Nile Basin Initiative

# Potential areas for irrigation development

## Kenya

# Potential for Irrigation Development
# Kano plains Area
# Kenya


The Nile Basin Initiative (NBI), under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the project Regional Agricultural Trade and Productivity Project (RATP) has undertaken a study entitled "Assessment of the Irrigation Potential in Burundi, Eastern DRC, Kenya, Rwanda, Southern Sudan, Tanzania and Uganda". The study was categorized as "preparation for a development program" and has a strategic perspective.

During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

## Overview

Kano plains focal area is situated in western Kenya within Nyanza province and Nyando District. Slopes are very gentle, and the area descends slightly from East to West. Elevation in the east is 1180 m which descends approximately 40 meters towards 1140 meter in the South West. Slopes reach up to 10% very locally, but on average they stay under 2%. The area is very uniform in topography which makes it very suitable for large scale irrigation if water is available abundantly.

## Land and Water Resources

The soil texture within the focal area ranges but is mainly clayey loam. The percentage of organic carbon in the top soil is relatively low with around 0.5%. Drainage capacity is somewhat poor to poor. The soil is deep, and has an available water holding capacity of 125-150 mm/m. This soil is typically formed under alluvial processes, and can be mainly characterized as a Fluvisol, in combination with Cambisols and Vertisols. Paddy rice cultivation is widespread on tropical Fluvisols with satisfactory irrigation and drainage. Paddy land should be dry for at least a few weeks every year in order to prevent the redox potential of the soil from becoming so low that nutritional problems (Fe or H2S) arise. Cambisols generally make good agricultural land and are used intensively. Cambisols in the humid tropics are typically poor in nutrients but are still richer than associated Acrisols or Ferralsols and they have a greater CEC. Cambisols with groundwater influence in alluvial plains are highly productive paddy soils. Vertisols contain a high proportion of swelling clays and form deep wide cracks from the surface downward when they dry out, which happens in most years. In Kano plains focal area the NDVI is 0.59, which is high compared to the Kenya average NDVI of 0.36. Land productivity is extraordinary high on places where irrigation takes already place around the river, and besides the land productivity is rather uniform over the area. Total precipitation in the focal area is 1570 mm per year, while reference evapotranspiration is 1500 mm per year. Temperature ranges between 18oC and 30oC respectively.

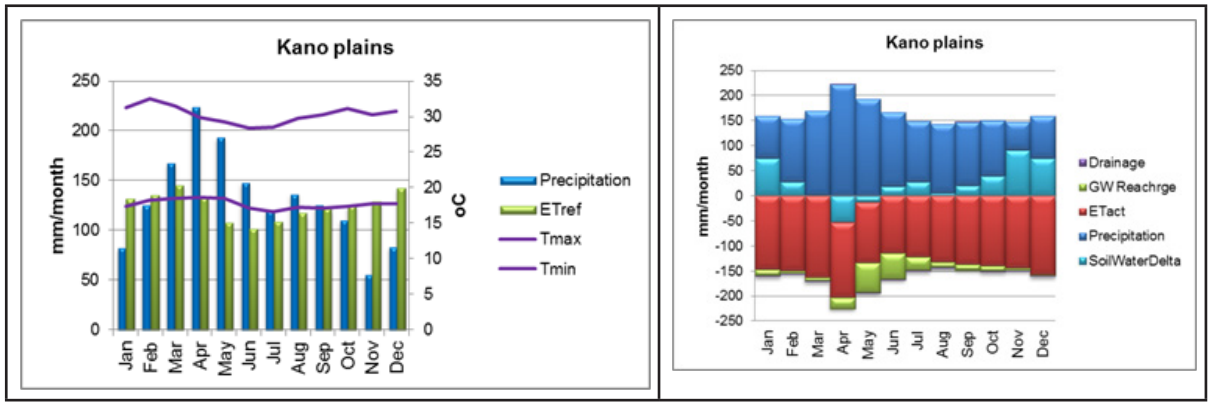


**Kenya at a Glance**
(World Development Indicators 2010)

| | |
|---|---|
| **Population** | 40.5 million |
| **Population below the poverty line (1.25 USD)** | 43.4 % (2005) |
| **GDP** | 32.2 billion USD |
| **GDP Per Capita** | 795 USD |
| **Agriculture as a % of GDP** | 25.2% |

# Socio-economic Factors

Within the focal area the population density is estimated to be slightly lower with 285 inhabitants/km2. The rapidly increasing population is largely the cause for degradation of the catchment and degradation of the focal area. All people live scattered around the area. However some highly productive agricultural grounds have not been inhabitant so far, and are used for agriculture. This makes is rather difficult to design a large scale irrigation system. With the design of an irrigation scheme, it is advised to limit any population displacement and to develop the irrigation scheme as much as possible around the existing houses. The majority (+/- 80%) of the people in the area belong to the Luo tribe and other tribes include Kisii, Luhya and Kalenjins. Infrastructure in the area is developed relatively well. Tarmac roads are passing through the focal area such as the Nairobi Kisumu highway and the Kisii Kisumu road. However within the focal area all other roads are weathered dirt roads. For irrigation development the infrastructure should be strengthened to make it easier to bring construction material and agricultural inputs, and to reach the nearby markets with the products. Nearby markets include Ahero, Kisumu or further away the larger towns Eldoret, Nairobi or Nakuru. The farmers have average knowledge about irrigation and agricultural cooperatives.




***Average climate conditions and water balances for the area based on various global and local datasets, satellite information and advanced modeling approaches.***

# Irrigation and Crop Potential

Field assessments have shown that currently approximately 80% of the land is used for agriculture. Most dominant crops are Maize, Sorghum, Paddy/rice and Sugarcane. Average Kenyan yields are the lowest of all research countries. Within the focal areas however the conditions are favorable and yields high, even compared to surrounding countries. For this focal area is chosen to focus on high value crops (rice/paddy, vegetables/freshnes, tomatoes, cabbages and other brassicas, dry onions), which give good return. These potential crops will al give an excellent yield under irrigation, and will be very rewarding. It is expected that the gains with these potential crops can double or triple per hectare.

# Benefit-Costs Analysis

A first-order benefit-cost analysis is undertaken for the area. Information for this is based on various sources such as FAO publications, IFPRI publications, local expertise and data. A full benefit-costs analysis has to be undertaken in a sub-sequent feasibility study for the area. The following table shows that based on the benefit-costs analysis for the area investments in irrigation are very positive.

| **Investment Costs** | |
|---|---|
| Irrigation infrastructure (US$/ha) | 5,000 |
| Social infrastructure (US$/farmer) | 500 |
| Accessibility infrastructure (million US$) | 2.0 |
| **Operational Costs** | |
| O&M irrigation (US$/ha/yr) | 60 |
| Extension service (US$/farmer) | 10 |
| O&M roads (US$/yr) | 40,000 |
| **Summary** | |
| Initial investments (million US$) | 24.9 |
| O&M costs (million US$/yr) | 0.337 |
| Net benefits per year (million US$/yr) | 21.421 |
| IRR (Internal Rate of Return) | 100.0% |

The initiative of this study was taken by Regional Agricultural Trade and Productivity Project (RATP) of the Nile Basin Initiative (NBI). Financial support was provided by the Canadian International Development Agency (CIDA). The study was undertaken by a large consortium headed by FutureWater and WaterWatch (Netherlands). More details is available from a series of reports and databases.

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# Potential for Irrigation Development
# Kuja Area
# Kenya


The Nile Basin Initiative (NBI), under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the project Regional Agricultural Trade and Productivity Project (RATP) has undertaken a study entitled "Assessment of the Irrigation Potential in Burundi, Eastern DRC, Kenya, Rwanda, Southern Sudan, Tanzania and Uganda". The study was categorized as "preparation for a development program" and has a strategic perspective.

During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

## Overview

Kuja focal area is situated within Nyatike district, within Nyanza province. This area completely in the West of Kenya is highly productive for agriculture. The area is about 30 km from the shores of Lake Victoria at an average elevation of 1300 m. The area descends from North West to South East from 1330 m towards 1260 m above sea level. The elevation difference of approximately 70 m results in very gentle slopes. Slopes range within the area but do not exceed 5% (250 m DEM) and are on average around 1-2%. On a 30 meter resolution slopes can reach up to 10% locally.

## Land and Water Resources

The soil texture in the focal area is mainly clayey loam. Locally this may vary to loam or clay. According to the field visit the drainage capacity is poor. The soil is formed under alluvial processes, and has a typically finer textured subsoil. The percentage of organic carbon in the top soil is relatively low, ranging from 1- 1.5%. The available water holding capacity is large in most of the area with 125-150 mm/m and may increase locally to over 150 mm/m. The largest part of the focal area can be characterized as a Planosol. Natural Planosol areas support a sparse grass vegetation, often with scattered shrubs and trees that have shallow root systems and can cope with temporary waterlogging. Land use on Planosols is normally less intensive than that on most other soils under the same climate conditions. Fertilizers are needed for good yields. Paddy fields should be allowed to dry out at least once a year in order to prevent or minimize microelement deficiencies or toxicity associated with prolonged soil reduction. In Kuja focal area the NDVI is 0.66, which is really high compared to the Kenya average NDVI of 0.36. The highest productive grounds can be found on the Northern side (NDVI 0.8) and on the South eastern part the NDVI is slightly lower (0.6). Total precipitation in the focal area is 1370 mm per year, while reference evapotranspiration is 1480 mm per year. Temperature ranges between 17oC and 29oC.

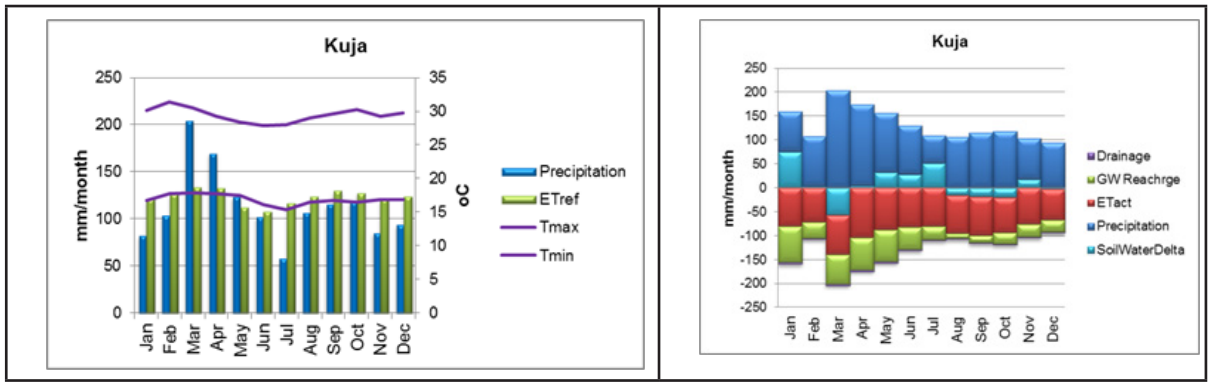


**Kenya at a Glance**
(World Development Indicators 2010)

| | |
|---|---|
| **Population** | 40.5 million |
| **Population below the poverty line (1.25 USD)** | 43.4 % (2005) |
| **GDP** | 32.2 billion USD |
| **GDP Per Capita** | 795 USD |
| **Agriculture as a % of GDP** | 25.2% |

# Socio-economic Factors

Within the focal area the population density is estimated to be 211 inhabitants/km2. All people live extremely scattered around the area. This makes is rather difficult to design a large scale irrigation system. With the design of any irrigation scheme, it is advised to limit any population displacement and to develop the irrigation scheme as much as possible around the existing houses. The rapidly increasing population is largely the cause for degradation of the catchment and degradation of this focal area. Most people in the area belong to the Luo tribe. Infrastructure in the area is not developed well. Tarmac roads are passing by the focal area, but within the focal area all roads are weathered dirt roads. For irrigation development the infrastructure should be strengthened to make it easier to bring construction material and agricultural inputs, and to reach the nearby markets with the products. Nearby markets include Migori, Kisii, or further away the larger towns Kisumu, Musoma or Nakuru. The farmer's knowledge about irrigation and agricultural cooperatives is low. Unemployment rate in this area is very high, irrigation development can create more agro-related jobs and as such reduce unemployment and poverty.




***Average climate conditions and water balances for the area based on various global and local datasets, satellite information and advanced modeling approaches.***

# Irrigation and Crop Potential

Field assessments have shown that currently approximately 45% of the land is used for agriculture. Most dominant crops are Sorghum, Maize, and Cassava. Average Kenyan yields are the lowest of all research countries. Within the focal area, however, the conditions are favorable and yields high, even compared to surrounding countries. For this focal area it is chosen to focus on high value crops, which give good return. These potential crops (cassava, rice/paddy, vegetables, pineapples, tomatoes, cabbages and other brassicas) will al give an excellent yield under irrigation, and will be very rewarding. It is expected that the gains with these potential crops can double or triple per hectare.

# Benefit-Costs Analysis

A first-order benefit-cost analysis is undertaken for the area. Information for this is based on various sources such as FAO publications, IFPRI publications, local expertise and data. A full benefit-costs analysis has to be undertaken in a sub-sequent feasibility study for the area. The following table shows that based on the benefit-costs analysis for the area investments in irrigation are very positive.

| | |
|---|---|
| **Investment Costs** | |
| Irrigation infrastructure (US$/ha) | 5,000 |
| Social infrastructure (US$/farmer) | 760 |
| Accessibility infrastructure (million US$) | 2.0 |
| **Operational Costs** | |
| O&M irrigation (US$/ha/yr) | 60 |
| Extension service (US$/farmer) | 15 |
| O&M roads (US$/yr) | 80,000 |
| **Summary** | |
| Initial investments (million US$) | 24.9 |
| O&M costs (million US$/yr) | 0.357 |
| Net benefits per year (million US$/yr) | 21.921 |
| IRR (Internal Rate of Return) | >100% |

The initiative of this study was taken by Regional Agricultural Trade and Productivity Project (RATP) of the Nile Basin Initiative (NBI). Financial support was provided by the Canadian International Development Agency (CIDA). The study was undertaken by a large consortium headed by FutureWater and WaterWatch (Netherlands). More details is available from a series of reports and databases.

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# Potential for Irrigation Development
# Nzoia river basin Area
# Kenya


The Nile Basin Initiative (NBI), under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the project Regional Agricultural Trade and Productivity Project (RATP) has undertaken a study entitled "Assessment of the Irrigation Potential in Burundi, Eastern DRC, Kenya, Rwanda, Southern Sudan, Tanzania and Uganda". The study was categorized as "preparation for a development program" and has a strategic perspective.

During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

## Overview

Nzoia river basin focal area (5141 ha) is located in the western part of Kenya, on the border of the Western and Nyanza province. The focal area spreads out within a valley, which covers the stream valley from Nzoia River. The area descends from East to West from 1240 m above sea level to 1200 m downstream. In the upper part of the focal area the river valley is quite small which makes that the area next to the river ascends for about 20 meters. Downstream the focal area is more flat. Slopes are very limited, and reach up to 10% locally, but stay well below 3% on a 250 meter resolution.

## Land and Water Resources

The soil texture in the focal area is loamy. The soil is deep, and is typically located in a depression in which products of rock weathering are deposited, or other sediments that have the characteristics of swelling clays. De drainage capacity is moderately. Whenever the soil is wet the swelling of the clay can easily cause water logging, and in dry season deep cracks in the soils cause excessive drainage. Vertisols have considerable agricultural potential, but adapted management is a precondition for sustained production. The comparatively good chemical fertility and their occurrence on extensive level plains where reclamation and mechanical cultivation can be envisaged are assets of Vertisols. Their physical soil characteristics and, notably, their difficult water management cause problems. A small part on the eastern tip of the focal area is characterized as an Acrisols. These soils have higher clay content in the sub soil as in the top sol, which limits the drainage capacity. Preservation of the surface soil with its all-important organic matter and preventing erosion are preconditions for farming on Acrisols. In Nzoia river basin focal area the NDVI is 0.66, which is really high compared to the Kenya average NDVI of 0.36. The land productivity is lowest directly bordering the Nzoia river, and is further uniform over the area. Total precipitation in the focal area is 1410 mm per year, while reference evapotranspiration is 1464 mm per year. Temperature ranges between 18oC and 31oCC.

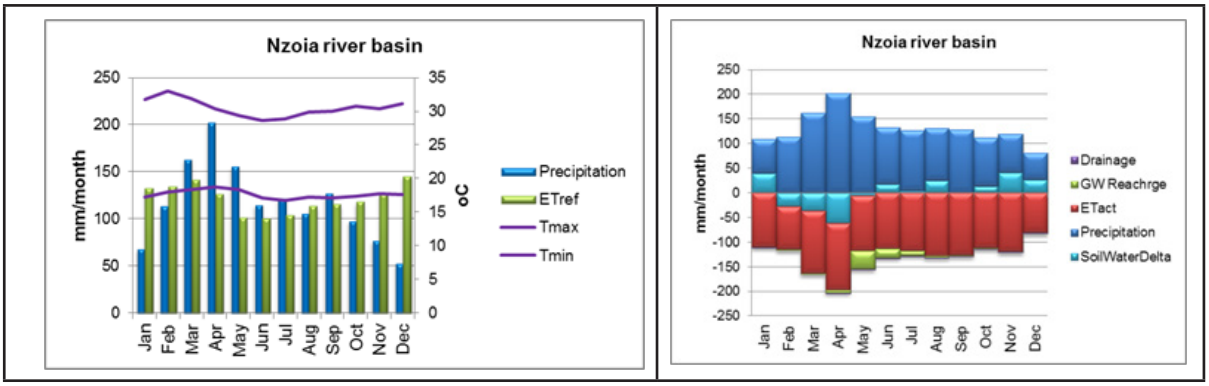


**Kenya at a Glance**
(World Development Indicators 2010)

| | |
|---|---|
| **Population** | 40.5 million |
| **Population below the poverty line (1.25 USD)** | 43.4 % (2005) |
| **GDP** | 32.2 billion USD |
| **GDP Per Capita** | 795 USD |
| **Agriculture as a % of GDP** | 25.2% |

# Socio-economic Factors

Within the focal area the population density is estimated to be slightly lower with 348 inhabitants/km2. The rapidly increasing population is largely the cause for degradation of the catchment and degradation of the focal area. All people live scattered around the area. However the areas in the stream valleys and near the Nzoia River have hardly been inhabitant so far, and are used for agriculture. This makes is rather difficult to design a large scale irrigation system. With the design of an irrigation scheme, it is advised to limit any population displacement and to develop the irrigation scheme as much as possible around the existing houses. The majority (+/- 90%) of the people in the area belongs to the Luo tribe and the remaining 10% belongs to the Luhya tribe. Infrastructure in the area is not developed really well. A tarmac road from Kisumu to Busia is passing by the focal area, however within the focal area all roads are weathered dirt roads. For irrigation development the infrastructure should be strengthened to make it easier to bring construction material and agricultural inputs, and to reach the nearby markets with the products. Nearby markets include Siaya, or further away the larger towns Busia, or Kisumu. The farmers have low knowledge about irrigation and agricultural cooperatives.




***Average climate conditions and water balances for the area based on various global and local datasets, satellite information and advanced modeling approaches.***

# Irrigation and Crop Potential

Field assessments have shown that currently approximately 75% of the land is used for agriculture. Most dominant crops are Maize, Beans, Cassava and Sorghum. Maize, Beans and Sorghum are all grown in two growing cycles per year. Average Kenyan yields are the lowest of all research countries. Within the focal areas, however, the conditions are favorable and yields high, even compared to surrounding countries. For this focal area is chosen to focus on high value crops (pineapples, tomatoes, cabbages and other brassicas, dry onions), which give good return. These potential crops will al give an excellent yield under irrigation, and will be very rewarding. It is expected that the gains with these potential crops can double or triple per hectare.

# Benefit-Costs Analysis

A first-order benefit-cost analysis is undertaken for the area. Information for this is based on various sources such as FAO publications, IFPRI publications, local expertise and data. A full benefit-costs analysis has to be undertaken in a sub-sequent feasibility study for the area. The following table shows that based on the benefit-costs analysis for the area investments in irrigation are very positive.

| | |
|---|---|
| **Investment Costs** | |
| Irrigation infrastructure (US$/ha) | 4,000 |
| Social infrastructure (US$/farmer) | 750 |
| Accessibility infrastructure (million US$) | 4.0 |
| **Operational Costs** | |
| O&M irrigation (US$/ha/yr) | 60 |
| Extension service (US$/farmer) | 15 |
| O&M roads (US$/yr) | 80,000 |
| **Summary** | |
| Initial investments (million US$) | 17.8 |
| O&M costs (million US$/yr) | 0.305 |
| Net benefits per year (million US$/yr) | 11.649 |
| IRR (Internal Rate of Return) | 100.0% |

The initiative of this study was taken by Regional Agricultural Trade and Productivity Project (RATP) of the Nile Basin Initiative (NBI). Financial support was provided by the Canadian International Development Agency (CIDA). The study was undertaken by a large consortium headed by FutureWater and WaterWatch (Netherlands). More details is available from a series of reports and databases.

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# Potential for Irrigation Development
# Sio basin Area
# Kenya


The Nile Basin Initiative (NBI), under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the project Regional Agricultural Trade and Productivity Project (RATP) has undertaken a study entitled "Assessment of the Irrigation Potential in Burundi, Eastern DRC, Kenya, Rwanda, Southern Sudan, Tanzania and Uganda". The study was categorized as "preparation for a development program" and has a strategic perspective.

During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

## Overview

Sio basin Focal area is located in the West of Kenya, near the border to Uganda, and about 20km North of Lake Victoria. The focal area is located within the Western province and Busia district. The Sio River is passing by the focal area on the South eastern side. The focal area itself is located on the foothills covering several valleys draining into the Sio River. Elevation differs from 1240 m in the North East towards 1160 m above sea level down in the valley in the South of the focal area. Slopes are limited, and can reach up to 10% locally but stay well below the 5% on average. If enough water is available from upstream the area would be very suitable for gravity irrigation.

## Land and Water Resources

Soils in the area are rather diverse and can differ from place to place. It can be said that the Sio river valley and the small stream valley within the focal area share most characteristics, and that the North western part which is hillier is more uniform. Soil texture in the area ranges from loamy to clayey loam. Drainage capacity is somewhat poor in the North, and moderately well in the southern part of the focal area. The percentage of organic carbon in the topsoil is nearly twice as high in the river valley with 1.5%. The available water holding capacity is large in the whole area with 150 mm/m. Management of the Gleysols, which are most common in the southern part of the focal area, should focus on drainage to make the soil useful. Adequately drained Gleysols can be used for arable cropping, dairy farming and horticulture. Soil structure will be destroyed for a long time if soils are cultivated when too wet. The soil in the North of the area can be predominantly characterized as an Acrisols although the soil here is very diverse. Acrisols have higher clay content in the sub soil as in the top sol, which limits the drainage capacity. Preservation of the surface soil with its all-important organic matter and preventing erosion are preconditions for farming on Acrisols. The NDVI is 0.64, which is high compared to the Kenya average NDVI of 0.36. Land productivity is highest within the river valley in the South and the stream valleys in the focal area. Total precipitation is 1435 mm per year, while reference evapotranspiration is at the same level of 1430 mm per year. Temperature ranges between 18oC and 31oCC.

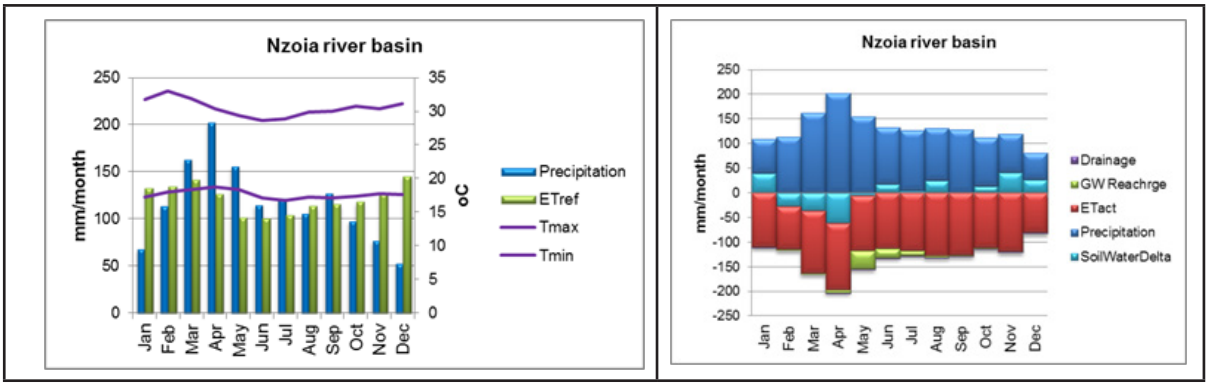


**Kenya at a Glance**
(World Development Indicators 2010)

| | |
|---|---|
| **Population** | 40.5 million |
| **Population below the poverty line (1.25 USD)** | 43.4 % (2005) |
| **GDP** | 32.2 billion USD |
| **GDP Per Capita** | 795 USD |
| **Agriculture as a % of GDP** | 25.2% |

# Socio-economic Factors

Within the focal area the population density is estimated to be slightly lower with 360 inhabitants/km2. The rapidly increasing population is largely the cause for degradation of the catchment and degradation of the focal area. All people live scattered around the area on the slightly higher places. However, the areas in the stream valleys and near the Sio River have hardly been inhabitant so far, and are used for agriculture. This makes is rather difficult to design a large scale irrigation system. With the design of an irrigation scheme, it is advised to limit any population displacement and to develop the irrigation scheme as much as possible around the existing houses. The majority of the people in the area belong to the Luhya tribe. Infrastructure in the area is developed quite well. A tarmac road from Kisumu to Busia is passing by the focal area and one other tarmac road surrounds the focal area. However, within the focal area all roads are weathered dirt roads. For irrigation development the infrastructure should be strengthened to make it easier to bring construction material and agricultural inputs, and to reach the nearby markets with the products. Nearby markets include Busia, Namble, Bumala, Bungoma, Mumias, Kisumu or towns in neighbouring Uganda. The farmers have low knowledge about irrigation and agricultural cooperatives.




***Average climate conditions and water balances for the area based on various global and local datasets, satellite information and advanced modeling approaches.***

# Irrigation and Crop Potential

Field assessments have shown that currently approximately 80% of the land is used for agriculture. Most dominant crops are Maize, Cassava, Beans and Sorghum. Maize, Beans and Sorghum are all grown in two growing cycles per year. Average Kenyan yields are the lowest of all research countries. Within the focal areas, however, the conditions are favorable and yields high, even compared to surrounding countries. For this focal area is chosen to focus on high value crops (tomatoes, cabbages and other brassicas, dry onions, watermelons), which give good return. These potential crops will al give an excellent yield under irrigation, and will be very rewarding. It is expected that the gains with these potential crops can double or triple per hectare.

# Benefit-Costs Analysis

A first-order benefit-cost analysis is undertaken for the area. Information for this is based on various sources such as FAO publications, IFPRI publications, local expertise and data. A full benefit-costs analysis has to be undertaken in a sub-sequent feasibility study for the area. The following table shows that based on the benefit-costs analysis for the area investments in irrigation are very positive.

| | |
|---|---|
| **Investment Costs** | |
| Irrigation infrastructure (US$/ha) | 6,000 |
| Social infrastructure (US$/farmer) | 500 |
| Accessibility infrastructure (million US$) | 2.0 |
| **Operational Costs** | |
| O&M irrigation (US$/ha/yr) | 60 |
| Extension service (US$/farmer) | 10 |
| O&M roads (US$/yr) | 40,000 |
| **Summary** | |
| Initial investments (million US$) | 24.6 |
| O&M costs (million US$/yr) | 0.282 |
| Net benefits per year (million US$/yr) | 15.509 |
| IRR (Internal Rate of Return) | 100.0% |

The initiative of this study was taken by Regional Agricultural Trade and Productivity Project (RATP) of the Nile Basin Initiative (NBI). Financial support was provided by the Canadian International Development Agency (CIDA). The study was undertaken by a large consortium headed by FutureWater and WaterWatch (Netherlands). More details is available from a series of reports and databases.

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