Nile Basin Initiative

Potential areas for irrigation development

Uganda

Potential for Irrigation Development
Acaba Area
Uganda

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.

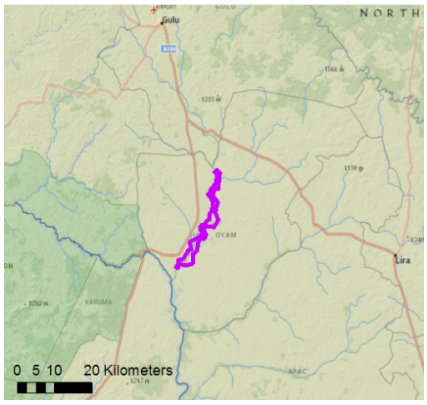
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

This focal area (4327 ha) is situated in Uganda's Northern region within the Apac province and Oyam district. The focal area covers the valley of one of the tributaries towards the White Nile. This includes the river and the flat land on the sides. Within the focal area the slopes are very limited. The area slightly descends from North (1047 m) to South (1037 m). Within the cross section of the focal area, the elevation difference is very limited to a maximum of 3 meter. Based on the ASTER 30 m slope map, it becomes clear that slopes vary significantly on this small scale. Slopes are predominantly limited to 0-5%. On smaller scales, however, they may increase to values exceeding the 10%.

Land and Water Resources

Soils in Acaba focal area are formed under fluvial processes. The entire focal area has mainly a Eutric Gleysol. The groundwater is rather shallow, and drainage is moderately to poor. The main obstacle to the utilization of Gleysols, is the necessity to install a drainage system to lower the groundwater table. If too wet soils are cultivated, the soil structure will be destroyed for a long period. Therefore, Gleysols in depression areas with insufficient possibilities to lower the groundwater table are best kept under a permanent grass cover or swamp forest. Gleysols are suitable for wetland rice cultivation. There are slight signs of erosion, thus erosion issues should be addressed when designing an irrigation scheme. Salinization is developing as a problem; a good drainage system can decrease the occurrence and development of salinization. Within the Acaba focal area the NDVI is 0.67. The land productivity is slightly higher in the South. This could suggest that there is no particular difference between dry en raining season. The variation in land productivity over the year is rather stable. The climate of the area can be characterized as warm with temperatures during the year ranging from about 20oC to 31oC, with the hottest months being January, February, and March. Annual average precipitation is 1229 mm and reference evapotranspiration 1652 mm per year.

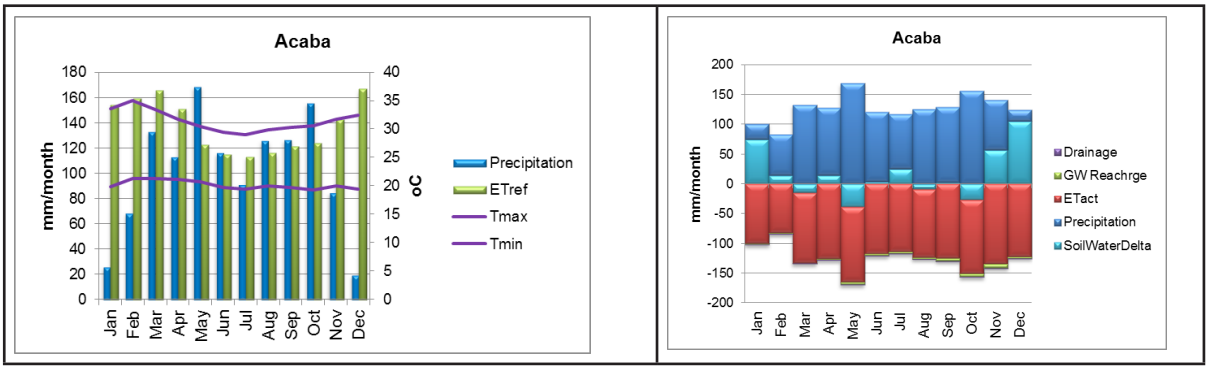


Uganda at a Glance
(World Development Indicators 2010)

Population	33.4 million
Population below the poverty line (1.25 USD)	38%
GDP	17 billion USD
GDP Per Capita	509 USD
Agriculture as a % of GDP	24%

Socio-economic Factors

The population density of Acaba focal area is around 170 people/km2, which is slightly above the Ugandan average of 150 people/km2. People in the focal area are living quite scattered around. Most houses can be found along the roads passing by on both sides of the focal area. Within the valley, which is mainly appointed as focal area, hardly anybody lives due to the high flood risks. When developing an irrigation scheme it is advised to design the scheme such that population displacement is not or hardly needed. However, due to the scattered houses in some areas, the irrigation possibilities will either be restricted, or minimal displacements are needed. Farmers have an average farming and irrigation knowledge, and have some experience in agricultural cooperatives. The area can easily be reached by road, as the Bobi-Masindi road is passing by on the Western side. Infrastructure within the area is poor, with a few dirt roads going through the area. Small markets are easy to reach, larger markets nearby include the markets in Oyam, Minakulu, Gulu and South Sudan. Within the focal area no protected areas are reported.



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

The yields in the Acaba focal area are relatively high, with yields about 25% higher than the Ugandan average. The yields of bananas and rice are low compared to African, or East African standards. Fruit Fresh Nes, however, is giving high yields, surpassing the African and world's average, approaching 33% of the highest obtainable in the world. Especially for bananas and rice the yield gap is rather large, and a large improvement can be made to overcome the yield gap. Banana yields can increase from 7.9% to around 30% of the world's highest, and rice can double towards 30-35% of the world's highest. The combination of these three crops is very suitable, since farmers know how to obtain high fruit fresh nes yields, and banana and rice are rather new. The combination can supply the area with a continuous food supply and push development.

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$)	21.3
O&M costs (million US$/yr)	0.245
Net benefits per year (million US$/yr)	22.432
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
Bigasha/Omumukura Area
Uganda

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.

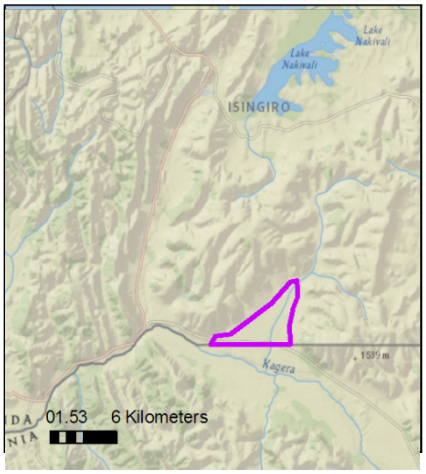
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

This focal area is situated in the absolute South of Uganda, in the Southern province, Isingiro district and Ngarama sub-county. Omukura River flows through the focal area from North to South. With 1942 ha, this focal area is the smallest of the five selected in Uganda. The area is rather flat, and descends gradually from 1260 m in the North to 1230 m in the South. The stream flowing through the area drains into the Kagera River, which flows from Tanzania. Compared to the areas nearby, the focal area can be classified as a plain, with most slopes under 5% and a few small places with slopes exceeding 10%.

Land and Water Resources

The focal area has clay based soils, due to a continuous process of sedimentation. The soils in the valley are moderately drained, while upland the soils are more sandy clay, and well drained. The soil in the valley is a Haplic Ferralsol, which is a classic deeply weathered, tropical red or yellow soil. Ferralsols have good physical properties; great soil depth, good permeability and stable microstructure make Ferralsols less susceptible to erosion than most other intensely weathered tropical soils. Moist Ferralsols are friable and easy to work. They are well drained, but may in times be dry because of their low available water storage capacity. The chemical fertility of Ferralsols is poor; weatherable minerals are scarce or absent. Maintaining soil fertility by maturing, mulching and/or adequate fallow periods or agroforestry practices, and prevention of surface soil erosion, are important management requirements. The average NDVI is 0.6, which is rather low, but higher values can be found in the center of the focal area. The variation over the year is quite diverse within the area. The center part, with the higher land productivity has also the lowest variation in land productivity over the year. The climate of the area can be characterized as warm with temperatures during the year ranging from about 15oC to 27oC. Annual average precipitation is 1247 mm and reference evapotranspiration 1439 mm per year.

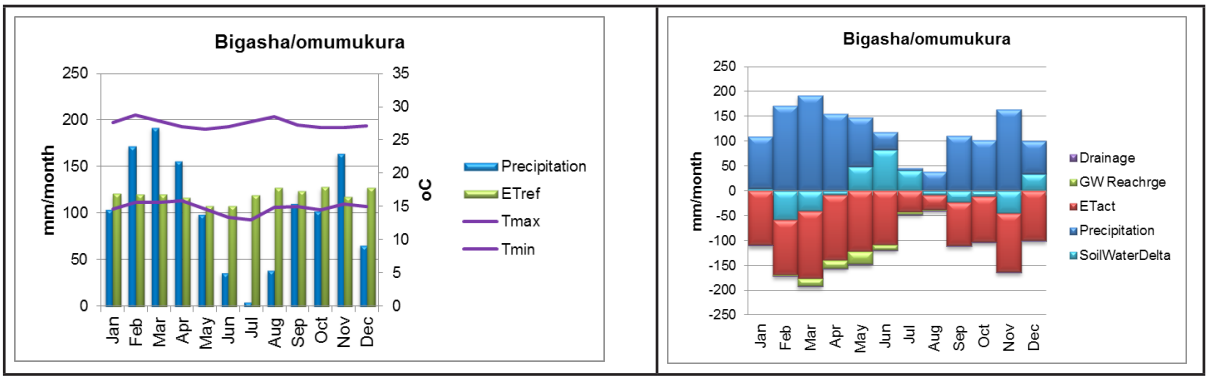


Uganda at a Glance
(World Development Indicators 2010)

Population	33.4 million
Population below the poverty line (1.25 USD)	38%
GDP	17 billion USD
GDP Per Capita	509 USD
Agriculture as a % of GDP	24%

Socio-economic Factors

The average population density in this focal area is 140 people/km2. People in the area mainly live at the transition between the flat land and the hills along the road on the western side of the focal area. Furthermore, some people live within the flat focal area, but they live quite scattered around. When developing an irrigation scheme it is advised to design the scheme in such a way that population displacement is not or hardly needed. However, due to the scattered houses in the low flat land, the irrigation possibilities will either be restricted, or minimal displacements are needed. People in the area have low experience with irrigation. This makes displacement also more difficult, as people are less aware of the advantages that irrigation brings. The nearest highway is at approximately 10-20 km from the focal area. This Mwizi – Isingiro road is also important to transport goods to nearby markets, which include Mbarara and Isingiro and the markets in Tanzania. Tribes inhabiting the area include Banyankole, Banyarwanda, Bafumbira, Bakiga and Banyambu. Farmers' knowledge is low, but they are rather business oriented towards faming. Farmers do have some experience with farmers' 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

Yields in Bigasha/Omumukura focal area are 10% above Ugandan average. All three potential dominant crops are cash crops, which are hardly grown today. Uganda has a good record with growing coffee and fruit fresh nes, as yields are above African average, and for fruit fresh nes even above the world's average. The transition to start growing these mainly perennial crops ask for a large investment, as the harvests will be low in the first years. The return will be high, and will push development in this area. Vegetables are currently crown at 8.2% of world's highest, and are expected to increase to about 20% of the world's highest with irrigation.

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$/ha)	7,000
Social infrastructure (US$/farmer)	750
Accessibility infrastructure (million US$)	2.5
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	15
O&M roads (US$/yr)	50,000
Summary	
Initial investments (million US$)	14.1
O&M costs (million US$/yr)	0.163
Net benefits per year (million US$/yr)	18.062
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
Lumbuye Area
Uganda

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.

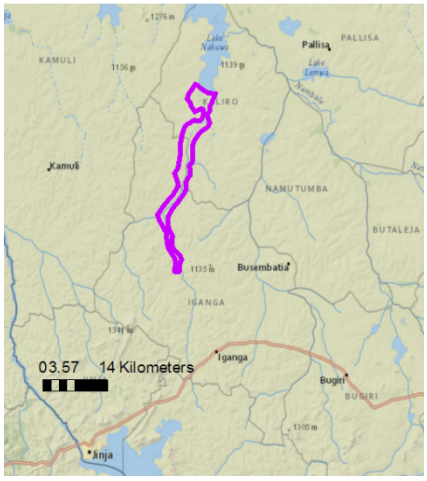
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by Future-Water and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

Lumbuye focal area spreads out from Lake Victoria towards the Eastern tip of Lake Kyoga. The river that flows through the focal area finds its source just north of Lake Victoria. The focal area covers the Northern and downstream part, which are the last 40 km before the river drains into Lake Nakuwa. The river valley descends from South to North from 1065 m in the South to 1035 m in the North. The valley bottom is nearly flat and is slightly higher on the sides. Slopes are very limited and remain below 3% on most places, with some small exceptions where slopes locally reach over 10%. The terrain suggests that the area is very well suited for gravity irrigation.

Land and Water Resources

The soils consist of silty clay loam, and drain poorly due to a dense and finer textured subsoil. Currently, only small parts of the area are used for agriculture. The water holding capacity is quite large (125-150 mm/m). The area is mainly classified as a Planosol, combined with Vertisols, Gleysols and Umbric Fluvisols. Natural Planosol areas support sparse grass vegetation, often with scattered shrubs and trees that have shallow root systems and can cope with temporary waterlogging. Yields from Planosols are modest. Vertisols are often unused or only used for extensive grazing. The main obstacle to utilization of Gleysols is the necessity to install a drainage system to lower the groundwater table. Gleysols in depression areas with inadequate possibilities to lower the groundwater table are best kept under a permanent grass cover or swamp forest. The Lumbuye focal area has an average NDVI of 0.68, which is quite high. Land productivity in the valley is very high and decreases more at the sides. These sides are mostly used for agriculture, as drainage in the valley is poor, and water logging occurs in the valley. The climate of the area can be characterized as warm with temperatures during the year ranging from about 19oC to 31oC. Annual average precipitation is 1174 mm and reference evapotranspiration 1475 mm per year.

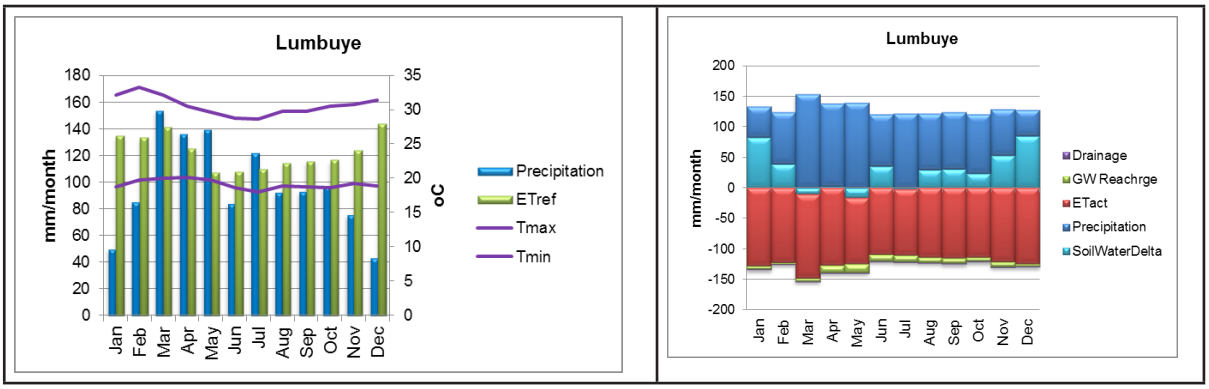


Uganda at a Glance
(World Development Indicators 2010)

Population	33.4 million
Population below the poverty line (1.25 USD)	38%
GDP	17 billion USD
GDP Per Capita	509 USD
Agriculture as a % of GDP	24%

Socio-economic Factors

The population density in the area is among the highest in Uganda and reaches 470 people/km2. People live in small communities along the roads, which mainly follow the contour lines of the hills surrounding the valley of the focal area. When developing an irrigation scheme, it is advised to design the scheme such that population displacement is not or hardly needed. People in the area have average experience with irrigation. This would make displacement also easier, as people are aware of the advantages that irrigation brings. Within the valley itself hardly any people live and the focal area consists mainly of wetland. If the area and the foothills will be developed for irrigation, the need for displacements is very low. The area is quite well accessible, with an average distance of 6 km to the nearest tarmac road, and approximately 10 km to the town of Iganga from the Southern tip of the focal area. The town of Kaliro is located in the East of the focal area. The farmers already practice informal rice irrigation, which makes it easy to adapt to a more professional irrigation system. The development of an irrigation system will be very costly, as flood control requires dams which need to be quite wide.



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

Lumbuye has favorable conditions for agriculture, which shows off in yields being approximately 25% higher than the Ugandan average. The yield of rice is still lower than African standards. The unpredictable river conditions destroy the harvest partially every now and then. Rice grown in an area with a well-managed irrigation system can increase yields towards 6000-7000 kg/ha, which would triple the current yields. Pineapples and fruit trees are not common in the area, but are both good cash crops. Uganda has good experience with fruit trees, which result in yields exceeding the world's average. Planting of fruit trees does require a large investment. This will not be payed back in the first years, due to low yields in the first couple of years. Pineapple is a good cash crop that can stimulate together with fruit trees the agro-industry in the area.

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$)	1.0
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	10
O&M roads (US$/yr)	20,000
Summary	
Initial investments (million US$)	66.0
O&M costs (million US$/yr)	0.731
Net benefits per year (million US$/yr)	55.958
IRR (Internal Rate of Return)	100.0%

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Potential for Irrigation Development
Rwimi Area
Uganda

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.

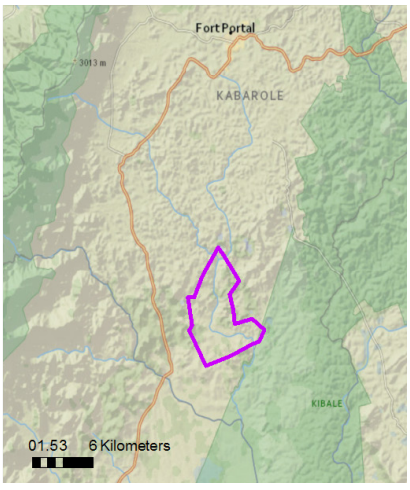
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by Future-Water and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

The Rwimi focal area is situated in Uganda's Western province in the Kabarole district and Rwimi sub-county. The river flowing through the area drains into the Katonga River. Elevation differences within the focal area are substantial. The river valley descends from North to South from 1290 m to 1120 m. In the Northern and Eastern part of the area the slopes ascend rather steep from the river valley. The area south of the stream is more flat. Slopes in the North-East range between 20-25%. Slopes in the Southern part of the area are moderately, and stay mainly under 10%.

Land and Water Resources

The loamy soil in the focal area is originating from volcanic processes. The soil is very deep, and contains more than 3% organic carbon in the top soil. The available water holding capacity is between 125-150 mm/m. These Chromic Cambisols generally make good agricultural land and are used intensively. Cambisols with high base saturation in the temperate zone are among the most productive on earth. Cambisols on steep slopes are best kept under forest, which is particularly true for Cambisols in highlands. Cambisols on irrigated alluvial plains in the dry zone are used intensively for production of food and oil crops. Cambisols in the humid tropics are typically poor in nutrients, but are still richer than the associated Acrisols or Ferralsols, and have a greater CEC. Cambisols with groundwater influence in alluvial plains are highly productive paddy soils. The Rwimi focal area has, with an NDVI of 0.74, the highest land productivity of the five Ugandan focal areas. Variation in land productivity is low, and increases slightly towards the South. The climate of the area can be characterized as relatively warm with temperatures during the year ranging from about 18oC to 29oC, with the warmest months being January, February, and March. Annual average precipitation is 1187 mm and reference evapotranspiration 1476 mm per year.

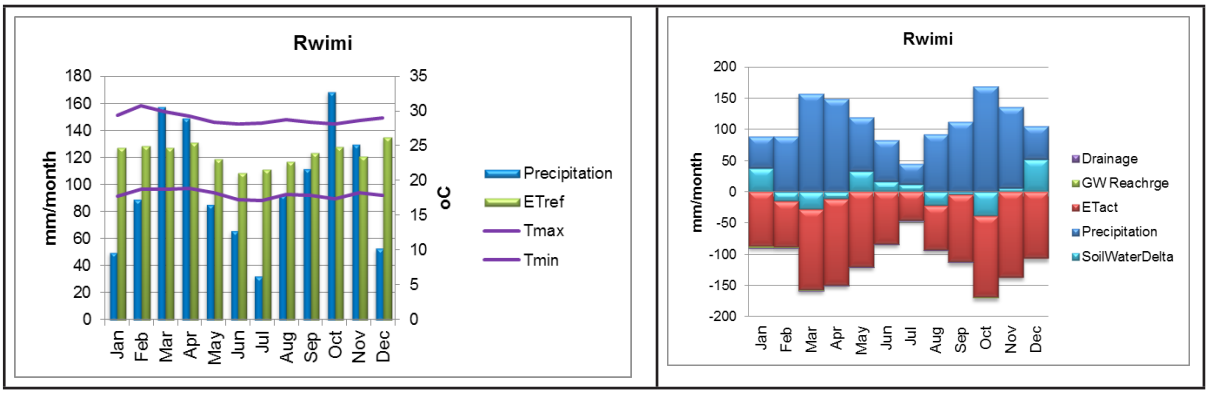


Uganda at a Glance
(World Development Indicators 2010)

Population	33.4 million
Population below the poverty line (1.25 USD)	38%
GDP	17 billion USD
GDP Per Capita	509 USD
Agriculture as a % of GDP	24%

Socio-economic Factors

The population density in the Rwimi focal area is high with 235 people/km2. The average age in Uganda is very young, with almost half of the population being younger than 15 years. This makes that the dependency ratio of the amount of people relying on one income is among the highest in the world. People in the focal area live quite scattered around. Most small settlements can be found along the roads and road junctions. Furthermore, the houses are very scattered and equally distributed over the area. When developing an irrigation scheme, it is advised to design the scheme in such a way that population displacement is not or hardly needed. However, due to the scattered houses and plots in some areas, the irrigation possibilities will either be restricted, or minimal displacements are needed. People in the area have good experience with irrigation. This increases the coop capacity of the people, as they are aware of the benefits that irrigation brings. The site has a good road infrastructure connection to the big markets in Fort portal, Kampala, etc., and even internationally. However, when developing irrigation systems, the current infrastructure in the area should be improved. Rwimi town is at approximately 13 km from the focal area.



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

Yields in the Rwimi focal area are very high, and reach nearly to 40% above Ugandan average. The area grown with upland rice has been expanded rapidly over the past year with good results. With irrigation the rice yields are expected to increase even further towards 5500-6500 kg/ha. This is approximately 50% of the world's highest yields. Vegetables already have good yields, and are expected to increase even more towards 20% of the world's highest yields. Currently, fruit fresh nes is hardly growing in the area, and the introduction of fruit trees will take a large investment. However, the return will be very high and the investment can be earned back rapidly. The only constraint is that yields from the fruit trees will be limited in the first few years.

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$/ha)	10,000
Social infrastructure (US$/farmer)	500
Accessibility infrastructure (million US$)	1.0
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	10
O&M roads (US$/yr)	20,000
Summary	
Initial investments (million US$)	27.6
O&M costs (million US$/yr)	0.201
Net benefits per year (million US$/yr)	16.672
IRR (Internal Rate of Return)	100.0%

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Potential for Irrigation Development
Soroti Area
Uganda

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.

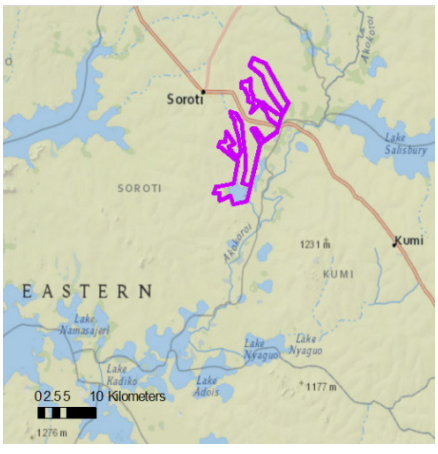
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

Soroti focal area is situated in Uganda's Eastern province within the Soroti district. It covers four valleys East of Soroti town, which drain into the Okot River towards the East. Okot River drains an extremely large area, and therefore the water levels and discharge within the river valley are unpredictable. The four valleys within this focal area all have their highest point in the west, at elevations of approximately 1070 m above sea level. The valleys descend towards the East towards 1040 m. The Northern two branches have slopes ranging from 0% to more than 15%, with quite some emphasis on the steep slopes. The Southern two branches clearly have less steep slopes, with most of the area having slopes of 0-5%.

Land and Water Resources

Soils in this focal area are quite uniform in the valleys (sandy clay loam). More upland this changes towards sandy loam. The soils in the largest southern part of the focal area are Eutric Plinthosols, while in the North Eastern part Eutric Leptosols can be found. Field observations showed that the area is drained well, and that slight erosion is present. Plinthosols are iron rich, and developed under changing groundwater regimes. The repeatedly drying and wetting of the soil hardened it. Plinthosols present considerable management problems. Poor natural soil fertility, caused by strong weathering, waterlogging in bottomlands, drought on Plinthosols with Petroplinthite, Pisoliths or gravels, are serious limitations. Leptosols, which can be found in the North East of the focal area, are very shallow and extremely stony. Therefore, they are mainly used for grazing, and have limited fertility for agriculture. Within the Soroti focal area the average NDVI is 0.58, which is rather low. The two southern valleys have a significant higher NDVI value than the northern two. The climate of the area can be characterized as warm with temperatures during the year ranging from about 20oC to 32oC. Annual average precipitation is 1232 mm and reference evapotranspiration 1644 mm per year.



Uganda at a Glance
(World Development Indicators 2010)

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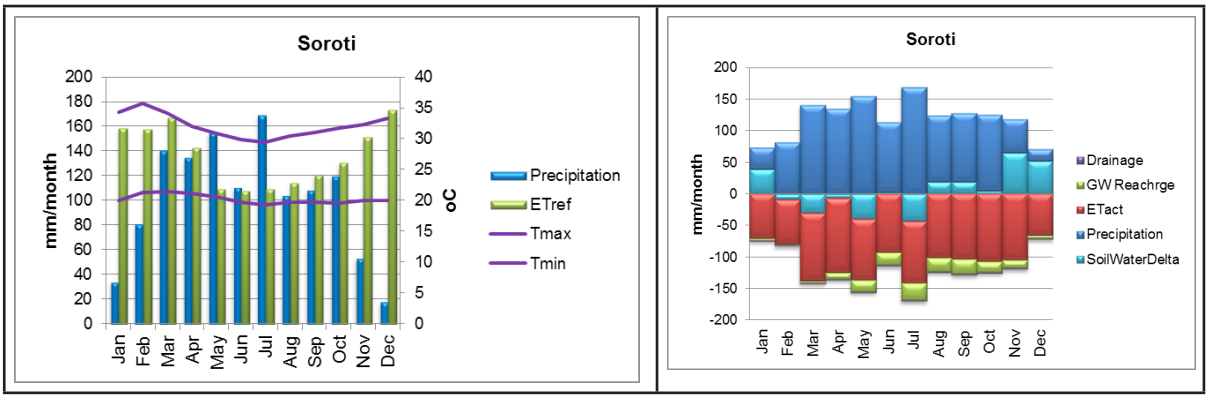
Agriculture as a % of GDP	24%

Socio-economic Factors

The population density in the extended Soroti focal area is 150 people/km2. People in the focal area live quite scattered around on the banks of the valley and on the upward slopes. Within the valley, which is mainly appointed as focal area, hardly anybody lives due to the high flood risks. When developing an irrigation scheme it is advised to design the scheme in such a way that population displacement is not or hardly needed. However, due to the scattered houses in some areas, the irrigation possibilities will either be restricted, or minimal displacements are needed. This increases the coop capacity of the people as they are aware of the benefits that irrigation brings. With the design of any irrigation scheme it is advised to limit any population displacement. The focal area is accessible by the Mbale highway, which passes through the focal area and connects to Soroti town, which is 15 km away. Quite some dirt roads are present within the focal area, but if irrigation will be developed, the infrastructure should be strengthened. The farmers have average expertise in farming and irrigation, and farmer's cooperatives do exists, but need to be strengthened.



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

Within the Soroti focal area the yields are with an average of 7% slightly higher than the Ugandan average yields. Uganda keeps good records for fruit fresh nes growing. Therefore, it is being introduced in many new areas. A change to fruit fresh nes will probably result in relatively high yields compared to Africa standards and even world standards. This can be a good move, but it should be kept in mind that with fruit trees the first years will not give abundant harvest. The yield gap for rice and vegetables is quite large. Rice currently gives yields of 1500 kg/ha, which is about 14-15% of the world's highest. The potential for rice is enormous, and yields under a good managed irrigation system can increase towards 5000 kg/ha. Vegetables currently give a yield of about 6000 kg/ha. Under a good managed irrigation system this can be increased towards 20,000 kg/ha.

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$/ha)	8,000
Social infrastructure (US$/farmer)	500
Accessibility infrastructure (million US$)	3.0
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	10
O&M roads (US$/yr)	60,000
Summary	
Initial investments (million US$)	23.7
O&M costs (million US$/yr)	0.234
Net benefits per year (million US$/yr)	14.694
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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