

Hydronomics and terranomics in the Nyando basin of Western Kenya

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This paper uses the concepts of hydronomics as systems of rules that define water management and terranomics as systems of rules that define land management and explores their linkages in rainfed agriculture and irrigation areas in the Nyando basin. The upper reaches of the basin have experienced a change from large scale commercial farming to more intensive small holder farming while in the flood prone lower reaches of the basin several irrigation schemes have been set up. The basin has a complex history of settlement, irrigation development and land tenure over the last 50 years, resulting in distinct patterns of poverty, land use, water management and land tenure across the basin. The changes in management of land have a corresponding effect on access to and use of water in the basin but there are no corresponding policy changes to ensure that no one is losing out.

Key words: hydronomics, terranomics, land tenure, settlement schemes, land buying companies, irrigation, dynamic property rights, legal pluralism

Introduction

The management of terrestrial waters is closely linked to the use and management of land. Until recent years, the land laws and the water laws in Kenya have developed along parallel lines without making adequate provisions for the links between land rights and access to water resources. This paper explores the links between water resource management systems (hydronomics) and land management systems (terranomics) in both rain fed agriculture and irrigation areas in the Nyando river basin. The term hydronomics is used to mean systems of rules that define water management and terranomics as systems of rules that define land management. The basin is occupied by two ethnic groups the Kalenjin in the highlands and the Luo in the lowlands. Each had their traditional ways of managing both water and land resources in the past. Over time statutory laws that cut across the cultures have been set up for managing the same resources. Traditional systems of managing the resources based on customary rights operate alongside statutory laws. This is described by Meinzen-Dick and Pradhan, (2002) as legal pluralism.

The concept of hydronomic zones

The term hydronomic is derived from two words, ‘*hydro*’ for water and ‘*nomus*’ from the Greek for a system of rules governing a specific field. The concept of hydronomic zones was developed by International Water Management Institute (IWMI) scientists David Molden, R.Sakthivadivel and Jack Keller to manage water for irrigation schemes. However it can also be used to understand water for other uses in a basin context. It is based on the assumption that all terrestrial fresh water use takes place in a basin context but within in basin different areas are likely to have distinct characteristics. The framework of hydronomic zones is an effort to deal with the differences. They note that water issues are site specific and water management strategies should be tailored to suit each zone in the basin. Consideration must be given to the characteristics of each zone in designing the strategies hence our characterization of the Nyando river basin.

Molden et al (2001) developed a set of six zones and defined them based on key differences in the different areas of the river basin. These are: 1) water source zones, 2) natural recapture zone, 3) regulated recapture zone, 4) stagnation zone 5) final use zone and 6) environmentally sensitive zone. The zones are defined based on similar hydrology, geology and topography. The hydronomic zones are also defined by where drainage water flows. There are two basic conditions. The first condition is where outflow can be re used and the second one is

where outflow cannot be re used .The two conditions are determined by geographic location in the basin. Water used in the upper reaches of the basin can find its way back into rivers and streams and be used again further down stream. In the lower reaches of the basin water used goes into a sink (the ocean) or becomes too polluted. *Natural recapture Zone* is the area of the basin where surface and subsurface drainage water are naturally captured by river systems or channel networks. *Regulated recapture zone* is any area of the basin where drainage can be regulated. Typical regulated capture zones are irrigated areas in the upper reaches of river deltas adjacent to coastal plains. If the drainage and underground flows are not captured they will flow into the sea. *Final use zone* is any area of the basin where there is no further opportunity for down stream re use. The water in the drains is of no value in productive uses. Final use zones fall at the end of the basin such as the lower delta in Egypt. *Stagnation zone* is any isolated area where the drainage capacity is insufficient for the removal of leached salts and excess water. They are characterized by water logging and salinasation. *Water source zone* is the area where excess precipitation provides runoff or ground water recharge for down stream processes. It is an important zone in the formulation of a water management programme. The water yield as a proportion of precipitation received in the basin and its sediment load are dependent on how the water source area is managed. Management strategies in the water source zone can affect water use in the whole basin. For example practices to decrease sediment load often decrease water yield. *Environmentally sensitive zone* is any area where there is a requirement of water for environmentally sensitive purposes. An example is a wetland.

Defining the hydronomic zones in the Nyando river basin

The River Profile

The river profile is a cross section of the river from the source to the mouth. All rivers flow from high ground to lower ground and the gradient is seen in the river profile. The activities of the river change along the river profile and these changes are a factor of the gradient. In the upper reaches of a river, the gradient is steepest and this is associated with fast flowing river water and high levels of erosion. The lower reaches of a river are flattest and are associated with slow moving river water, sedimentation and flooding. The river basin can be divided into three strata: up stream, mid stream and the down stream based on the river profile. Such zoning draws similarities with the hydronomic zones as defined by Molden et al (2001). Both zones are based on geographic position within water catchments.

Upstream

The upper reaches of the Nyando river basin lie between 1800 and 3000 meters above sea level. The rainfall regime is bimodal with the long rains in march/April/may and the short rains in September/October. Annual average rainfall ranges from 1200mm to 1600 mm. The annual average maximum temperatures range from 19 to 27 degrees centigrade. While the annual average minimum temperatures range from 5 to 12 degrees centigrade. The high altitude and high rainfall favor the growth of forests. Two indigenous forests the Mau forest and Tinderet forest found in this region are the source of the Nyando River. The region is also endowed with many springs which feed into the rivers. Due to the steep gradient of the terrain in this region, it is expected to have the highest level of erosion. Studies have identified the region as one of the erosion hot spots in the Lake Victoria basin (Walsh et al 2004). The forested areas here form the *Water Source Zone* while the adjacent descending regions would be the *Natural Recapture Zone*.

This zoning takes care of the biophysical dimensions of water management. It does not address the socio cultural aspects of water management such as the fact the people who live in the region have only moved in since independence in 1964. They came from all parts of Kenya there fore the region is not homogeneous in terms of ethnicity. Politics has stirred ethnic hostility and distrust culminating in tribal clashes in the 1990s. In a community with such diverse origin and a history of distrust statutory laws are stronger than customary laws. Private property rights are very strong. This is evident in the construction of barbed wire fences to keep away tress passers and the absence of free ranging for livestock.

The region has experienced dramatic land use changes in the last 40 years as the land converted from large scale farming to intense smallholder cultivation. In the same time period the population of the area has increased as people move in to occupy the subdivided farms. Nyaribari 'A' village in Bartera sublocation,

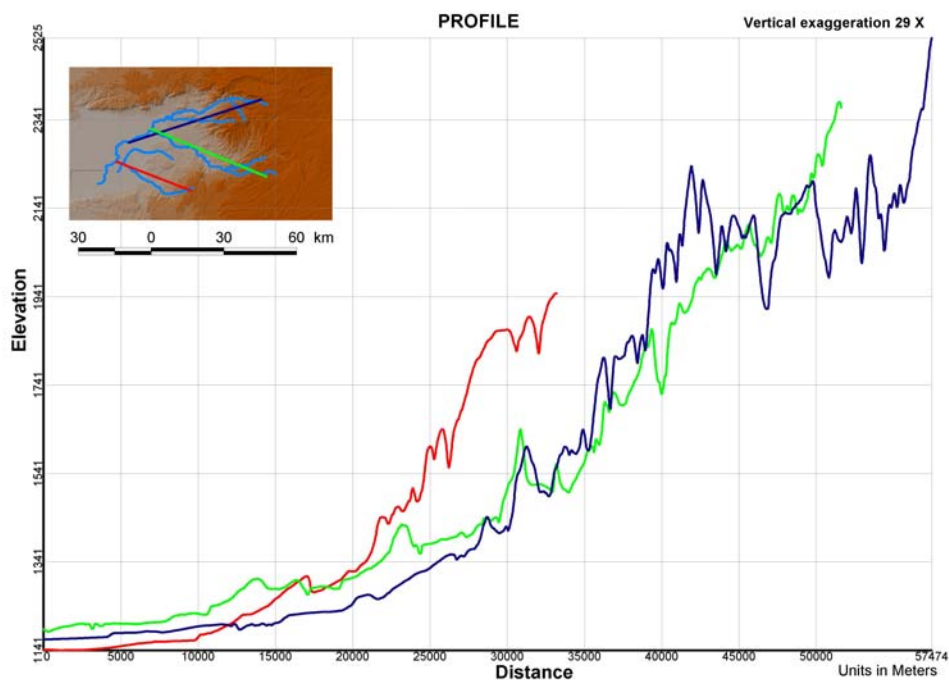
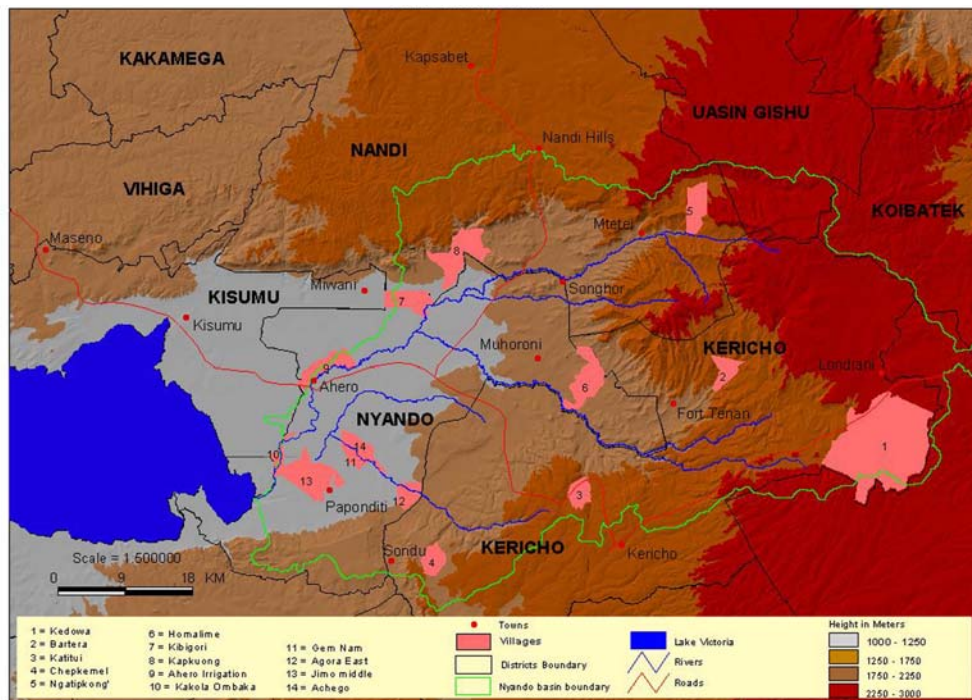


Figure 1. Nyando Basin

marked as 2 in Figure 1 was formerly Lelu farm (LR.1442/2). It was one farm holding owned and managed by one person. It was purchased by a land buying company (Nyagacho) that subdivided it and settled its members. Today Lelu farm makes up Bartera sub location with a population of 2810 people, 526 households and a density of 273 people per km² (Kenya, Republic of, 2000b). The impacts of these changes on the environment are seen in the emerging environmental problems such as deforestation and landslides. This study sampled three villages in this region located in Kedowa, Bartera and Ng'atipkong sub locations as shown in figure 1. The

use of land management systems as a criterion for zoning the basin can capture the socio-cultural and socio-economic dimensions hence our examination of terranomic zones to compliment the hydronomic zones in the basin.

Mid Stream

The middle reaches of the Nyando river lie between 1300 and 1800 meters above sea level and is characterized by gentle slopes. The annual average rainfall ranges from 1200mm to 1600 mm. The annual average maximum temperatures range from 31 to 27^oc. While the annual average minimum temperatures range from 14 to 9^oc. This area has both large scale and smallholder sugar cultivation. It also has small-scale tea in the higher altitudes. It is the transition zone between highland and lowland. It is also the transition zone between two ethnic communities; the Luo who are peasant farmers and fishermen live near the lakeshore and the Kalenjin who are livestock keepers and live in the highlands. There is cross boundary trade in this region between the two communities. There is also potential for tribal conflict. This makes these communities vulnerable. The region would fall in the *natural recapture zone*.

This study sampled five villages in this region .These are found in Ketitui (3),Chepkmel (4),Homalime (6), Kibigori (7) and Kapkuong (8) sub locations as indicated in figure 1. The first two villages are both exclusively Kalenjin speaking communities and growing smallholder tea. The following two are both settlement schemes that are predominantly Luo and grow smallholder sugar cane. The last one is a labor camp on a large-scale sugar plantation. It was invaded by one ethnic community as a result of conflicting land interests and politics.

Down stream

The lower reaches of the Nyando river lie between 1300 and 1000 meters above sea level. The soils are poorly drained because of the high clay content and the low gradient. The river is slow moving and carries a heavy silt load. Dominant river action is deposition and the region is characterized by flooding. It is the hottest and the driest region of the basin with annual average rainfall ranging from 800mm to 1200 mm, the annual average maximum temperatures ranging from 29 - 31^oc while the annual average minimum temperatures range from 12-16^oc. The natural vegetation is open scrubland. The region is flood prone and several rice irrigation schemes have been set up. Annual flooding near the delta leaves rich alluvial deposits that are cultivated and yield good harvests. The deposits also cause the river channel to shift. This has led to serious inter-clan conflict in the delta region because the river is used as a boundary and this boundary keeps shifting. The government is yet to find a lasting solution. In Kokola Ombaka (shown as 10 in figure 1) sub location the most valued fields are those found in the flood plains near the Nyando delta.

Irrigation in the basin is done under different systems. There is a National irrigation Board (NIB) scheme in Ahero irrigation sub location (9); In Jimo middle sub location (13) and Acheho sub location (14) there are Provincial Irrigation Unit (PIU) schemes and in Agoro East sub location (12) there is self organized irrigation of horticultural crops. The lower reaches of the Nyando basin fit the description of the Regulated recapture zone. The many wetlands found at the mouth of the Nyando River form the Environmentally Sensitive zone

The concept of Hydronomic Zones is a planning tool. It enables one to define, characterize and develop management strategies for areas with similar characteristics. It has been applied in the Kirindi Oya basin in Sri Lanka, the Nile valley in Egypt, the Gediz basin in Turkey and the Bhakra area of India. The reason for separating basins into hydronomic zones is because each zone has its set of water saving strategies. It is not enough to save water. It must go hand in hand with improving the well being of man. Falkenmark (2002) examines compatibility of the goals of human security verses ecological security and concludes that emphasis must be put on balancing.

Catchments

The Nyando river basin has several sub catchments within it and these can be used to create water management zones. The use of water catchments for water resource management has been adopted by the Kenya government in its water sector reform programme. The Nyando river has three major tributaries; Ainabngetuny, Kipchorian and Awach each forming a water catchment. The Ainapngetuny and Kipchorian catchments cover the highest elevations of the basin. They are endowed with springs that feed into the streams which join the

main river. The Awach catchment on the other had is on the low-lying region of the basin where rainfall is low and temperatures are high. The bio physical conditions found in each region determine the possible options in terms of livelihood strategies. The use of catchments to create zones is based on hydro-geological considerations.

The Water Act 2002 is the main piece of legislation that is used to manage water as a resource. It vests all water resources in the state. The act provides an elaborate structure for water resource management based on catchments. It provides for the establishment of the Water Resource Management Authority (WRMA) which formulates a National Water Resource Management Strategy (NWRMS). Catchment areas are defined by WRMA in accordance with NWRMS. The Water Act 2002 also creates a Water Services Regulatory Board whose role is to regulate the utilization of water, rather than the conservation of water like the Authority.

Why Terranomic Zones?

Hydronomic zones as defined above are based on biophysical conditions and do not factor in the human environment. It is based on naturally occurring zones. To address the socio cultural and socio economic needs of man it is necessary to create another level of zoning to compliment the hydronomic zones. Land management systems do not occur naturally but are a response to socio economic and socio cultural requirements of a society or a government. Zoning a watershed on the basis of both water and land management systems takes care of both human and ecological security.

Property rights determine access to resources. There are multiple sources of authority that give people access to resources. The written law on land is usually clear. The written law on water is also usually clear. However issues of public access to water on private land are not. If water belongs to the government but it is on private land how do others access it or plan for it? How much access do others have to the river as it passes through private land? This study established that as land tenure changes so does access to water resources on the land. This acts as a driver for the dynamics of water use and management. It also established that as culture changes across the landscape so do livelihood strategies. For instance the life of a pastoralist is not the same as that of a fisherman or a rice farmer in an irrigation scheme. These changes also drive the dynamics of water use and management. In planning water management strategies for catchments it is important to take into consideration these differences keeping in mind that there must be a connectedness between upstream and downstream management for sustainability. Diversity in culture and property rights in catchments is a universal a phenomenon and this justifies their consideration in defining zones for planning purposes.

Defining the Terranomic Zones in the Nyando River Basin

The Evolution of Land Tenure Systems in the Nyando basin

Land in the Nyando river basin is held in different ways in different places and this has changed over time and continues to change. Most rural livelihoods in Kenya depend on agriculture therefore it is important to explore the ways in which land is held, how this has changed over time and how much access each land holding system allows the holder and in particular the poor in these communities. The existing land holding systems in the basin can be best understood in its historical context? The evolution is traced back to the colonial era. The Crown Lands Ordinance of 1902 gave authority to the Crown to alienate land. The Crown and not the local people had original title of the land. Any land that was not physically occupied by the locals was considered wasteland (free land) and free for alienation to the European settlers. The local people's right to land was defined by occupancy while the settlers were given free hold titles by the Crown. This set the stage for two parallel land holding systems. When the settlers required land that was occupied by the locals they had to negotiate for it and they did not like this because they felt a free hold title was superior to a right of occupancy. They advocated for grouping the Africans in definite reserves far removed from any lands likely to be suitable for European settlement. The Crown Lands Ordinance of 1915 allowed the Governor to create Native reserves and provided for the settlers to be given agricultural leases of 999 years instead of free hold titles. Following the Kenya Land Commission (Carter Commission) of 1934, the Native Lands Trust Ordinance of 1938 re designated Native Reserves as Native Land and removed them from the Crown Lands Ordinance. This created a set of laws to govern native lands and another set to govern crown land. Even after independence both sets of

law were still in force explaining the current state of confusion in land administration. The Native Land Trust Board under the Chief Native Commissioner held native land in trust for the communities. The local people lost all their rights to lands outside of the native lands. The Crown Lands Ordinance was amended to define the highlands, which were administered by a Highland Board. Both boards and their boundaries were set up by 1939 and remained the same up to the time of independence. The highlands are commonly referred to as the white highlands. They were often the most productive parts of the country and developed cash economies whereas the native lands were often the less productive and developed subsistence economies. These patterns that were developed in the past era have persisted to date.

This study identified six ways in which land is held in the basin : 1) Trust land-not titled; 2) Government land-not titled; 3) Adjudicated land-freehold titles on completion of adjudication;3) Settlement schemes-freehold titles on discharge from the Settlement Fund Trustee (SFT); 4) Large-scale farms-lease hold titles; 5) Land buying companies-free hold title on subdivision to small units, 6) Forest land-reservations on gazettelement. For purposes of analyzing the evolution of tenure in the basin, this study has generated a map of land tenure in 1964 (figure 2) when the country got independence and one of land tenure in 2004 (figure 3). Using the two map products it is possible to examine the changes that have occurred in the last 40 years and how this has impacted on the lives of the affected communities and on the environment.

Trust land

Public land in the *native lands* is held in trust for the people by the local authorities and is referred to as trust land. Before adjudication was done all land in the native areas were trust land. In the Nyando basin there are three county councils; Nandi county council, Kipsigis county council and Nyando county council. There are also several municipal/town councils. All trust land that is not alienated for a specific use is held in trust by these local authorities. However a survey of the three county councils established that most trust land in the basin has been alienated .What remains under the jurisdiction of the county councils today are schools, cattle dips dispensaries and a few wetlands (Dobbie.W and Onyango.L, 2003).

Access to water in trust lands

Trust lands are areas of open access. People living in the same community have equal access to all water resources found in the trust lands. There are exceptions when people from an outside community try to access the resources. They are not refused access but the locals are given priority especially if the commodity is scarce.

Government land

At independence all crown land converted to government land and was administered by the commissioner of lands on behalf of the president. All government land that is not alienated is still held in the same way. No one has any right to use or occupy it unless granted a lease by the government. However it is common to find unofficial users of these lands who are thrown out when the land is officially allocated. In the Nyando basin such land is found only in the urban centers such as Kericho and Muhoroni.

Access to water on government land

Although government land is not free for use, there is no one who watches over it before alienation so water resources on it are often unofficially available to all. There is very little government land in Kenya because most of the land has been allocated for private developments. In towns there is very detailed land use planning and the riparian reserves are planned and designated as *riparian reserves* and not allocated for any other use. Ideally the local authority should be the custodian but they rarely take up the responsibility so on record they remain government land. It is evident in all major cities of Kenya that these are the areas where slums sprout.Kibera slums along the Ngong River in Nairobi is one of the largest slums in Africa. Other slums that have developed on riparian reserves in the city of Nairobi include Mathare, Mukuru Kayaba, Mukuru Kwa Njenga, Ngomongo and Korogocho.In the nyando basin towns like Muhoroni and Ahero with rivers flowing through them are already showing similar trends. One very negative impact of the open access to the riparian reserve is that the rivers in towns are recipients of refuse form both people and industries.

ONYANGO, SWALLOW AND MEINZEN-DICK

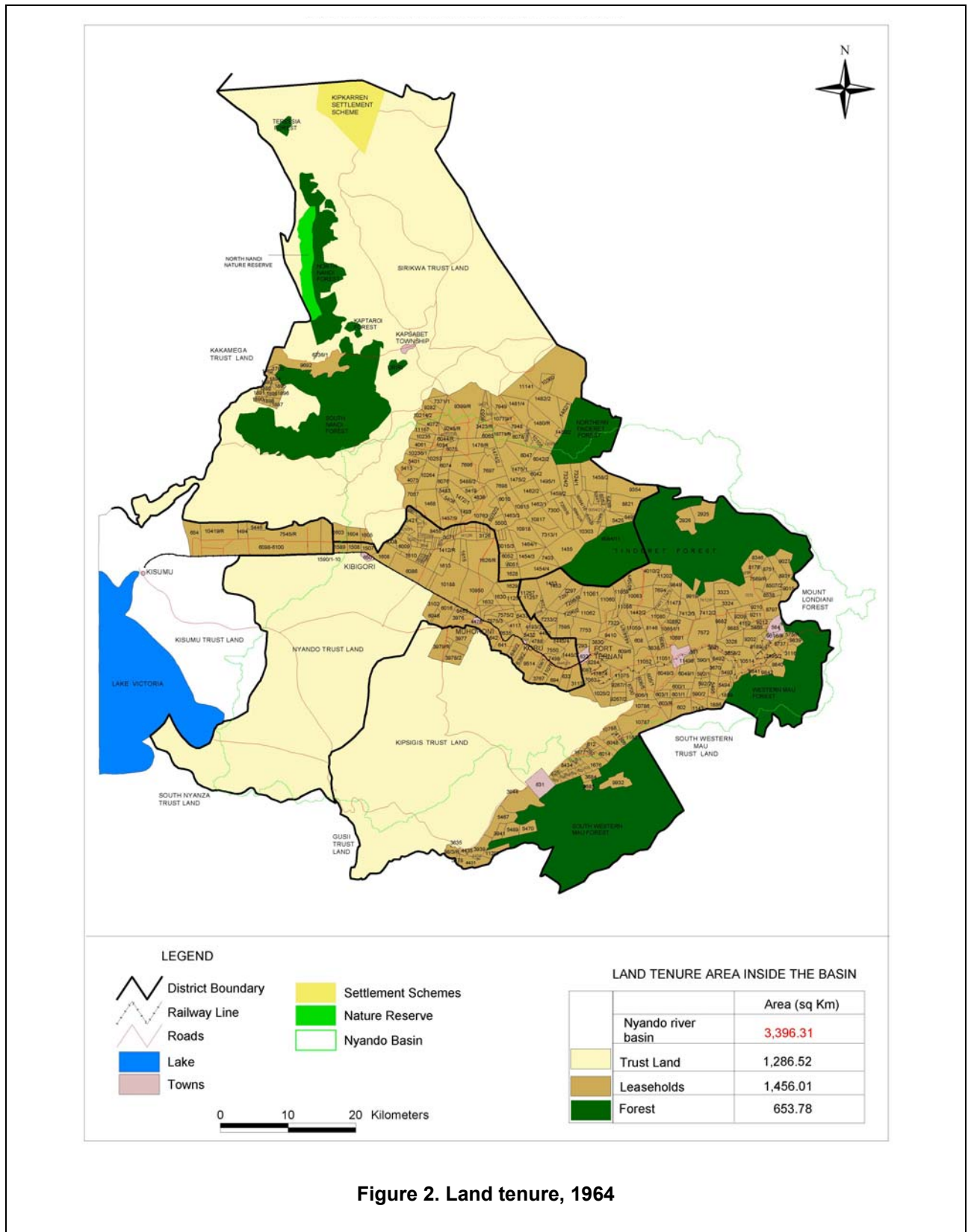


Figure 2. Land tenure, 1964

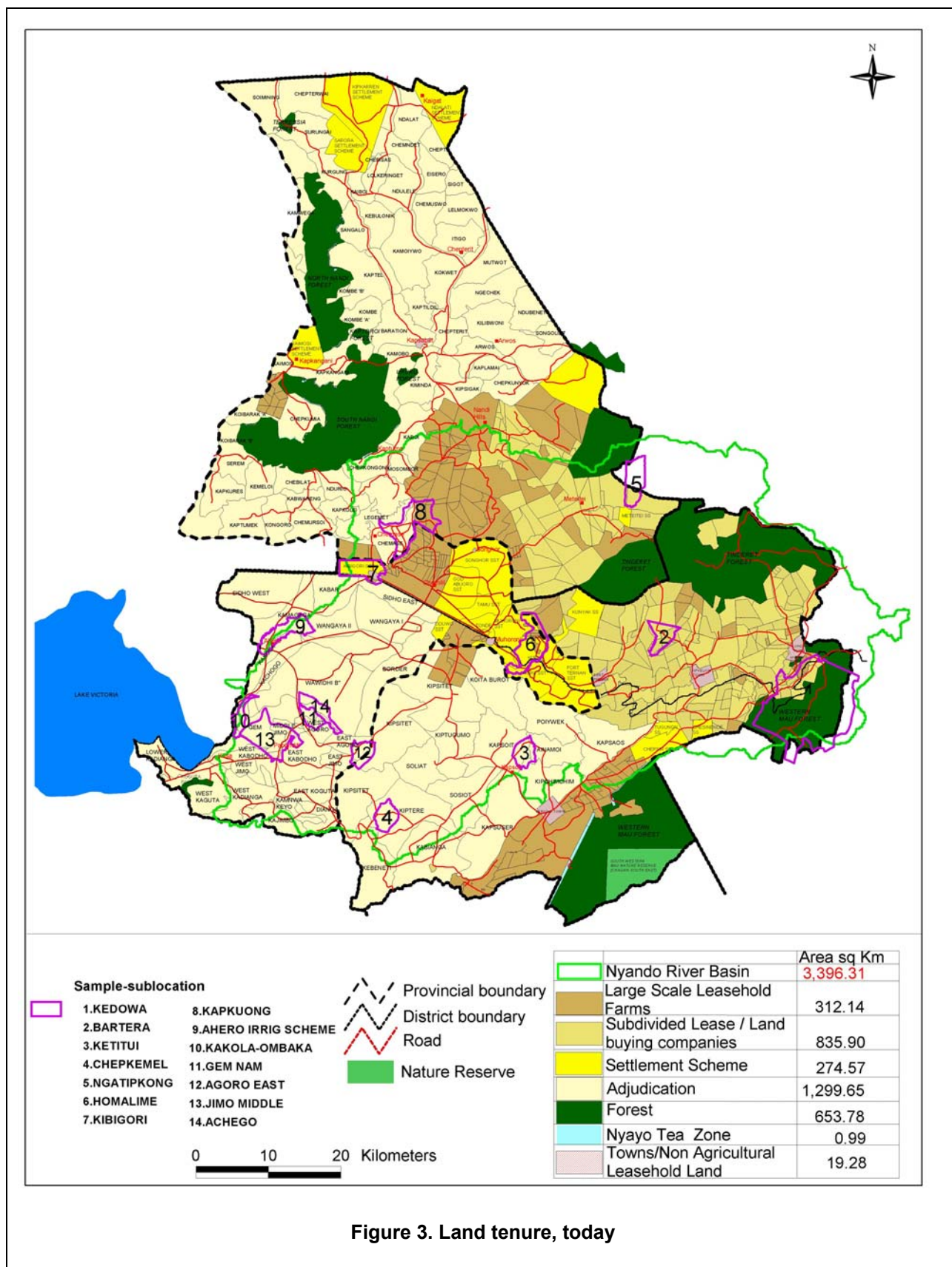


Figure 3. Land tenure, today

Adjudicated land

Land adjudication is the process through which land in the native reserves is surveyed and registered as a free hold interest. This process started in 1956 in some parts of central Kenya but was widely implemented only after independence. The process of adjudication was slow because it had an inbuilt mechanism for hearing and determining disputes and in many instances it included land consolidation. The land holding system in the native lands encouraged the people to have small parcels of land in different places. This was sound ecological reasoning because it spread out risk and benefit but it reduced the economies of scale in cultivating these pieces of land. In some areas consolidation was achieved but in others the people resisted it. On completion of adjudication a freehold interest is registered and a title deed issued. The process of adjudication was prompted by the Swyennerton plan of 1954 as the colonial government looked for ways of improving agricultural production in the Native lands. It recommended that this could be achieved if titles were issued to the Africans for the land they cultivated. The government was to provide loans for improving agriculture using the titles as security. Despite these efforts the economies remained predominantly subsistence.

Adjudication sections are carved out along ethnic lines and are homogeneous in terms of ethnicity. As a result property rights are heavily influenced by culture. An examination of the adjudication registers yielded very few female names. The implication is that women hardly ever own ancestral land. However examination of the land registers in the settlement schemes and the land buying companies yielded increasing numbers of female names. The study sampled seven villages on adjudicated lands. These villages are located in Ketitui (3), Chepkemel (4), Kakola Ombaka (10), Gem Nam (11), Agoro East (12), Jimo Middle (13) and Acheho (14) sub locations as shown in Figure 3.

Access to water in adjudicated areas

Land adjudication is followed by survey to establish the boundaries and the area of a parcel of land for purposes of registration. The process did not take care of a riparian reserve. It used the river as a boundary and did not give it any width. This had the effect of privatizing the riparian reserve. Anyone whose land did reach the river did not get access to the riparian reserve. Since the river was drawn as straight line it was part of the two pieces of land on either side. Public access to the river was at the bridge where the road and the river meet. All adjudicated land is former ancestral land and is subject to customary laws. Customary laws dictate that no one should be denied water. Even the hyena, the least respected of the animals has a right to water. (derived from Kalenjin saying) Because of this belief, people will let others pass through their private property to access river water even where there is no official road. The lack of fencing which is characteristic of adjudicated land makes it possible to create and use short cuts. When the river water is harnessed for a piped water supply two methods can be used to secure passage through private land. The safest and most secure is to obtain an easement or a way leave, which will allow the pipes to officially pass through private property without interference from the registered owner. This is provided for in the Way leaves Act Cap.292. The other alternative, which is often used, is to seek verbal permission from the owners of the land through which the pipes will pass. Because water projects serve many people and because the customary laws dictate that no one should be denied water, this approach works but it is not secure. In the event of any of the people falling out with the rest, then he can cause a lot of trouble.

Springs as source of water were also not taken care of in the adjudication process. As result all springs in adjudication areas fall on private land. There is no official road leading to the springs and people use the roads passing closest to the springs and where the roads end they pass through private land. No one denies other members of the community water from the springs. However of late access to the springs is getting more restricted as people get more individualistic. Many water projects around springs still do not enter into any legal or written agreement with the landowners on which the springs are found. This study established that most water project around springs in the basin rely on customary laws to secure rights to the springs. (Kipsiwo and Kiptegan spring protection and water supply among others)

Settlement schemes

Settlement schemes are a deliberate effort by the government to resettle landless people and at the same time improve agricultural production. At independence the government set up a scheme to transfer land in the white

highlands to the African farmers. This was done in several ways. One of these was through the Settlement Fund Trustee (STF) that paid off the white farmer; planned and subdivided the land then settled African farmers on it. SFT allocated the land on loan and registered a charge with the Permanent Secretary in the ministry of lands. When a farmer paid off the cost of the land he obtained a discharge of charge from the permanent secretary in the ministry and lands and registered a free hold interest in his favor. SFT also provided the farmers with a loan for working capital. The settlement schemes (Koru, Oduwo, Muhoroni, Songhor, Tamu) in Nyando district fall in the mid altitudes and were set up to promote sugar cane farming. Three sugar factories Miwani, Chemelil and Muhoroni were put up to process the crop. The cash economy that had been started by the white farmers was continued. In Kericho and Nandi Districts there are fewer settlement schemes and none of them promoted a specific crop. People who settled the schemes were not necessarily of the same origin there fore cultural ties were weak.

Access to water in the settlement schemes

Settlements schemes were a creation of the government and although a lot of planning was done in other aspects of land use they did not take care of the riparian reserve. This can be blamed in part on legislation under which the land was registered. It did not state clearly the width of the riparian. The river was used as a boundary once again letting the riparian reserve fall in private land. The government involved professional land use planners who took care of springs dams and swamps as sources of water. They were identified surveyed and reserved as Special Plots (SP) to be held in trust by the local authority for the community. The land reserved was substantial to allow for the catchments protection and conservation. Due to the lack of a focused land policy some of these special plots were recently allocated to individuals because they were large enough to farm.

Large-scale leasehold farms

Large-scale farms are found only in the former white highlands and are operated as commercial enterprises. All large-scale farms hold 999-year leases from the government. In the higher altitudes are tea plantations and in the mid altitudes are the sugar plantations. Multinational companies operate most of the tea plantations but most of the sugar plantations are locally owned. There are factories located within the region to process both sugar and tea. The large-scale farms are labor intensive and source their labor from both near and far. Those from far are provided with housing in the labor lines. Some do not live in the camps but are allowed to put up temporary homes on the un-cultivated portions of the land. Over the years there are people who have lived on the plantations to the point where they have lost touch with their lands of origin. These are second and third generation laborers whose grandfathers moved to the large scale farms to work for the white settlers. Today they are posing a problem to the plantation owners because they feel they too are entitled to own land in the area. Several of the large-scale farms have had to excise portions of their land to settle the “squatters” as they are popularly known. These excisions are converted to freehold interests. The tea estates that have made attempts to settle the squatters include Siret, Kapchorua, Kapsumbeiwa, Kibabet, Savani, Sitoi, Kaitet, and Sara Boit tea estates.

Access to water in the large scale farms

The operations of the large scale farms are strictly guided by the statutory laws. Water resources on the plantations are accessed by authorized persons only. Their environmental management is exemplary and their water sources well protected. The riparian is conserved as riparian and the natural vegetation left intact. Most have employed environmental officer in response to the governments increasing concern about environmental protection and its implementation of the Environmental Management and Coordination Act. of 1999.

Land-buying companies

This is a phenomenon that emerged after independence as a result of land transfers in the white highlands. There were several modalities in this transition. The government was not able to purchase all the land from the white settlers who wanted to sell. It therefore allowed them to negotiate sale agreements with anyone who was willing and able to make an outright purchase. Very few Africans were in a position to do this so they came together to form land buying companies or cooperatives. The members contributed money for the purchase of land and were allocated land worth the value of their share contribution on subdivision. There were no rules restricting membership in the land buying companies and this led to problems. Some companies had so many

members that they were not able to settle all the members so people lost their money. At other times they were allocated very small parcels of land. They also did not pay much attention to the provision of public utilities so they were poorly provided for despite the increases in population. Little professionalism was applied in preparing subdivision plans. As a result people were allocated land on very steep slopes, swamps, riverbanks, hilltops etc. Many times this was their only piece of land so they settled and worked it at the expense of the environment. Most of the land in the upper reaches of the Nyando river basin was bought by land buying companies. On subdivision the land converted to freehold and the members of the land buying company were each issued with a free hold title. Property rights are dynamic and policy makers must keep abreast with these changes so that no part of society loses out.

Many land buying companies still have not issued their members with their title deeds to date e.g. Kotetni farm in Chilchula division of Kericho district which was purchased in 1968. People were allowed to settle the land before they completed the process of subdivision and issuance of title. The members were in the meantime issued with share certificates as evidence that they had a right to a share of the land. These certificates were inadequate because they only indicated that a member owned shares but did not say the location. The companies took very long to process the documents and sometimes the final survey numbers did not tally with the actual position members had already settled on. Corruption and lack of accountability were rife in the workings of the land buying companies. In some instances the president had to intervene for the title deeds to be issued. Such appeals are common in the daily papers.

Access to water in Land buying companies areas

The processes of subdividing the large scale farms was spearheaded by the private sector. They wanted to get as much land as possible to give to their members so they did not spare any land in the riparian reserves. People who formed the land buying companies come from different places so their cultural ways were not always the same. This implies that customary laws take a back seat in this scenario. The people tended to rely more on the written laws. Properties were fenced making the distance to the river longer because people had to revert to the officially prescribed road. People living in these areas rely more on written agreements as opposed to the verbal arrangements that are common in the ancestral lands. Springs in this region suffered the same fate as the ones in adjudication areas. No provision was made for them to be accessible to the public. They all fell on private land. Access to them is not as easy as is the case of ancestral land because here privacy of property is adhered to. Fences are more and are of barbed wire unlike eco friendly fences grown in native lands

Forest reserves

The Crown Lands Ordinance that established the native reserves was the same that made provision for the established forest reserves through gazette notices. Once land has been gazetted as forest reserve it cannot be put to any other use unless it is de-gazetted through another gazette notice. Forests in the basin include Tinderet forest, North Tinderet forest, Londiani forests and West Mau forest. The gazettement of forest reserves displaced the forest dwellers such as the Okiek/Dorobo. Many of them are landless or living illegally on the fringes of the forest as was the case in one of our sample village Ngendui in Ng'atipkong sub location (5). The government prohibits entry into the forest yet the way of life of forest dwellers dictates that they must access the forest. They have customary claims to forest and tree resources. A forest dweller outside the forest is like a pastoralist without livestock but statutory provisions do not safeguard their rights to these resources. In the past the communities bordering the forest were allowed to grow crops in the forest as non-resident cultivators (the shamba system) but this was abused and subsequently abolished by the government. The Nyayo Tea Zones were established on forestland to create a physical buffer zone between the forests and neighboring human settlement.

Access to water in the forest land

Water sources in the forest are not easily accessible due to the government policy that aims to keep people away from the forests. The forests are guarded by forest guards who often harass the local people. However the forests are a sources of many springs whose waters never ran dry even at the height of drought. Kaminjeiwa village in Kedowa sub location (1) is a forest frontier community and here the most permanent and the cleanest sources of water are in the forest. The people use these sources although they suffer constant harassment from the forest guards. Ngendui village is inhabited by forest dwellers and sits on the fringe of forest land. In this village the livestock and the people water from the same point. Crops are cultivated up to three meters from the

eye of the spring and despite being on forestland almost all the trees have been cut down. The people have no incentives to protect or conserve the water resources because of the insecure nature of their tenure.

Ethnicity

The Nyando basin sits astride two ethnic communities; the Luo and the Kalenjin. The Kalenjin are found in the upper reaches of the basin (Nandi and Kericho districts) and are livestock keepers. The villages in this study that are Kalenjin speaking are Kaminjeiwa (V1), Kiptegan (V3), Chepkemel (V4) and Ngendui (V5). The Luo are found in the lower reaches of the basin (Nyando district) and are predominantly peasant farmers and fishermen. The villages covered by this study that fall in the Luo speaking region of the valley are Kimira Aora (V7) Nakuru (V9), Kasirindwa (V10) Karabok (V11), Miolo (V12), Kasiwindhi (V13), and Awach Scheme (V14). Mixed ethnic groups are found in the settlement schemes like Ongalo village (V6) and in labor camps like Poto Poto village (V8). In areas where there were land buying companies there is also a mix of ethnic groups like in Nyaribari'A village (V1). The significance of the ethnic groupings is that areas occupied by one ethnic group exhibit strong customary laws and vice versa. Ethnicity can therefore be used to create strata for management of water resources because it defines levels of cohesion in a community and addresses the socio-cultural aspects of water management.

Agricultural production systems

The farming systems in the basin are divided into three broad categories; large-scale commercial farming (tea and sugar plantations), irrigation agriculture (rice irrigation under the National irrigation board and the Provincial Irrigation unit) and small-scale mixed farming (cash crops/subsistence crops /live stock). This zoning is determined by both biophysical factors such as rainfall, soil fertility, temperatures etc; human factors such as access to productive resources (e.g. land) and the cultural values and practices. The agricultural production systems in the basin are a reflection of both hydronomic and terranomics.

Property rights and legal pluralism in the Nyando river basin

The analysis of hydromic and terranomics in the basins brings out issues of property rights in each of the strata created. The upper reaches are either large scale farms or have been taken over by the land buying company so there are no cultural ties. Multiple sources of authority still exist but the statutory ones are the strongest. The cash economy that was created by the settlers is still evident and this promotes statutory laws. Customary norms do not expect you to prosecute your brother/neighbor even if he lets his goats eat your crops year in year out. This does not promote a cash economy. This attitude is reflected in the management of all resources. The lower reaches on the other hand are ancestral lands and people are held together by culture so statutory laws are applied only when they must. Many activities are done as a way of life without calculating optimum levels of production and sharing is encouraged since every one is his brother's keeper. This makes it difficult to accumulate wealth—a possible explanation for the high incidence of poverty. Poverty is not shunned but is accepted as something that everyone in society must experience at some point in their life. No one is expected to be always rich. It is summed in a saying "*inind diere inind tung*" loosely translated means that today you sleep between the others and you are kept warm and safe but tomorrow you will sleep on the edge where no one will shield you from the vagaries of life—even if you are not poor today you get there some day. The lower reaches of the basin are not well endowed with natural resources so it may be that people who have lived there over the years have come to accept the inevitability of poverty. The middle reaches of the basin are transitional areas both socially and physically.

The institution of the chief and the villager elder is a point where customary law and statutory law merge. The chief in the rural setting is always a local person and well versed with the customs of the people. He works with village elders who not only know the customs but also know the families. Many issues are resolved at the level of the chief and his village elders. Where it has to go beyond them to the courts of law, then cultural rights are represented by the chief. In this way non statutory laws blend with the statutory. Land cases are common areas where this has been applied in the basin.

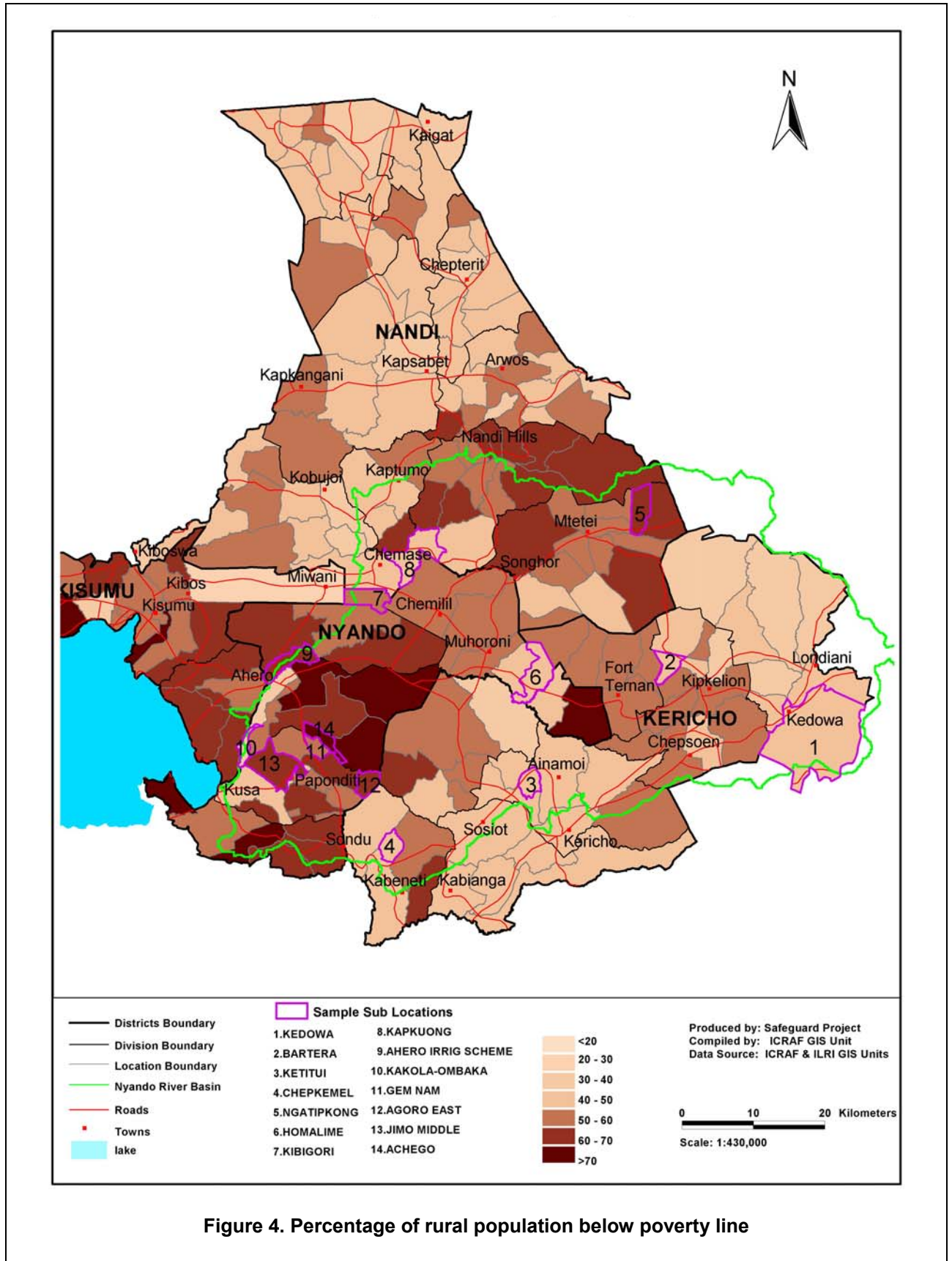


Figure 4. Percentage of rural population below poverty line

Table 1. Nyando river basin; poverty dynamics (poor now/ poor 25yrs ago)

Village code	Village name	Name of sub location	Total number of poor (25yrs ago)	Percentage %	Total number of poor (now)	Percentage %	Change	%
V1	Kamenjeiwa	Kedowa	1	2	1	1	-	1
V2	Nyarybari A	Barera	0	0	5	18	+	18
V3	Kiptegan	Ketitui	20	16	6	4.69	-	11.3
V4	Chepkemel	Chepkemel	0	0	12	16.4	+	16.4
V5	Ngendui	Ngatipkong	10	20	19	37	+	17
V6	Ongalo	Homalime	5	7	18	25	+	18
V7	Kimira-Aora	Kibigori	1	1	21	22.8	+	21.8
V8	Poto poto	Kapkuong	1	1	9	10	+	9
V9	Nakuru	Ahero Irrigation	24	34	44	62.9	+	18.9
V10	Kasiwindhi	Kakola Ombaka	2	3	18	28.6	+	25.6
V11	Karabok	Gem Nam	9	9	23	22.8	+	13.8
V12	Miollo	Agoro East	35	35	57	56.4	+	21.4
V13	Kasirindwa	Jimo middle	20	39	19	37	-	9.5
V14	Awach scheme	Achego	41	47	33	37.5	-	9.5

Source :The Safeguard project

Patterns of poverty and land use across the basin

Figure 4 is generated from data obtained from welfare monitoring surveys using conventional measures of poverty. It indicates the levels and patterns of poverty across the basin. Table 1 is derived from non conventional measures of poverty obtained from a survey of 14 villages in the basin through participatory approaches. It indicates the incidence and the dynamics of poverty in the basin. The two sets of information point to higher incidence of poverty in the lower reaches of the basin. The survey also established that although the rice irrigation schemes produced a cash crop the rice irrigation areas still experienced high incidents of poverty. Communities with insecure tenure had some of the highest levels of poverty in the basin. Poverty dynamics in the lower reaches is driven more by the terranomic whole in the lower reaches it is driven by hydronomics.

Relevance of hydronomic and terranomic zones to poverty reduction and resources management in Kenya

Reducing of poverty is one of the major challenges of this century and there are many global initiatives that have been started to this end. In Kenya several approaches are being taken to address poverty. These include: 1)

District Focus for Rural Development and District Development Planning. Hydronomic and terranomic zones are about natural resource management and can be used to design strategies that become part of the District Development Plans; 2) *Catchment management strategies.* The Water act 2002 provides for the management of water as a resource within the context of catchments. The concept of hydronomic zones can be used as a tool for planning the catchments; 3) *Environmental Planning.* The Environmental Management and Coordination Act of 1999 established the National Environment Management Authority (NEMA) as the principle instrument of the government in implementation of all policies related to the environment Every five years NEMA must produce a National Environmental Action Plan (NEAP) a Provincial Environment Action Plans (PEAP) and District Environment Action Plans (DEAP) .The concept of hydronomic and terranomic zones can be very useful in meeting some of the objectives of environmental planning; 4) *Land use planning/physical development plans.* The Physical Planning Department in the Ministry of Lands is given the mandate by the government to develop guidelines to control the spatial aspect of development The concept of hydronomic and terranomic zones can be used in regional planning.

Conclusion

The link between access to land and access to water resources must be addressed by policy makers in order to safeguard equal access to water resources for all especially for the poor. Property rights are dynamic and policy makers must keep abreast with these changes so that no part of society loses out.

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Notes

1. *The Safeguard project.* This is an acronym for a collaborative project between Maseno University ICRAF, IFPRI, ACTS and IWMI –“Safeguarding the rights of the poor to critical water land and tree resources in the Nyando River basin”

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