 4 x 10 m) on degraded sites would allow for both wood and grass production, where the grass could be used to augment fodder availability for farmers. Another option that needs to be explored with communities is intercropping food crops with a legume that can also be used as animal feed. One such system is improved fallows. The legume, *Dolichos lablab* can also be used as animal feed.

In general, few farmers have improved breed livestock. To upgrade the breeds, the project should introduce hybrid bulls and goats perhaps in collaboration with the Kenyan dairy goat association. Their regional office for Western Kenyan branch is in Mbale. Rotating the hybrid sires in the area and controlling breeding with local bucks will be more cost effective compared to buying individual hybrid animals. However, a rotational system requires more management.

Finally, establishing and strengthening of community groups should also be an activity of the project. Most of the farmers who have received training are members of groups. Yet a significant number of farmers in the area do not belong to groups and have not received training. Also, for the scaling up of successful project activities, well functioning groups are imperative. Furthermore, the problems of flooding in the middle and lower parts of the block are caused in part by activities up slope. The link between the farmers up slope and the farmers down slope should be made through joint training sessions for groups in both locations.

4. Middle Yala

The Middle Yala block is located in Vihiga and Kakamega Districts. The block contains twenty-eight sub-locations as well as the Kaimosi forest (Figure 4.1). The landscape consists of mountainous highlands in the northern part of the block, with numerous small streams and clusters of wetlands. In the south-eastern part of the block, the Kaimosi forest is located where logging is taking place and the forest reserve is being used for cultivation. Throughout the block there are remnant forests which are used for cultural ceremonies. These forests are preserved and not accessible for the communities for wood and firewood supply. The conversion to agriculture took place in the 1930s. Today the majority of the farms are over utilized and few farms are practicing the traditional rotations with periodic fallows.

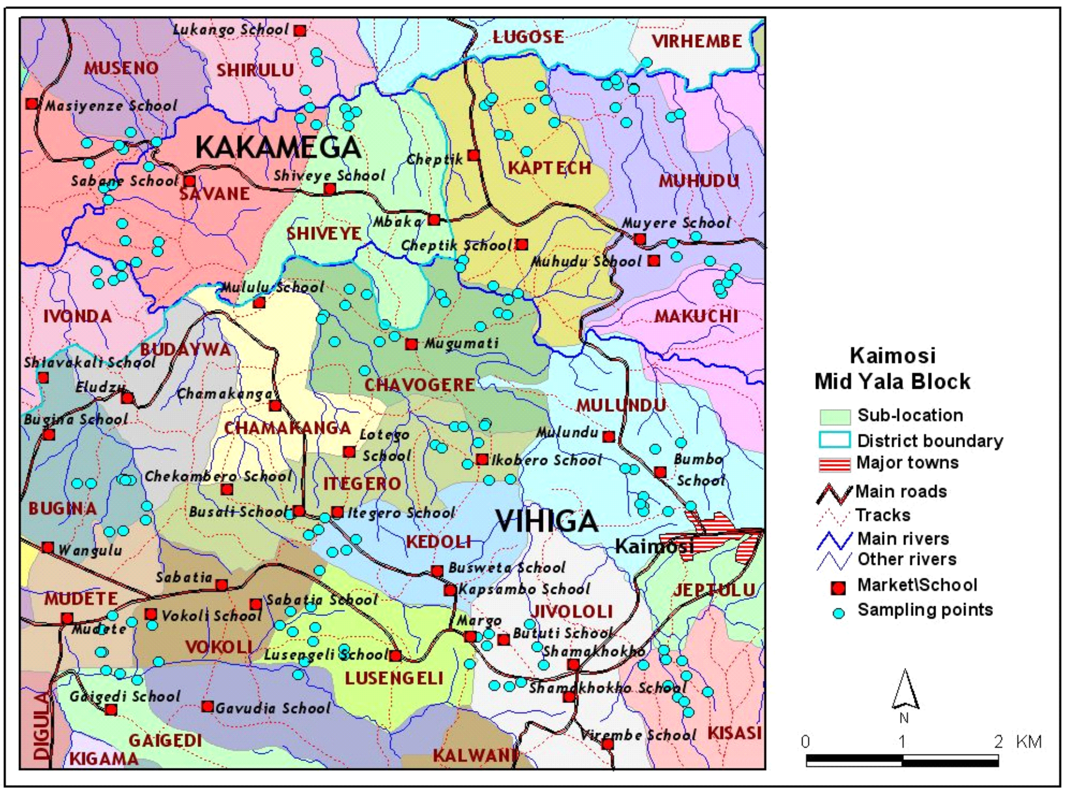

Figure 4.1. Administrative map of the middle Yala Block. The blue dots are the sampling points for the biophysical survey.

The Gold River divides the block into the southern and northern parts. The southern part of the block is characterized by better farming practices and a greater presence of trees in the landscape. The major cash crop is tea. In this area all farms have hedges along the farm boundaries and few animals are seen to graze freely. The northern part of the block is characterized by poor farming practices with cultivation of steep slopes without conservation measures. In this area, few trees are seen in the landscape and few land owners have demarcated their farms. The area around cluster 16 is part of the Kakamega forest reserve, however, all trees have been cut and the area is bare, with scattered patches of grasses present. The tea farms in this area are not well managed, contrary to the southern part of the block where the tea is well established and managed.

4.1 Biophysical baseline data summary

4.1.1 Topography

The area of Middle Yala is made up of highlands with numerous small streams and clusters of wetlands (Figure 4.2). Elevation ranges from 1430 to 1720 m, with the highest areas in the southern part of the block. Lowest elevations occur on the river flood plains. Average slope ranges from 1 to 11%; however, slopes of more than 15% are not uncommon and steep slopes are found throughout the block (Table 4.1).

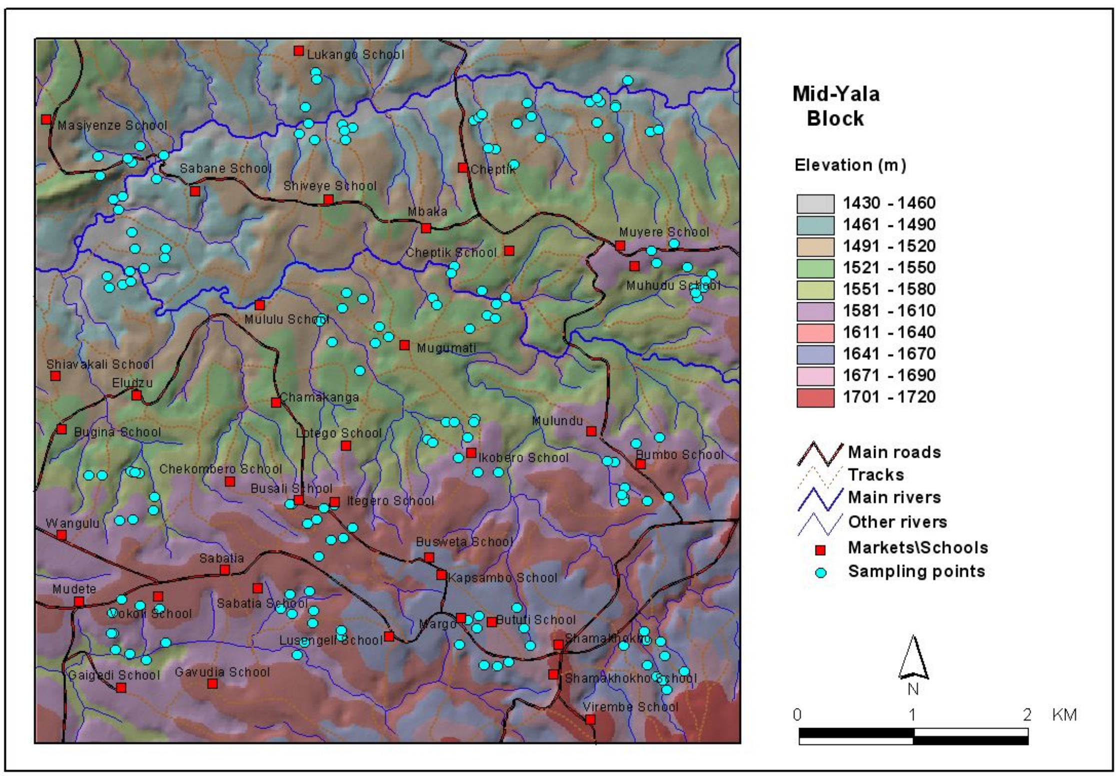

Figure 4.2. Elevation map of the Middle Yala block showing roads, streams and rivers.

Table 4.1. Average slope, slope range and incidence of steep slopes

Cluster	Average slope (%)	Slope range (%)	No. values > 10%
1	11.2	2.62 – 44.62	3
2	12.3	5.67 – 31.73	5
3	13.9	5.23 – 36.24	6
4	15.9	6.1 – 32.14	7
5	7.4	2.18 – 19.51	2
6	12.0	3.05 – 39.07	3
7	17.3	5.67 – 37.46	8
8	12.6	4.36 – 31.73	6
9	6.1	1.75 – 19.08	1
10	9.8	3.49 – 19.51	3
11	8.3	2.18 – 21.64	2
12	13.0	5.67 – 27.56	6
13	22.0	3.93 – 40.27	6
14	12.7	4.8 – 25.88	6
15	16.6	8.28 – 39.87	7
16	14.3	5.67 – 30.07	8

4.1.2 Soil texture and soil depth restriction

The soils found in this block are predominantly loamy to clayey in texture. The most common soil type is clay (46%) and silty clay soils (32%), as listed in Table 4.2.

Table 4.2. Soil texture.

Silty clay	Clay	Clay loam	Silty clay loam	Silty loam	Loam
32%	46%	15%	1%	6%	<1%

Soils in the block are moderately deep to deep. Soil depth restriction was not important in this block. Restrictions were apparent in less than 10% of the sites sampled and found to be present mainly around clusters 4, 8, 9 and 13.

4.1.3 Vegetation and land use

Farming is the major land-use and drives land cover in the block (Table 4.3). Agriculture is dominated by maize, beans, banana, and sweet potatoes. The southern part of the block has a significant area under tea, which is sold to the local factory in the area.

Table 4.3. Land cover classification (N=158)

Vegetation strata	No. points	Percentage
Farm land	121	77%
Forage land	4	3%
Perennial grassland	15	9%
Shrub land	3	2%
Plantation / forest	7	4%
Other	8	5%

The second most common vegetation type was grasslands. Some remnant forests are also seen around cluster 7, 10, and 11 which are all located in the centre of the block. The woody vegetation found in these forests has not been assessed since outsiders are not allowed inside these areas, for cultural reasons. The Kaimosi forest, which is located in the proximity of cluster 16 is the only forest left in the area. A classification of the primary current land use showed the following:

Food / beverage:	69%	Timber / fuel wood:	19%
Forage:	28%	Other:	8%

Generally the woody vegetation is broadleaf and evergreen (Table 4.4). An assessment of the trees in the landscape shows that of the 160 sampled plots only 53 (33%) had trees in the vicinity. Clusters for which more than half of the sampled plots had trees in the vicinity were 5, 7, 9, 11, 13 and 14.

Table 4.4. Woody vegetation type (% of plots with vegetation types present)

Broadleaf	Needle leaf	Allophytic	Evergreen	Deciduous
68.1	0.0	3.1	53.1	3.1

The following species were seen in the landscape: *Eucalyptus spp.*, *Pinus patula*, *Bischovia spp.*, *Croton macrostachys*, *Cupressus lusitanica* and *Bridelia micranthus*. Eucalyptus is mainly planted for timber and construction whereas the other species are planted for shade, boundary demarcation and fuel wood. Fruit trees in the area are mainly Mango (*Mangifera indica*), Avocado (*Persia americana*) and Paw paw (*Carica papaya*). There appears to be a culture of planting trees in the southern part of the block, which the project should build upon. However, the majority of the farmers are planting Eucalyptus seedlings and there is therefore a need for diversification of the woody vegetation. This can be achieved through training and nursery establishment in the targeted micro-catchments.

The shrubby vegetation is generally less than 1m in height. Among the plots, 67% have vegetation between 0.03 to 0.8m, whereas 11% of the plots do not have any shrubby vegetation present. Hence, 23% of the plots have shrubby vegetation larger than 0.8m.

In this area the majority of the farms are privately owned (94%). No farms are located on communal land, whereas nine farms are situated on government land. Land-use appears stable as owners of 46 % of the surveyed plots report that has not changed since 1990; 40% of the farms did not know whether land use has changed or not. Only 14% of the farmers reported that land use on their farms has changed since 1990.

4.1.4 Soil erosion and conservation measures

Soil erosion is visible over about half of the survey area: 41% of the sampled plots showed visible signs of sheet erosion and 5% showed active rill erosion (Table 4.5). One farm experienced gully erosion.

Sheet erosion is widely observed in clusters 1, 2, 7, 10 and 13; however, only 20 farms have established soil and water conservation measures: 11 vegetative and 9 structural. Of the 63 plots experiencing sheet erosion, only 19 have soil and water conservation structures in place: 9 vegetative and 9 structural. Of the plots experiencing rill erosion (7) only one farmer has established measures to control erosion and runoff. The high presence of soil erosion and the low numbers of soil and water conservation measures should be one of the key-entry points in this block.

Table 4.5. Percent of plots showing different types of erosion in each cluster.

Cluster	None	Sheet	Rill	Gulley
1	40	60	0	0
2	30	70	0	0
3	80	10	10	0
4	60	40	0	0
5	40	10	50	0
6	60	40	0	0
7	20	60	0	0
8	80	20	0	0
9	90	10	0	0
10	10	80	10	0
11	70	20	0	0
12	60	20	0	0
13	30	70	0	0
14	60	40	0	0
15	60	40	0	0
16	50	40	0	10

Table 4.6. Summary of baseline parameters

Cluster	Texture	Slope (%)	Woody vegetation cover*	Soil depth restriction (%)	Soil erosion (%)	Household size
1	Silty clay	6.5	Low	0	60	6.9
2	Clay	7.1	Low	0	70	6.2
3	Silty clay	8.1	Low	0	10	8
4	Silty clay	9.2	Low	0	40	5.2
5	Clay	4.3	Low	0	10	5.3
6	Clay to Clay Loam	7.0	Low	0	40	6.9
7	Clay	10.0	Low	0	60	7.1
8	Silty clay	7.3	Low	0	20	6.7
9	Clay	3.5	Low	0	10	8
10	Clay	5.6	Low	0	80	6.1
11	Silty clay	4.8	Low	0	20	6.8
12	Silty clay	7.5	Low	0	20	6.6
13	Silty clay	12.9	Moderate	0	70	6
14	Clay	7.3	Low	0	40	7.4
15	Clay loam	9.6	Low	0	40	5.8
16	Silty clay	8.2	Low	0	40	5.3

**** Low: <15%; Moderate: 15 to 65%, High: > 65%.***

4.2 Socio economic baseline data summary

4.2.1 Household parameters

Average household size is seven people with 93% of the household having 10 members or less (Table 4.7). A few households have more than fifteen members (3 homes). Farms are particularly small in this block and population densities are very high. Average farm size is only 1.9 acres; however, more than 45% of the households have farms of less than one acre. Only 16% of the farms have farm sizes larger than 4 acres (Table 4.8). Population density is highest in highlands in the southern portion of the block (Figure 4.4) and is particularly low in the north-eastern corner of the block. The majority of the households are male headed (83%) where 14% is female headed. Only one household is headed by orphans, whereas 3 households are polygamous.

Table 4.7. Household size (N=160)

Household size	Number in sample	Percentage
3 or less	20	12.5
4	26	16.3
5	22	13.8
6	16	10.0
7 – 10	64	40.0
11- 15	9	5.6
More than 15	3	1.9

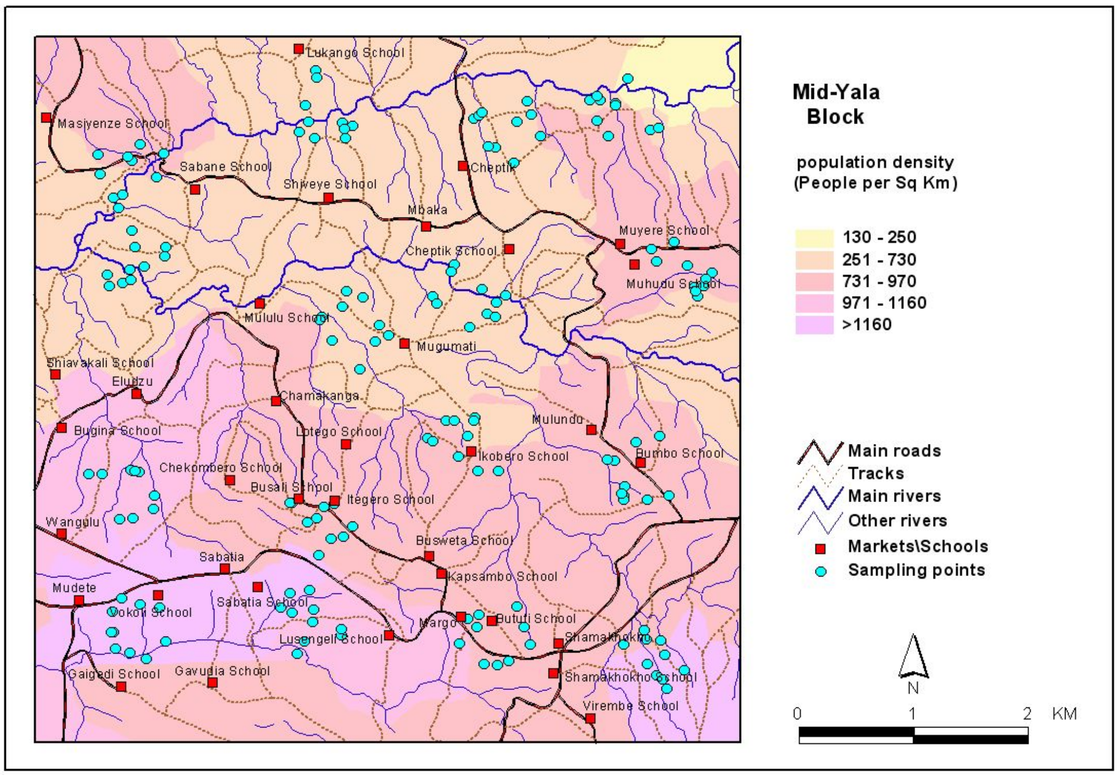

Figure 4.4. Population density in the Middle Yala Block

Table 4.8. Farm size (N=160)

Farm size	No. households	Percentage
2 acres or less	105	66%
3 acres or less	29	18 %
4 acres or less	16	10 %
5 to 9 acres	9	6 %
10 acres or more	1	<1 %

4.2.2 Land use and livestock

In this block eight households in the sample did not keep livestock, hence 152 household reared livestock. Table 4.9 presents a breakdown of livestock by type. Only one household in the study area has pigs. In general farmers are keeping local cows, bulls and chickens. Only a few farmers keep improved breeds: cows 30 households, bulls 7 households and chicken 2 households.

Table 4.9. Livestock ownership in percentage (N=160)

No.	Cow		Chicken		Goat		Bull		Sheep
	Local[1]	**HB[2]**	**Local**	**HB**	**Local**	**HB**	**Local**	**HB**	**Local**
0	33	81	14	0	89	0	75	96	90
1	32	11	12	0	5	0	14	3	6
2	21	4	6	0	3	0	6	1	3
3	10	2	13	0	2	0	2	0	0
>3	4	2	54	1	1	0	3	0	1
Highest no.	7	5	30	24	4	n/a	5	2	5

[1]Local indicates local breed, [2]HB indicates improved breed

The source of fodder is mainly grasses (74%) and crop residue (66%). Average acreage used for production of crop residue for fodder is 1 acre, whereas livestock is grazed on 0.4 acres, on the average. Few farmers leave their livestock to graze on communal (16 cases) and government land (19 cases). Commercial feed is an additional source of fodder for 14 households, and 16 households also buy feed at the local market (dairy meal and cattle salt). Approximately half of the households (53%) are experiencing problems with their livestock and a similar amount does not have adequate land for feeding their livestock (48%). Free-grazing livestock is a problem to 53% of the households, which corresponds well with the fact that 52% of the households practice free grazing.

Therefore, establishment of fodder banks and promotion of trees such as *Albizia coriaria*, *Calliandra calothyrsus*, *Cordia abyssinica*, *Croton spp.*, *Grevillea robusta*, *Gliricidia sepium* and *Leucena spp.*, which are also palatable for livestock, should be one of the key activities for the project.

4.2.3 Major constraints at the farm level

Farmers identified numerous constraints at the farm level (Table 4.10), the most prevalent of which are: lack of income, farm size and low soil fertility. Erratic rainfall was also listed by many farmers. Other problems cited included pests and diseases and soil erosion.

Table 4.10. Major constrains at farm level listed by farmers

Constraints	No. 1 (N=160)	No. 2 (N=143)	No.3 (N=110)
Income	74	33	18
Farm size	23	14	10
Low soil fertility & yields	23	17	3
Lack of implements & inputs	14	19	12
Rainfall	8	11	15

4.2.4 Soil and water conservation

Soil erosion is being addressed by 121 of the households interviewed (76%) and the most common conservation measures are terraces (93 farms) and strips of grass and shrubs (80 farms). Of the 93 farms using terracing, 10 farmers say they have constructed Fanya chini terraces, which most studies show increase soil erosion. Reporting by farmers does not correspond to what we observed during the biophysical baseline survey. Thus, the Project should look carefully at these landscapes and evaluate the adequacy of soil conservation measures.

Farmers also make use of crop residue, Napier grass and bananas to control soil erosion, whereas few farmers use shrubs and trees in association with conservation measures. Only two farmers also mentioned *Sesbania sesban* and *Calliandra spp.* when asked about species used to control soil erosion.

Many farmers also harvest rain water for domestic use and mention lack of storage facilities as a major constraint to fully benefit from this initiative.

4.2.5 Trees and Agroforestry

The majority of the farmers are practicing agroforestry (Table 4.11). More than 95% of the homesteads have trees that are protected and more than 80% of the interviewed farmers are interested in planting more trees, which corresponds well with the farmers' response to practicing agroforestry. Here more than 99% of the farmers say they practice agroforestry. Only 30 farmers out of 160 are not interested in planting more trees, which was mainly due to land size (37%) and the fact that the husband makes such decisions (10%). Other reasons mentioned are theft, being a squatter and having enough trees on the compound. A fairly high percentage mentioned cultural practices as a hindrance to tree planting (51%). There is no clear pattern to this belief with regards to the clusters. The project, therefore, needs to look into this in more detail before planning any activities in relation to tree planting.

Agroforestry products were rated as follows with regards to the usage:

1. Fuel wood
2. Fruits
3. Wind breaker
4. Food
5. Timber
6. Fodder
7. Medicine
8. Aesthetics
9. Soil conservation
10. Soil Fertility

Table 4.11. Tree species on-farm (N=160)

Tree species	No. farms with the species
Eucalyptus spp.	135
Fruit trees	81
Avocado	62
Croton macrostachys.	38
Cupressus lusitanica.	30
Grevillea robusta	23
Markhamia lutea	13

The fact that 50% of the households do not have adequate fodder for their livestock and the low rating of fodder on the usage of agroforestry products should be one of the key interest points in this area for the Project. In addition, the low rating of agroforestry for soil and water conservation and soil fertility needs to be addressed in this area. Here the project should capitalize on the fact that 76% of the farmers practice soil and water conservation and the relatively high interest in tree planting.

4.2.6 Household energy supply

The main sources of fuel are wood, paraffin and charcoal (Table 4.12). More than 90% of the households are not self sufficient with fuel, which might explain the high number of farmers interested in planting more trees. The fact that almost one third of the households interviewed use plant residues as a source of fuel should be addressed. Crop residue should be returned to the soil to improve the nutrient balance and not be exported from the system. Training on nutrient cycling and crop rotation should be given to the communities with special emphasis on leguminous trees and shrubs.

Table 4.12. Fuel source

Fuel source	Percentage
Wood	100%
Paraffin	99%
Charcoal	49%
Crop residue	29%
Animal waste	0%
Gas	3%

4.2.7 Training and group membership

The majority of the farmers have not received any form of training. Only 37 of the 160 farmers interviewed had received training and of these 22 farmers are members of a group. Only 15 farmers who are currently not a member of any groups have received training. Therefore, there seems to be a need to assist the communities in establishing groups and to train these groups in the topics mentioned above. However, special focus should be on the importance of trees and functions of trees in terms of products and uses. Secondly, soil and water conservation measures should be addressed in association with fodder production. There are groups in the area that are already focusing on tree planting, intensification of agricultural practices, horticulture and livestock. Table 4.13 lists some of these groups.

Table 4.13. Groups and main activity undertaken

Group name	Cluster	Main activity
Kiyaguza	2	Agriculture
Kinyenyi Women	2	Women's activities
Itoro Women	7	Horticulture & livestock
Avirina Women	7	Women's activities
Isukha Mulindi	8	Tree planting – indigenous trees
Jitolee Youth	10	Horticulture & fuel wood
Chavogere Maendeko Women	10	Horticulture
Jinjini Farmers	12	Tree planting & banana production

4.3 Market accessibility

Market accessibility is generally good throughout the block, but a few areas in the north and western part of the block are relatively isolated from markets (Figure 4.4). In this block as well, the area has a reasonably good road network, so market oriented activities, like growing wood for timber or fuelwood may be feasible.

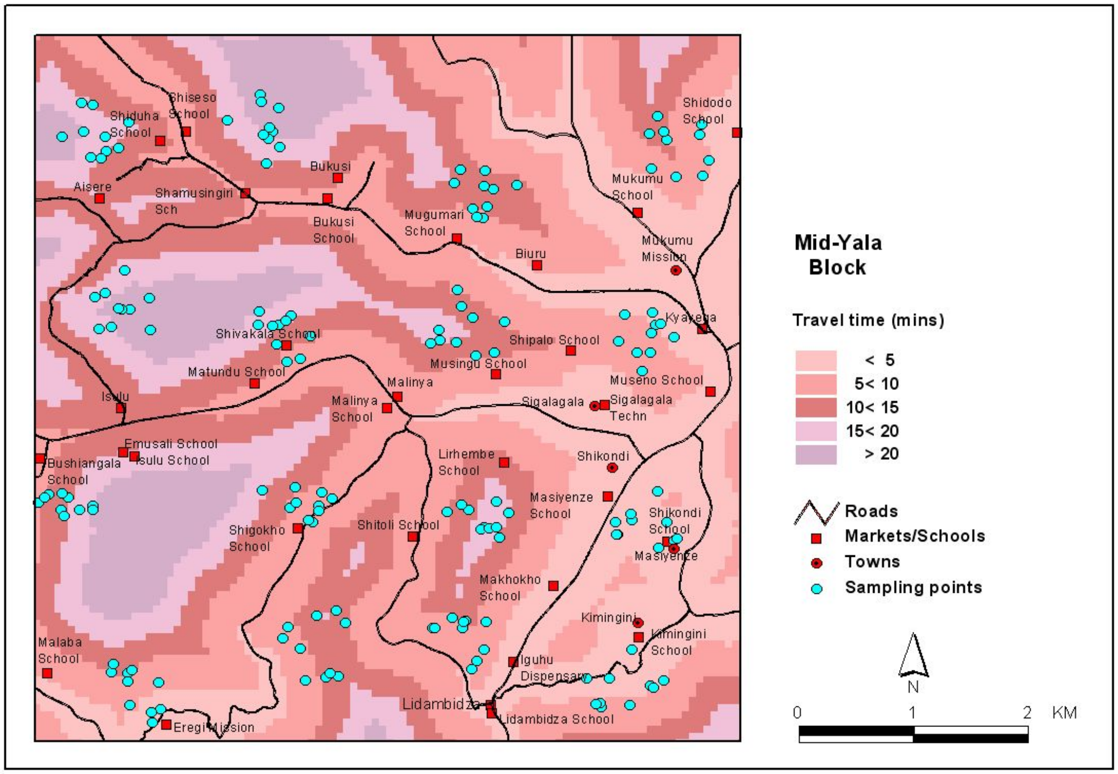

Figure 4.4 Market accessibility.

4.4 Management recommendations

This block has some of the highest population densities in the Project areas and some of the most acute incidences of land degradation. The main crops in the area are maize, beans and sweet potatoes, and conditions range from fair to good in most of the farms. The area has a potential for tea growing but only scattered tea plantations are seen ranging from 1.5 to 2.5 acres in size.

In this block, the Project should focus on three main areas identified as a result of the baseline data and field trips to the block. The block can be divided into two parts with the Gold River serving as the dividing line. The northern part of the block is characterized by unsustainable farming practices and low woody vegetation cover, whereas in the southern part of the block has greater tree cover and better managed farms with established tree plantations and banana orchards. Sheet erosion can be found in the entire block and farming of steep hill sides is common, with few or no conservation measures in place. Therefore, the management recommendations for the Middle Yala block involve five distinct sets of activities:

- Increasing the woody cover with special focus on diversification through promotion of indigenous trees.
- Soil and water conservation. Here focus should be on the importance of soil and water conservation in relation to sustainable production and on the integration of trees in soil and water conservation measures.
- Intensification of current land use, with special focus on conservation agriculture and legumes.
- Establishment of hay production and fodder banks, with special focus on indigenous trees and legumes.
- Capacity building of communities and CBO's in the above mentioned topics and elements related to their preferences.

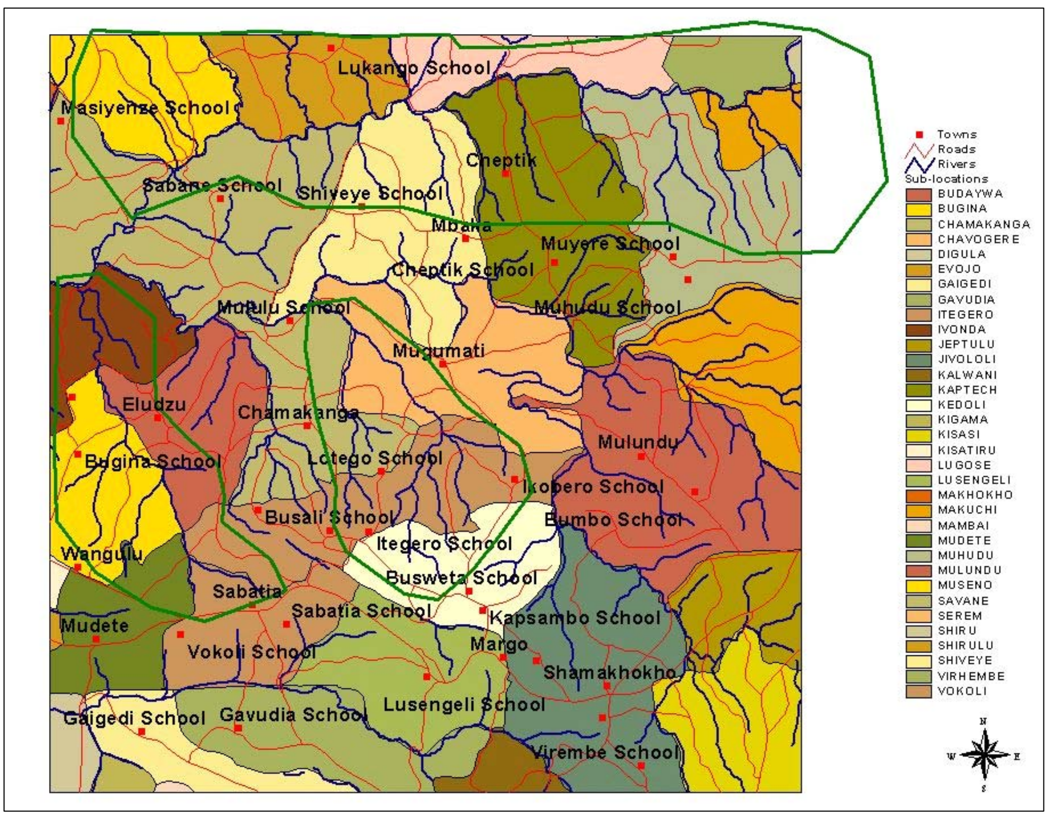

Figure 4.5. Priority intervention areas in the block.

The map above shows the suggested intervention areas for the block. Three priority areas have been selected for intervention with the intentions of the information on improved practices spreading to the entire block once good management practices have been established.

Area 1 is located in the northern part of the block and covers clusters 4, 8, 12 and 16. This area has been selected because of the prevalence of unsustainable farming practices in the area and the low presence of trees in the landscape. The eastern part of the area is located in the Kakamega forest reserve, yet there are no trees in the landscape. An organization called the Green Zone is currently reforesting this area; however, they need more advice on appropriate tree species and the importance of diversification. The area around cluster 8 is severely eroded and more than half of the sampled plots show visible signs of sheet erosion.

From the socio economic survey, we have identified several groups in this area that would be useful partners for project implementation:

- Kiyaguza and Kinyenyi around cluster 2, both of which focus on Women's activities.
- Isukha Mulindi around cluster 8; which focuses on tree planting and promotion of indigenous trees.
- Jinjini Farmers around cluster 12 which also focuses on tree planting and promotion of indigenous trees.

There seems to be a general awareness among the population in the block regarding the importance of trees, which the project should build upon and strengthen.

Recommended activities for the project include: Soil and water conservation through terracing and contour planting. In areas where conservation measures are already established, the project should introduce various leguminous trees and shrubs (*Sesbania sesban*, *Gliricidia sepium* and *Tephrosia spp.*) as well as crops and trees for fodder production (*Calliandra calothyrsus*, *Leucena spp.* etc). This is in line with the need to increase production per unit area since the farms in this area are very small and often under utilized. In this area, the majority of the farmers mentioned small farm size and low soil fertility as the major constraints. Conservation agriculture, which works around three principals: crop rotation, reduced tillage and permanent soil cover, is one option to intensify the agricultural production. This concept argues that crop rotation and permanent soil cover increase the nutrient content of the soil, especially if promoted in association with legumes. Establishment of horticulture units is another option to diversify the current cropping systems of maize intercropped with beans.

Another activity which should be undertaken in this area is large scale tree planting. Since the 1980s this area has been deforested with little focus on replanting and diversification of the woody cover. The most common trees in the area are *Eucalyptus spp.*, fruit trees and *Croton spp.* Several groups in the eastern part of this area are already focusing on the importance of indigenous trees and the project should partner with these groups and assist with establishing tree nurseries and with providing good quality seeds to increase the proportion of indigenous trees being planted.

Finally, free grazing is a serious problem in this area and more so than in the southern part of the block. Generally there is no clear demarcation of individual farms and livestock is roaming freely in the area. More than 50% of the farmers interviewed said that free-grazing livestock is a problem to them. The success stories of Lower Nyando in relation to the creation of by-laws could be drawn upon and implemented here. It is essential that free grazing be controlled if large-scale afforestation is to take place.

Area 2 is located around cluster 2 in the western part of the block. This area has been chosen because of the severe soil erosion taking place here (rill erosion). Farmers also recognize low soil fertility as a major problem. Thus, the first activity that should be under taken is the establishment of soil and water conservation measures on the hill sides and the integration of trees into the farming system. Much focus should be given to interventions, which replenish soil fertility and at the same time offer other products to farming families such as fruits, fodder and firewood. Very few farmers are aware of the various functions of trees, which indicate the need for the project should focus on this issue. In this area, agroforestry is not being practiced for soil fertility and erosion control, yet there is a genuine interest in tree planting. Hence, the project should give training in the communities to raise awareness of the various functions and products of trees.

The Kiyaguza and Kinyenyi Women's group could be one of the entry points in this area. These two groups focus on agricultural issues in relation to women. Conservation agriculture and legumes in general, should be promoted in this area, which with time can replenish soil fertility and provide fodder and firewood relatively quickly after being established. Since land size is relatively small in this area, forage legumes such Dolichos lablab and Mucuna spp. could be introduced as an intercrop.

The last area selected in this block (Area 3) and is located in the centre of the block covering clusters 7 and 10. This area has been selected because of the unsustainable farming techniques being used and the severe erosion taking place, even on gentle slopes. In this area, farmers are farming down to the river bank and the natural vegetation along the river bank is being removed and replaced by maize and beans. Gold mining is still an attractive business to many people in the area and the river banks are being disturbed in the search for gold. Therefore, one important activity in this area is stabilization of the riverbank and promotion of alternative livelihood strategies to the gold miners, in association with training on the importance of conservation of the river, its flow pattern and vegetation. Furthermore, as mentioned above, activities that focus on soil fertility replenishment, intensification of the cropping systems and integration of trees in the farming systems is equally important in this area. The systems recommended are well described under Area 1 and 2. In this area, there are 4 groups which all focus on related activities; Cluster 7: Itoro Women's group which focuses on horticulture and livestock and Avirina Women's group which focuses on women related topics in agriculture; Cluster 10: Jitolee Youth group which focuses on horticulture and firewood production and Chavogere Maendeko Women's group which also focuses on horticulture.

For all three areas, the livestock component of the project also needs to be developed. The majority of the farmers rear livestock; however, very few have invested in improved breeds, which is something the project could focus on. It is important to ensure that the conditions for sustainability of this component are met before any livestock is introduced to the communities, since farmers are not producing sufficient fodder for the currently herd. Fodder production can easily be integrated in the soil fertility replenishing activities as well as in association with soil and water conservation measures and structures.

The activities recommended above are based on a summary of the baseline data collection. However, it is imperative that before initiating any activities in the respective blocks, more information be collected for the targeted area chosen for interventions. Equally important is it that the communities and farmers need to be involved in the process of prioritizing activities.

5. Upper Yala

The Upper Yala block is located in Uasin Gishu District. The block contains nine sub-locations with Kesses and Tulwet sub-locations covering more than 80% of the block area (Figure 5.1). Lake Lessos is located in the centre of the block, and this lake is one of the main sources of Yala River. This block is characterized by medium gradient hills, shallow depressions, wetlands and flood plains with small permanent streams.

Before independence, white settlers were managing the land as grasslands with indigenous trees interspersed across the landscape and enclosed paddocks of improved pastures. Some areas were cropped to wheat in a rotation system with other food crops. Today the area is largely planted to maize with grasslands interspersed. Only a small portion of the block is planted to wheat. There are a few shrubs and trees seen in the landscape. Farms are very large in the area and there is little subsistence agriculture.

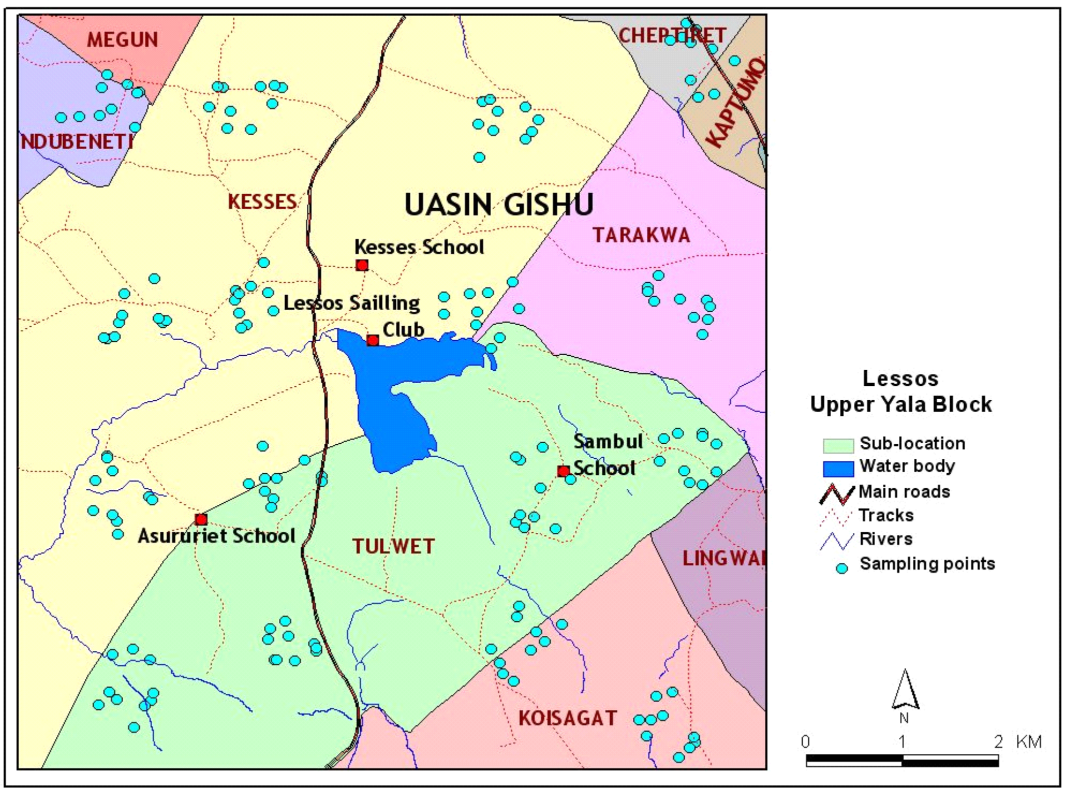

Figure 5.1. Administrative map of the Upper Yala block. The blue dots are the sampling points for the biophysical survey

5.1 Biophysical baseline data summary

5.1.1 Topography

The area of Upper Yala is generally characterized by level terrain at a relatively higher altitude (2100 – 2400 masl) with slopes ranging between 1 and 6% (Table 5.1). More than 65% of block area is located on plains with 13% being located on plateaus (cluster 14 & 15) and medium gradient slopes (Figure 5.2). The areas around clusters 9, 10 and 14 are more hilly, with slopes up to 10%. Shallow depressions constitute 8% of the landscape (cluster 1, 2, 9, 11, 12, 13 and 16).

Table 5.1. Average slope, slope range and incidence of steep slopes.

Cluster	Average slope (%)	Slope range (%)	No. values > 10%
1	1.5	0.50 – 2.50	0.0
2	6.0	2.00 – 16.25	4.0
3	2.1	0.75 – 3.50	0.0
4	1.6	0.75 – 3.75	0.0
5	1.3	1.00 – 2.00	0.0
6	1.6	1.00 – 2.50	0.0
7	1.1	0.75 – 1.50	0.0
8	1.3	0.75 – 2.00	0.0
9	3.6	1.75 – 8.00	1.0
10	2.3	0.5 – 6.25	1.0
11	1.9	0.50 – 4.00	0.0
12	1.2	0.50 – 2.50	0.0
13	2.5	1.50 – 3.25	0.0
14	4.7	1.75 – 9.00	5.0
15	1.4	0.75 – 2.75	0.0
16	2.0	1.00 – 4.75	0.0

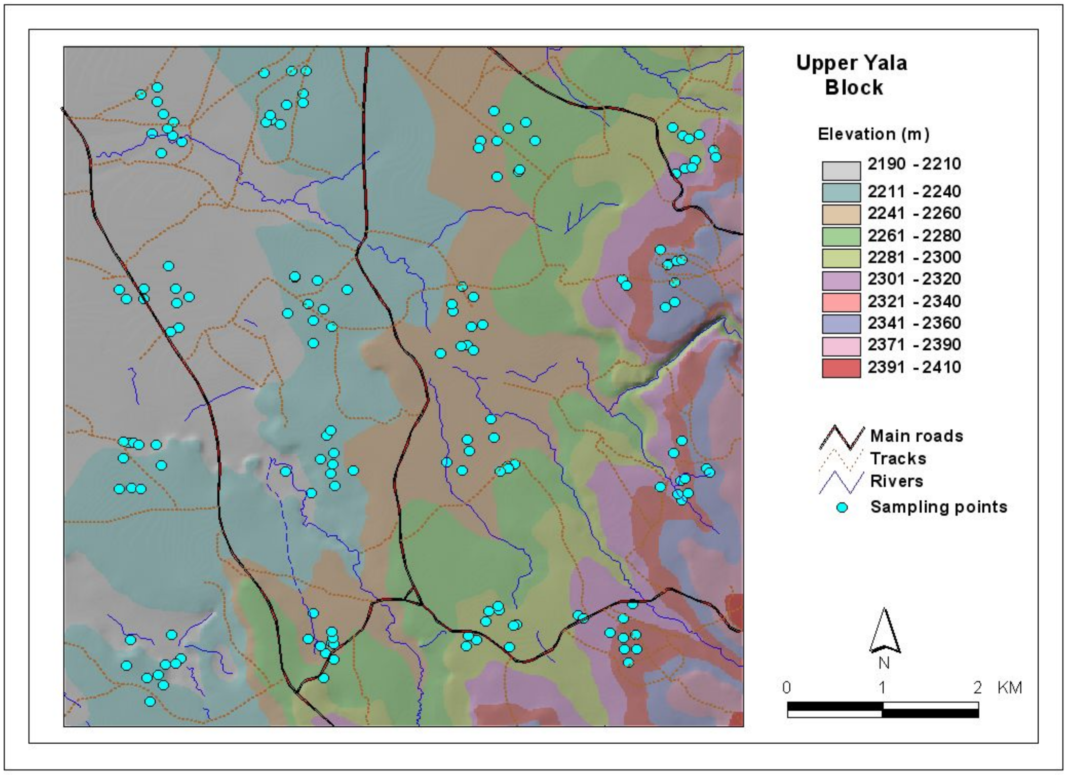

Figure 5.2. Elevation map of the Upper Yala Block showing sampling points, streams and roads.

The area around Lake Lessos, in the centre of the block, is characterized by wetlands and shallow depressions, with medium gradient hills located around cluster 3 and 13, which often floods. The table below lists average slope, slope range, and slope for point with slopes larger than 10%.

5.1.2 Soil texture and soil depth restrictions

The soil texture in this area is mainly silty clay to clay (Table 5.2). The remaining 1% of the sampled area is a mixture of sandy loam and silty clay.

Table 5.2. Soil texture (percent of samples).

Silty clay	Clay	Silty clay	Sandy loam
74.3	24.6	0.5	0.5

Soil depth restrictions were not very apparent in this area. Only 11% of the sampled area showed soil depth restrictions, with several of the eastern-most clusters (1, 3, 4, 7, and 8) not experiencing any restrictions. For clusters 2, 5, 9, 10, 13 and 16, less than 30% of the sampled areas experienced depth restriction. Only cluster 12 experienced depth restrictions in more than 60% of the sampled areas.

5.1.3 Vegetation and land use

Farming is the major land-use and drives land cover in the block (Table 5.3). Agriculture is mainly for subsistence and production is dominated by maize, beans, sorghum, and banana. Wheat is the cash crop in the area, but is grown in only a few areas. The block is also an important area for dairy production. The second most common vegetation type was grasslands. Natural grass species includes both perennial and annual both palatable and unpalatable for livestock. The dominant species in the area are:

1. *Setaria sphacelata*: perennial grass; good forage;
2. *Sporobolus pyramidalis*: annual grass; low forage value;
3. *Digitaria ciliaris*: annual grass; low forage value;
4. *Digitara gazensis*: perennial grass; high quality forage
5. *Eragrostis aspera*: annual grass; moderate forage quality;
6. *Eragrostis superba*: perennial grass; good quality forage;
7. *Hyparrhenia collina*: perennial grass; good forage, but it should be stocked in the early stages of growth.

Other grass species are *Cyperus spp.* which is dominant in swampy areas, while *Sedge ssp.* is a weed in cultivated areas.

Table 5.3. Land cover classification

Vegetation strata	No. points	Percentage
Farm land	76	48%
Forage land	16	10%
Perennial grassland	56	35%
Fallow	8	5%
Shrub land	1	<1%
Other	3	2%

A classification of the primary current land use showed the following:

Food / beverage:	48%	Timber / fuel wood:	8%
Forage:	56%	Other:	3%

In general there are few trees in the landscape. No woodlots or planted plantations were found during the survey. Of the 160 plots sampled only 8% or 12 plots had trees in the vicinity. This woody vegetation is mostly broadleaf and evergreen, (Table 5.4).

Table 5.4. Wood vegetation type.

Broadleaf	Needle leaf	Allophytic	Evergreen	Deciduous
19%	1%	0	16%	>1%

The woody vegetation present in this area is broadleaf and evergreen. An assessment of the trees seen in the landscape showed the following species to be present: *Acacia mearnsii*, *Eucalyptus spp.*, *Pinus patula*, *Cupressus lusitanica*, *Grevillea robusta* and *Casuarina equisetifolia.* These trees are mainly planted in the homestead and along farm boundaries. Most of the indigenous trees have disappeared from the landscape and are mainly found in small tickets on hill tops and sloping hillsides. These species include: *Olea africana* (Wild olive), *Juniperus procera* (African pencil cedar), *Albizia gummifera*, *Cossonia holstii*, *Erythrina abyssinica* (Red hot poker tree) and *Dombeya goetzii* with *Acacia abyssinica* being the dominant thorn tree in the area. However around cluster 14 indigenous trees are seen more frequently in the landscape.

Shrubby vegetation is present at all sampling plots, is less than 0.8m in height (87%) and is generally a mixture of annual and perennial types. The dominant indigenous shrubs are *Clevendenron myricoides*, *Rhamus staddo*, *Rhus vulgaris*, *Carissa indulis* and *Vangueria acutiloba*. These shrubs are mainly found in higher altitudes and in small thickets on hill tops and hill sides.

In this block all farms surveyed are privately owned and for 9% of the plots land use has not changed since 1990. However, for the majority of the plots, it is not know whether land use has changed or not (64%).

5.1.4 Soil erosion and conservation measures

Soil erosion was visible in 22% of the plots, with highest incidence in clusters 3, 8, 10 and 14, which corresponds well with average slope and slope range (Table 5.5). Clusters 3, 10 and 14 have steeper slopes compared to the other clusters (up to 10%). The type of erosion is mainly sheet erosion with only one farm showing signs of rill erosion.

Soil and water conservation is not being practiced in this block. Despite the presence of sheet erosion on 35 farms and steep slopes on several farms, none of the farms in the sample had established contour lines, terraces or other conservation measures to divert runoff and control soil erosion. Therefore, soil and water conservation in association with tree planting should be one of the first activities undertaken in this block.

Table 5.5. Percent of plots showing erosion in each cluster

Cluster	None	Sheet	Rill	Gulley
1	90	10	0	0
2	80	10	10	0
3	60	40	0	0
4	80	20	0	0
5	70	30	0	0
6	80	20	0	0
7	80	20	0	0
8	50	40	0	0
9	90	10	0	0
10	70	30	0	0
11	60	40	0	0
12	100	0	0	0
13	90	10	0	0
14	70	30	0	0
15	70	30	0	0
16	90	10	0	0

Table 5.6 Summary of baseline parameters.

Cluster	Texture	Slope (%)	Woody vegetation cover*	Soil depth restriction incidence (%)	Soil erosion (%)	Household size
1	Silty clay	1.5	Absent	0	10	6.0
2	Silty clay	6.0	Low	30	20	6.6
3	Silty clay	2.1	Absent	0	40	8.4
4	Silty clay	1.6	Absent	0	20	6.3
5	Silty clay	1.3	Absent	20	30	7.1
6	Clay to Silty clay	1.6	Absent	30	20	7.8
7	Silty clay	1.1	Absent	10	20	7.7
8	Silty clay	1.3	Absent	0	40	5.7
9	Silty clay	3.6	Absent	30	10	8.6
10	Silty clay	2.3	Absent	20	30	6.7
11	Silty clay	1.9	Absent	30	40	6.0
12	Clay	1.2	Absent	60	0	7.2
13	Silty clay	2.5	Absent	40	10	7.1
14	Silty clay	4.7	Absent	40	30	8.6
15	Silty clay	1.4	Absent	30	30	7.8
16	Silty clay	2.0	Absent	50	10	7.6

**** Low: <15%; Moderate: 15 to 65%, High: > 65%.***

5.2 Socio economic baseline data summary

5.2.1 <u>Household parameters</u>

Average household size is 7.3 people with 93% of the household having 10 members or less (Table 5.7). A few households have more than fifteen members (3 homes). Population density is moderate in this block, with highest densities in the northeast (Figure 5.4). Average farm size is 15 acres; however, 50% of the households have farm sizes of less than four acres. Thirty percent of the farms are larger than 10 acres (Table 5.8).

Table 5.7. Household size (N=160)

Household size	No. households	Percentage
3 or less	12	7.5
4	11	6.9
5	21	13.2
6	31	19.5
7 – 10	62	39.0
11- 15	17	10.7
More than 15	5	3.1

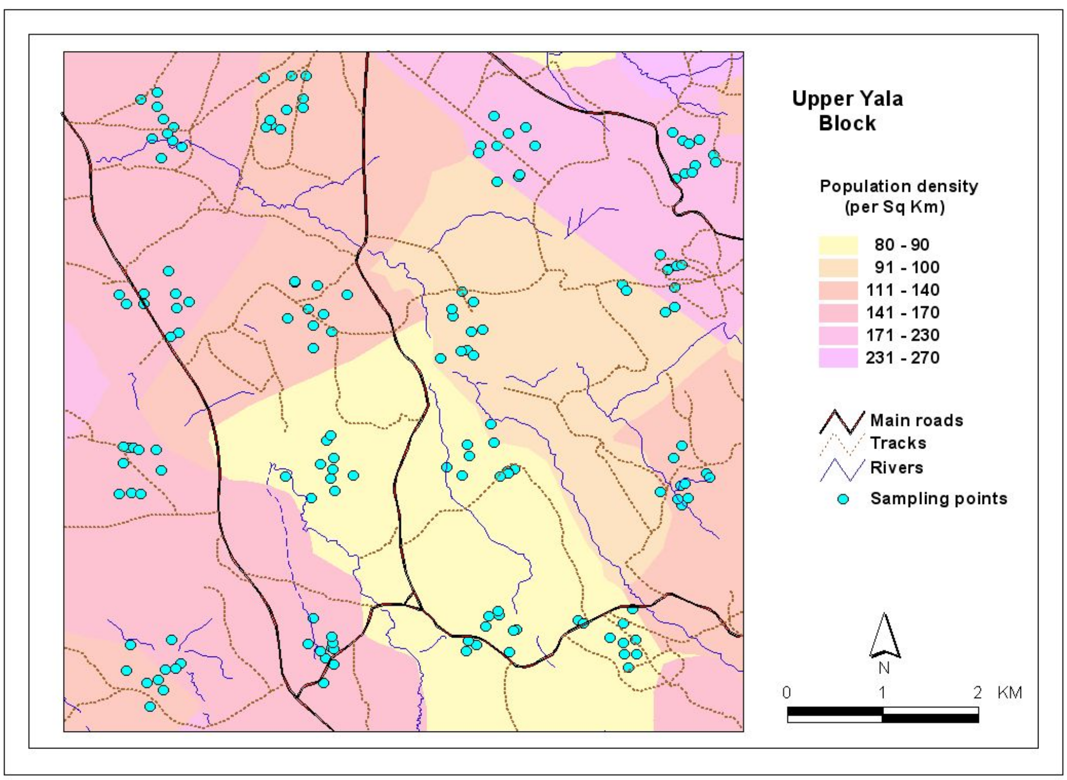

Figure 5.3 Population density of Upper Yala Block.

Table 5.8 Farm size (N=160)

Farm size	No. households	Percentage
2 acres or less	49	31%
3 acres or less	22	14%
4 acres or less	9	5%
5 to 9 acres	30	19%
10 acres or more	49	31%

The majority of the households were male headed (88%), while the rest (12%) were female headed. No household was headed by orphans and only one household was polygamous.

5.2.2 Land use and livestock

Of the 160 households surveyed, 150 rear livestock. Table 5.9 lists the percentage of households with different species of livestock. Improved breed cattle are widespread in the block, but improved breeds of other livestock were not reported. No household in the study area had pigs and only one household had donkeys (2).

Table 5.9. Livestock ownership in percentage (N=160)

No.	Cow		Chicken		Goat		Bull		Sheep
	Local[1]	HB[2]	Local	HB	Local	HB	Local	HB	Local
0	98	21	19	0	94	0	98	59	47
1	1	12	0	0	1	0	1	21	4
2	1	26	9	0	2	0	0	7	11
3	0	9	5	0	1	0	0	3	8
>3	0	33	67	0	3	0	0	10	31
Highest no.	1	46	70	n/a	70	n/a	2	16	30

[1]Local indicates local breed, [2]HB indicates improved breed

The source of fodder is mainly grasses (81%) and crop residue (69%). Average acreage used for crop residue production is 4 acres and livestock grazes on around 7 acres, on average. Few farmers leave their livestock to graze on communal (26 cases) and government land (13 cases). Artificial feed is a source of fodder for 56 households and 35 households also buy feed at the local market. However, 85% of the households are experiencing problems with their livestock. More than 58% of the households say they do not have adequate land for feedings their livestock and 48% experience problems with free-grazing livestock from neighbours, which corresponds well with the fact that 79% of the households practice free-grazing.

5.2.3 Major constraints at the farm level

The largest constraints at the farm level are lack of income and the high prices for inputs (Table 5.10). Farmers also listed low soil fertility, flooding and farm size as major constraints. Low market prices of products as well as poor access to markets are also rated high by farmers as constraints. Compared to the Middle and Lower blocks of the Yala River basin, major constraints are somehow different in this area. Here prices of inputs are rated very high as is access to good market for farm produce.

Table 5.10. Major constrains at farm level listed by farmers

Constraints	No. 1 (N=160)	No. 2 (N=136)	No.3 (N=89)
Income	60	25	21
Price of inputs	25	32	9
Low soil fertility	15	7	4
Flooding during rainy seasons	14	8	5
Farm size	8	4	6

5.2.4 Soil and water conservation

Soil erosion is being addressed by 93 of the households interviewed (58%) and the most common conservation measures are terraces (66 farms) and strips of grass and shrubs. Here the most common species are local grass species and Napier grass. Of the 66 farmers using terracing as a conservation measure, seven farmers have constructed 'Fanya chini' terraces. Nine farmers have established contour lines and three farmers are mulching with crop residue. Trash lines are used by three farmers, however, most farmers are saying their efforts are not effective during heavy rains mainly due to siltation.

In addition to these measures, 44 farmers are also harvesting water, mainly from the roof, for domestic use. Hence there seems to be a need to assess the soil and water conservation measures and assist the farmers in selected better measures and integrating trees and legumes in the control of runoff water and soil erosion. This would simultaneously address the low soil fertility that many farmers are mentioning as one of the largest constraints at farm level.

5.2.5 Trees & Agroforestry

The majority of the farmers are practicing agroforestry. More than 95% of the homesteads have trees which are protected (Table 5.11) and a similar number of farmers are interested in planting more trees, which corresponds well with the farmers' response to practicing agroforestry. Only five farmers out of 160 are not interested in planting more trees, which is mainly due to land size (2 farmers), age (1 farmer), husband making such decisions (1 farmer) and land ownership(1 farmer). Approximately 20% of the farmers interviewed are planning to cut down trees on their farm. Three farmers from Tarakwa, Cheptiret and Tulwet sub-locations mentioned cultural practices as a hindrance to tree planting.

Reasons for growing trees include producing fuel wood and timber and to reduce the negative effects of wind. Few farmers use trees to produce fodder and address soil fertility. Therefore, the project should organize community training to raise awareness of opportunities offered by expanding the growing of trees and production of other tree products to facilitate better integration of trees into the farming system.

Table 5.11. Tree species on-farm (N=160)

Tree species	No. farms with the species
Eucalyptus spp.	97
Acacia mearnsii	95
Cypress spp.	91
Grevillea robusta	43
Fruit tress (incl Mango & avocado)	22

Using farmers' answers to rank the importance of agroforestry products the top 10 uses were:

1. Wind breaks
2. Fuel wood
3. Timber
4. Medicinal products
5. Fruits
6. Food
7. Aesthetics
8. Cash
9. Soil fertility
10. Fodder

5.2.6 Household energy supply

The main sources of fuel for the farming families in this block are wood and paraffin (Table 5.12). More than 85% of the households are not energy self sufficient, which might explain the high number of farmers interested in more tree planting as mentioned above.

Table 5.12. Fuel use by source

Fuel source	Percentage
Wood	98%
Paraffin	94%
Charcoal	42%
Crop residue	34%
Gas	3%
Electricity	5%

5.2.7 Trainings and group membership

The majority of the farmers interviewed have not received any training. Only 45 of the 160 farmers interviewed have received any type of training: 20 are members of a group and 25 are not members of a group. In this area in general, few farmers of members of groups. Only 58 farmers out of the 160 interviewed said yes to being members of a group. Therefore, the Project should look into the reasons why there is such low adherence to groups and determine the desirability of assisting the communities in establishing groups. From the socioeconomic survey several relevant groups were identified:

Table 5.13. Community groups and main activities undertaken

Group name	Cluster	Main activity
Sambul Lekembai Self Help Group	5	Farming & livestock
Kesses Farms Federation	5	Farming & livestock
Tulwet Chamiet	6	Women's activities
Federation	6	Agriculture
Ngoisebek	9	Livestock & horticulture
Kokwet Women's Group	9	Livestock
Moruto	11	Tree planting & livestock
Mzalendo	12	Bee-keeping and selling cereals
Upendo Women's Group	12	Livestock
Sigilai Cheryigei	13	Farming & livestock

5.3 Market accessibility

Market accessibility is only moderately good throughout the block, and large areas throughout the block are relatively isolated from markets (Figure 4.4). There appears to be a lack of feeder roads into these areas to facilitate transport of goods. Thus, the project needs to examine marketing networks for products more closely in this block than in the others in this river basin.

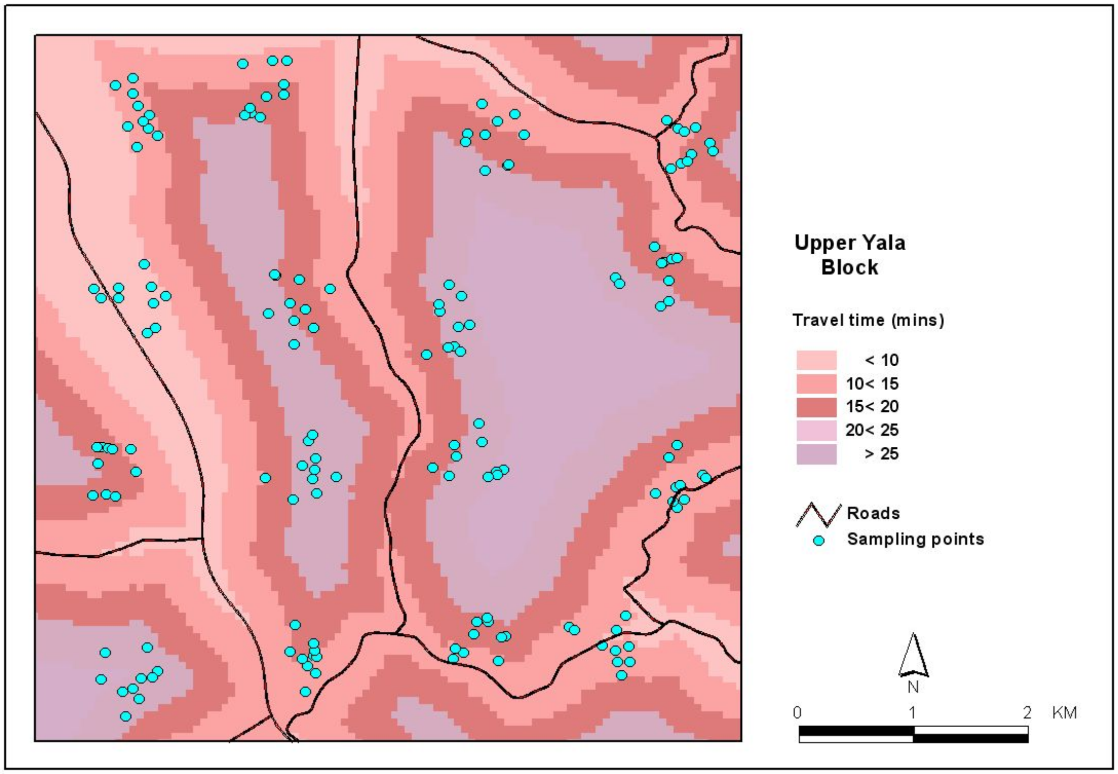

Figure 5.4 Market accessibility.

5.4 Management Recommendations

Since this area is one of the source important areas of water for the River Yala, the micro catchments approach used for the Lower and Middle blocks is not appropriate. Instead focus has been given to landscapes and major landforms and the appropriate land management systems for these landforms. The Upper Yala block is characterized by four main landforms: sloping hillsides, plains, depressions and wetlands. Management recommendations will therefore cover all four areas with the intention that these areas serve as demonstration sites for best-bet / best management practices, which should then been up-scaled to the entire block. As such, three main areas have been selected (Figure 5.2).

The first area is located on the gentle plains and shallow depressions along the main road crossing the block. The main activities in this area are livestock rearing and woodlots. The second area covers clusters 11 and 12 as well as the area close to cluster 15. This area is mainly made up of wetlands, which are currently is under maize and wheat production; there are also some grasslands. The third area selected covers clusters 9 and

13. This area consists of hill slopes and is located in the south-eastern corner of the block. The runoff from this area drains into the wetlands surrounding Lake Lessos.

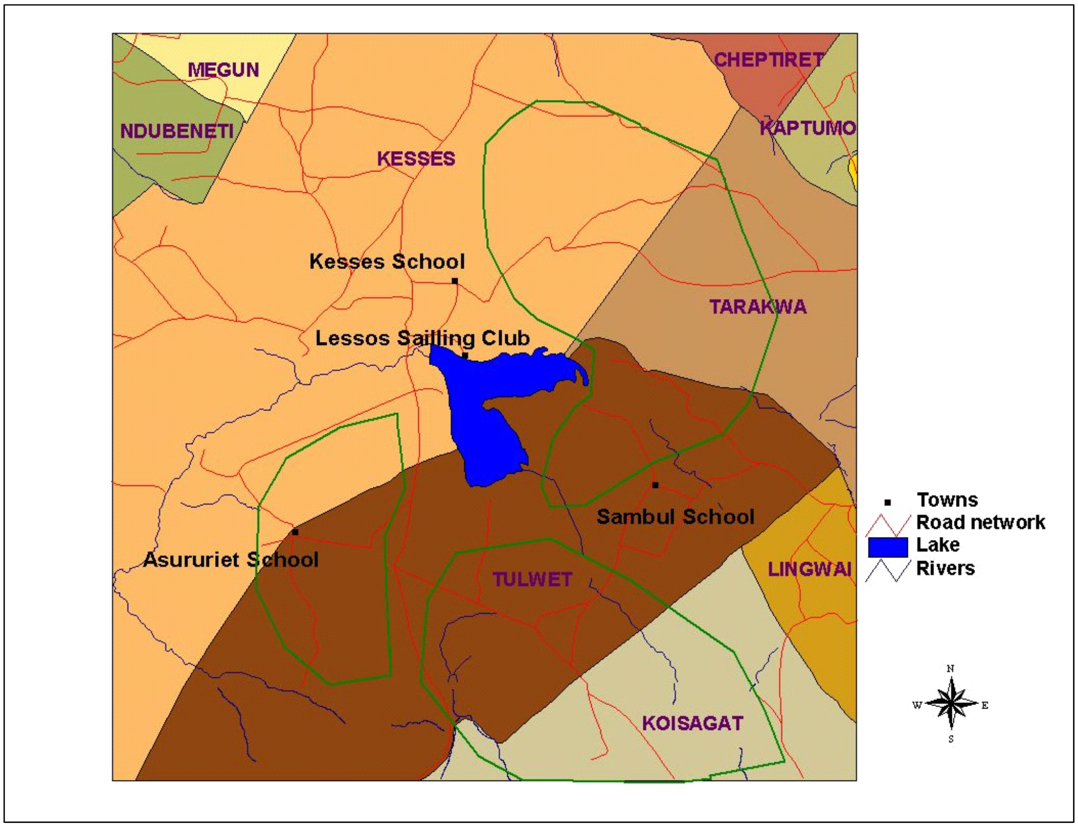

Figure 5.5. Priority intervention areas in Upper Yala block.

The areas around clusters 3 and 4 consist of large scale commercial farms, and thus will not be the focus of the activities of the WKIEM Project. Additionally, the area around cluster 8 is very well managed and the efforts of this project should target the more degraded areas. The area around cluster 14 is also well managed and in this area there are many indigenous trees in the landscape. However, these well managed areas offer good opportunities for the project for farmer-to-farmer training. The project should liaise with farmers in this area and learn from their experiences in tree growing and preference of species for the area. Building communication between farming communities will be the foundation for more effective extension activities.

Management recommendation for the Upper Yala block has been grouped into four main categories:

- Conservation of wetlands and small streams
- Improved pastures through use of paddocks
- Increasing the woody vegetation cover with special focus on conservation of indigenous trees
- Promotion of simple farming techniques to increase soil fertility and yields

Area 1: Management recommendations include improved pasture through use of paddocks. Majority of the farms in the area rear improved livestock, yet little attention is given to high quality feed. Farm sizes are relatively large and many farmers have fenced grazing fields (paddocks). However, few farmers seed high quality grass to improve the quality of the pastures. Improving animal nutrition is the key to increasing the quantity of milk produced. Therefore, in Area 1, the project should set up demonstration sites of paddocks using improved pasture grasses. Grass species which will grow well in this area and that can be used to improve pastures are listed in section 5.1.3. Additionally, the project should liaise with the NALEP program to explore the possibility of introducing Rhodes grass and other promising species for pasture improvement. The production of fodder legumes also needs to be explored.

Indigenous trees such as *Albizia coriaria* and *A. gummifera*, *Cordia abyssinica* and *Delonix regia,* which are all hard wood species, can be found in the area and plantation should be expanded. *D. regia* is also palatable to livestock and could be used as a feed supplement. *Croton macrostachys* and *C. megalocarpus* will also do well in this area, however both of these species are soft wood and not palatable to livestock. *Acacia spp.* should also be promoted since these are leguminous. Finally, the exotic *Grevillea robusta* could also be promoted for wood production.

In this area, four groups were mentioned in the socioeconomic survey, with two focusing on livestock and two on agriculture. These four groups should be contacted and relationships developed to facilitate the initiation of project activities in the area.

Area 2: This area is situated on the plains, which often flood and are partly wetlands. Farmers are encroaching more and more into the wetlands and in many areas the channels draining the upland areas have been obstructed and destroyed. Therefore, many areas flood during the rainy season, affecting cereal production through water logging and flooding. There are very few trees in the landscape and maize and wheat are cropped continuously with commercial fertilizers for the majority of the farms. In some instances, maize is planted very densely, to the point where competition between plants for limited resources can affect yields. Improved agronomic practices must be introduced

Management recommendations therefore include increasing the woody vegetation and setting up demonstration sites on better cereal production practices with the integration of crop rotation. Farmers need to be educated about the importance of wetlands and how best to manage these areas. The drainage channels need to be rehabilitated by the communities to allow excess surface runoff to drain into the wetlands and ensure steady flow of water into the lake and streams which are part of the source area of River Yala. Indigenous species should be promoted to increase the woody vegetation cover and for the production of fodder for livestock. Trees could also be introduced into some areas of the landscape to increase water use by the vegetation and promote 'bio-drainage'.

In this area three groups were mentioned in the socioeconomic survey. All three groups focus on livestock with one also focusing on tree planting (Table 5.11). These groups should be contacted and relationships developed to facilitate the initiation of project activities in the area.

Area 3: This area is located on the sloping hillsides from which water drains into the wetlands situated below. The first activity to be undertaken in this area is the establishment of soil and water conservation and there is clearly need for training in the importance of such measures and interventions. Slopes in this area range between 1 and 10%, however, steeper slopes can be found below cluster 13 and 14. The integration of trees and legumes in soil and water conservation measures should be enhanced. The project should introduce ideas associated with contour planting for both conservation purposes and fodder production.

When promoting species that are palatable to livestock, it is essential that the communities be sensitized to the need for controlling free-grazing. The project should build the capacity of the communities to develop by-laws governing free-grazing. More than 45% of the farmers experience problems with free-grazing animals from neighbouring farms. Finally, activities which focus on soil fertility replenishment should be promoted. In this area, farms are relatively small and farmers need to intensify their production, which can be done through the integration of legumes and conservation agriculture.

In this area, three groups were mentioned in the socioeconomic survey as focusing on livestock, farming and bee-keeping. These groups should be contacted and relationships developed to facilitate the initiation of project activities in the area (Table 5.11).

6 Lower Nzoia

The Lower Nzoia block is located on the lake plain in Siaya and Busia districts. The block contains fifteen sub-locations. This block is bisected by the Nzoia River is characterized by generally flat terrain (2 to 6% slopes), a few shallow depressions, wetlands and flood plains with small permanent streams. There are several large hills in the western part of the block.

Most of the block is dedicated to subsistence agriculture, with crops typical of low elevations in western Kenya. Farmers principally grow maize, bean, sorghum, cassava, and potatoes. There are many wetlands and floodplains in southern part of block, which frequently floods when the River Nzoia bursts it banks in very rainy years (e.g. El Niño years). The soils have high concentrations of sodium and are highly susceptible to erosion.

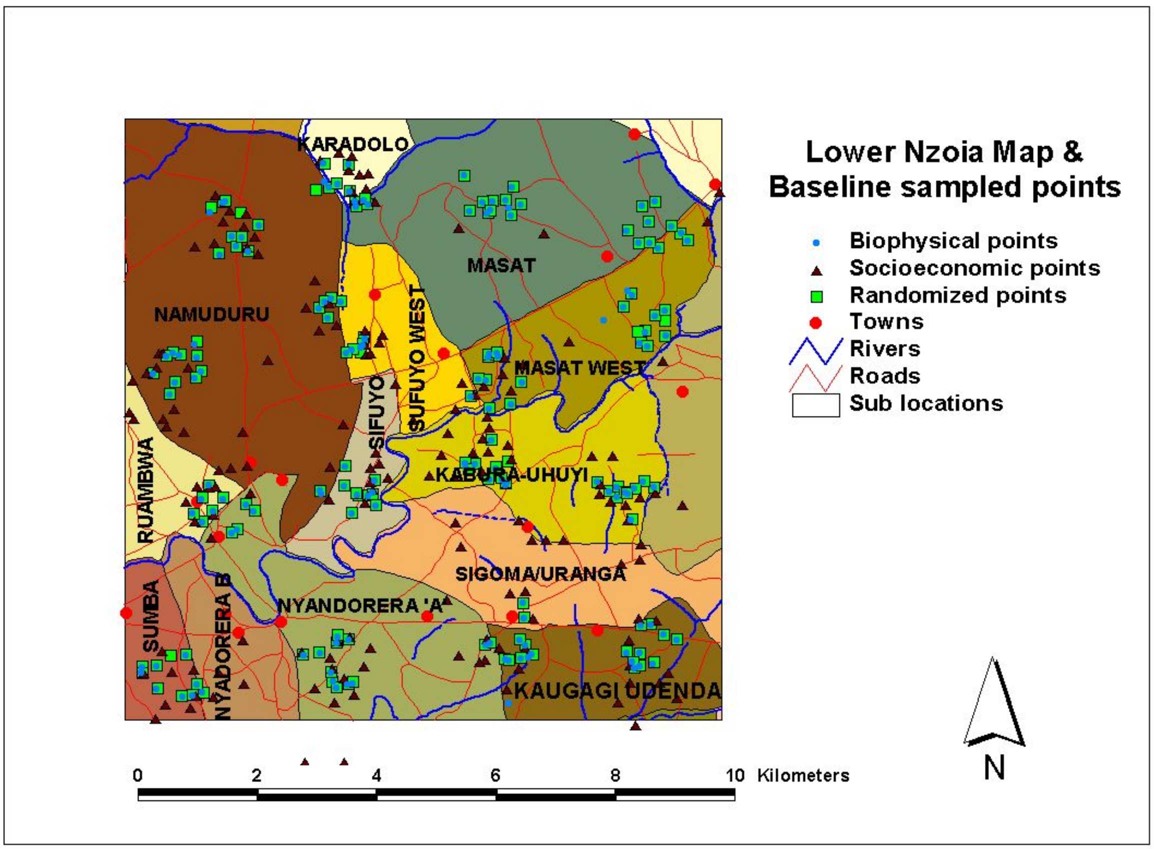

Figure 6.1. Administrative map of the Lower Nzoia block. The blue dots are the sampling points for the biophysical survey; socioeconomic samples are shown by triangles.

The earliest conversion of land took place in early 1900's and more recent conversion took place in 1980's. Since the time of conversion the land has remained under continuous cultivation, mainly with cassava, sorghum, maize and sweet potatoes. Currently, the productivity of the land is low. Cassava still remains the most preferred crop in the area, although the variety grown requires up to two years to mature for harvesting, and is used only for flour production. Besides farming, livestock raising is another important activity within the block. Natural grazing is the main resource especially on the seasonally flood plains during the dry seasons and crop residues are fed to the animals after the harvest.

6.1 Biophysical baseline data summary

6.1.1 Topography

The area Lower Nzoia is characterized by flat terrain with slopes ranging between 1 and 6% (Figure 6.2; Table 6.1). The block is located on the lake plain and therefore has little relief. There are a few hills in the north-western portion of the block. Only Cluster 3 has any significant relief, with 60 % of the plots sampled having slopes > 10% and an average slope of 17%. The other clusters in the western half of the block had a few steep areas, but overall slopes were gentle in these areas. The eastern half of the block has a flat terrain. The block is bisected by the Nzoia River which traverses from east to west.

Table 6.1. Average slope, slope range, and incidence of steep slopes.

Cluster	Average slope (%)	Slope range (%)	No. values > 10%
1	3.13	0.87 - 18.22	1
2	1.79	1.31 - 2.18	0
3	17.59	1.75 - 43.05	6
4	6.05	2.18 - 16.5	2
5	2.75	1.31 - 6.10	0
6	5.20	0.87 - 28.4	1
7	2.88	1.31 - 5.23	0
8	6.04	1.75 - 23.34	2
9	6.75	3.49 - 13.92	2
10	2.09	0.87 - 4.80	0
11	3.45	1.31 - 4.80	0
12	2.23	1.75 - 2.62	0
13	4.19	2.62 - 6.10	0
14	3.75	2.18 - 5.67	0
15	3.67	1.40 - 5.23	0
16	3.97	2.62 - 5.23	0

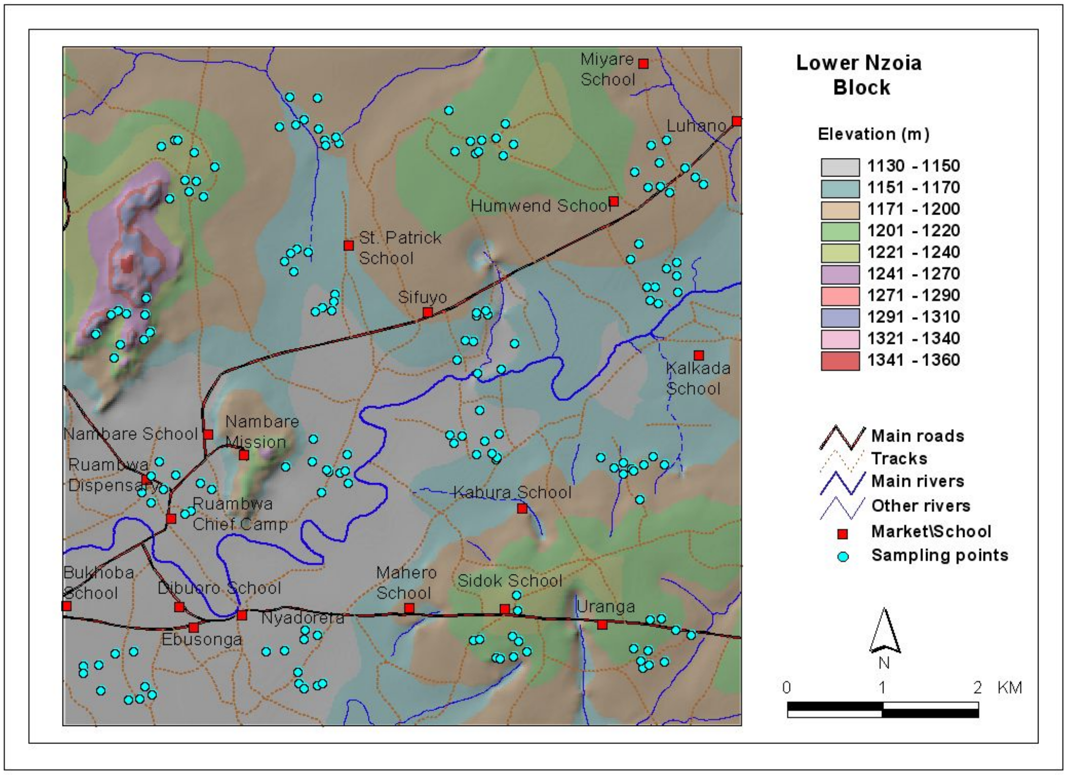

Figure 6.2. Elevation map of the Lower Nzoia block showing roads, sampling points, rivers and streams.

6.1.2 Soil texture and soil depth restrictions

The soil texture in this area is fairly homogenous and either clayey or clay loam (Table 6.2). The soils tended to have slightly higher silt contents in the eastern part of the block.

Table 6.2. Soil texture (% of samples).

Clay	Clay loam	Loam	Loamy sand	Sandy clay loam	Sandy loam	Silty clay	Silty clay loam
66	46	10	1	1	7	23	6

Soil depth restrictions were widespread across the block, with 27% of the subplots sampled showing restrictions within the first 50 cm and 16% of the subplots showing restrictions within the first 20 cm. Clusters 1, 3, 4 and 9 have very high incidence of depth restriction. Clusters 8, 10, 11, and 12 have almost no depth restrictions.

Table 6.3. Incidence of depth restrictions per cluster (values = % of subplots per cluster with depth restrictions; n = 40).

Cluster	Shallow (≤ 20 cm)	Deep (> 20 cm)
1	43	28
2	3	18
3	20	40
4	25	25
5	13	15
6	15	15
7	3	0
8	0	0
9	38	30
10	0	0
11	15	3
12	3	3
13	33	18
14	15	13
15	18	28
16	10	18

6.1.3 Vegetation and land use

Farming is the major land-use and agricultural activities determine land cover in the block (Table 6.4). Agriculture is focused on cereal production, but there are also large areas with perennial grasses for livestock grazing. The largest allocation of land in this block was for farmland. However, a significant portion of this farmland was found to be temporarily abandoned because of flooding. Forage land and perennial grasslands also make up a significant portion of the block. The dominant species in the area are as follows:

1. *Sporobolus pyramidalis*: annual grass; low forage value;
2. *Digitaria ciliaris*: annual grass; low forage value;
3. *Digitara gazensis*: perennial grass; high quality forage
4. *Eragrostis aspera*: annual grass; moderate forage quality;
5. *Eragrostis superba*: perennial grass; good quality forage;
6. *Hyparrhenia collina*: perennial grass; good forage, but it should be stocked in the early stages of growth.
7. *Cynodon dactylon*: perennial grass; good forage quality.

Table 6.4. Land cover classification

Vegetation strata	No. points	Percentage
Farm land	69	43.4
Forage land	16	10.1
Perennial grassland	40	25.2
Fallow	20	12.6
Other	14	8.8

A classification of the primary current land use showed the following:

Food / beverage:	48%	Timber / fuel wood:	17%
Forage:	56%	Other:	4%

Trees are not very common in the landscape. Out of the 640 sub plots sampled, we found 166 trees. No woodlots or planted plantations were sampled in the survey, but we did find several orchards with Mangoes and citrus species. Of the 160 plots sampled, 41% or 66 plots had trees in the vicinity. This woody vegetation is mostly broadleaf and evergreen, (Table 6.5).

The woody vegetation present in this area is broad leaf and evergreen. *Markhamia lutea* was the tree most commonly encountered. *Acacia brevispica* and *A. hockii*, *Albizia coriaria* and *Cassia siamea* were all fairly common as well. There were a few cypress plantations in the central portions of the block, but these were not picked up in our sample. Shrubs were widely present in the landscape and were measured on 90% of the plots. Few exotics were found on the plots sampled. *Ipomea spp.* was found in several sites in this block indicating low soil fertility.

Table 6.5. Wood vegetation type

Broadleaf	Needle leaf	Allophytic	Evergreen	Deciduous
78.1	0.0	15.0	63.1	8.8

In this block all farms surveyed are privately owned and for 24% of the plots were known to have a change in land use since 1990, while 28% of the plots were known to be in the same land use since that time. However, for the other 48% of the plots, it was impossible to ascertain whether land use has changed or not. Thus, there appears to be a moderate level of on-going land-use change in this area.

6.1.4 Soil erosion and conservation measures

Soil erosion was visible in 36% of the plots, with highest incidence in clusters 4, 13 and 16. Clusters 1, 2, 7 and 12 had the lowest incidence of soil erosion. The principal type of erosion is sheet erosion, but rill erosion in clusters 9 and 14 merit special attention by the Project. Table 6.6 indicates on a cluster basis, the percentage of points showing visible signs of erosion.

Soil and water conservation is not widely practiced in this block, but needs to be expanded. We found conservation structures present on only 10 plots, and most were in clusters 5 and 14. The clusters with the highest incidence of erosion were not the areas where most of the erosion control structures were encountered. Therefore, the project needs to begin creating awareness of the problem and then build on this awareness to help farmers begin to deal with the problem. Soil and water conservation practices in association with tree planting should be one of the first activities undertaken in this block.

Table 6.6. Percent of plots showing erosion features for each cluster

Cluster	None	Sheet	Rill
1	80	20	0
2	100	0	0
3	50	40	10
4	40	50	0
5	50	40	10
6	70	30	0
7	100	0	0
8	70	30	0
9	40	30	30
10	70	30	0
11	70	30	0
12	90	10	0
13	40	60	0
14	50	30	20
15	70	30	0
16	30	60	10

Table 6.7. Summary of baseline parameters

Cluster	Texture	Slope (%)	Woody vegetation cover*	Soil depth restriction (%)	Soil erosion (%)	Household size
1	Clay	3.13	Moderate	80	20	9.4
2	Silty clay	1.79	Low	20	0	6.0
3	Clay	17.59	Moderate	90	50	7.4
4	Clay loam	6.05	Low	60	50	6.0
5	Clay loam	2.75	Low	50	50	7.2
6	Clay loam	5.20	Low	40	30	6.9
7	Clay	2.88	Low	10	0	8.0
8	Clay	6.04	Moderate	0	30	5.8
9	CL	6.75	Moderate	70	60	6.9
10	Clay	2.09	Low	0	30	7.3
11	Clay	3.45	Moderate	30	30	6.0
12	Clay	2.23	Moderate	20	10	6.8
13	Clay loam	4.19	Moderate	70	60	5.3
14	CL	3.75	Moderate	60	50	5.8
15	Clay	3.67	Moderate	40	30	4.6
16	Clay	3.97	Moderate	20	70	6.2

**** Low: <15%; Moderate: 15 to 65%, High: > 65%.***

6.2 Socio economic baseline data summary

6.2.1 Household parameters

Average household size is 6.6 people with 90% of the households having 10 members or less (Table 6.8). Only two households have more than 15 members. Population density was moderate overall with the highest in the central portion of the block, along the river (Figure 6.3). The eastern portion of the block, with the exception of the floodplain had low population densities. Average farm size is 3.2 acres; however, 77% of the households have farm sizes of 4 acres or less. Less than 5% of the households have farm sizes larger than 10 acres (Table 6.9). The majority of the households were male headed (51%), but a sizeable portion of the households (38%) were female headed. One household was headed by orphans and 18 households were polygamous.

Table 6.8. Household size (N=160)

Household size	Number in sample	Percentage
3 or less	25	15.6
4	14	8.8
5	21	13.1
6	23	14.4
7 - 10	61	38.1
11- 15	14	8.8
More than 15	2	1.3

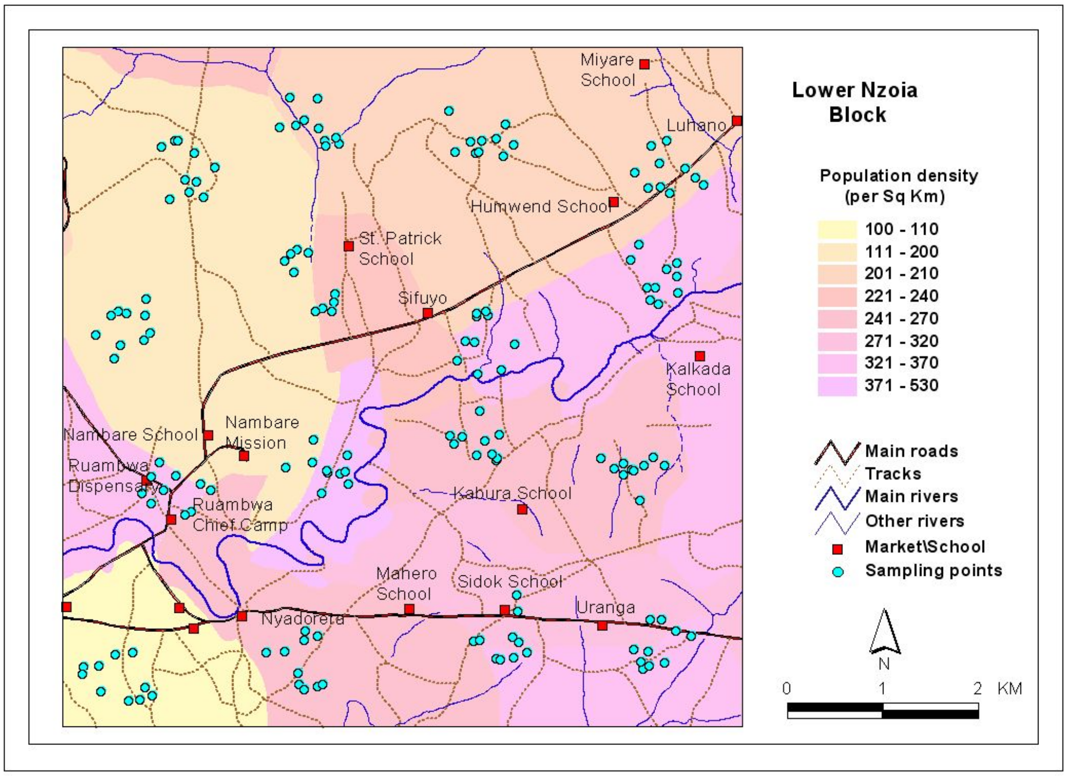

Figure 6.3 Population densities in Lower Nzoia Block.

Table 6.9 Farm size (N=160)

Farm size	No. households	Percentage
2 acres or less	78	48.8
3 acres or less	26	16.3
4 acres or less	19	11.9
5 to 9 acres	32	20.0
10 acres or more	5	3.1

6.2.2 Land use and livestock

All households surveyed rear livestock. Table 6.10 lists the percentage of households with different species of livestock. Only 11 households in the study area had pigs and no households had donkeys. Improved breeds are not raised in the area. Thus, the project should consider developing a strong livestock programme in this block to introduce improved breeds and increase productivity. This needs to be accompanied by the development of adequate fodder sources to support improved breeds.

Table 6.10. Livestock ownership in percentage (N=160)

No.	Cow		Chicken		Goat		Bull		Sheep
	Local[1]	HB[2]	Local	HB	Local	HB	Local	HB	Local
0	71	0	16	0	98	0	111	0	123
1	28	0	9	0	15	0	25	0	7
2	22	0	18	0	10	0	14	0	9
3	12	0	10	0	12	0	2	0	5
>3	27	0	107	0	25	0	8	0	16
Highest no.	39	0	50	0	50	0	30	0	30

[1]Local indicates local breed, [2]HB indicates improved breed

The source of fodder is mainly grasses (59%) and crop residue (36%). Average acreage used for crop residue production is 1.4 acres and livestock grazes on around 1.4 acres, on average. Grazing on communal land is common (34%) and uncommon on government land (2 cases). Commercial feed is a source of fodder for only 7 households and only 25 households buy feed at the local market. However, 93% of the households are experiencing problems with their livestock. The major problem is livestock health, with respondents reporting problems with ticks and with disease incidence. Feed and fodder availability was the number two cause of problems and was reported by 15% of the households. However, 14% say they do not have adequate land for grazing their livestock, and 53% experience problems with free-grazing livestock from neighbours, which corresponds well with the fact that 50% of the households practice free-grazing.

6.2.3 Major constraints at farm level

The most important constraints at farm level are problems with pests and diseases, lack of capital for investment and the inability to anticipate climate variability (Table 6.11). The high incidence of problems with flooding points to a lack of resilience to climate related problems in this region. Farmers also listed ill health and old age as a major constraint. Thus, the project needs to be aware of the demands on labour that proposed interventions require in this block. Soil constraints were down the list for farmers, but there is still a perception of significant soil related problems in the block. Input costs were not listed as a major constraint; however the frequency with which capital was cited indicated that farmers do not feel that they can adequately invest in their enterprise. Striga was cited frequently as a major pest problem in the block. This problem is strongly associated with poor soil fertility, particularly N deficiency.

Table 6.11. Major constrains at farm level listed by farmers

Constraints	No. 1 (N=160)	No. 2 (N=156)	No.3 (N=141)
Pests and diseases	13	22	27
Capital	13	17	17
Weather	18	15	11
Health	20	13	9
Flooding	18	11	12
Soil fertility	24	10	6
Farm size	12	15	9
Income	14	17	-
Erosion	3	12	14
Input costs	5	1	17

6.2.4 Soil and water conservation

Soil erosion is being addressed by 90 of the households interviewed (59%) and the most common conservation measures are terraces (43%). Several farmers were practicing contour ploughing and are erecting trash line barriers. Of the 68 farmers using terracing as a conservation measure, 31 have constructed 'Fanya chini' terraces. These need to be discouraged as they usually increase erosion, unless the soil is properly spread. In addition to these measures, 21 farmers are also harvesting rainwater, mainly from the roof, for domestic use.

Thus, there seems to be a need to assess the soil and water conservation measures and assist the farmers in selected better measures and integrating trees and legumes in the control of runoff water and soil erosion. This would simultaneously address some of the pest problems and the low soil fertility that farmers are mentioning as one of the largest constraints at farm level.

6.2.5 Trees & Agroforestry

The majority (98%) of the farmers are practicing agroforestry. All of the homesteads sampled have trees which are protected (Table 6.12) and 92 percent of the farmers interviewed are interested in planting more trees, which corresponds well with the farmers' response to practicing agroforestry. Only 13 farmers out of 160 are not interested in planting more trees, which is mainly due to land size (7 farmers), age and ill health (2 farmers), Approximately 24% of the farmers interviewed are planning to cut down trees on their farm. Two farmers from mentioned cultural practices as a hindrance to tree planting, as women are not allowed to plant trees.

Table 6.12. Tree species on-farm (N=161)

Tree species	No. farms with the species
Markhamia lutea	117
Mango	75
Thevetia peruviana	30
Grevillea robusta	24
Albizia coriaria	20
Euphorbia	17
Orange	17
Eucalyptus spp.	15

Reasons for growing trees include producing fruits, fuel wood, and timber (>75% for each). Forty-four percent of the respondents use trees grown on the farm for medicine and 54% grow trees for cash income. About 26% of the farmers use trees to address soil fertility and only 13% use trees as fodder. Therefore, the project should organize community training to raise awareness of opportunities offered by expanding the growing or trees and production of other tree products to facilitate better integration of trees into the farming system.

Using farmer's answers to rank the importance of agroforestry products the top 10 uses were:

1. Fuelwood
2. Wind breaker
3. Timber
4. Fruits
5. Food
6. Aesthetics
7. Cash income
8. Medicine
9. Soil fertility
10. Fodder

6.2.6 Household energy supply

The main sources of fuel for the families in this block are wood and paraffin (Table 6.13). About 86% of the households are not energy self sufficient, which might explain the high number of farmers interested in more tree planting as mentioned above. More than 90% of the interviewed farmers are interested in planting more trees.

Table 6.13. Fuel use by source

Fuel source	Percentage
Paraffin	99
Wood	100
Charcoal	76
Crop residue	20

6.2.7 Trainings and group membership

The majority of the farmers interviewed have not received any training. Only 29 of the 161 farmers interviewed have received any type of training; most (19) were members of a group. Many farmers in this area (57%) are of members of groups. We found 106 groups during our survey (examples in Table 6.14). Thus, the base upon which to build the training program in the block for these groups is weak and needs to be built in order for the project to achieve its objectives.

Table 6.14. Selected community groups and their locations.

Group name	Cluster	Main activity
Luhwa women	1	Cultivate farms and save the money they are paid
Joka Ondege	1	Helps members during funerals.
Unami	1	Contribute to help members when there is a problem
Akili unatoa Kwa mwenzako	2	Merry go round and offer loans to members
Pida	3	Bee keeping, horticultural crops production, livestock production (sheep)
Jirani Mwema	6	Vegetable production e.g. tomatoes, kales
Arambe Konyruok	10	Chicken rearing
Mother's union	11	Give donation to members
Konyruok Ber women	12	Agriculture
Kondeng women	16	Grow maize, beans and cassava, buy plots and construct residential houses.

6.3 Market accessibility

Market accessibility is generally good throughout the block, with the exception of the centre eastern area, which remains rather isolated from markets (Figure 4.4). In this block as well, the area has a reasonably good road network, so market oriented activities, like growing wood for timber or fuelwood may be feasible. However, as the project considers activities in the rather isolated areas, networks for moving goods to markets need to be looked into closely.

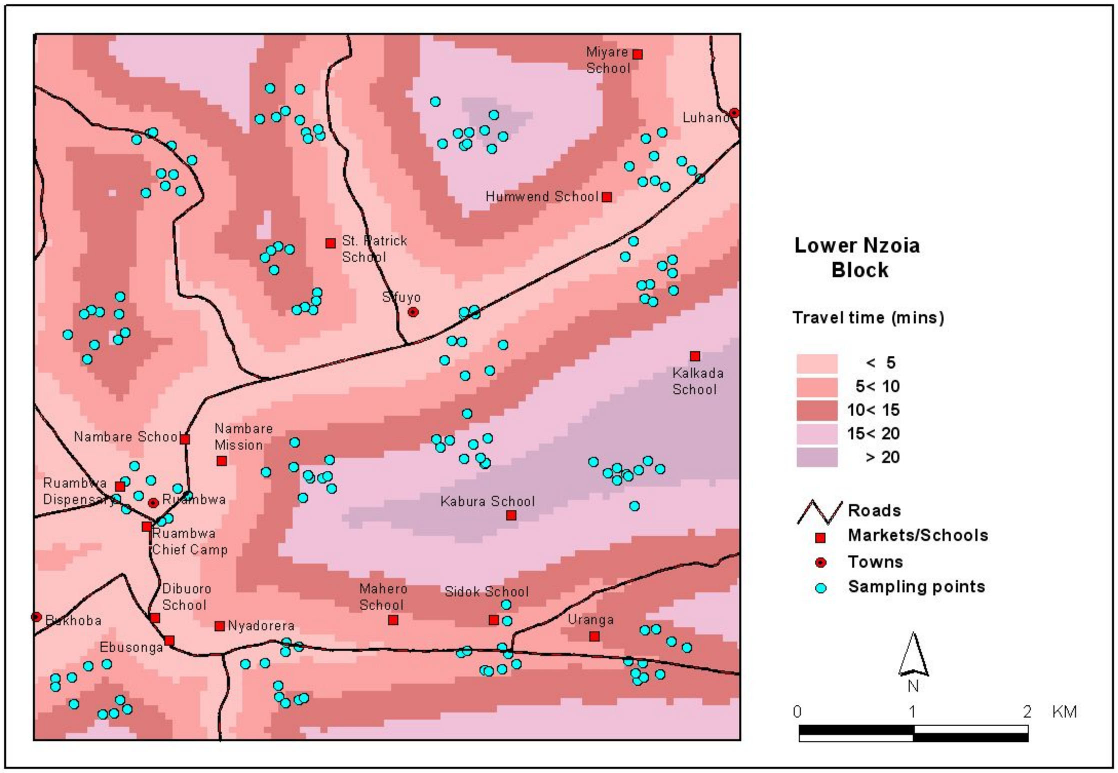

Figure 4.4 Market accessibility.

6.4 Synthesis and Management Recommendations

The greatest amount of abandoned degraded land occurs in the southern and western portions of the block, particularly around clusters 3, 4, 6, and 9. Steep areas are also degraded and abandoned around clusters 4 and 5. These abandoned areas should be the focus for land rehabilitation work. In the southern portion of the block (clusters 1, 5, 9 and 13) there is a high incidence of depth restrictions on soils that are still cultivated. These areas are frequently flooded. There is also a hotspot of depth restrictions around cluster 11. These areas should be targeted for soil conservation and development of agroforestry systems that maintain more permanent vegetative cover. Additional erosion and hard setting on these sites could render them unfit for cultivation.

Interventions in this block should mainly focus on soil conservation and increasing soil cover, boosting soil fertility and enhancing biodiversity. When discussing interventions with communities, farm size and soil depth restriction need to be considered. Average farm size is only 3.2 acres, which is considerably smaller than elsewhere in the Project. Around 20% of the sampled points have soil depth restriction at 20 cm, hence it is important that soil depth is assessed before any activity is planned and implemented.

Soil erosion is an important problem in this block, but it is not as advanced as elsewhere. The project has the opportunity to intervene here before the problem reaches crisis proportions. The high incidence of depth restrictions cited above suggests that this block is near a tipping point and could see significant erosion problems in the near future. However, clusters 4, 13, and 16 already have very high incidence of sheet erosion, because of the steep slopes, and should be prioritized for intervention. Elsewhere in the block sheet erosion was observed in 30% or less of the fields visited. This is not insignificant and suggests that the project should begin raising awareness of farmers to this problem. Perhaps site visits to areas that are severely degraded will help raise awareness of what could happen if the problem is allowed to progress unchecked. Already 59% of the households practice conservation, so there is some awareness of the problem and the farmers are taking action. This initiative needs to be encouraged by the project and supported.

In general, farmers are interested in agroforestry. Many farmers have planted *Markhamia lutea*, but have poor knowledge of other indigenous trees and their purposes. Other commonly planted species include fruit trees, *Thevetia peruviana* and *Grevillea robusta*. There are a wide range of indigenous trees which are suitable for the area which should be promoted through trainings and meetings with community groups and extension officers. Focus should be on species suitable for timber, fuel, fodder, and soil fertility. In order to successfully increase the tree cover of this block, there is a need to focus on the purposes and benefits of indigenous trees. More than 80% of the farmers are not self sufficient with firewood and under general comments many farmers asked for more knowledge on trees and especially inquired about access to seeds. Hence, there is an interest for tree planting which this project should capitalize on. This can be done through trainings of community groups, by tree planting in screening trials and degraded areas and in schools.

Farmers are not reporting significant problems with *Striga*, but this may be because the survey was conducted during the dry season. The Field Officer should look into this during activity planning to assess the importance of this problem. Low soil fertility levels and low use of fertilizer in the block suggest that soil fertility and associated pest problems might be major constraints at farm level. *Striga* weeds grow well on poor soils with low soil fertility. Studies in Western Kenya, by Boye (2005)[3] and Gacheru and Rao (2005)[4], show that relay-cropping maize and beans with improved fallows reduce Striga infestation after a few rotations. At the same time, soil fertility is improved and the farmer has additional benefits from the wood produced by the fallow crop, fodder and firewood. Problems with monkeys and other wild animals are clearly significant in parts of the block and the project could look at alternatives for reducing these threats.

Many farmers listed erratic rainfall as a major constraint at farm level. The erratic rainfall pattern of Lower Nzoia is likely to continue and perhaps worsen in the coming years because of climate change. Hence, interventions which increase soil cover, contribute to soil fertility, and diversify production should be given priority, since these interventions will buffer the harsh climatic conditions which are especially found in the lower part of the block. Secondly, the few but heavy rains should be harvested in ponds and dams to ensure better water availability throughout the year. Hence, establishment of ponds and dams is another priority activity for the project.

All households surveyed have livestock; however, over 90% of the farmers are experiencing problems with their livestock, mainly from ticks and tick-borne diseases. Lack of adequate and good quality fodder is also a widespread problem. The Livestock Officer of the Project should look into this and liaise with potential service providers to find affordable and appropriate solutions for these farmers. Establishment of fodder banks and the encouragement of hay production are also of high importance, since more than 70% of the households interviewed do not have adequate fodder. Fodder shrubs could be introduced to improve the nutritional status of the herd in this block. Ensuring adequate fodder should precede any activities to introduce improved breeds,

Free-grazing is a major problem in the entire block and is a threat to tree plangent activities. The project should therefore assist the communities in setting-up by-laws to control free-grazing and promote live fencing. It is imperative that free-grazing is controlled for the project to have any impact in terms of tree planting and rehabilitation of degraded areas. Several Acacia species can be planted as live fences since they are tolerant to browsing. If farmers begin controlling grazing, an alternative fodder source needs to be provided. Planting trees at wide spacing (e.g. 4 x 10 m) on degraded sites would allow for both wood and grass production, where the grass could be used to

[3] Boye, A. (2005) Effect of Short Term Fallowing on Maize Productivity and Soil Properties on a depleted Clayey Soil in Western Kenya. PhD dissertation University of Copenhagen
[4] Gacheru, E. & Rao, M.R. 2005. The potential of planted shrub fallows to combat Striga infestation on maize. *International J. Pest Management*, 51(2): 91-100.

augment fodder availability for farmers. Another option that needs to be explored with communities is intercropping food crops with a legume that can also be used as animal feed. One such system is improved fallows. The legume, *Dolichos lablab* can also be used as animal feed.

Finally, establishing and strengthening of community groups should also be an activity of the project. Most of the farmers who have received training are members of groups. Yet a significant number of farmers in the area do not belong to groups and have not received training. Also, for the scaling up of successful project activities, well functioning groups are imperative. Furthermore, the problems of flooding in the middle and lower parts of the block are mainly caused by activities up-slope. The link between the farmers up-slope and the farmers down-slope should be made through trainings for groups in both locations.

7 Conclusion

This baseline report presents the results of the data collected from the combination of field and household surveys in four blocks of the Western Kenya Integrated Ecosystem Management Project. Interpretation and management recommendations are based solely on the data and do not represent a consensus view between the Project and the participating communities. It is imperative that before initiating any activities in the respective blocks, more information be collected for the targeted area chosen for interventions. It should be noted that recommendations made within this report are not based on any dialog with communities. It is therefore vital for the Project to establish a dialog with the target communities and farmers. These communities and farmers need to be actively involved in the process of prioritizing activities. Thus the information contained within the report should provide support to the field officers of WKIEMP, but the ultimate decisions concerning priorities need to be made based upon consensus between the communities and the Project.