Nile Basin Initiative

Potential areas for irrigation development

RD Congo

Potential for Irrigation Development
Abia-Tungudu Area
DR Congo

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.

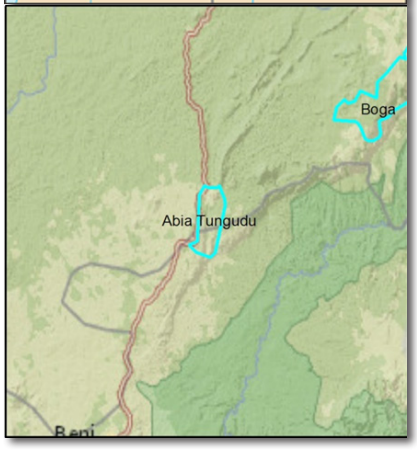
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

The focal area (4358 ha) stretches from the village of Abia towards the village of Tungudu, and is situated in the territory of Beni, in the district of of Goma, in the province of North-Kivu in eastern Democratic Republic of Congo. The area covers a stream valley and two hills on the side draining on the stream. Elevation differs from 1250 m in the far northeastern tip towards 930 down the valley in the South. Slopes in the area can be steep; especially directly bordering the stream valley in the middle of the focal area the slopes are steep (25%). This is one line of steep slopes that goes through the area from North to South. On the higher lands slopes are moderate, and at most places under 5%.

Land and Water Resources

The soil in Abia-Tungudu focal area is silty loam, and drainage is slightly poor. The soil has an average pH, and contains about 2.5% organic carbon in the top soil. The water holding capacity is large with over 150 mm/m. The soil is not uniform within the focal area; most common are the Lixisols, and secondly the Ferralsols. Lixisols are found in seasonally dry tropical and subtropical regions on Pleistocene and older surfaces. Lixisols comprise soils that have a higher clay content in the subsoil than in the topsoil. Preservation of the surface soil with its all-important organic matter is of utmost importance. Degraded surface soils have low aggregate stability and are prone to slaking and/or erosion, where exposed to the direct impact of raindrops. Tillage of wet soil, or use of excessively heavy machinery, compacts the soil and causes serious structure deterioration. Tillage and erosion control measures, such as terracing, contour ploughing, mulching, and use of cover crops, help to conserve the soil. Ferralsols represent the classical, deeply weathered, red or yellow soils of the humid tropics. They are less susceptible to erosion than most other intensely weathered tropical soils. Within the Abia-Tungudu focal area, the average land productivity (NDVI) value is 0.83, which is the highest of all focal areas within the study.



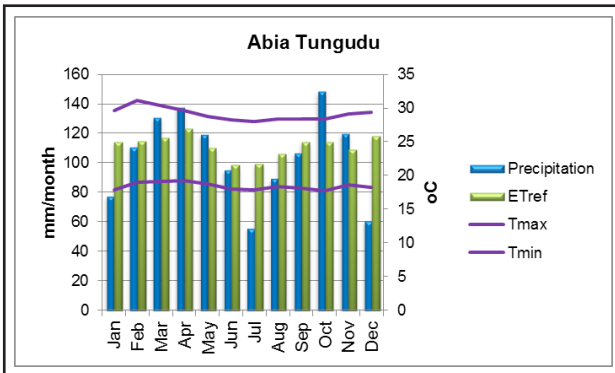
DR Congo at a Glance
(World Development Indicators 2010)

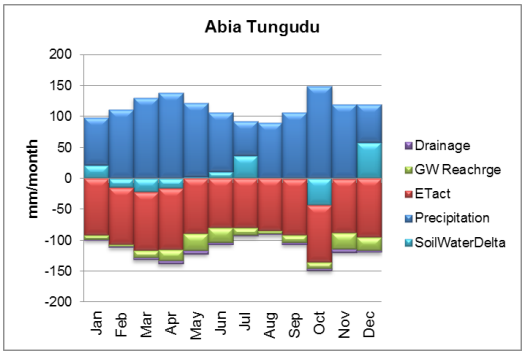
Population	66 million
Population below the poverty line (1.25 USD)	87.7 % (2006)
GDP	13.1 billion USD
GDP Per Capita	199 USD
Agriculture as a % of GDP	42.9%

The climate of the area can be characterized as warm with constant temperatures during the year ranging from about 18°C to 29°C. Annual average precipitation is 1254 mm and reference evapotranspiration 1340 mm per year.

Socio-economic Factors

The population density within the focal area is small, except for the villages, where the density increases. Within the Ituri district, the population density is the highest of the Orientale province with 65 people/km^2 (2003 population estimate). The ratio male to female is slightly in favor of the female with 0.96. Most people live along the road that borders the focal area on the western side. The village of Eringite, Katola and further South the town of Owicha are the main settlements. If an irrigation system is developed, it is not expected that any population displacement is needed, as villages will be avoided and the rural area is very sparsely populated. With the design of any irrigation scheme, it is advised to limit any population displacement. The irrigation scheme can be developed around the existing houses. Infrastructure in this area is quite good; one main road passes the focal area on the western side. The infrastructure within the rural area, however, is much worse. This makes it more difficult to develop the area. Main markets are at Owicha, Bunia or Beni, which are all good reachable. The farmers do have low to average irrigation experience, and have some knowledge about farmers' cooperations.





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

Currently, about 10-20% of the area is used for agriculture. Agricultural practice varies over the area, but main crops that are currently grown are oil palms, cassava, rice, beans, and banana plantains. Yields in the Abia- Tungudu focal area are approximately 40% above DRC average. The need for agricultural intensification is large, and therefore a mixture between staple crops and cash crops is required to meet the food demand and to develop the region, and reduce poverty. The staple crop sorghum is currently grown at 6.8% of the maximum obtainable in the world. Since sorghum is a rather drought resistant crop, the yields do not increase enormously under irrigation. It is expected that yields will increase towards 10%, or slightly above of the world's maximum obtainable yields.

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$)	1.0
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	10
O&M roads (US$/yr)	20,000
Summary	
Initial investments (million US$)	5.3
O&M costs (million US$/yr)	0.055
Net benefits per year (million US$/yr)	0.527
IRR (Internal Rate of Return)	8.5%

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

Bilukwa Area
DR Congo

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

Bilukwa (1259 ha.) is located in the village of Bilukwa in Mahagi territory in the district of Ituri, in Orientale Province, north - east of the DRC. Bilukwa is squeezed between the boundary of the Nile basin on the western side, and Lake Albert on the eastern side. Therefore, the focal area descends from the water divide in the west (2200 m) towards the lake (615 m). Slopes range largely within the area, but are generally quite steep. Slopes reach to over 50% on some places, and even on the more 'moderate' places they are mostly still around 20%. This makes that the terrain is rather fragmented in topography and agricultural potential.

Land and Water Resources

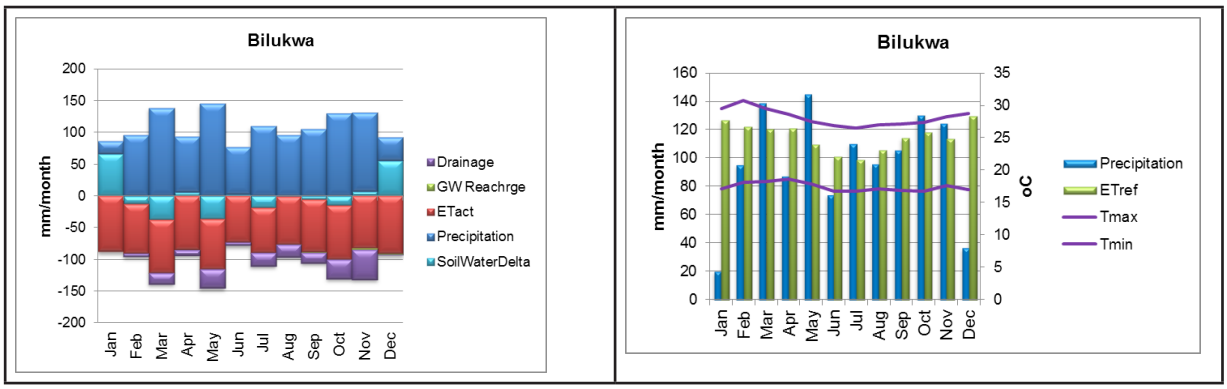
The soil in the focal area is loamy. The drainage of the soil is rather poor to well drained. The top soil is relatively poor in organic carbon (1%). The overall water holding capacity is surprisingly well for a Ferralsol, with over 150 mm/m. Ferralsols represent the classical, deeply weathered, red or yellow soils of the humid tropics. 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. Maintaining soil fertility by maturing, mulching and/or adequate (i.e. long enough) fallow periods or agroforestry practices, and prevention of surface soil erosion, are important management requirements. Fertilizer selection, and the mode and timing of fertilizer application determine to a great extent the success of agriculture on Ferralsols. . Within the Bilukwa focal area, the land productivity (NDVI) is 0.76, and around the focal area even higher values can be found. Land productivity tends to be higher on the flatter land surrounding Lake Edward. The annual variation in land productivity is in general quite low. The lowest coefficient-of-variation can be found at the lake shores. The climate of the area can be characterized as relatively warm with constant temperatures during the year ranging from about 17°C to 28°C. Annual average precipitation is 1165 mm and reference evapotranspiration 1382 mm per year.

DR Congo at a Glance
(World Development Indicators 2010)

Population	66 million
Population below the poverty line (1.25 USD)	87.7 % (2006)
GDP	13.1 billion USD
GDP Per Capita	199 USD
Agriculture as a % of GDP	42.9%

Socio-economic Factors

The population density within the focal area is low with less than one person/km^2. People live very scattered over the area, and there are few small settlements. Most people live in the lower part of the focal area or near the lake. If an irrigation system is developed, it is not expected that any population displacement is needed. Especially since the population density and topography do not allow for large scale irrigation development. With the design of any irrigation scheme, it is advised to limit any population displacement. The irrigation scheme can be developed around the existing houses. Within the Ituri district, the population density is the highest of the Orientale province with 65 people/km^2 (2003 population estimate). This is well above the DRC average of 30 people/km^2. The ratio of male to female is slightly in favor of the females with 0.96. According to the field visits, the tribe inhabiting the region is the Hema. Other tribes may include Lendu, Nyali and Mambisa. 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

Current cropping patterns include mainly maize, green beans, bananas and cassava. In total, approximately 10% of the focal area is used for agriculture and mainly in the lower land, which is closer to Lake Albert. Yields in Bilukwa focal area are nearly 30% above the DRC average. The potential crops, cassava and cabbage, are both crops from which DRC keeps good records. Due to the farmers' experience with these crops, it is expected that the yields of these two crops can easily double under irrigation. Pineapple is a good cash crop, but yields are relatively low. Due to this large yield gap, it is expected that the pineapple yield can increase four fold to 20% of the world maximum yield. Onions will increase in yield, and may double compared to current yields. With an expected focus on cassava, pineapple and cabbage, the yield increase of onions may not contribute much in the total yield increase.

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)	750
Accessibility infrastructure (million US$)	3.0
Operational Costs	
O&M irrigation (US$/ha/yr)	60
Extension service (US$/farmer)	15
O&M roads (US$/yr)	60,000
Summary	
Initial investments (million US$)	3.7
O&M costs (million US$/yr)	0.068
Net benefits per year (million US$/yr)	0.138
IRR (Internal Rate of Return)	-5.3%

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

Boga Area
DR Congo

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.

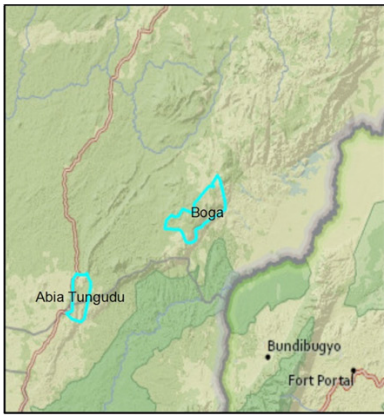
During 2011-2012 an overall assessment on the potential to develop irrigation has been undertaken by a consortium headed by FutureWater and WaterWatch (Netherlands). Based on these analyses 35 high potential areas have been selected. This note provides the highlights of one of these areas.

Overview

Boga Focal area (9361 ha) is located in the village of Boga in Irumu in the district of Ituri, in Orientale Province, north - east of DRC. The western boundary of the focal area is formed by the water divide from the Nile basin and the Congo basin. Most of the area is currently covered with forest. The area is located at an average elevation of 1300 m, which ranges from 1550 m in the center towards 950 m in the North East. Slopes in the area are steepest at the eastern side, where there is a transition between the low land and the mountainous highland on which the focal area is situated. Slopes in the East go up to 30%, and slopes on the highland are mainly limited to 5% or less.

Land and Water Resources

The soil in Boga focal area is silty loam, and drainage is slightly poor. The soil has an average pH, and contains approximately 2.5% organic carbon in the top soil. The water holding capacity is large with over 150 mm/m. The soil is not uniform within the focal area. Most common are the Lixisols, and secondly the Ferralsols. Lixisols are found in seasonally dry tropical and subtropical regions on Pleistocene and older surfaces. Lixisols comprise soils that have a higher clay content in the subsoil than in the topsoil as a result of pedogenetic processes, leading to an argic subsoil horizon. Preservation of the surface soil with its all-important organic matter is of utmost importance. Degraded surface soils have low aggregate stability, and are prone to slaking and/or erosion where exposed to the direct impact of raindrops. Tillage of wet soil, or use of excessively heavy machinery, compacts the soil and causes serious structure deterioration. Tillage and erosion control measures, such as terracing, contour ploughing, mulching, and use of cover crops, help to conserve the soil. Within Boga focal area the average land productivity (NDVI) is 0.80. There is a quite large variation. Lower values can be found at the steep transition from the lower land to the higher land. The highest land productivity values can be found on the higher lands with values around 0.85. The climate of the area can be characterized as warm with constant temperatures during the year ranging from about 18oC to 29oC. Annual average precipitation is 1355 mm and reference evapotranspiration 1314 mm per year.

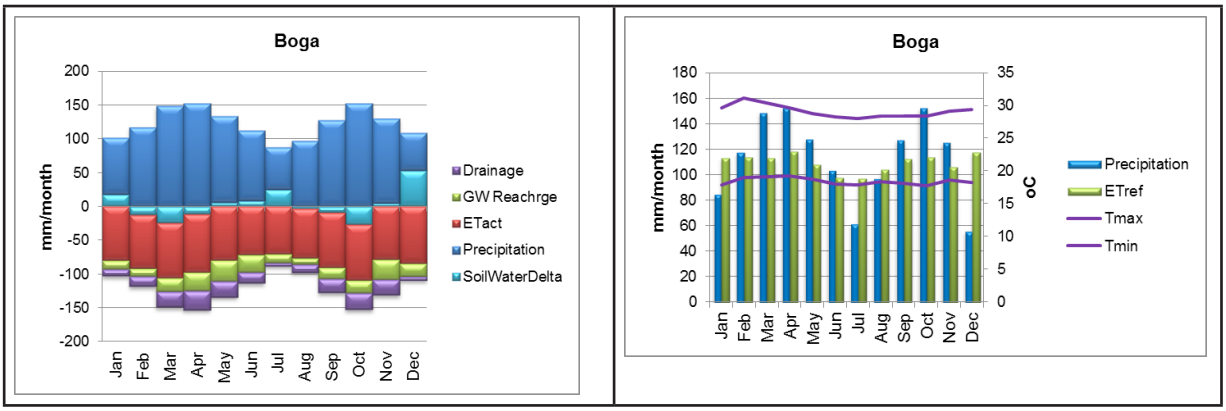


DR Congo at a Glance
(World Development Indicators 2010)

Population	66 million
Population below the poverty line (1.25 USD)	87.7 % (2006)
GDP	13.1 billion USD
GDP Per Capita	199 USD
Agriculture as a % of GDP	42.9%

Socio-economic Factors

The population density within the focal area is relatively large with 37 persons/km2. Within the Ituri district, the population density is highest of the Orientale province with 65 people/km2 (2003 population estimate). People live in Boga village, and further mainly in linear structures along the roads. The land is fragmented by the houses, and some displacements may be needed; especially if large scale irrigation is planned. However, with the design of any irrigation scheme, it is advised to limit any population displacement. The irrigation scheme can probably be developed around the existing houses. The ratio male to female is slightly in favor of the female with 0.96. According to field visits, the tribes inhabiting the region are the Hema and Boga. Although some small roads cross the focal area, the main roads are rather far away on 50 km distance. Main markets at Owicha, Bunia or Beni are even further. The farmers do have average irrigation experience, and also have some knowledge about farmers' cooperations.



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 focal area a maximum of 10% of the land is used for agricultural purposes. The South of the focal area is mainly covered with forest, while in the North more land is prepared for agriculture. The current grown crops are cassava, beans, rice and maize. Yields in Boga focal area are over 30% above DRC average. The four selected crops are a good combination of staple crops and cash crops. Sorghum can be grown on a large scale, and yields under irrigation are expected to double. Yields of coffee in the area are already above African average, but under irrigation this may increase towards 40% of the world's maximum yield. The yield gap for cabbage in the focal area is relatively small, as yields are already high. Yields of cabbage will increase under irrigation, but not largely. Eggplant will be a good crop for the focal area, which can reach towards African average, which is at 5% of the world's highest obtainable yield. When irrigation is developed, rice will be another high potential crop, which will deliver high yields.

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)	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$)	10.0
O&M costs (million US$/yr)	0.120
Net benefits per year (million US$/yr)	1.194
IRR (Internal Rate of Return)	11.1%

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Potential for Irrigation Development

Kitoba-Lubango Area
DR Congo

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

The Kitoba-Lubango focal area (5664 ha) is situated in is located between the villages of Kitoba and Lubango, in the territory of Lubero, in the district of Goma, in the province of North Kivu, in eastern DR Congo. The area is located on high elevation, and descends from North East (2500 m) to South West (2150 m). The focal area can be seen as a small catchment area, of which all the water drains towards the South West. Slopes differ very much on a 30 m scale, with many slopes reaching over 30%. Steep slopes can be found all over the area. On a 250 m scale, however, it becomes clear that most severe slopes can be found in the North eastern region, and that slopes decrease towards 0-10% in the whole southwestern region.

Land and Water Resources

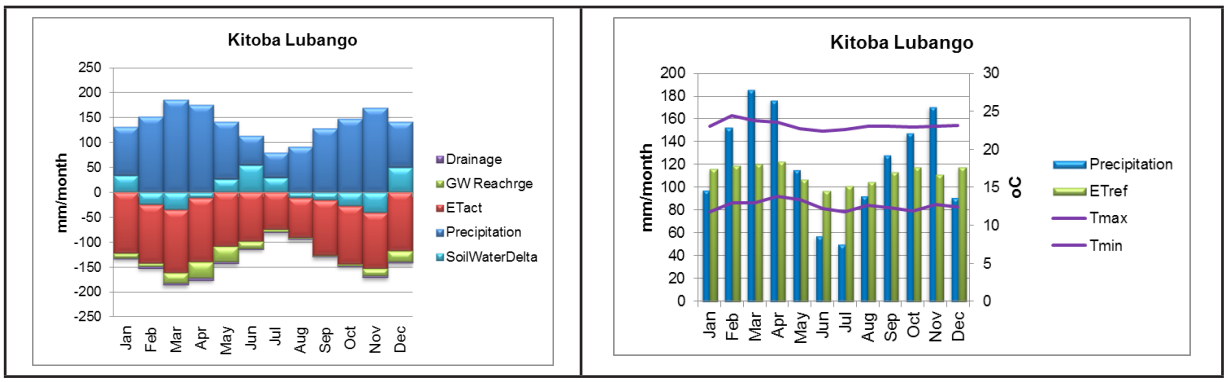
Soil texture in the area is silty loam to loam. Drainage is somewhat poor to moderately well drained. The percentage of organic carbon in the top soil is large with approximately 4%. The soil has a large water holding capacity of over 150 mm/m. The soil is acid with a pH of 4-5.5. Soils in the area consist for 70% of Acrisols. Acrisols are soils that have a higher clay content in the subsoil than in the topsoil as a result of pedogenetic processes. Preservation of the surface soil with its all-important organic matter, and preventing erosion, are preconditions for farming on Acrisols. Mechanical clearing of natural forest, by extraction of root balls and filling the holes with surrounding surface soil, produces land that is largely sterile, where Al concentrations of the former subsoil reach toxic levels. Adapted cropping systems with complete fertilization and careful management are required if sedentary farming is to be practiced on Acrisols. Agroforestry is recommended as a soil-protecting alternative to shifting cultivation, in order to achieve higher yields without requiring expensive inputs. Within the Kitoba-Lubango focal area, the annual average land productivity (NDVI) value is 0.66, which is the lowest of all DRC focal area values, but still well above the country average. The climate of the area can be characterized as moderate with constant temperatures during the year ranging from about 13oC to 23oC. Annual average precipitation is 1468 mm and reference evapotranspiration 1350 mm per year.

DR Congo at a Glance
(World Development Indicators 2010)

Population	66 million
Population below the poverty line (1.25 USD)	87.7 % (2006)
GDP	13.1 billion USD
GDP Per Capita	199 USD
Agriculture as a % of GDP	42.9%

Socio-economic Factors

The population density within the focal area is small with 43 persons/km2. People in the focal area mainly live in villages. Main villages are Kitoba, Bikara and a few others. Apart from the villages people tend to stick together. This limits the amount of solemn houses, which is positive for irrigation development. If an irrigation system is developed, it is not expected that many population displacement are needed. It is advised to limit any population displacement also in the rural areas. The irrigation scheme probably can be developed around the existing houses. It is estimated that 40% of the people live in an urban environment, and that 60% lives in a rural environment. Within the territory of Lubero the ratio female to male is 1.11. The population in North Kivu is extremely young with over 50% of the population being under the age of 20 years. The area is good reachable by road, as one main road passes the focal area and one crosses trough. Main markets nearby include Lubero, Kipese, Butembo and other towns. North Kivu has eight airports, which are mainly owned by individuals. One of these airports is at Lubero. The farmers do have average irrigation experience, and also have some knowledge about farmers' cooperations.



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 area used for agriculture is relatively large (70-80%). Main crops include banana, maize, beans, cassava, rice, soybeans, potatoes, and vegetables. Yields in the Kitoba-Lubango focal area are approximately 10% above DRC's average. With the selected potential future crops the yield gap is large. With irrigation a large part of the yield gap can be closed, and yields are expected to increase dramatically under irrigation. Bananas grown on an irrigated plantation can reach towards 10.000 kg/ha, which would be an increase towards 15-20% of the world's maximum obtainable. Maize under irrigation is expected to triple in yield towards 10%, which is about the East African average. Rice production is preferred above maize, as yields and benefits are higher. Yields can triple towards 30% of the world's maximum yield. Vegetables are already performing quite well, and yields will increase, but will maximum be doubled.

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$)	21.1
O&M costs (million US$/yr)	0.243
Net benefits per year (million US$/yr)	4.502
IRR (Internal Rate of Return)	25.1%

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