

10. PRESENT SITUATION OF ROAD TRAFFIC AND TRANSPORT IN AMURU AND NWOYA DISTRICTS

10.1 Road Traffic Condition in Acholi Sub-region

10.1.1 Traffic Survey

(1) Outline of the Survey

A Traffic Survey was conducted to grasp the baseline traffic information, e.g., traffic volume and OD (origin and destination) along the main trunk road and district roads, in order to understand the current traffic flow and carry out the demand forecast analysis.

(2) Survey Method and Survey Location

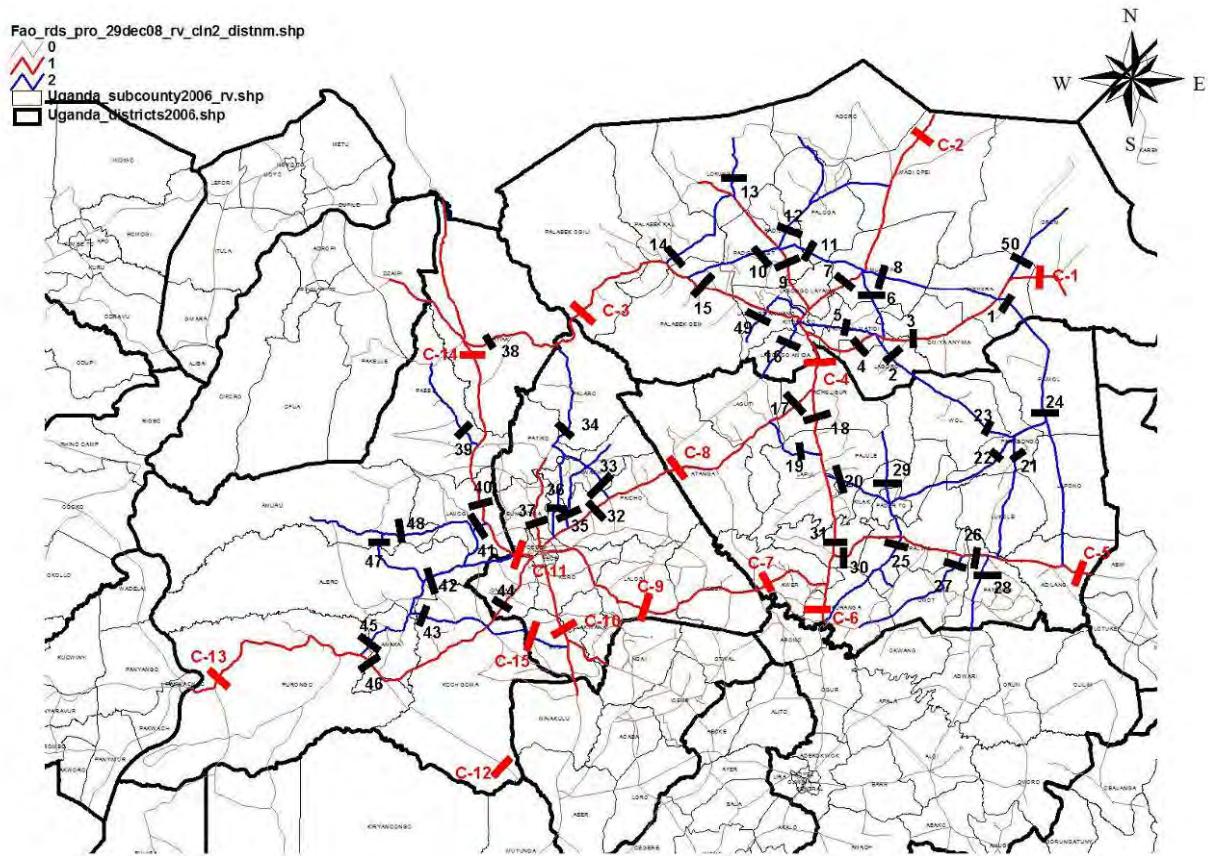
The Traffic Survey was conducted, covering Acholi Sub-region, at 15 locations mainly located along the national roads at the provincial boundaries and cross border points and at 50 locations mainly located along the national and district roads. At the 15 locations, both 12-hour traffic count and OD interview surveys were carried out. At the 50 locations, only 6-hour traffic count surveys were carried out. The Traffic Survey is summarized in Table 10.1.1.

Table 10.1.1 Summary of Traffic Survey

Survey Name	Survey Period [Date]	Survey Time	Survey Location
(1) 12-hour Traffic Count Survey	1 weekday [9/21/2009 – 10/2/2009]	12 hours (6:00 - 18:00)	15 locations
(2) Roadside OD Interview Survey	1 weekday [9/21/2009 – 10/2/2009]	12 hours (6:00 - 18:00)	15 locations
(3) 6-hour Traffic Count Survey	1 weekday [9/21/2009 – 10/2/2009]	6 hours (6:00 - 12:00 or 13:00 – 19:00)	50 locations

Source: JICA Study Team

The attached map describes the survey locations.



Source: JICA Study Team

Figure 10.1.1 Survey Locations

(3) Survey Items

1) Traffic Count Survey

The classification of vehicle types adapted for the Traffic Survey is as shown below, with vehicles divided into 11 types. These classifications basically follow the previous traffic surveys.

- Saloon cars and taxis
- Vans, pickups and 4WDs
- Small buses (Matatus)
- Medium bus
- Large bus
- Light single unit trucks (2 axle)
- Medium and large single unit trucks (3 axles)
- Trailers
- Motorcycles
- Bicycles
- Passenger

2) Roadside OD Interview Survey

The roadside OD interview survey was performed for 25% of all vehicles. The following items were surveyed.

- Origin and destination (address/date/time)
- Number of passengers
- Type of commodity (only for trucks/trailers)
- Tonnage of commodity (only for trucks/trailers)

10.1.2 Results of the Traffic Survey

(1) Calculation of Average Daily Traffic

As one of the indicators to assess traffic flow, the average daily traffic was calculated based on the result of a traffic count survey. The following formula was used for calculation of the average daily traffic.

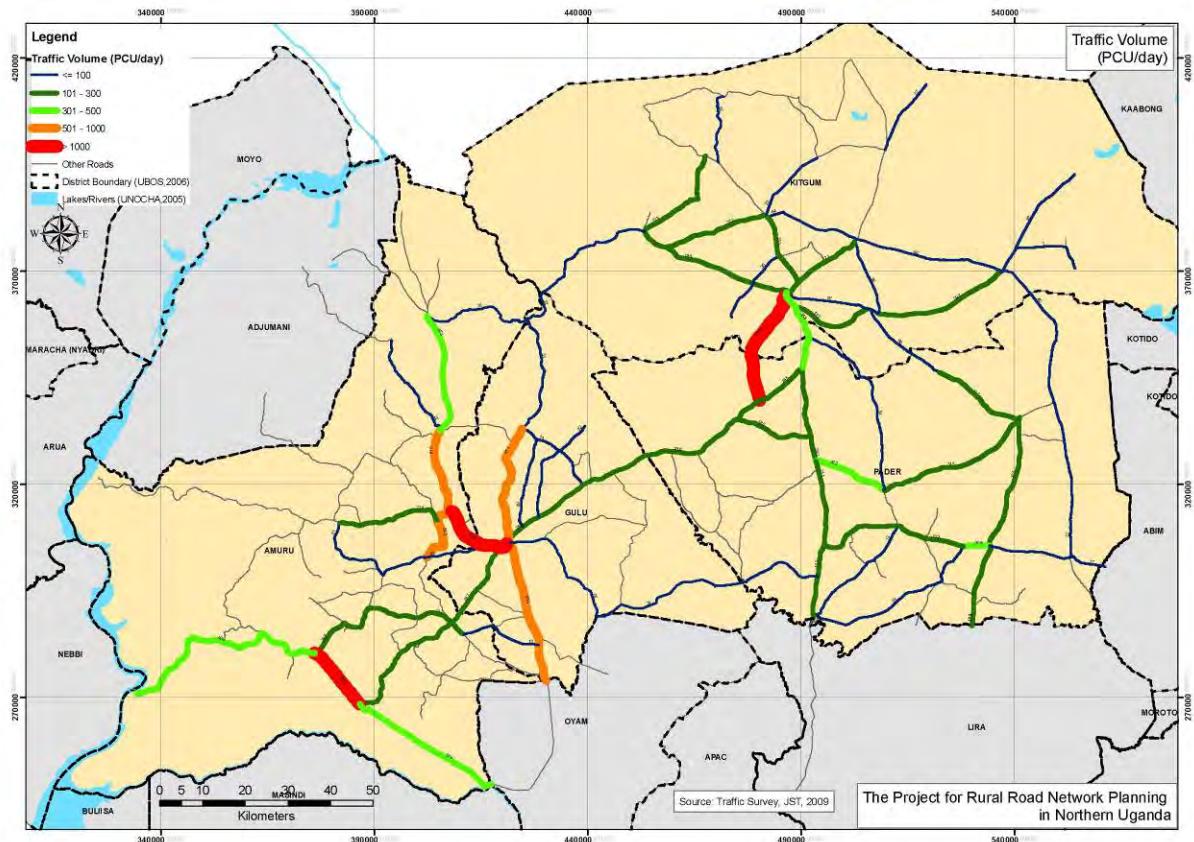
$$\text{Average Daily Traffic} = \text{Sum} (\text{Conversion Factors} * \text{Surveyed Traffic}).$$

Conversion factors were prepared for each vehicle type to convert 6-hour and 12-hour surveyed traffic to 24-hour traffic.

(2) Average Daily Traffic Volume by Survey Location

Using the conversion factors, Average Daily Traffic was estimated for all 65 survey locations. As seen in the Figure 10.1.2, traffic counts of more than 1,000 PCU (passenger car unit) per day were observed near the district centres of Gulu and Kitgum and along Arua Road. At most of the survey locations, there was less traffic, for instance 500 PCU per day, was observed. During the survey, a maximum traffic volume of 2,040 PCU per day was observed on Arua Road. Assuming the traffic capacity of a 2 lane road is 10,000 PCU per day, it was deduced that there weren't any capacity constraints in Acholi Sub-region.

Looking at the Amuru and Nwoya Districts, the main traffic corridor was observed along the national roads, e.g., the north-south corridor between Gulu – Sudanese border and the east-west corridor on Arua Road, where international and inter-regional traffic are frequently observed. Less traffic, ranging between 100 and 300 PCU per day was observed between Amuru Centre and Gulu and Anaka and Gulu.

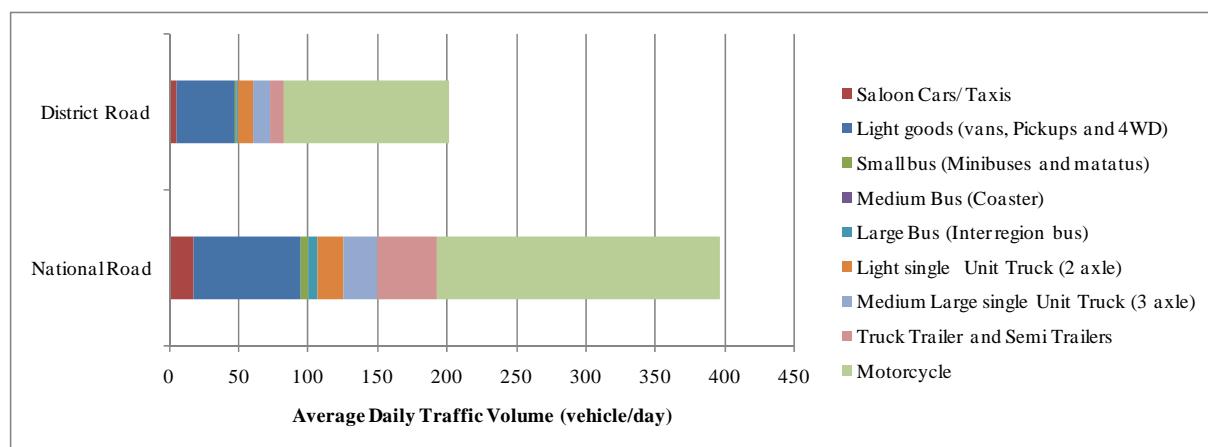


Source: JICA Study Team

Figure 10.1.2 Daily Traffic Volumes (All Traffic)

(3) Average Daily Traffic Volume by Road Classification

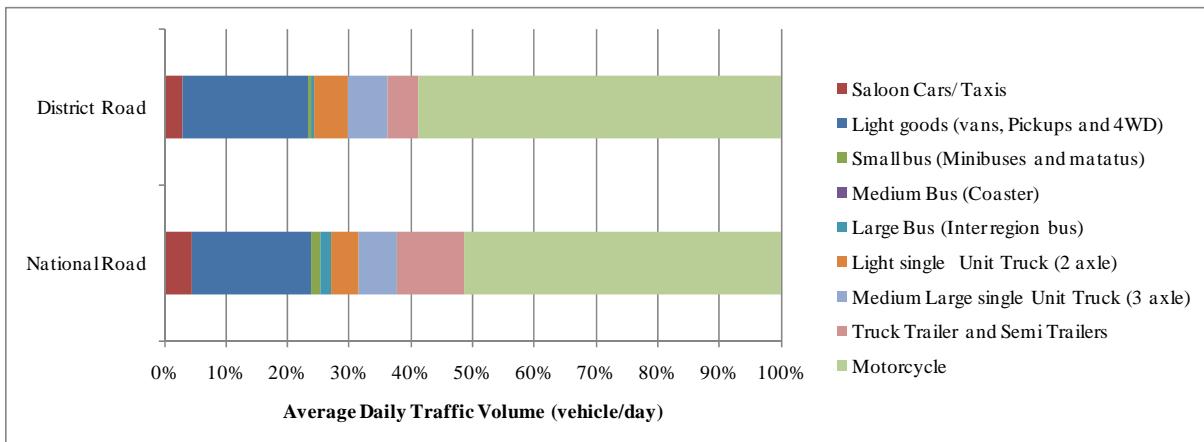
Figure 10.1.3 compares the average daily traffic volume by road classification. Nearly 400 vehicles on average were observed along the surveyed National Roads and only 200 vehicles were observed along the District Roads. More than half of the observed vehicles were motorcycles. Though the share of the truck trailers and semi trailers is slightly different, the composition of the vehicles shows the same tendency between National Roads and District Roads.



Source: JICA Study Team

Note: This analysis does classify the roads that were newly upgraded from district roads to national roads in 2009 as district roads.

Figure 10.1.3 Average Daily Traffic Volume by Road Classification



Source: JICA Study Team

Figure 10.1.4 Composition of Daily Traffic Volume by Road Classification

10.2 Travel Characteristics in Former Amuru District

10.2.1 Household Interview Survey

(1) Outline of the Survey

A Household Interview Survey was conducted to grasp the baseline trip information, e.g., trip purpose, travel time and distance, mode of transport, and the family and personal attributes in order to understand the current travel patterns. The survey was conducted in three districts: former Amuru, former Kitgum and Gulu Districts to compare and highlight trip information of residents in former Amuru.

(2) Survey Method and Survey Items

The survey was performed by home interview, interviewing the head of the household and family members. Survey items are listed below:

- Family attributes (no. of family members, monthly income, car ownership)
- Personal attributes (sex, age, employment, monthly income and car ownership)
- Trip information (frequency, trip purpose, travel time and distance, mode of transport)

The questionnaire for the Household Interview Survey is attached to the Progress Report of this Study.

(3) Sample Size

The Household Interview Survey was conducted at 355 individual households selected from former Amuru, former Kitgum and Gulu Districts (202 households in former Amuru, 51 in former Kitgum and 102 in Gulu District). These households were randomly selected from the designated survey area. Sample sizes of the Household Interview Survey are shown in Table 10.2.1.

Table 10.2.1 Sample Sizes for Household Interview Survey

District	Sub-county	Samples
Former Amuru	Alero	67
	Amuru	68
	Anaka	67
Gulu	Bungatira	20
	Koro	22
	Layibi	28
	Pece	32
Former Kitgum	Mucwini	24
	Town council	27
Total		355

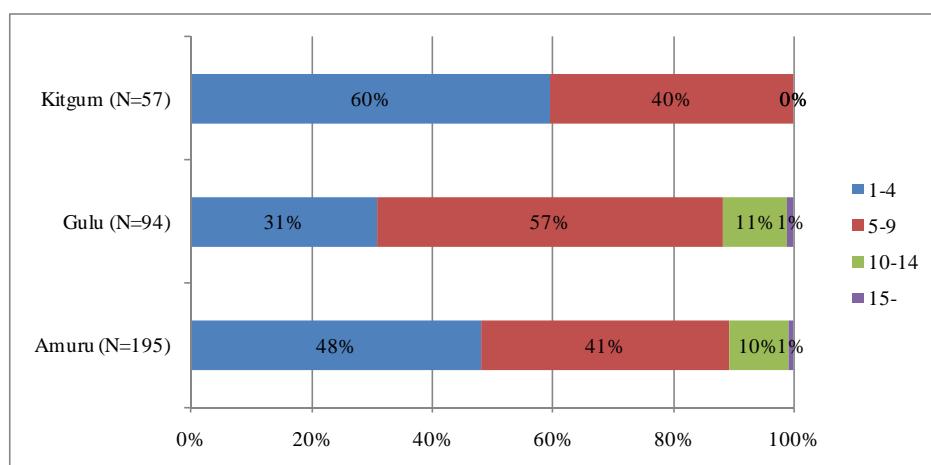
Source: JICA Study Team

10.2.2 Results of the Household Interview Survey

In order to reveal the travel characteristics of the Amuru and Nwoya residents, the following data analysis compares and demonstrates the travel characteristics among the three districts; former Amuru, Gulu and former Kitgum.

(1) Family Members

The travel patterns are strongly related to the family and personal attributes. Looking at the size of the family, around 48% of the sampled households in former Amuru have only 1 to 4 family members, whereas 31% of the sampled households in Gulu and 60% in Kitgum have 1 to 4 family members. More than 10% of sampled households in former Amuru have more than 10 family members.

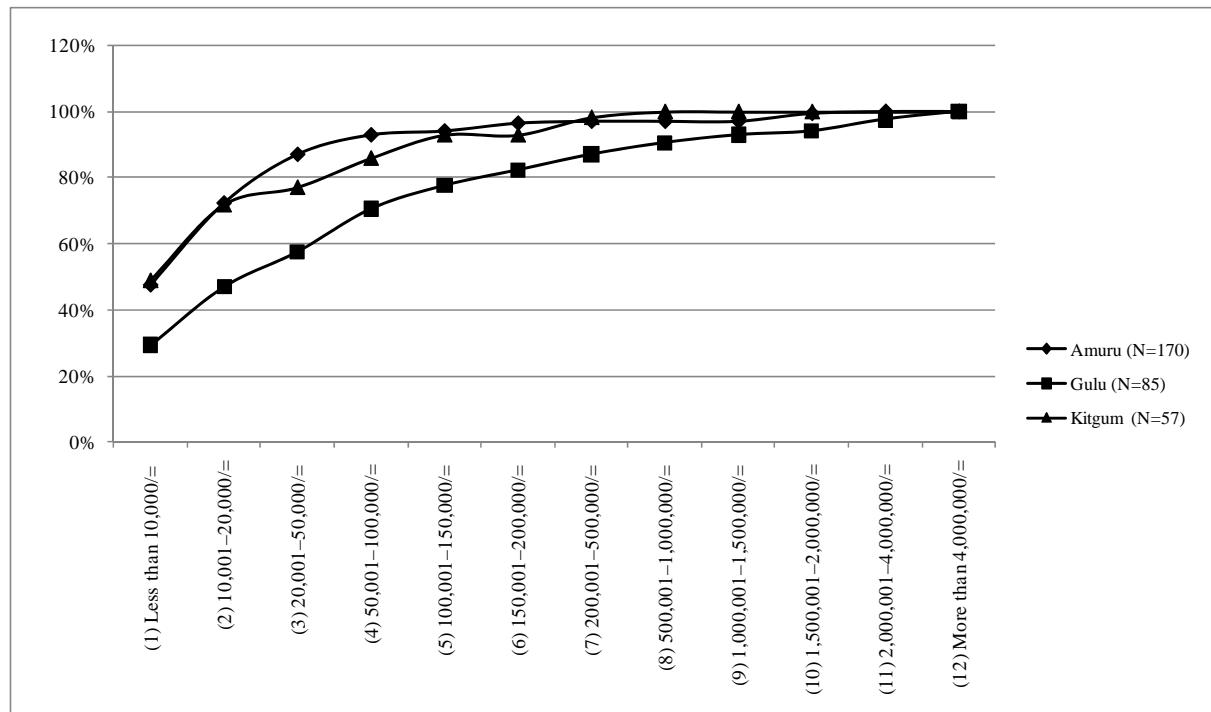


Source: JICA Study Team

Figure 10.2.1 Number of Family Members

(2) Household Income

There is also an apparent relationship between household income and the travel pattern: the more households earn, the more trips they tend to make. The household income in former Amuru, like that of Kitgum, is relatively lower than the household income in Gulu. About half of the sampled households in former Amuru earn less than 10,000 Shillings per month. Approximately 90% of the sampled households in former Amuru earn less than 50,000 Shillings per month.

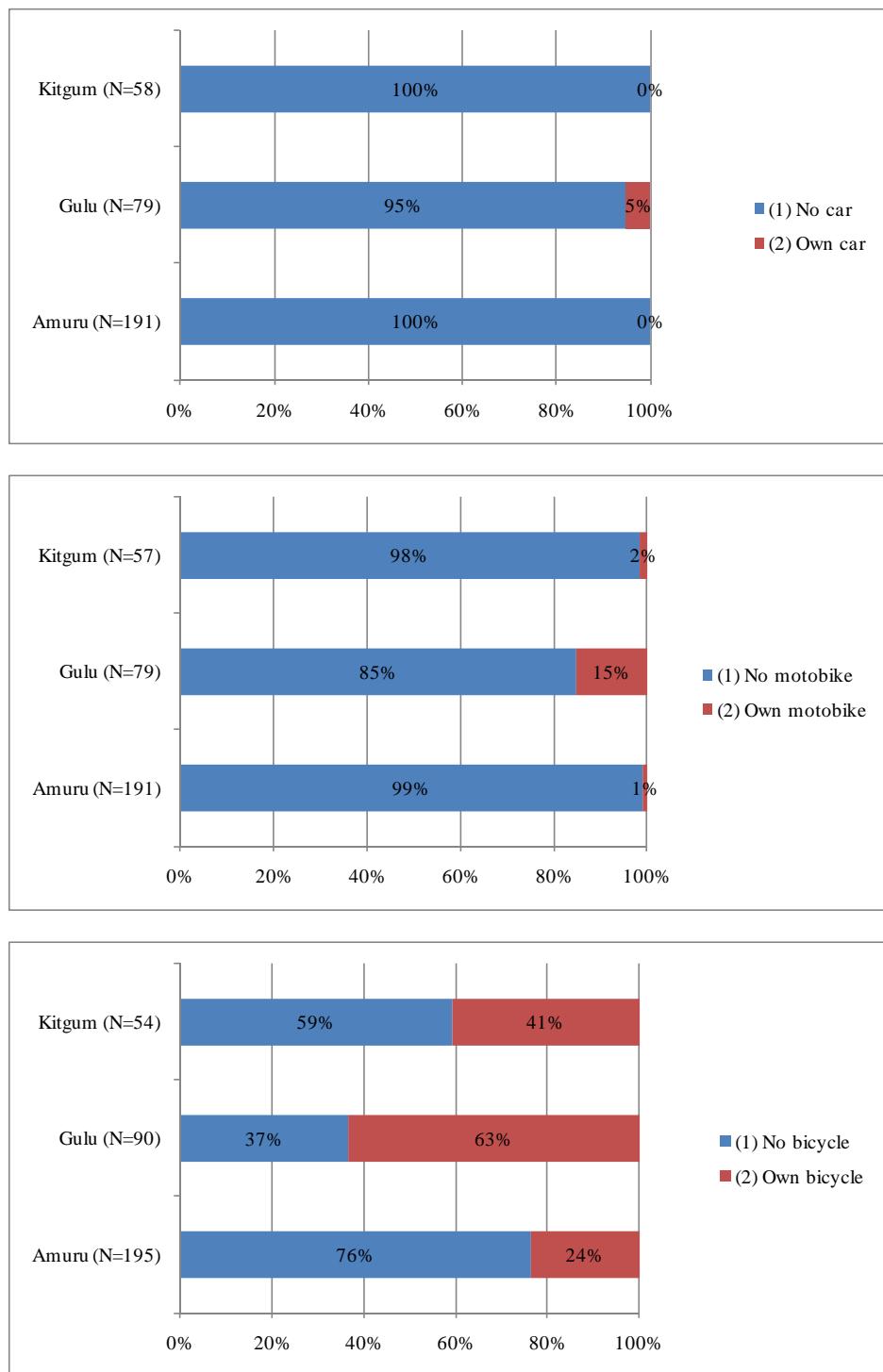


Source: JICA Study Team

Figure 10.2.2 Household Income Distribution

(3) Vehicle Ownership

Vehicle ownership in the survey area was observed as being at quite a low level. For instance, none of the sampled households in former Amuru owned their own cars while only 1% of them owned motorbikes. Amongst the three districts, Gulu shows distorted figures, with 5% of sampled households owning cars and 15% owning motorbikes.

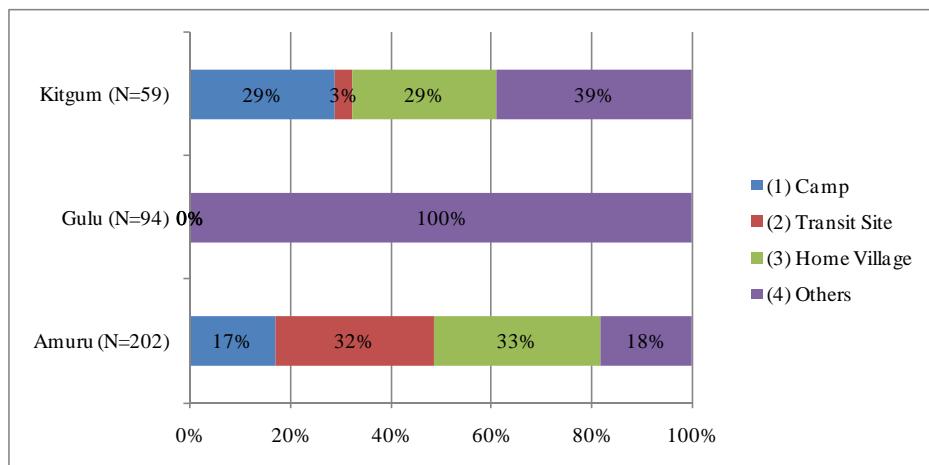


Source: JICA Study Team

Figure 10.2.3 Vehicle Ownership (Upper: Car, Middle: Motobike, Lower: Bicycle)

(4) Type of Village

Villages are categorized into the following three types: Camp, Transit Site and Home Village. A total of 17% of the sampled households in former Amuru were located in camps while 32% of sampled households were in transit sites. Only 33% of the sampled households in former Amuru were in their original home villages.

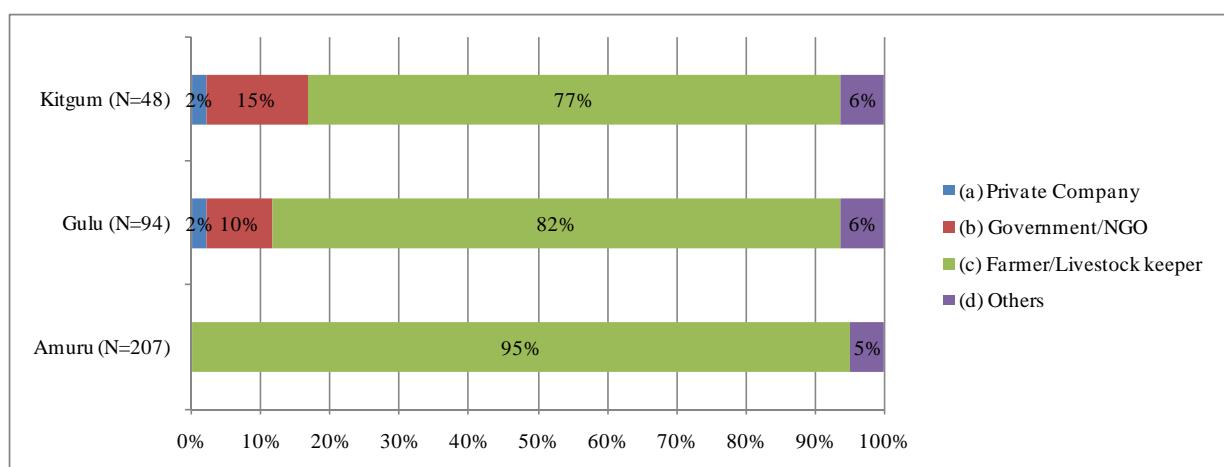
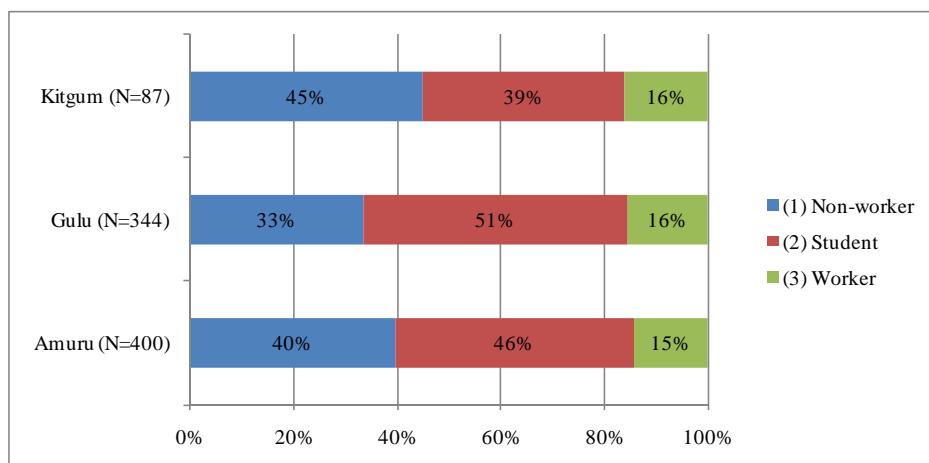


Source: JICA Study Team

Figure 10.2.4 Type of Village

(5) Occupation

More than half of interviewees were either students or workers. Taking an example of former Amuru, 15% of the interviewees were workers and 46% were students. The remaining 40% of the interviewees in former Amuru were non-workers including housewives. A total of 95% of the workers interviewed in former Amuru, were farmers/livestock keepers.



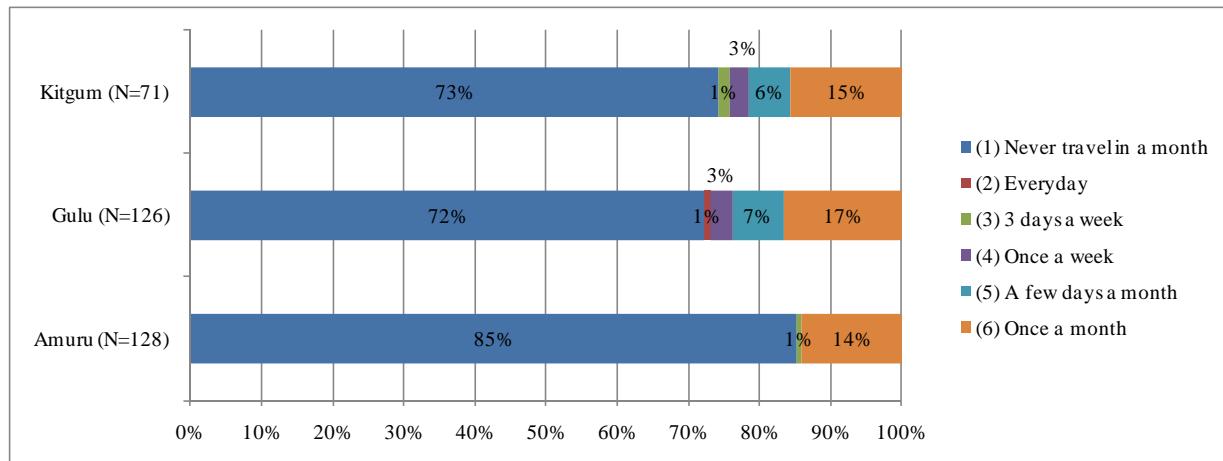
Source: JICA Study Team

Figure 10.2.5 Occupation

(6) Trip Information – An Example of a Trip to Kampala

1) Frequency of Travel

The interviewees were asked how often they travelled to the designated place. Taking an example of frequency of travel to Kampala, most of the interviewees responded that they never travelled to Kampala during a typical month. Compared to the other two districts, residents in former Amuru tend to make fewer trips to Kampala, with a total of 85% of the interviewees in former Amuru revealing that they never travelled to Kampala in a month while only 14% responded that they travelled to Kampala only once a month.

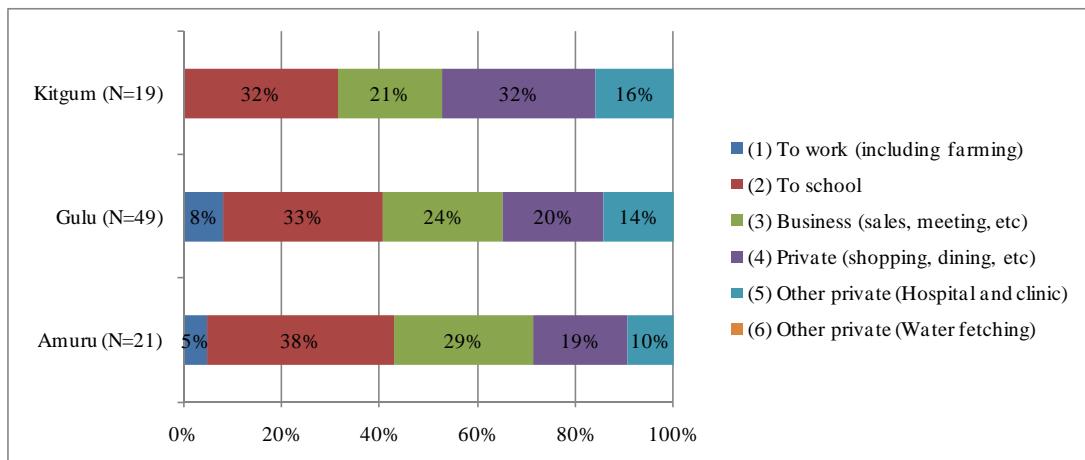


Source: JICA Study Team

Figure 10.2.6 Frequency of Travel (Kampala)

2) Trip Purpose

Those who make trips to Kampala have various reasons for travelling there. The interviewees in former Amuru visit Kampala mainly for the following three purposes: school (38%), for business (29%) and for private reasons, such as shopping (19%).

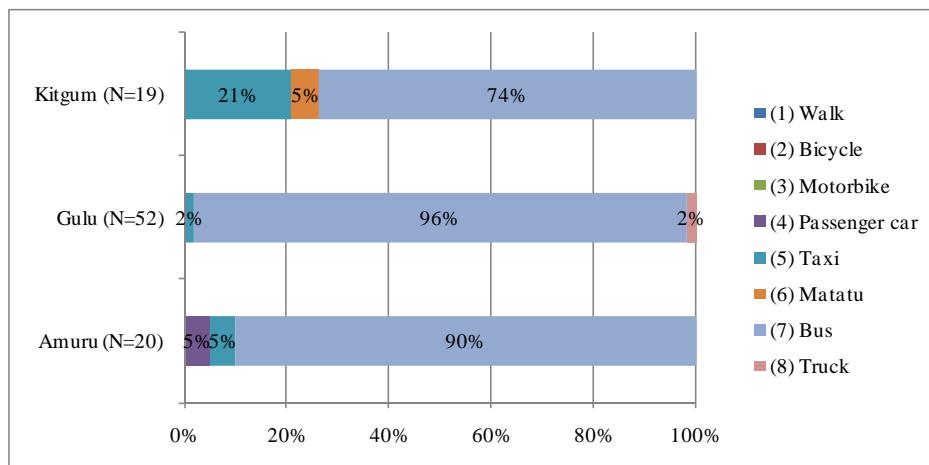


Source: JICA Study Team

Figure 10.2.7 Trip Purpose (Kampala)

3) Mode of Transport

The interviewees who sometimes travel to Kampala tend to use public transport, especially buses. A total of 90% of the interviewees in former Amuru responded that they use buses to travel to Kampala.



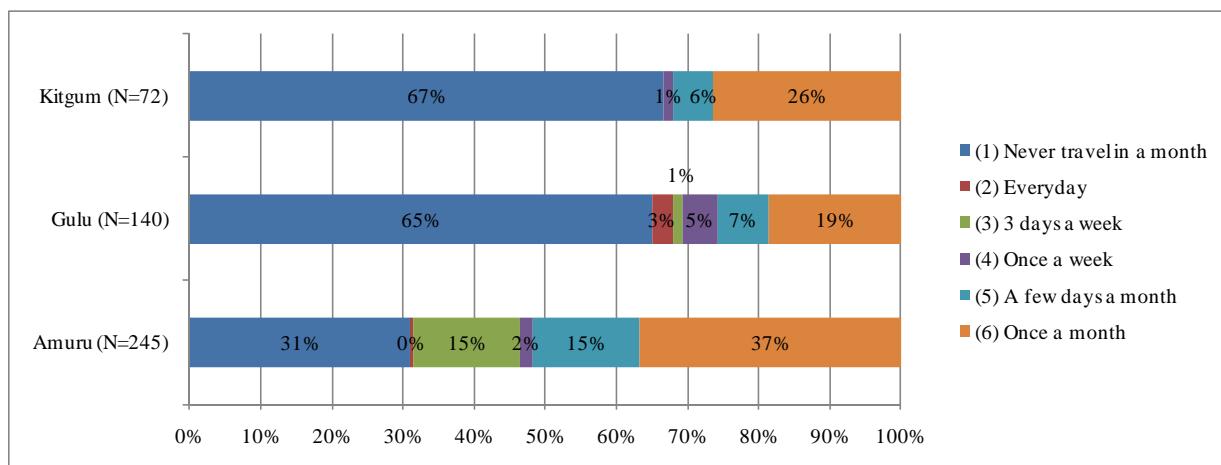
Source: JICA Study Team

Figure 10.2.8 Mode of Transport (Kampala)

(7) Trip Information – An Example of Trips to Gulu/Other Districts

1) Frequency of Travel

Taking an example of the trip to the centre of Gulu (for the interviewees in both former Amuru and former Kitgum) and the other district centres (for the interviewees in Gulu), the frequency of the travel observed is distorted within the survey areas. About half of interviewees in former Amuru travel to the centre of Gulu a few days a month or once a month. Only one-third of the interviewees in former Amuru answered that they never travelled to Gulu in the last month. However, two-thirds of the interviewees in Gulu and Kitgum never travel to other districts or to Gulu, respectively.

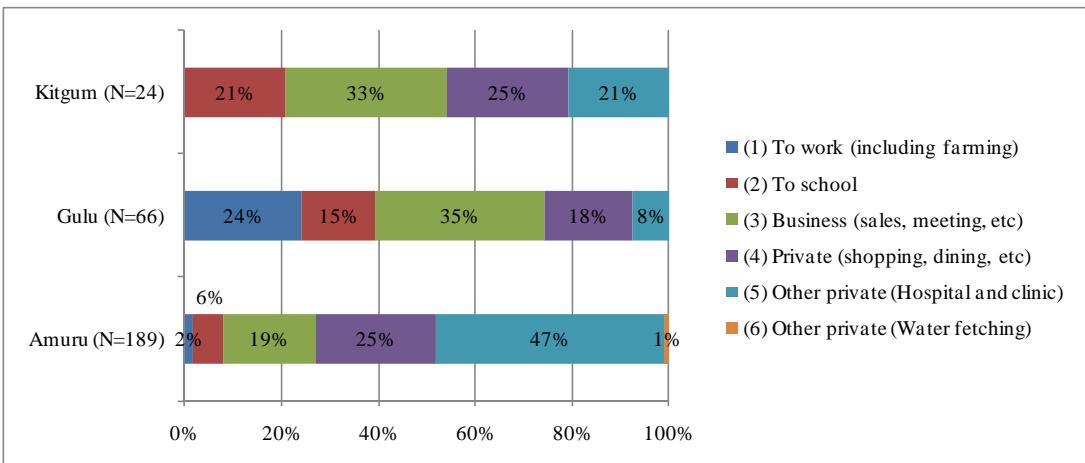


Source: JICA Study Team

Figure 10.2.9 Frequency of Travel (Gulu/Other Districts)

2) Trip Purpose

Residents in former Amuru tend to go to Gulu for private purposes. A total of 47% of the interviewees in former Amuru who sometimes travel to Gulu do so for the purpose of visiting hospitals and clinics. A total of 25% of the interviewees go to Gulu for other private purposes, such as shopping and dining.

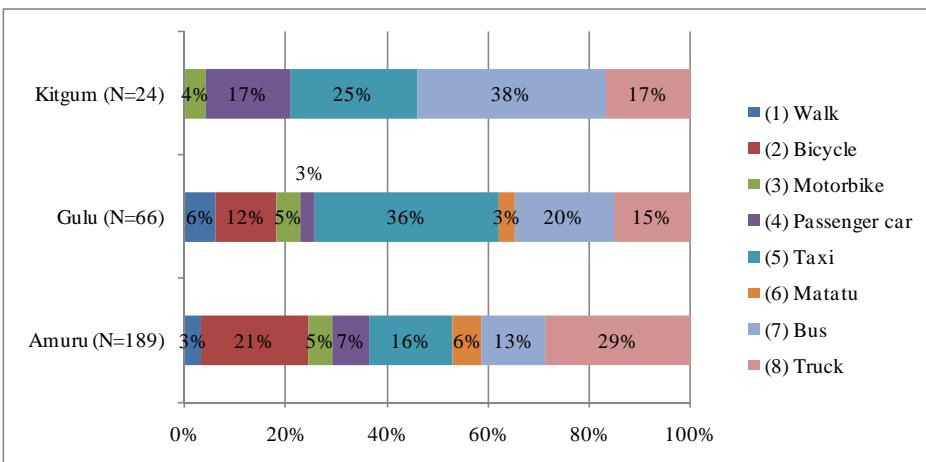


Source: JICA Study Team

Figure 10.2.10 Trip Purpose (Gulu/Other Districts)

3) Mode of Transport

The interviewees who sometimes travel to Gulu and other district centres tend to use various modes of transport. For instance, residents in former Amuru who sometimes go to Gulu use trucks (29%), bicycles (21%), taxis (16%) and buses (13%).

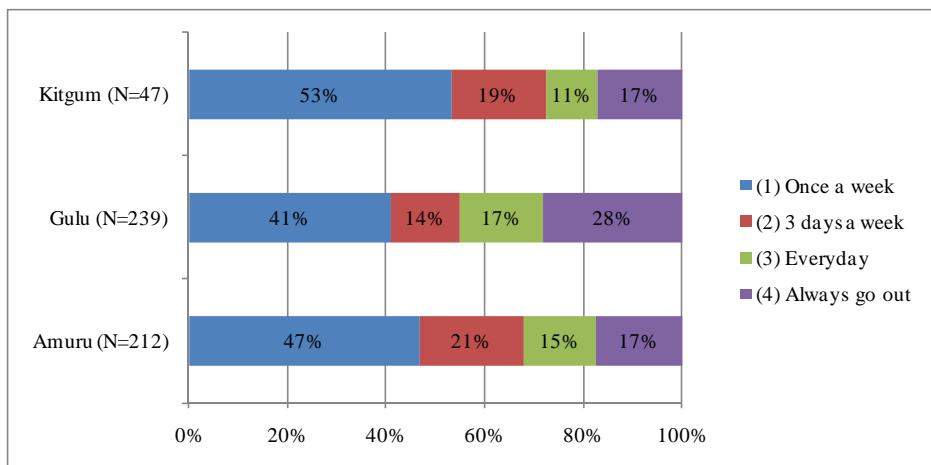


Source: JICA Study Team

Figure 10.2.11 Mode of Transport (Gulu/Other Districts)

(8) Outgoing Ratio

The interviewees were also asked about how often they travel. For instance, 17% of the interviewees in former Amuru district responded that they travel (leave home) daily. Only 15% of the interviewees responded that they always stay at their premises and never make a trip.



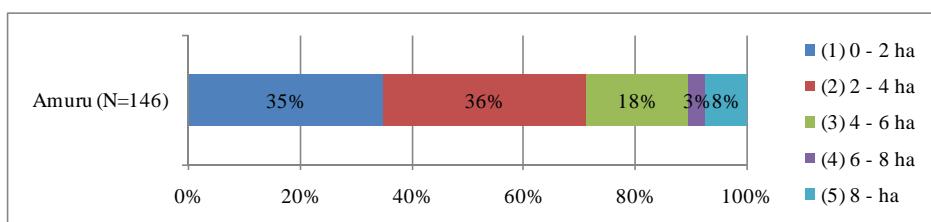
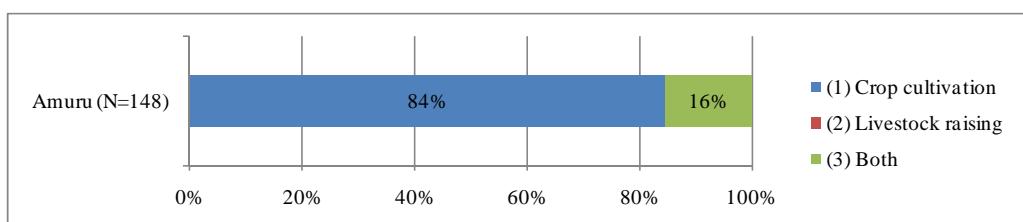
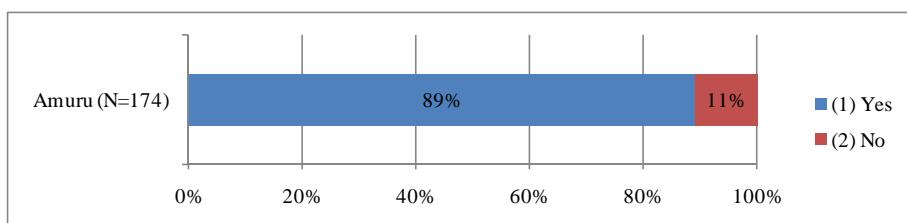
Source: JICA Study Team

Figure 10.2.12 Outgoing Ratio

(9) Agricultural Activity

1) General

Residents in former Amuru were also asked about their agricultural activity. A total of 89% of the interviewees in former Amuru were involved in agricultural activities, mostly for crop cultivation works. More than two-thirds of the interviewees cultivate farms of less than 4 ha and only 8% of the interviewees cultivate farms of more than 8 ha.



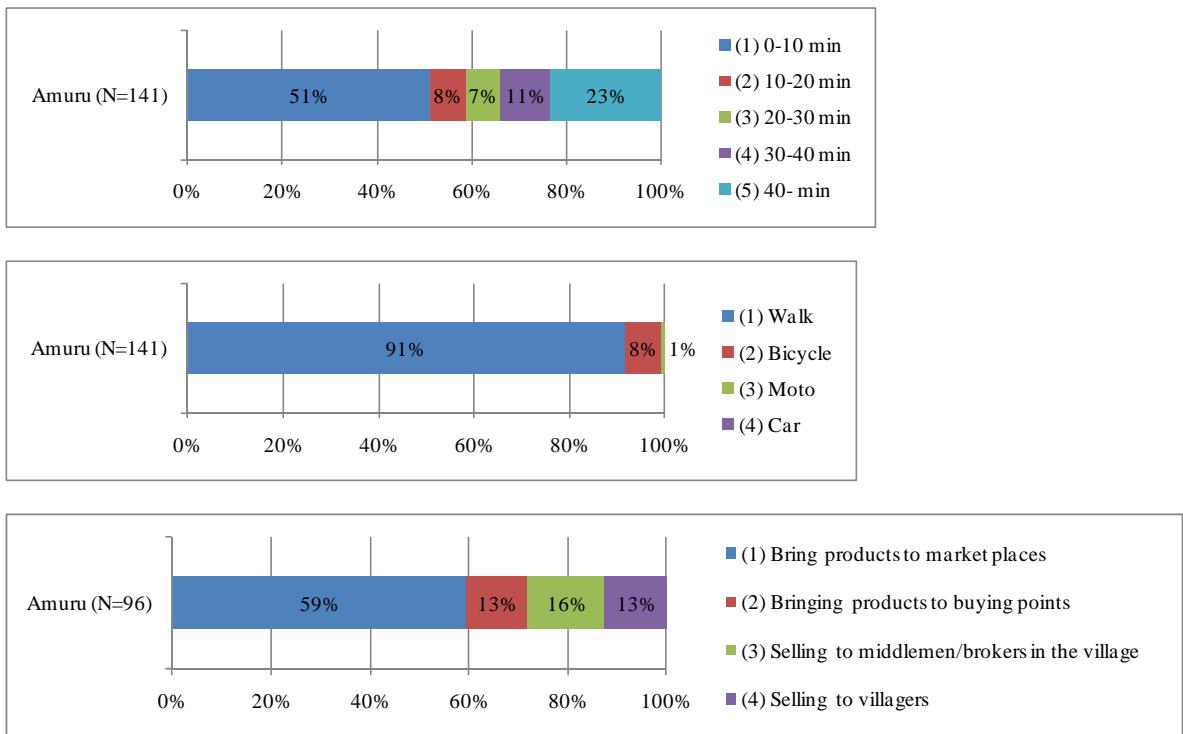
Source: JICA Study Team

Figure 10.2.13 Agricultural Activity

2) Transport for Agricultural Activity

Accessibility to the farm was observed as being relatively good. Half of the residents in former Amuru cultivate their farms within a 10-minute distance. A total of 91% of the interviewees responded that they accessed their farms by foot. Two-thirds of the interviewees sell their

products by themselves, either by taking them to the market places or by taking them to the buying points.



Source: JICA Study Team

Figure 10.2.14 Transport for Agricultural Activity

10.3 Summary of Results

As discussed above, two traffic surveys; the Traffic Survey and Household Interview Survey, were conducted to reveal traffic and travel characteristics of the residents in former Amuru. The present situation of road traffic and transport in former Amuru District can be summarized as below.

- A lot of traffic was observed along the national roads; the north-south corridor between Gulu – Sudanese border and the east-west corridor on Arua Road. However, the number of the vehicles observed in former Amuru District was very low, with a maximum traffic volume of only 2,040 PCU per day at Arua Road. There seem to be no capacity constraints in former Amuru District.
- The motorcycle is the dominant mode of transport in the region, accounting for 51% of the vehicles observed on the national roads and 59% on the districts roads. Following motorcycles, light goods vehicles (vans and pickups), truck and trailers were frequently observed at the survey locations. Public transport, including matatus, was rarely observed at the survey locations and account for less than 3% of the traffic on both national and district roads. There seems to be no reliable transport network or cost effective transport mode for vulnerable people who have no access to the public transport.
- The interviewees in former Amuru District have almost no private transport means, with only 1% of sampled households in former Amuru owning motorbikes and only 24% owning bicycles. Access to public transport is the key towards enhancing the mobility of the residents in former Amuru. However, as mentioned earlier, there seems to be very limited public transport service available to the residents.
- Agriculture is the dominant economic activity in former Amuru District. A total of 95% of the workers interviewed in former Amuru were farmers/livestock keepers. A total of

89% of the interviewed households in former Amuru were involved in agricultural activities, mostly for crop cultivation works. Accessibility to the farm was observed as being relatively good. Half of the residents in former Amuru cultivate their farms within a 10-minute distance of their homes. A total of 91% of the interviewees responded that they accessed their farms by foot. Two-thirds of the interviewees responded that they sell their products by themselves, either by bringing them to the market places or by bringing them to the buying points. As a consequence, maintaining good linkage connecting home villages, farms and markets is an essential element towards accelerating the return process of the IDPs to their home villages and sustaining their livelihoods.

11. PRESENT SITUATION AND ISSUES OF THE ROAD NETWORK AND CONDITIONS IN AMURU AND NWOYA DISTRICTS

11.1 Present Rural Road Network and Conditions in Amuru and Nwoya Districts

11.1.1 Analysis of the Present Rural Road Network

Based on the results of the road inventory survey, the roads in Amuru and Nwoya Districts were analysed in terms of the road network, road surface condition and service level.¹

1) Comparison with other districts in Acholi Sub-region

The lengths of national roads and district roads by district in Acholi Sub-region are shown in Table 11.1.1. Note that the reclassification of national and district roads in January 2009 is reflected only for the road network in Amuru and Nwoya Districts. The maps showing the road network and the population density juxtaposed with the road network in Acholi Sub-region are also shown in Figures 11.1.1 and 11.1.2.

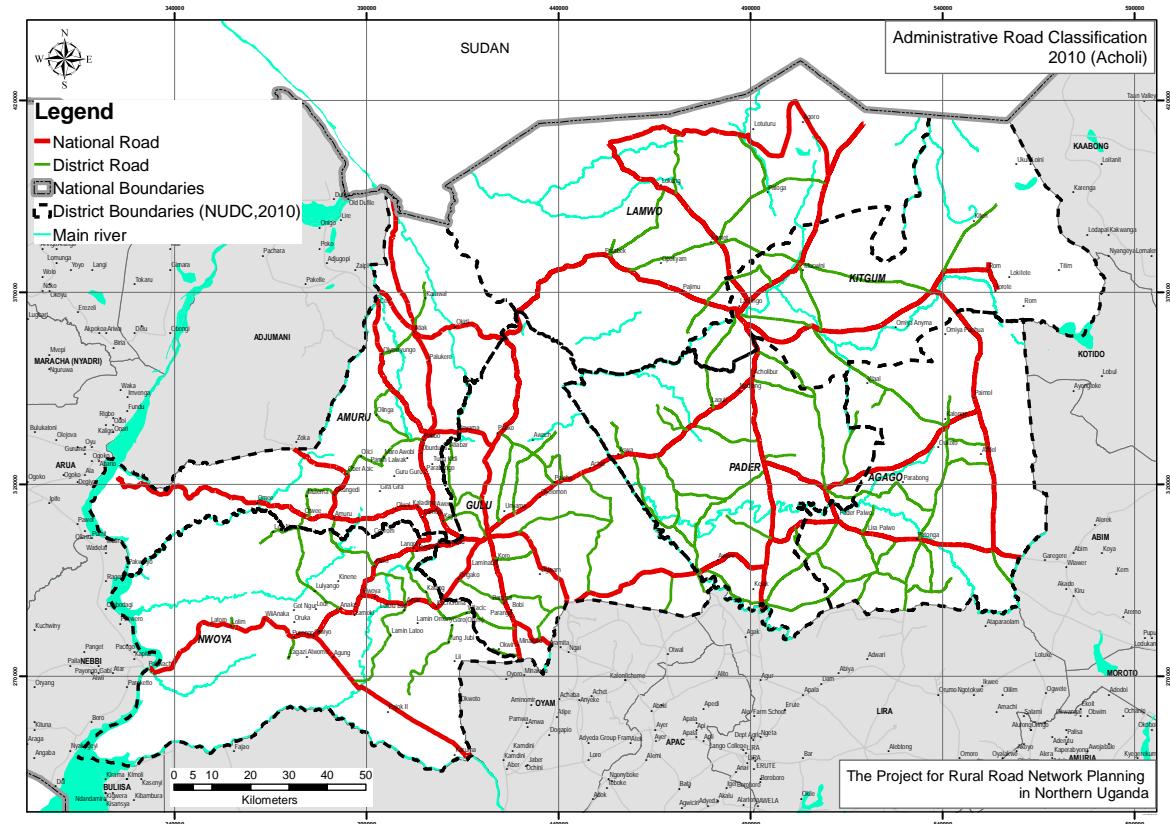
Table 11.1.1 Road Length by District in Acholi Sub-region, 2009

Unit: km

Road Class	Amuru District	Nwoya District	Gulu District	Lamwo District	Kitgum District	Pader District	Agago District
National Road	321.86	185.86	267.22	237.07	143.33	181.87	164.30
District Road	97.29	170.10	282.00	155.13	153.96	334.50	283.31

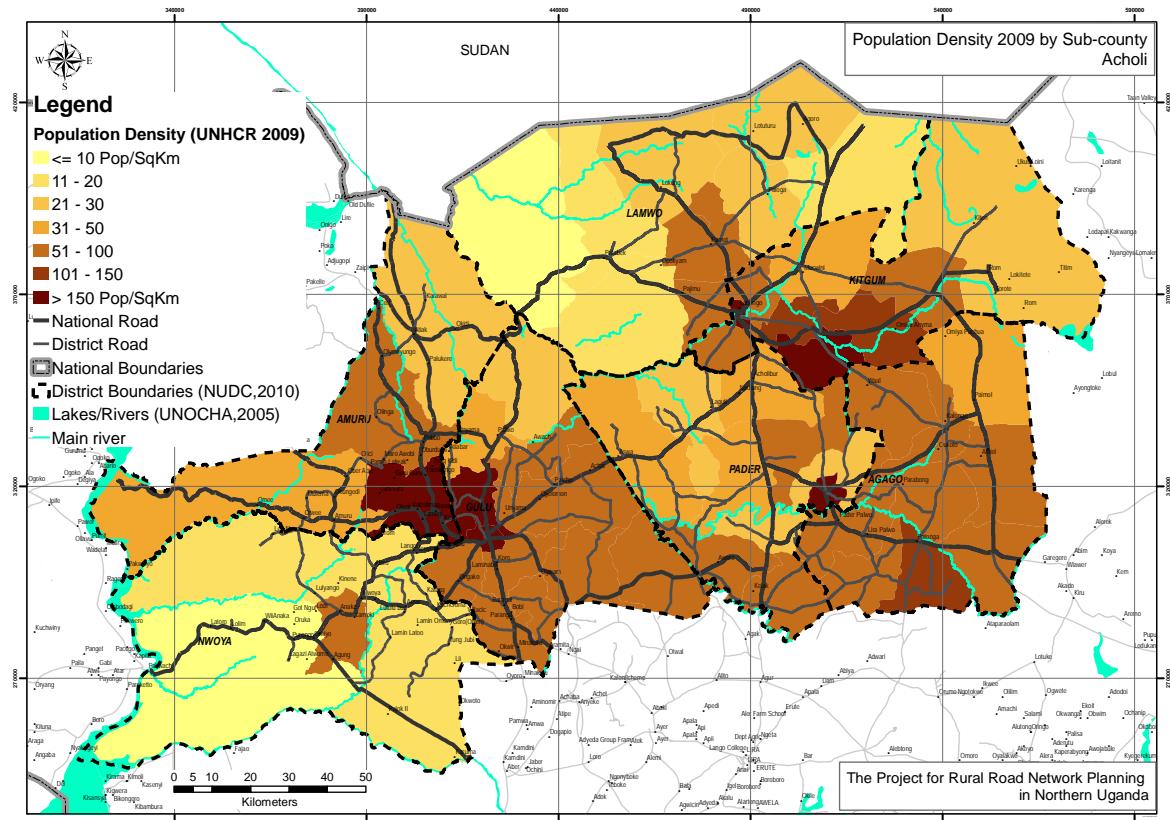
Source: Information was provided by District Engineers. The measurement of road length was done by the JICA Study Team.

¹ Note that the information and data used in this chapter are those created by the JICA Study Team.



Source: JICA Study Team

Figure 11.1.1 Road Network in Acholi Sub-region



Source: JICA Study Team

Figure 11.1.2 Road Network with Sub-county Population Densities in Acholi Sub-region

2) Amuru and Nwoya Districts

After reclassification of district roads to national roads in January 2009, Amuru and Nwoya Districts have 9 routes that are national roads and 13 routes that are district roads. The road from Karuma to Pakwach via Olwiyo is paved and connects Kampala and Western Nile. On the other hand, the road from Gulu town to Nimule which penetrates the north-west area of the districts plays an important role as a trade route between Uganda and South Sudan. Other national roads traverse to connect the above 2 major national roads with the main trading centres and other district centres. The location of existing roads are shown in Figure 11.1.3.

Table 11.1.2 National Roads in Amuru and Nwoya Districts

	Road Name	Road Surface Type	Length (km)	Location (Sub-county)
1	Karuma - Olwiyo - Pakwach	Bituminized	110	Koch Goma, Anaka, Purongo
2	Awee - Amuru - O mee - Rhino Camp	Loose surface gravel road and partly earth road	120	Lamogi, Amuru Town Council, Amuru
3	Nwoya - Lamogi	Loose surface gravel road	34.4	Alero, Lamogi
4	Temum - Adegnunu	Loose surface gravel road	6.65	Alero
5	Unyama - Pabbo	Loose surface gravel road	9.4	Pabbo
6	Pabbo - Ceri	Loose surface gravel road	43	Pabbo, Adjumani
7	Katikati - Pabbo - Atiak - Nimule	Loose surface gravel road	98	Lamogi, Pabbo, Atiak
8	Amuru Junction - Zoka - Mungula - Adjumani	Loose surface gravel road	70	Amuru, Adjumani
9	Gulu - Koch Goma - Olwiyo	Loose surface gravel road	42	Koch Goma, Anaka, Purongo

Source: District Development Plan (DDP) of Former Amuru District (2009/10-2011/12) with some modifications by the JICA Study Team

Table 11.1.3 District Roads in Amuru and Nwoya Districts

	Road Name	Road Surface Type	Length (km)	Location (Sub County)
1	Goma - Wilacic	Loose surface gravel road	9.6	Koch Goma
2	Alero - Aswa River - Amuru	Loose surface gravel road	21	Alero, Amuru
3	Purongo -Lagazi	Loose surface gravel road	6.5	Purongo
4	Keyo - Lalem	Loose surface gravel road	3.3	Lamogi
5	Koch Goma -Langol	Loose surface gravel road	20	Koch Goma, Alero
6	Atiak - Karawal	Loose surface gravel road	12	Atiak
7	Goma - Lii -Pajok II	Loose surface gravel road	36	Koch Goma
8	Otwee - Anaka	Loose surface gravel road	40	Amuru, Alero, Anaka
9	Otwee - Aswa - Lolim	Loose surface gravel road	51	Amuru, Alero, Purongo
10	Otwee - Mutema - Okungedi	Loose surface gravel road	17	Amuru
11	Ober Abic - Otici - Olinga -Pabbo	Loose surface gravel road	48	Amuru, Lamogi, Pabbo, Atiak
12	Olinga - Olamnyungu - Ayugi - Atiak	Loose surface gravel road	45	Atiak, Pabbo
13	Alero - Amar	Loose surface gravel road	22	Alero, Koch Goma, Anaka

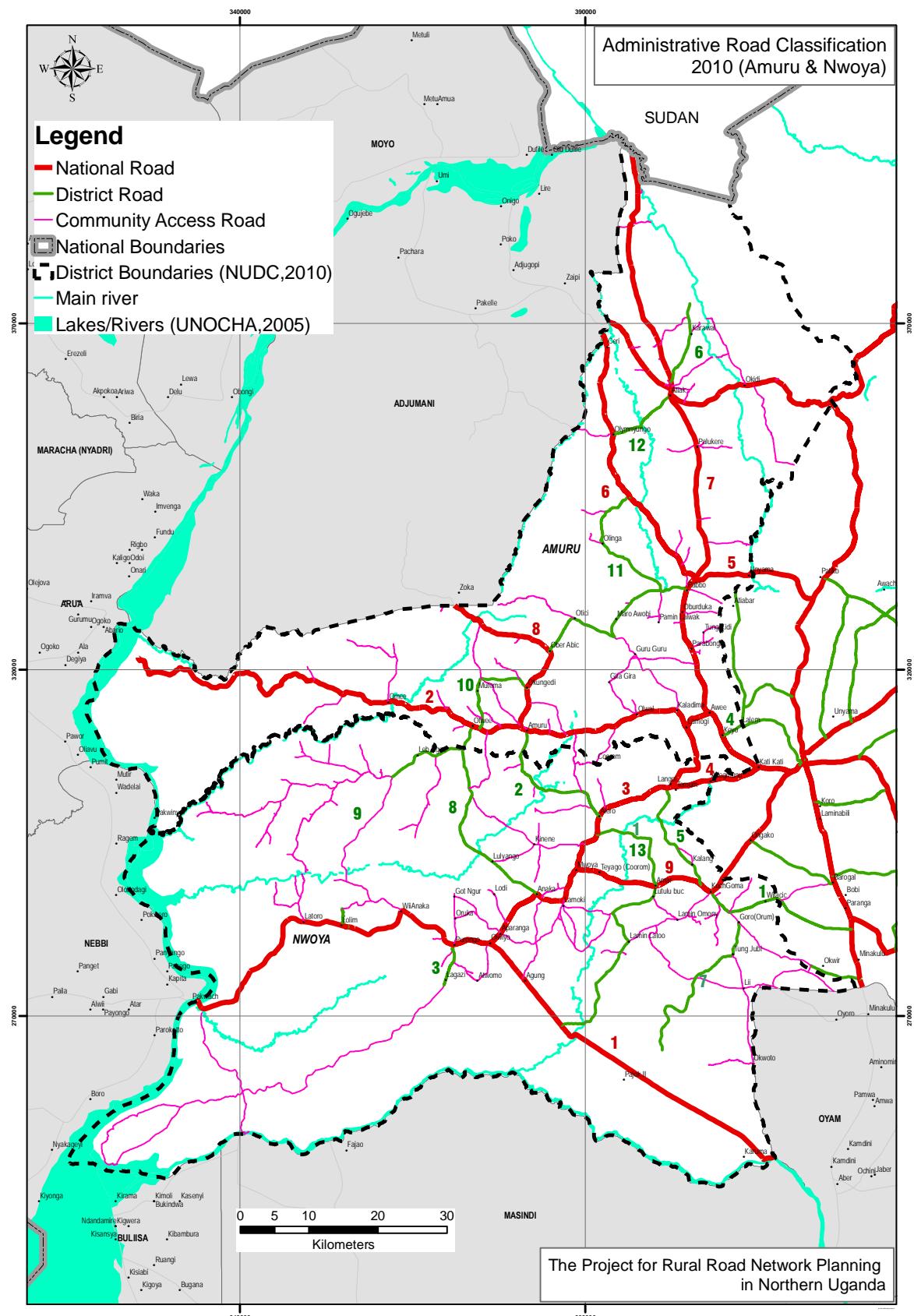
Source: District Development Plan (DDP) of Former Amuru District (2009/10-2011/12)

Table 11.1.3 Road Length by Sub-county in Amuru and Nwoya Districts

Unit: km

Road Class	Alero Sub-county	Amuru Sub-county	Anaka Sub-county	Atiak Sub-county	Koch Goma Sub-county	Lamogi Sub-county	Pabbo Sub-county	Purongo Sub-county
National Road	36.6	112.3	20.1	140.3	91.4	61.1	101.0	76.7
District Road	99.9	37.1	5.8	15.6	106.9	6.5	-	26.1
Community Access Road	329.6	179.9	8.0	195.1	224.7	97.9	144.9	351.2

Source: JICA Study Team



Source: JICA Study Team

Figure 11.1.3 Existing Roads in Amuru and Nwoya Districts

(2) Road Conditions

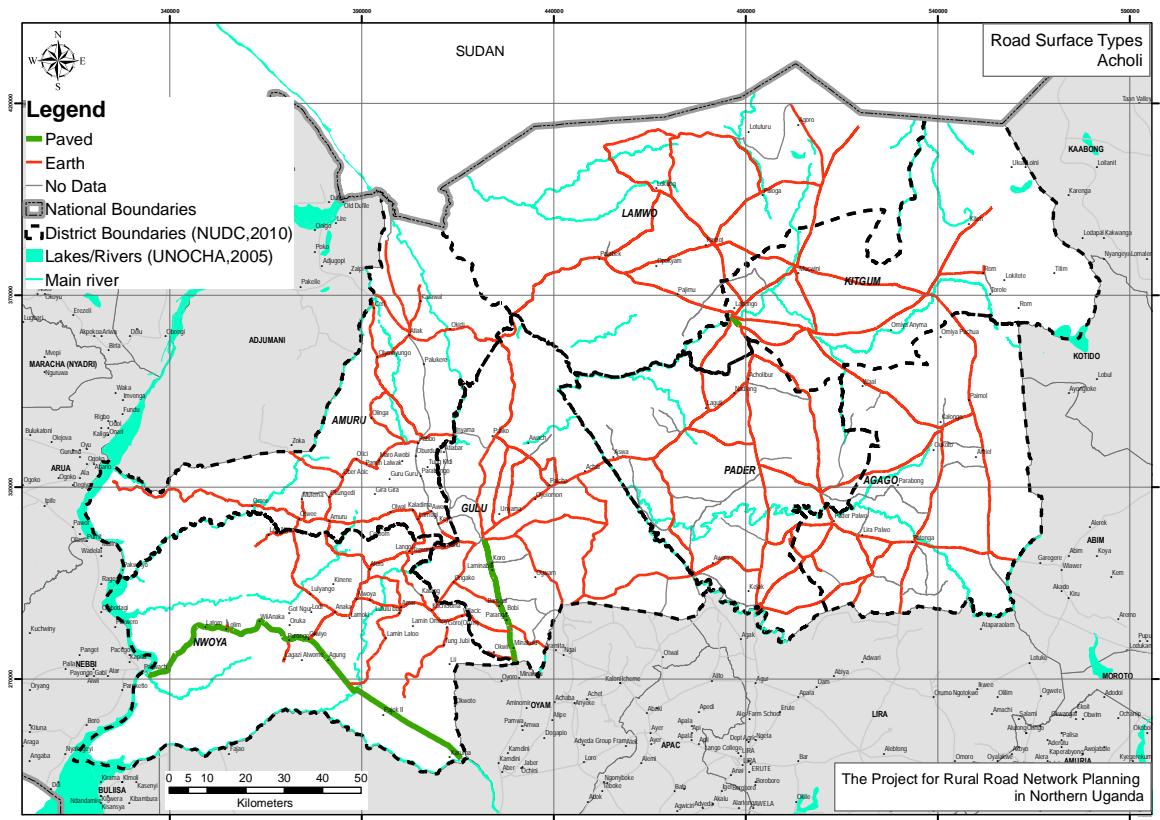
1) Comparison with other districts in Acholi Sub-region

There are only 3 routes of paved roads, namely; Kampala-Gulu Road in Gulu District, Pakwach Road in Nwoya District and around town in Pader. In addition, the road from Gulu (Kati Kati in Amuru District) to Nimule in South Sudan will be upgraded to an asphalt road by using loans from WB and the Japanese Government. Although most of the national roads are “Fair” in surface condition, most district roads and community access roads are in “Poor” or “Bad” condition. The road width of most national roads ranges from 3 to 6 m. However, there are some sections with widths below 3 m.

Table 11.1.4 Road Condition by District in Acholi Sub-region

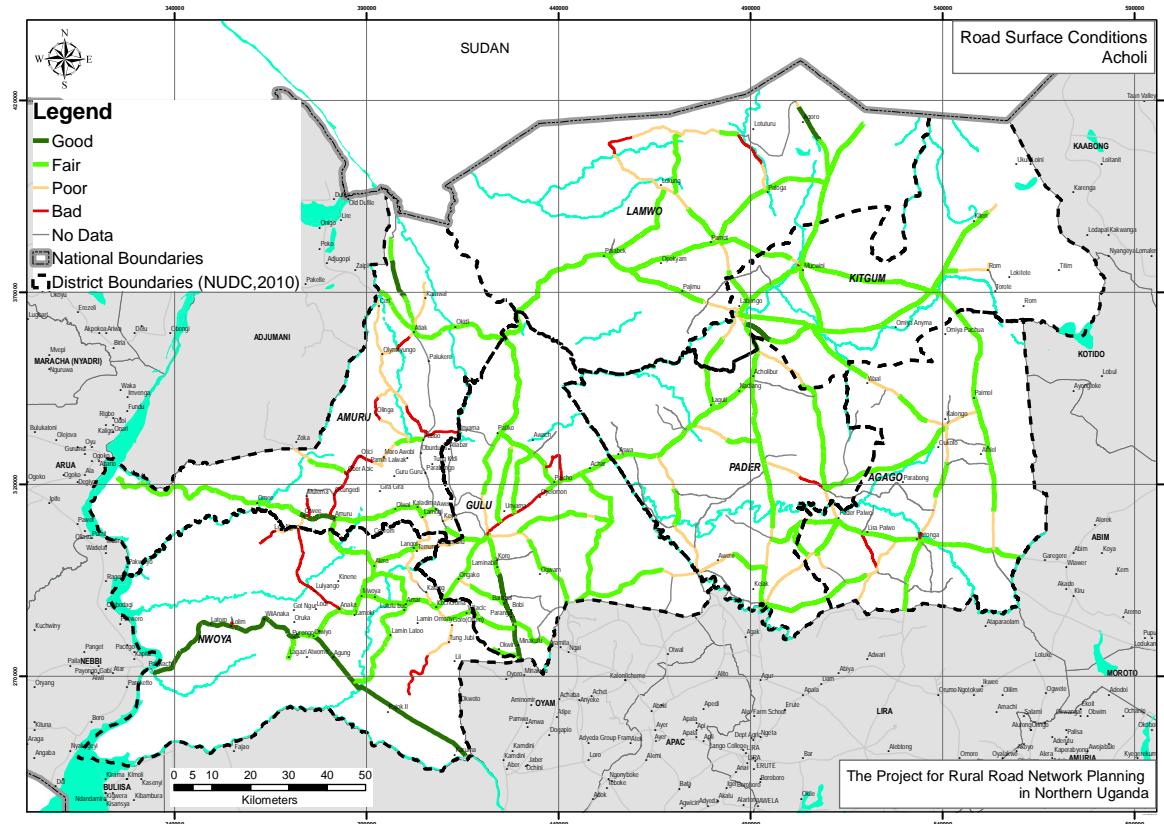
		Unit: km						
		Amuru District	Nwoya District	Gulu District	Lamwo District	Kitgum District	Pader District	Agago District
National Road	Good	20.0 (6%)	101.7 (55%)	23.7 (9%)	10.0 (4%)	7.7 (5%)	(0%)	(0%)
	Fair	160.0 (50%)	67.5 (36%)	174.8 (65%)	116.5 (49%)	113.1 (79%)	139.4 (77%)	140.2 (85%)
	Poor	41.4 (13%)	13.5 (7%)	37.5 (14%)	70.7 (30%)	15.8 (11%)	34.4 (19%)	24.1 (15%)
	Bad	33.3 (10%)	(0%)	20.0 (7%)	10.0 (4%)	1.1 (1%)	8.1 (4%)	(0%)
	Unknown	67.2 (21%)	3.2 (2%)	11.2 (4%)	29.9 (13%)	5.6 (4%)	0.0 (0%)	0.0 (0%)
	Total	321.9	185.9	267.2	237.1	143.3	181.9	164.3
District Road	Fair	10.2 (10%)	78.5 (46%)	154.6 (55%)	116.1 (75%)	124.4 (81%)	83.1 (25%)	72.7 (26%)
	Poor	48.8 (50%)	36.1 (21%)	7.0 (2%)	7.3 (5%)	13.4 (9%)	66.7 (20%)	64.7 (23%)
	Bad	27.4 (28%)	50.9 (30%)	12.7 (4%)	10.0 (6%)	(0%)	(0%)	11.7 (4%)
	Unknown	10.9 (11%)	4.7 (3%)	107.7 (38%)	21.7 (14%)	16.2 (11%)	184.8 (55%)	134.2 (47%)
	Total	97.3	170.1	282.0	155.1	154.0	334.5	283.3

Source: JICA Study Team



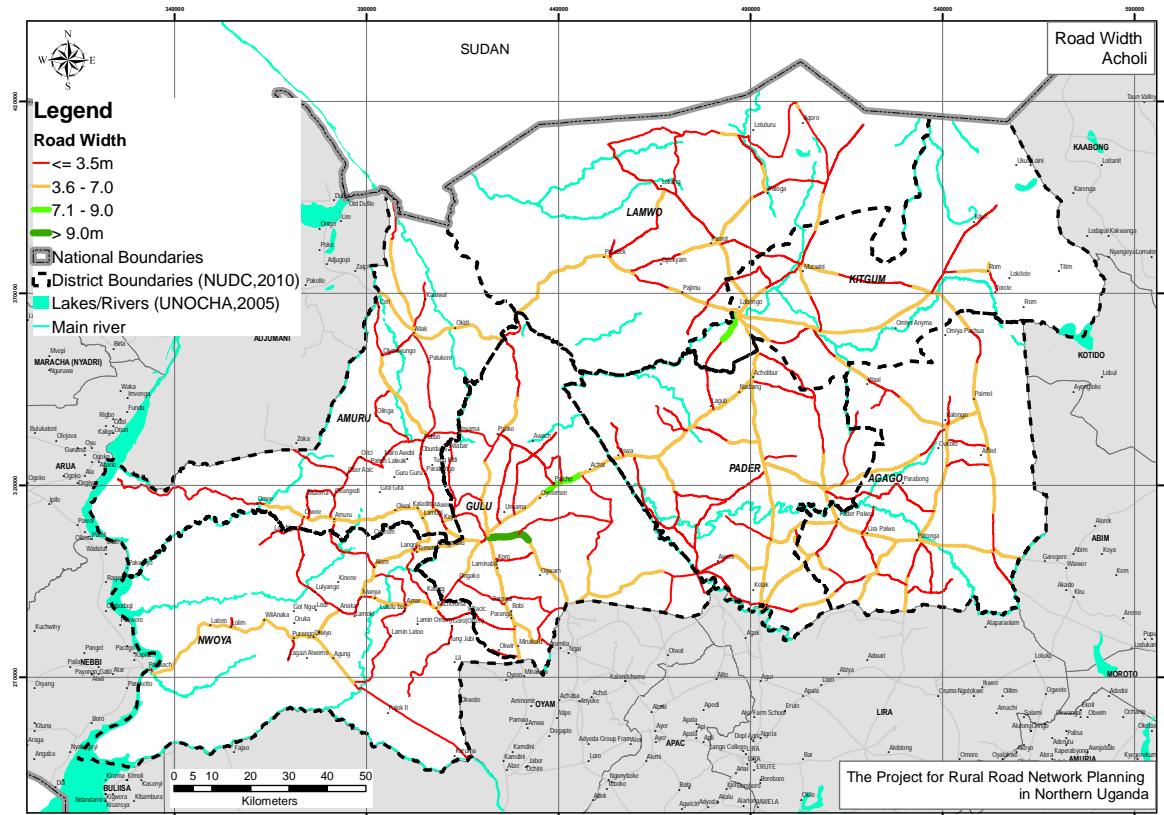
Source: JICA Study Team

Figure 11.1.4 Road Surface Type in Acholi Sub-region



Source: JICA Study Team

Figure 11.1.5 Road Surface Condition in Acholi Sub-region



Source: JICA Study Team

Figure 11.1.6 Road Width in Acholi Sub-region

2) Amuru and Nwoya Districts

The road section from Karuma to Pakwach via Olwiyo is paved while the other roads in Amuru and Nwoya Districts are coated with loose gravel on their surfaces. As illustrated in the road condition map, most of the national roads are classified as being at the “Fair” level. However, some of the national roads, especially the recently reclassified roads, are still at the “Poor” level. For example, the road from Pabbo to Ceri became a national road last year, but the road is considerably rough and some vehicles get stuck in mud when it rains.

It seems that the road network covers the entire district adequately. However, many road links are broken up by bottlenecks which hinder vehicle traffic. There are more than 60 bottleneck sections caused by bushes and over 40 caused by rivers. Wooden bridges which were constructed by the local government or NGOs enable pedestrians and bicycles to cross rivers or streams; however, they do not have adequate structural strength to enable the passage of motor vehicles.

Table 11.1.5 Road Surface Condition by Sub-county in Amuru and Nwoya Districts

Unit: km

Class/Road Surface Condition		Alero	Amuru	Anaka	Attiak	Koch Goma	Lamogi	Pabbo	Purongo
National Road	Good		10.0	5.4	10.0				60.5
	Fair	23.1	83.0	14.7	58.7	22.0	19.4		7.8
	Poor	13.5	5.2				4.7	46.7	
	Bad		14.0					28.6	
	Unknown				71.6	69.4	37.0	25.8	8.4
District Road	Fair	21.4	2.2			29.2			6.4
	Poor	27.0	3.5		15.6	40.6	6.5		
	Bad	51.5	10.7	5.8		30.3			7.0
	Unknown		20.7			6.7			12.7
Community Access Road	Fair				3.5				
	Poor	7.8	52.9	67.3	97.1	31.0	7.2	33.1	13.3
	Bad	291.3	105.7	22.6	75.5	98.1	64.5	67.5	104.2
	Unknown	6.9	4.3	18.1	19.0	14.0	3.9	8.4	225.3
Unknown	Fair					31.5		8.0	3.2
	Poor	14.6	8.5			40.2	13.9	19.9	
	Bad	9.0	8.6			10.0	8.5	8.1	5.3

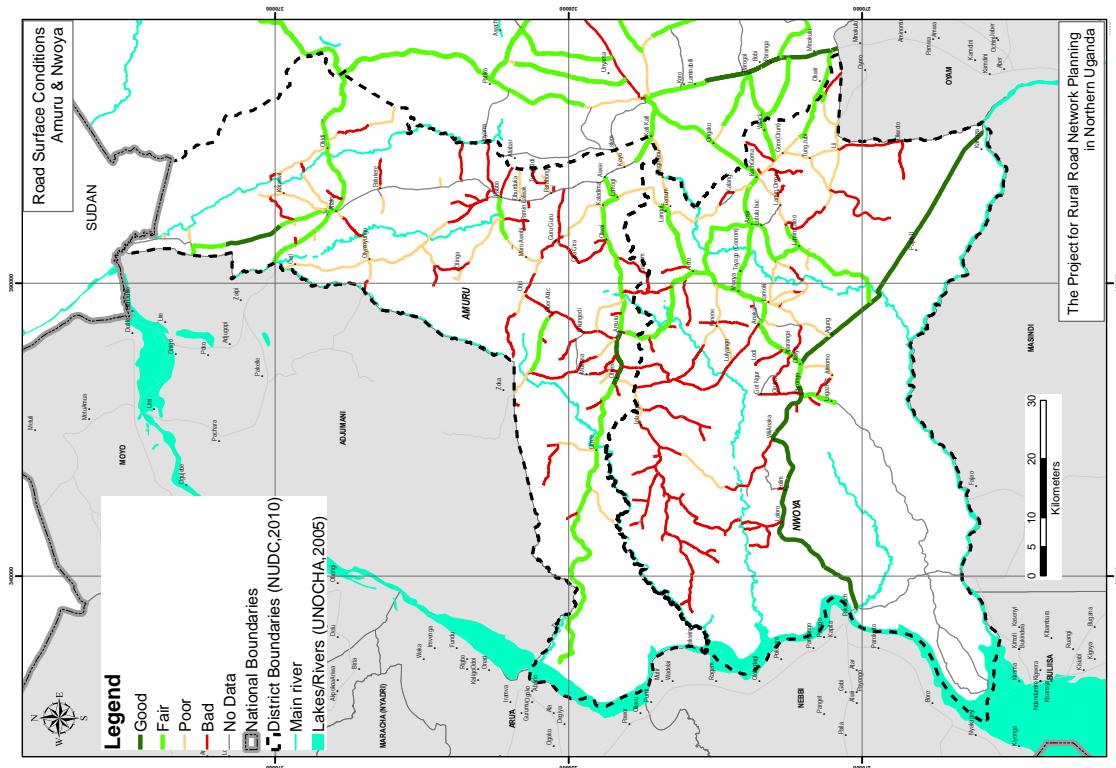
Source: JICA Study Team

Table 11.1.6 Road Width by Sub-county in Amuru and Nwoya Districts

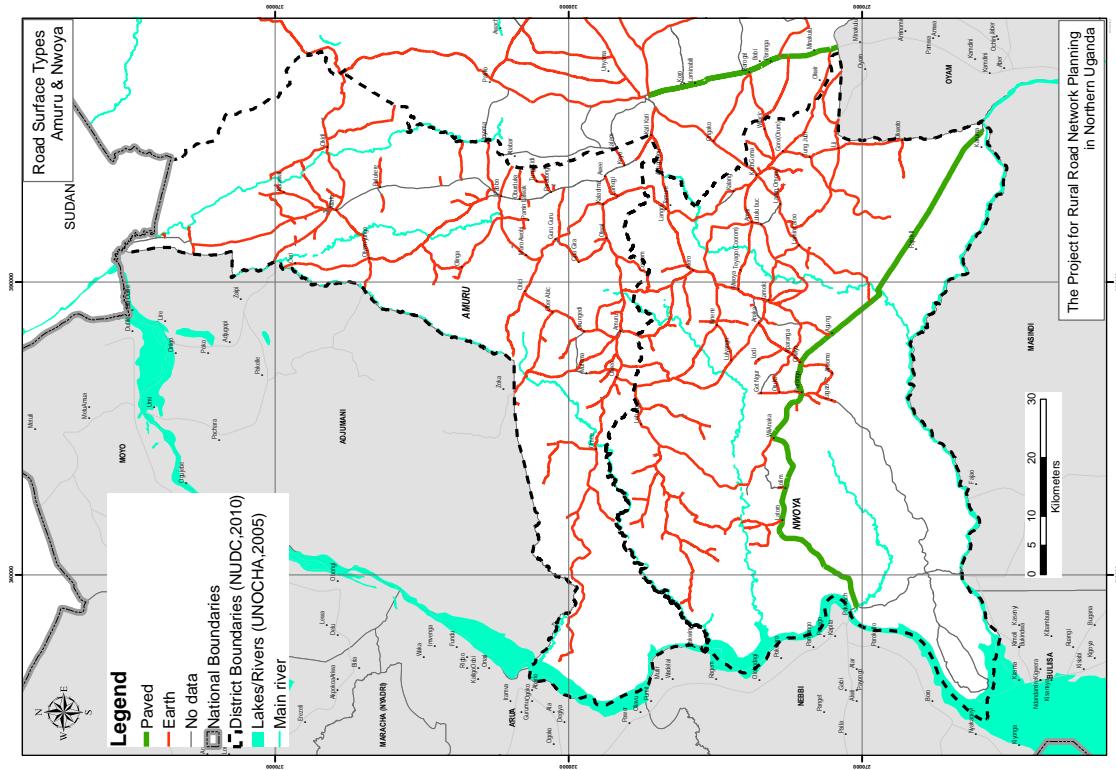
Unit: km

Road Class	Width	Alero	Amuru	Anaka	Attiak	Koch Goma	Lamogi	Pabbo	Purongo
National Road	1.5 to 3m	-	73.4	-	1.2	-	-	49.1	-
	3 to 6m	36.6	38.9	18.3	67.6	22.0	24.2	26.1	46.4
	> 6m	-	-	1.7	-	-	-	-	21.9
	Unknown	-	-	-	71.6	69.4	37.0	25.8	8.4
District Road	1.5 to 3m	96.2	16.4	5.8	15.6	88.3	-	-	13.4
	3 to 6m	3.6	-	-	-	11.9	6.5	-	-
	Unknown	-	20.7	-	-	6.7	-	-	12.7
Community Access Road	<= 1.5m	22.1	34.3	9.1	15.5	-	8.1	26.0	27.2
	1.5 to 3m	278.5	124.4	53.0	140.0	127.7	63.5	74.5	77.0
	3 to 6m	-	-	27.7	20.6	1.4	-	-	13.3
	Unknown	5.5	4.3	18.1	19.0	14.0	3.9	8.4	225.3
Unknown	<= 1.5m	9.0	-	-	-	-	-	-	-
	1.5 to 3m	10.00	16.1	-	-	54.5	22.4	30.1	8.5
	3 to 6m	4.6	0.9	-	-	27.2	-	6.0	-

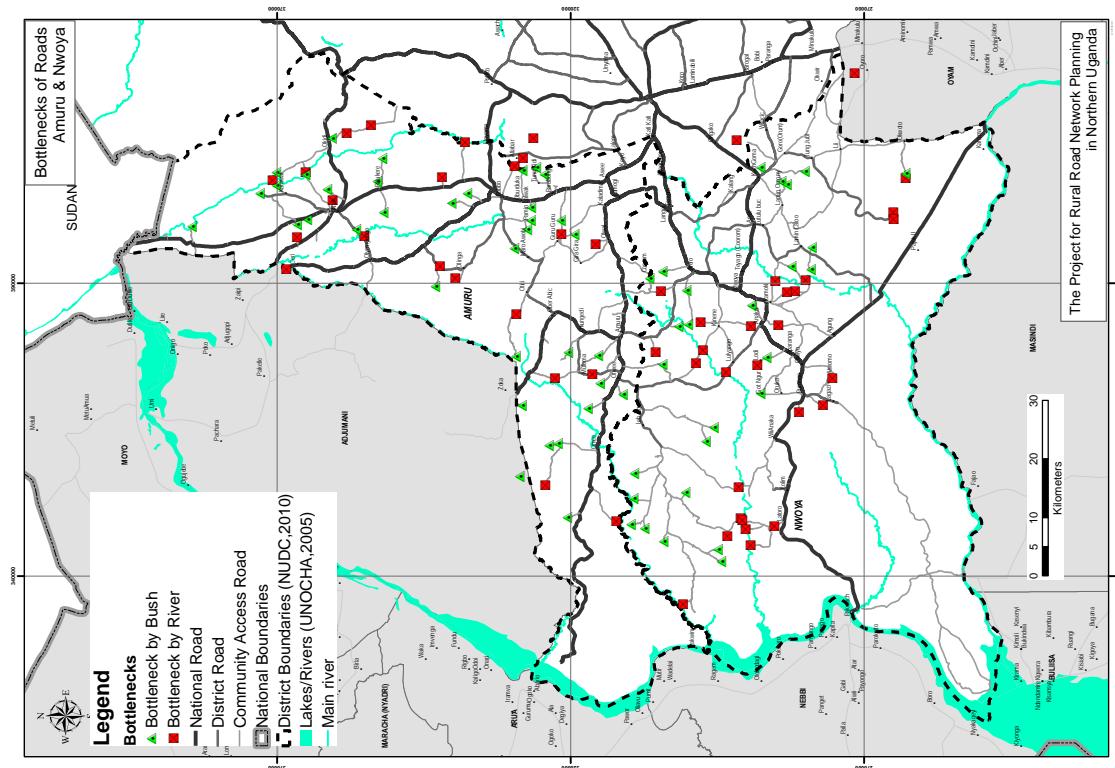
Source: JICA Study Team



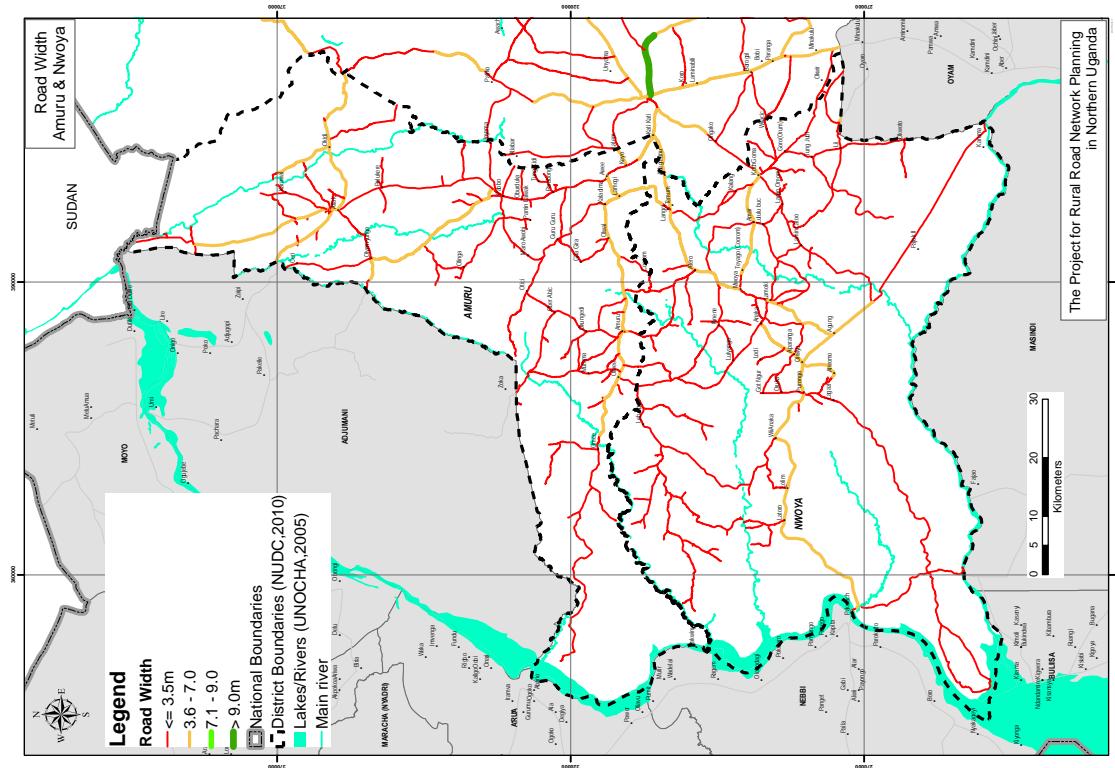
Source: JICA Study Team
Figure 11.1.8 Road Surface Conditions in Amuru and Nwoya Districts



Source: JICA Study Team
Figure 11.1.7 Road Surface Type in Amuru and Nwoya Districts



Source: JICA Study Team
Figure 11.1.10 Bottlenecks on Roads in Amuru and Nwoya Districts



Source: JICA Study Team
Figure 11.1.9 Road Width in Amuru and Nwoya Districts

(3) Rural Road Service Level

1) Coverage Area by Travel Time

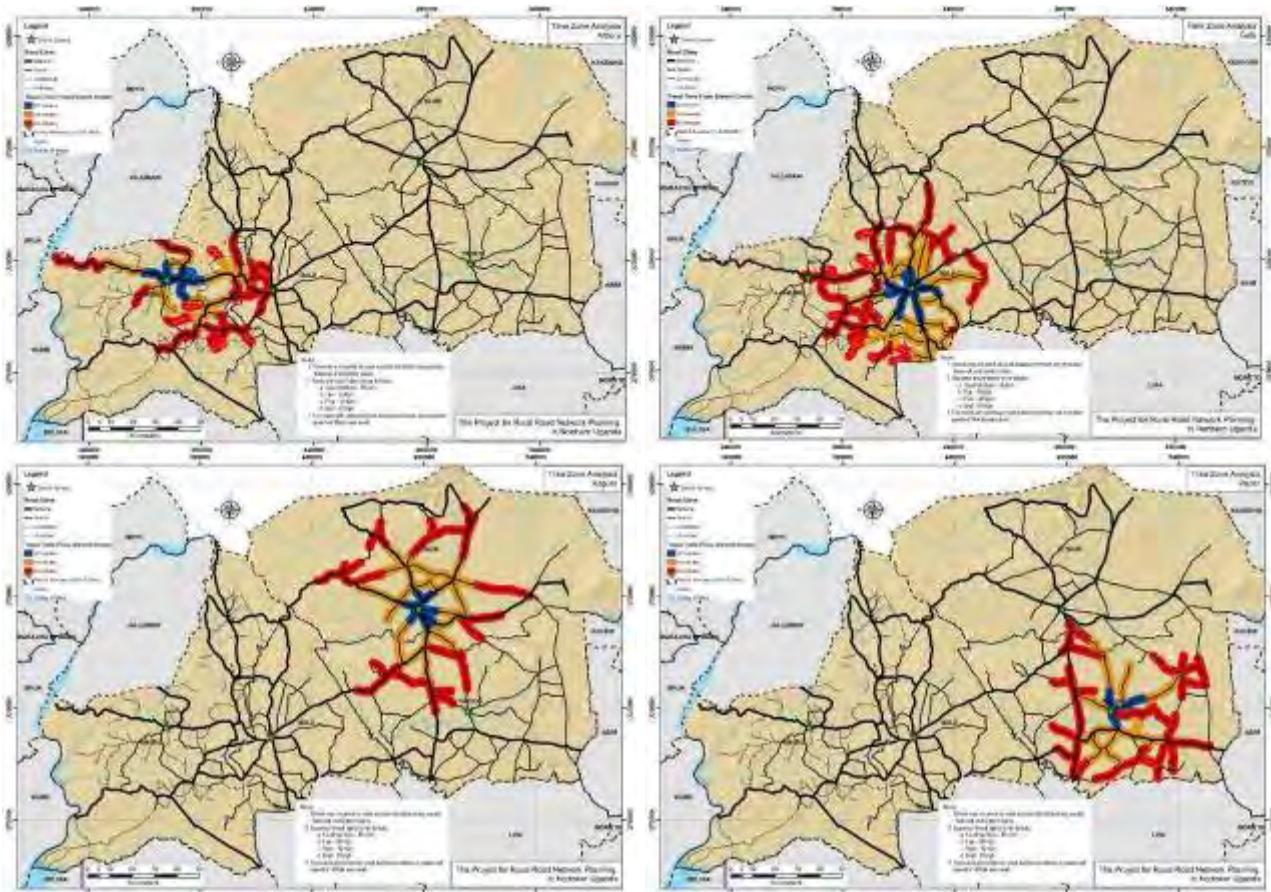
The level of service of the rural road network was evaluated using the coverage area of the rural road network and population inhabited in the coverage area. Assuming travel speeds of 80 km/h for good surface condition, 60 km/h on fair surface, 40 km/h on poor surface and 20 km/h on bad surface, the travel time from each district centre in Acholi Sub-region was estimated and different coverage areas of ‘within 20 minutes’, ‘within 40 minutes’ and ‘within 1 hour’. The populations within each travel distance are illustrated in the following table and figures. The findings of this network analysis can be summarized as shown below.

- Comparing population in the coverage area from each district centre, the population figures observed are very much distorted. Since Gulu is the most populated area amongst the four districts, the population within 1 hour travel distance from Gulu Center reaches around 237,000 people. Like Kitgum and Pader, the population within 1 hour travel distance from Amuru Centre was estimated at only 136,000.
- The population within 20 minute travel distance from Amuru Centre was estimated to be as low as 4,300 people and that within 40 minute travel distance was estimated at only 21,000 people: these numbers are relatively smaller than those for other districts. This is mainly because (i) the road network to access Amuru Centre is very limited and Amuru Centre is only accessible by the Gulu – Nimule Road, (ii) the road surface condition in Amuru District is relatively poor; to be more specific, there are no good roads to connect the northern and southern parts of Amuru District, (iii) Amuru District as a whole and Amuru Centre in particular are located in less populated areas.
- The population by travel time from the district centres in Amuru and Nwoya Districts is relatively small compared with other districts. As illustrated in the following figures, most of the road networks in Gulu, former Kitgum and former Pader are covered within 1 hour travel distance, whereas most of the road network in the northern and southern parts of former Amuru District are not reachable within 1 hour travel distance.

Table 11.1.7 Population by Travel Time from District Centre

	Within 20 min	Within 40 min	Within 1 hour
From Gulu Town	133,357	191,612	236,930
From Kitgum Town	50,718	95,951	137,526
From Otwee Town	4,300	21,133	136,088
From Pader Town	7,570	42,805	115,785

Source) JICA Study Team



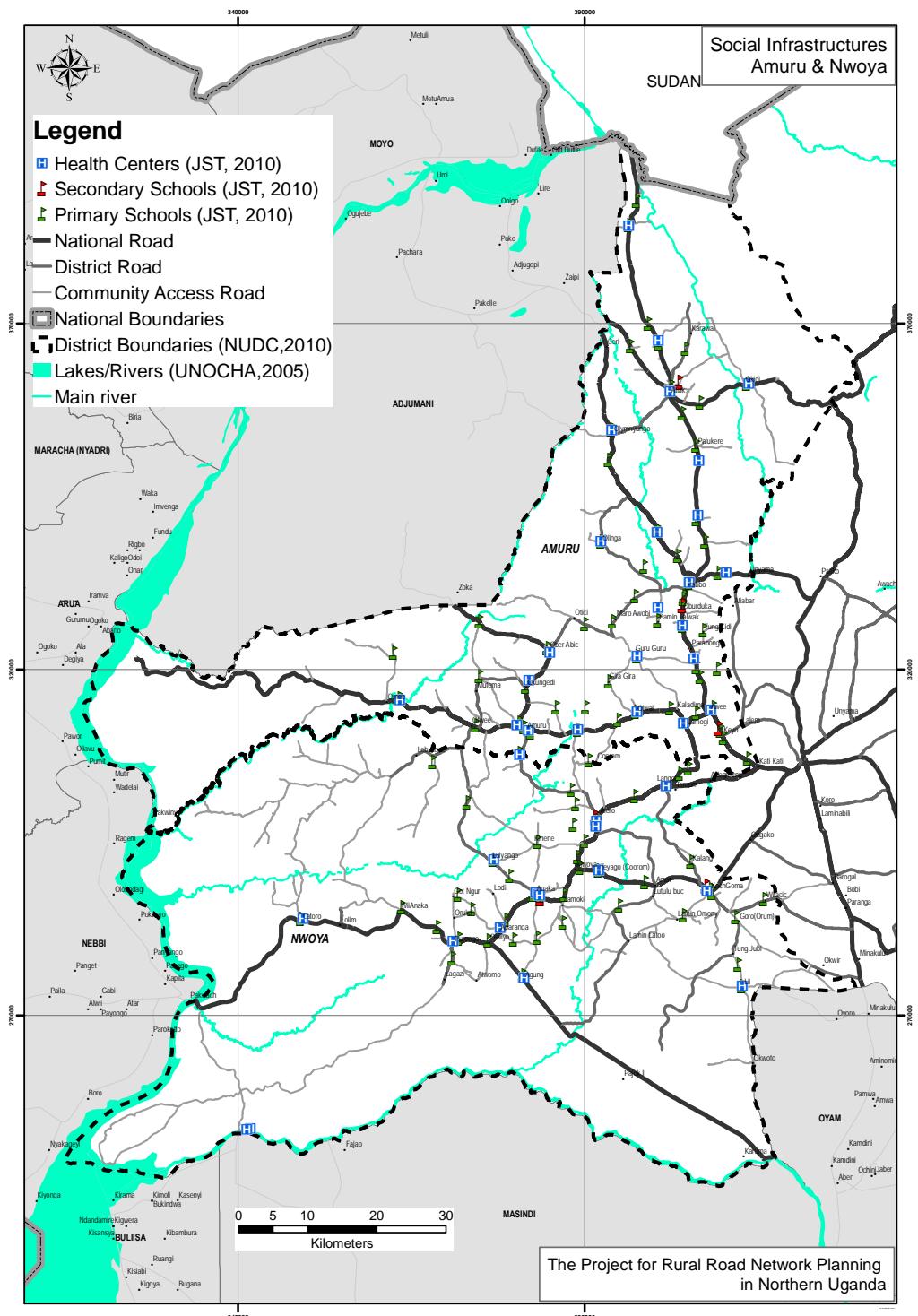
Source: JICA Study Team

Figure 11.1.11 Coverage Area from District Centres

2) Accessibility to Social Infrastructure

a) General

One of the reasons the IDPs' return process to their home villages has been hindered is the lack of accessibility to social infrastructures, due to both insufficient infrastructure and inadequate transport service. In Amuru District, where there still remains a considerable number of IDPs in the camps, the number of social infrastructures is still below the national standards. Health units in Amuru District, for instance, include a hospital, health centre IVs (HC IV), health centre IIIIs (HC III), and health centre IIs (HC II). Under the national standard, there should be 1 HC II per parish, 1 HC III per sub-county and 1 HC IV per county. In reality however, 24 out of 51 parishes in Amuru do not have any health units. Accordingly, a key factor to accelerate the IDPs' return process is to improve accessibility to social infrastructure by the rural road network and transport service. The following discussion will reveal the trip characteristics to three types of social infrastructure in Amuru District: water points, health units and schools.



Source: UNHCR

Figure 11.1.12 Location of Schools and Health Units

b) Water Points

The table below shows a summary of the survey of three sub-counties (Amuru, Alero, and Anaka). Some questions regarding individual information as well as access-related items were asked at various water points in the area in September 2009. As it is shown in the table, the average age of interviewees was 36.8 years old and 30% of interviewees were from IDP camps, 26% from transit sites and 37% from home villages. More than half of the interviewees were

female. Most of the interviewees used the water for domestic purposes (drinking, cooking, washing, bathing, etc).

Table 11.1.8 Results of Accessibility Survey (Water Points)

Sub-county	Amuru, Alero, Anaka	
Number of interviewees	144	
Average interviewees' age	36.8	
Interviewees' addresses	IDP camp	43 (30%)
	Transit site	37 (26%)
	Home village	53 (37%)
	No answer	11 (8%)
Sex composition	Male	45 (31%)
	Female	97 (67%)
	No answer	2 (1%)
Average carrying volume (litre)	85.7	
Average travel time (one way) (minutes)	34	
Average travel time by type of interviewees' address (minutes)	IDP camp	39
	Transit site	29
	Home village	38
Difficulties in travelling	Yes	109 (76%)
	No	31 (22%)
	No answer	4 (3%)

Source: JICA Study Team

Almost all of the respondents came to water points by foot and the average travel time between their homes and water points was 34.5 minutes. Looking at average travel time by interviewees' address, average travel time was 39 minutes for people from IDP camps, 29 minutes for people from transit sites, and 38 minutes for people from home villages, which shows that the differences in travel time were not that significant among them. Comparing the travel times to the national average for rural areas, the figure is much worse than the national average. Looking at the result of "National Service Delivery Survey 2008"², average travel time to and from water points in rural areas in the wet season is only 24 minutes, which means that it takes only 12 minutes for one-way on average. Water coverage in Amuru is at the same level as the national average. On the other hand, accessibility to water in Amuru is far below the national average. This is probably because Amuru has a very low population density and the population is scattered sparsely within the district³.

The survey also inquired about the difficulties encountered by Amuru residents in travelling between their homes and the water points. As is shown in the table above, 76% of the interviewees answered they felt there were difficulties. The major difficulties people pointed out are the following:

- Long distance between homes and water points
- Bushy roads
- Fear of accidents
- Fear of snakes
- Dusty roads
- A lot of pot holes in the roads

² National Service Delivery Survey 2008 Report, Ministry of Public Service and Uganda Bureau of Statistics, May 2009

³ Population density of Amuru District in 2009 was 23 people per square kilometre whereas that of Uganda is 153 people per square kilometre. Amuru has one of the lowest population densities in Uganda.

- Narrow roads
- Muddy roads (especially after raining)
- Hilly roads

c) Health Units

Five health units in three sub-counties were selected considering accessibility to roads from the health units and the surveyors interviewed about 50 people who visited each health unit. The table below shows the surveyed health units.

Table 11.1.9 Survey Points (Health Units)

Sub-county	Health Units
Amuru	<ul style="list-style-type: none"> • Amuru HC III • Okunggedi HC II
Lamogi	<ul style="list-style-type: none"> • Kaladima HC III • Guru-Guru HC II
Anaka	<ul style="list-style-type: none"> • Anaka General Hospital

The summary of the survey is shown in the table below. The average age of interviewees was 29.7 years old and the interviewees' ages ranged from 3 years to 90 years. A total of 49% of interviewees were men and 51% were women. 3% revealed that they were from IDP camps, 15% from transit sites and 38% from home villages. A large number of interviewees did not reveal where they were from, which made it difficult to compare answers by interviewees' addresses. Most of the interviewees were patients and the purposes of their visits were various, and included: "to treat", "to test for HIV/AIDS", "to accompany family members", to receive medicines", to see patients", "to attend family planning workshop", etc.

Table 11.1.10 Result of Accessibility Survey (Health Units)

Number of interviewees	261	
Average interviewees' age	29.7	
Sex composition	Male	127 (49%)
	Female	134 (51%)
Interviewees' addresses	IDP camp	9 (3%)
	Transit site	39 (15%)
	Home village	99 (38%)
	No answer	114 (44%)
Average travel time (one way) (minutes)	91	
Means of transport	Foot	178 (68%)
	Bicycle	47 (18%)
	Motorbike	28 (11%)
	Passenger car	3 (1%)
	Bus	3 (1%)
	No answer	2 (1%)
Travel frequency	Everyday	38 (15%)
	3 days a week	20 (8%)
	Every week	48 (18%)
	A few days a month	114 (44%)
	Every month	26 (10%)
	Others	9 (3%)
	No answer	6 (2%)
Difficulties in travelling	Yes	210 (80%)
	No	49 (19%)
	No answer	2 (1%)

Source: JICA Study Team

Average travel time from houses to health units was 91 minutes. A total of 68% of interviewees came to the health units by foot. Bicycles (18%) and motorbikes (11%) were also utilised to move to the health units. The means of transport used basically reflects the results of the national survey which show that 63% walk to health units, 20% utilised private bicycles, and 9% utilised boda-bodas (motorbike taxis)⁴. The survey also inquired about transportation costs for one-way travel if people needed to pay for transportation. A total of 35 interviewees (about 13% of all) responded that they paid for transportation to come to health units. Most of them used motorbikes (boda-bodas) and paid fees ranging from 1,500 to 16,650 Ushs.

A total of 44% of interviewees responded that they came to the health units a few days a month; 18% claimed they did it “every week” while 15% answered “everyday”.

In terms of the difficulties in travelling between their houses and the health units, 80% of interviewees answered that they faced difficulty. The major difficulties were the following:

- Long distance between their homes and the health centres
- Bushy roads
- A lot of pot holes on the roads
- Narrow roads
- Muddy roads (especially after raining)
- Flooding roads after rain/ no drainage
- Crossing streams/ no bridges/ weak bridges
- Hilly roads
- Fear of accidents

d) Schools

There is supposed to be one primary school per parish and one secondary school per sub-county. According to Amuru District, each parish has one primary school, but, two (Amuru and Purongo) of the eight sub-counties do not have secondary schools. Most of schools have already been re-established in their home villages. However, 4 primary schools and 2 secondary schools are still displaced.

In order to capture some reality of the access to schools in the district, the JICA Study Team also conducted small surveys at several schools in September 2009. Considering accessibility from several types of roads, five schools from five sub-counties were selected as survey sites. About 50 interviewees were interviewed on travel time, travel means, difficulties in travelling, etc at each survey site.

Table 11.1.11 Survey Points (Schools)

Sub-county	Schools
Amuru	• Okunggedi Primary School
Lamogi	• Guruguru Primary School
Pabbo	• Macro-awobi Primary School
Alero	• Lungulu Primary School
Anaka	• Anaka P7 Primary School

⁴ National Service Delivery Survey 2008 Report, Ministry of Public Service and Uganda Bureau of Statistics, May 2009

The table below shows the summary of the results of the survey. Since most of interviewees were students, the average age of interviewees was much lower at 19.3 years old. A total of 64% of interviewees were male. About half of the interviewees were from home villages, but, 34% of them did not answer where they were from. A total of 70% of interviewees were students, 16% were teachers, 9% were parents, and 3% were others such as support staff for schools. Major purposes of parents' visits were "to attend a meeting", "to pay fees", and "to meet with teachers".

Table 11.1.12 Result of Accessibility Survey (Schools)

Number of interviewees	270	
Average interviewees' age	19.3	
Sex composition	Male	174 (64%)
	Female	95 (35%)
	No answer	1 (0%)
Interviewees' addresses	IDP camp	17 (6%)
	Transit site	23 (9%)
	Home village	137 (51%)
	No answer	93 (34%)
Interviewees' categories	Student	190 (70%)
	Teacher	43 (16%)
	Parent	24 (9%)
	Other	8 (3%)
	No answer	5 (2%)
Average travel time (one way) (minutes)	69	
Average travel time for selected category (one way) (minutes)	Student	69
	Teacher	82
Means of transport	Foot	227 (84%)
	Bicycle	39 (14%)
	Motorbike	3 (1%)
	Taxi	1 (0%)
Difficulties in travelling	Yes	223 (83%)
	No	38 (14%)
	No answer	9 (3%)

Source: JICA Study Team

Average travel time among all interviewees was 69 minutes. Average travel time among students was 69 minutes and that among teachers was 82 minutes. According to the result of the "National Service Delivery Survey 2008"⁵, 77% of pupils lived within 3km of their schools and 18% within 3km-5km of their schools in rural Uganda. In the Upper North sub-region where Amuru belongs, 80% lived within 3km and 9% within 3km-5km. Furthermore, MoES reported that the average distance pupils walked to primary schools was 2.31km in 2008⁶. Although it is difficult to compare travel time and travel distance, it could be proffered that the situation at these survey points is worse than the regional average.

A total of 84% of interviewees came to the schools by foot and some of them used bicycles and motorbikes. Most of the people who used bicycles and motorbikes were teachers. Interviewees who had to pay for the transportation paid from about 6,000 Ushs to 10,000 Ushs.

⁵ National Service Delivery Survey 2008 Report, Ministry of Public Service and Uganda Bureau of Statistics, May 2009

⁶ The Education and Sports Sector Annual Performance Report (ESSAPR) – covering Financial Year 2007/08, Ministry of Education and Sports, November 2008

A total of 80% of the interviewees answered that they faced difficulty when travelling from their homes to the schools. Major difficulties cited by interviewees were as follows:

- Long distance between their homes and the schools
- Bushy roads
- A lot of pot holes on the roads
- Narrow roads
- Muddy roads (especially after raining)
- Slippery roads
- Flooding roads after rain/ no drainage
- Crossing streams/ no bridges/ weak bridges
- Fear of accidents
- Fear of snakes

11.2 Issues in Rural Road Development and Maintenance in Amuru and Nwoya Districts

In this section, problems in road development and maintenance are summarized from various problems pointed out in the previous chapters on the present situational analysis of roads (Chapters 8 and 10).

(1) Road Network

- The length of roads in Amuru and Nwoya Districts is much shorter than that of other districts, considering their populations and vast areas.
- All-weather roads are few in Amuru and Nwoya Districts. More all-weather roads are required since more motor vehicles are expected on the roads in Amuru and Nwoya Districts in the future.
- The road network of Amuru and Nwoya Districts has many missing links because bridges and culverts are broken or simply non-existent. Some existing bridges are made of wood. Those wooden bridges are too weak and/or too narrow for motor vehicles and motorbikes to cross.
- Most roads in Amuru and Nwoya Districts are earth roads with no cross slopes provided. As a result, rainwater pools up on road surface, which accelerates deterioration of the road condition.
- In the rainy season, many road sections are in poor condition and are sometimes not passable by vehicles. Organic soils exist on road surfaces, especially in the western part of Amuru and Nwoya Districts. In such areas, earth roads are too slippery to allow vehicle passage. Those earth roads become so muddy that vehicles often get stuck in the mud. In the rainy season, the service level of roads in Amuru and Nwoya Districts is unstable and unreliable.
- While people can cross most rivers without well-built bridges in the dry season, they cannot cross those rivers when the river water becomes high during the rainy season. In such situations, some villages are isolated and children cannot go to school for days.
- Many community access roads are not passable by vehicles in Amuru and Nwoya Districts.
- Home villages and hamlets are scattered along community access roads, many of which are not passable by vehicles. It is difficult to secure accessibility to social infrastructure

from home villages/hamlets. It is also difficult to secure mobility and accessibility for vulnerable people, such as the elderly, pregnant women and small children.

- Major roads of Amuru and Nwoya Districts are radial roads from Gulu City. There are a limited number of roads connecting those radial roads to each other in Amuru and Nwoya Districts.
- Although vehicle roads run through most villages in Amuru and Nwoya Districts, there aren't any direct access roads to some villages or access roads to some villages are in very poor condition.
- Most villages have only one access road, which limits the mobility of the villagers. They usually have to take long detours to reach some trading centres. Such a road situation does not secure enough redundancy for people's social and economic activities.
- In the dry season, running vehicles on earth roads raises dust so heavily that visibility for drivers is hampered compromising their ability to drive cars safely.
- In the western part of Amuru Sub-county and the southern part of Koch Goma Sub-county, wild animals and tsetse flies pose a danger to road users.

(2) Public Transportation

- Public transportation, such as taxis (using HIACE type vehicles), pick-up trucks and small trucks, is not yet properly developed due to poor road conditions in Amuru and Nwoya Districts. There isn't much capacity for public transportation in Amuru and Nwoya Districts. Moreover, transportation charges for taxis are relatively high for people.
- Boda boda (motorbike taxi) is a more expensive mode of public transportation. However, people have to rely on boda boda transportation occasionally for emergency purposes.

(3) Administration of Road Maintenance

- Although the central government decided to introduce a government policy on force account for road maintenance of district roads, there is neither budgetary support for the policy nor an implementation program.
- For the force account policy for road maintenance, Amuru and Nwoya Districts have neither equipment nor human resources for road maintenance because the districts were established recently.
- Road maintenance works in rural areas like Amuru and Nwoya Districts cannot attract a reasonable quality of contractors, since many high quality contractors with proper machinery and adequate skill levels are mainly active in large urban areas like Kampala and Entebbe.
- With their limited budgets, the district governments cannot award requisite contracts to contractors for road maintenance.
- Companies operating in northern Uganda are financially weak. Therefore, such contractors tend to implement Labour-based Technology (LBT) maintenance work by not using even simple equipment. As a result, this situation adversely affects the quality of road maintenance work. They cannot compact the road surfaces strongly enough because they do not own or rent rollers. They cannot use appropriate material (murrum) for the road surfaces because they do not own or rent trucks.
- Sub-county governments are supposed to maintain community access roads. However, almost no budget allocations have been made for road maintenance purposes. In fact, sub-

county governments have done nothing on road maintenance in Amuru and Nwoya Districts.

- Although the central government and donors have provided funds for road development and rehabilitation for many road sections to encourage the process of resettlement and development in northern Uganda, these roads have deteriorated rapidly in the absence of any substantial road maintenance work.
- The selection of priority sections for road maintenance is done by using tools, such as RAMPS and QPR. However, those tools use the data of only road conditions and population for selecting priority sections, but they do not pay attention to needs for social infrastructure and services (health centres, schools and boreholes).
- In Uganda, the university education of civil engineers is too academic in concentrating on theories, but not on practical technology and skills. As a result, Ugandan engineers tend to lack practical knowledge and management skills.
- Government officers including engineers tend to leave their government positions after a few years of experience in search of private sector jobs. Training and on-the-job experience would be lost by such job hopping.

(4) Functional Classification of Roads

- In early 2009, about 10,000 km of district roads were reclassified into national roads in Uganda. In Amuru and Nwoya Districts, about 150 km of district roads were reclassified into national roads. As a result, most major roads in Amuru and Nwoya Districts are national roads, and are thus under the jurisdiction of UNRA for rehabilitation and maintenance. At present, Amuru and Nwoya District Governments cannot directly control road maintenance work for the most important roads within their own districts.
- The roads reclassified as national roads include those roads that are to function as inter-district roads in the future. It is not necessary to upgrade such roads to the level of inter-district roads (national roads) in the short term. It is however necessary to improve such roads in a manner suitable for the current road function.

(5) Road Safety

- Increase of traffic volume and improvement of roads would increase the incidence of traffic accidents and risk to pedestrians and cyclists.
- There is not enough space for pedestrians because road shoulders are not provided on most roads in Amuru and Nwoya Districts. Dense bushes at roadsides hinder car drivers from seeing pedestrians and bicycles, increasing the risks of traffic accidents.

(6) Road Development Plans

- Road proposals in district development plans are not clear because different types of roads are mixed up in the proposals. In addition, different types of proposals, such as new construction and rehabilitation, are also mixed up in their proposals. It is partly because no road maps are used in district development plans.
- No roads proposed by sub-county development plans have been given proper placement in the district development plans.
- No relation is seen between road proposals in sub-county development plans and road proposals in district development plans.

(7) Road Inventory and Monitoring

- The Work Department of the District is supposed to conduct road inventory surveys regularly, in accordance with the District Road Manual of MoWT. However, Amuru and Nwoya Districts have not completed any road inventory surveys.
- The Works Department of the District does not monitor road conditions in Amuru and Nwoya Districts. Amuru and Nwoya Districts have not established any baseline for monitoring.

12. TRAFFIC DEMAND FORECAST

12.1 Introduction

The objective of the traffic demand forecast in this study is to estimate the future traffic volume and to provide an input for selection of priority projects proposed in the road master plan in Amuru and Nwoya Districts. The future traffic volume will also be utilized to test the economic feasibility of selected priority projects. Intermediate and target years for the demand forecast are set as 2018 and 2030, respectively. Since the traffic observed in Amuru and Nwoya Districts flows internationally and inter-regionally, the study area of the traffic demand forecast is not limited to Amuru and Nwoya Districts but extends to Acholi sub-region.

12.2 Overall Methodology

The future traffic demand in Acholi sub-region is forecast based on the current traffic demand estimated from the results of the roadside traffic count and driver interview surveys conducted in the course of this Study and the population projections carried out by UBOS and UNHCR. The methodology applied to estimate the current traffic demand and project the future demand is the conventional four-step demand forecast model: trip production model, trip distribution model and traffic assignment model. The procedure for the traffic demand forecast in Acholi sub-region is illustrated in the following diagram.

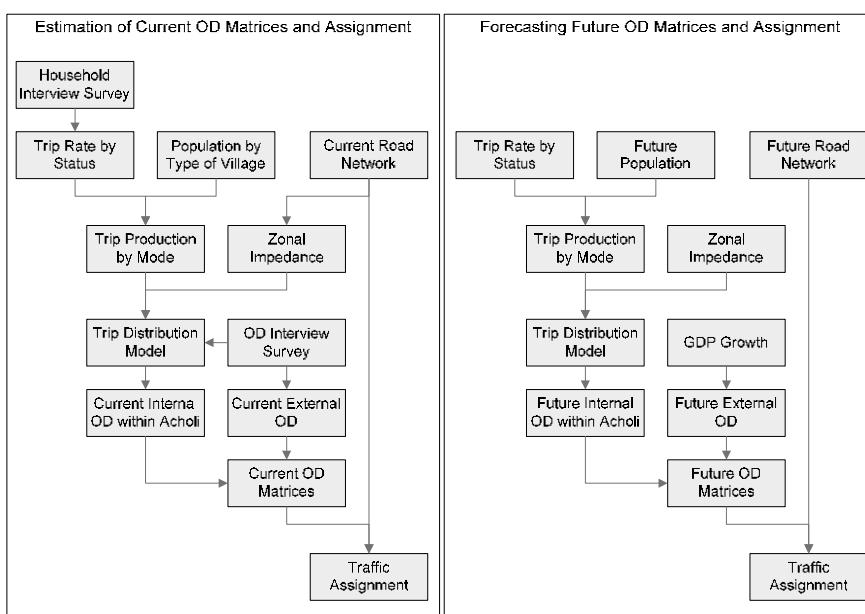


Figure 12.2.1 Work Flow for Traffic Demand Forecast

First of all, the current zonal trip production is calculated by the trip ratio based on results of the household interview survey and current regional population. Then the trip distribution within Acholi sub-region is estimated by using the trip distribution model based on the results of the roadside OD interview survey, zonal impedance and estimated trip production. Current OD matrices within Acholi sub-region and current external OD are estimated based on the results of the roadside interview survey at the cordon points located at the boundary of Acholi sub-region. Following this, the traffic volume of each road section is calculated by the traffic assignment model using the JICA STRADA. At the same time, future OD matrices within Acholi sub-region are forecast by using trip rate, future population and trip distribution models. Future external trips are expanded by the elasticity of the traffic volume and GDP growth rate.

A detailed numerical analysis of this four-step demand forecast model has been explored in Chapter 3 of the Interim Report Part III: Planning and Preparation of Urgent Project in Acholi Sub-region. Accordingly, the following section summarizes the result of the traffic demand forecast in Acholi sub-region.

12.3 Minor Amendment in Preconditions of Traffic Demand Forecast

12.3.1 Existing and Future Road Service

a) Service Level of Existing Road Network

“Free flow speed” is defined by the road surface condition based on the road inventory survey conducted using GPS equipment at major road sections.

Table 12.3.1 Definition of Free Flow Speed in Road Network

Road Pavement	Surface Condition	Free Flow Speed (km/h)
Paved	Good	80
Earth	Fair	60
	Poor	40
	Bad	20

Source: JICA Study Team

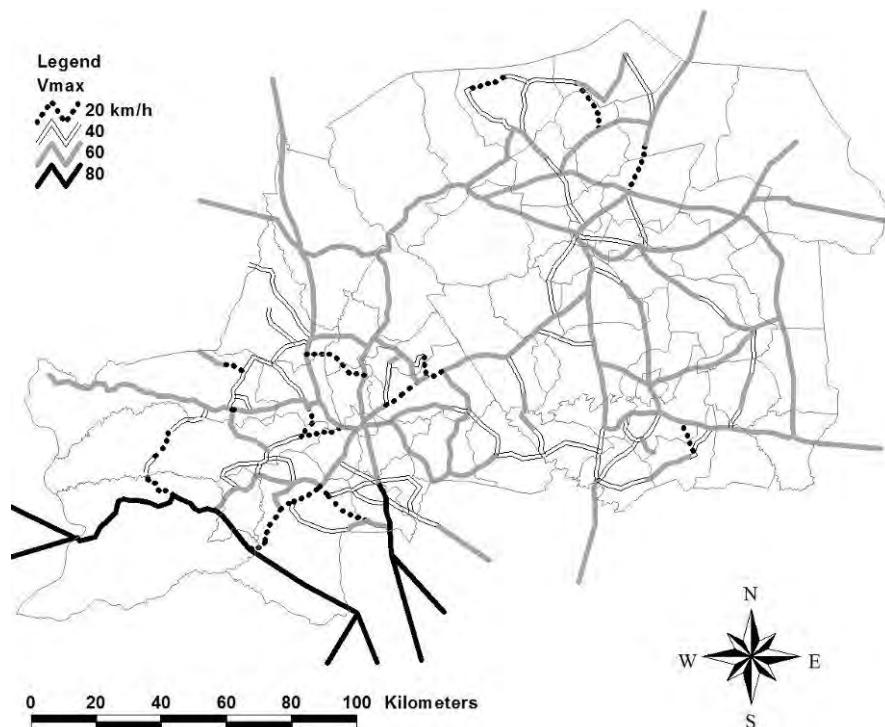
Also, link capacity is defined as shown in the table below, considering the condition and width of each road section.

Table 12.3.2 Definition of Capacity (pcu/day)

Road Pavement	Surface Condition	Carriageway Width	
		Less than 3.5 m (1 lane road)	3.5 m and more (2 lane road)
Paved	Good	-	23,200
Earth	Fair	8,400	17,400
	Poor	5,600	11,600
	Bad	2,800	5,800

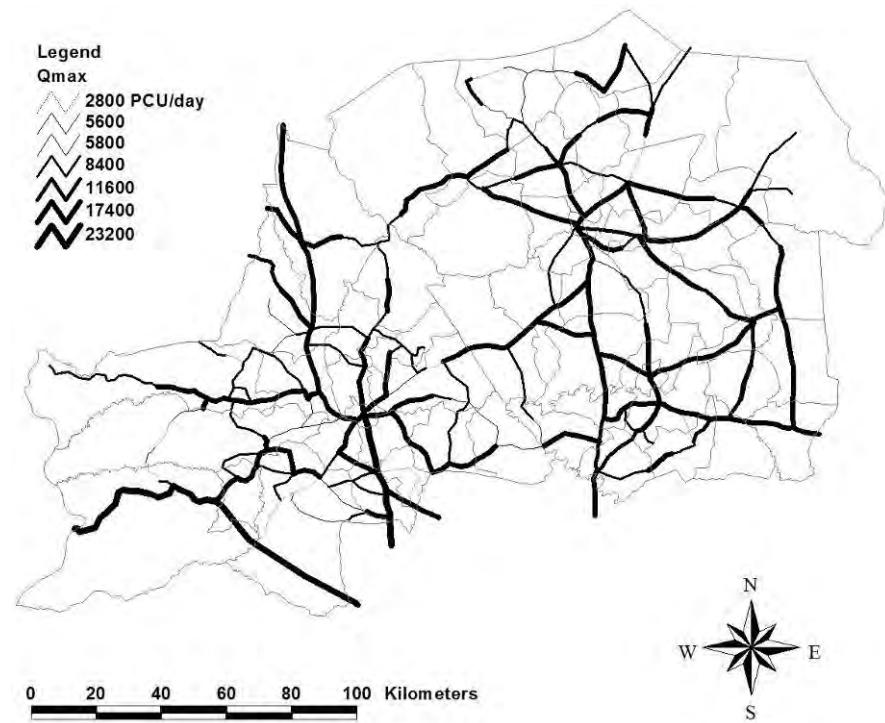
Source: JICA Study Team

Figures 12.3.1 and 12.3.2 show the defined free flow speed and road capacity of the road network tested for the traffic demand forecast.



Source: JICA Study Team

Figure 12.3.1 Defined Current Free Flow Speed



Source: JICA Study Team

Figure 12.3.2 Defined Road Capacity

a) Service Level of Future Road Network

Free flow speed and road capacity are determined based on the design standard of future functional classification. As discussed in Chapter 14 of this report, all the roads in Amuru and

Nwoya Districts are classified into the following seven classes in accordance with the existing road manual and standards in Uganda.

- International Trunk Road: Design class (Ia Paved), (Ib Paved), (II Paved) or (III Paved) can be applied in consideration of road function and traffic volume.
- National Trunk Road: Design class (Ib Paved), (II Paved), (III Paved) or (A Gravel) can be applied.
- Primary Trunk Road: Design class (II Paved), (III Paved) or (A Gravel) can be applied to national roads. Design class (I) can be applied to district roads.
- Secondary Trunk Road: Design class (A Gravel), (B Gravel) or (C Gravel) can be applied to national roads. Design class (II) can be applied to district roads.
- Tertiary Trunk Road: Design class (B Gravel) or (C Gravel) can be applied to national roads. Design class (III) can be applied to district roads.
- District Collector Road and Community Access Road: there is no specific design standard proposed in the existing road manual. Accordingly, this Study examines and proposes several options for the design standard for district collector roads and community access roads, discussed in Chapter 14 in this report.

Tables 12.3.3 and 12.3.4 show design standards for both national roads and district roads published by the MoWT.

Table 12.3.3 Design Standard for Trunk Roads

Design Class	Capacity [pcu x 1,000/day]	Road-way width[m]	Maximum Design speed Km/h			Functional Classification				
			Level	Rolling	Mountainous	A	B	C	D	E
Ia Paved	12 – 20	20.80 -24.60	120	100	80	✓				
Ib Paved	6 – 10	11.0	110	100	80	✓	✓			
II Paved	4 – 8	10.0	90	70	60	✓	✓	✓		
III Paved	2 – 6	8.6	80	70	50	✓	✓	✓		
A Gravel	4 – 8	10.0	90	80	70		✓	✓	✓	
B Gravel	2 – 6	8.6	80	60	50				✓	✓
C Gravel		6.4	60	50	40					✓

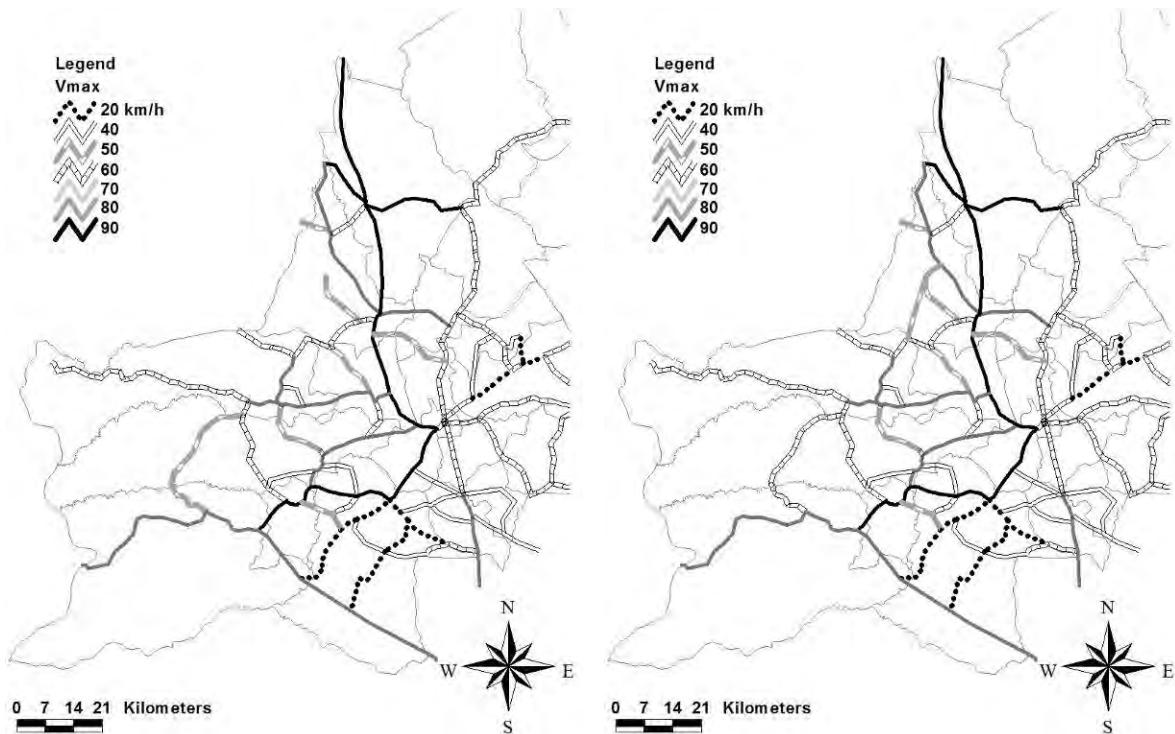
Source: Geometric Design Manual in Uganda

Table 12.3.4 Design Class for District Roads

Design Class	Traffic Volume (vpd)	Max Grade (%)	Design Speed by Terrain Condition (km/hr)			Carriageway Width (m)	ROW (m)
			Flat	Rolling	Hilly		
I	> 50	10	70	60	50	6.0-7.4	15-30
II	20-50	12	60	50	40	4.5-5.8	15-25
III	< 20	15	50	40	30	4.0-5.4	15-18

Source: Disservice Road Works Manuals

Figure 12.3.3 shows the defined future road service (free flow speed) in Amuru and Nwoya Districts in 2018 and 2030.

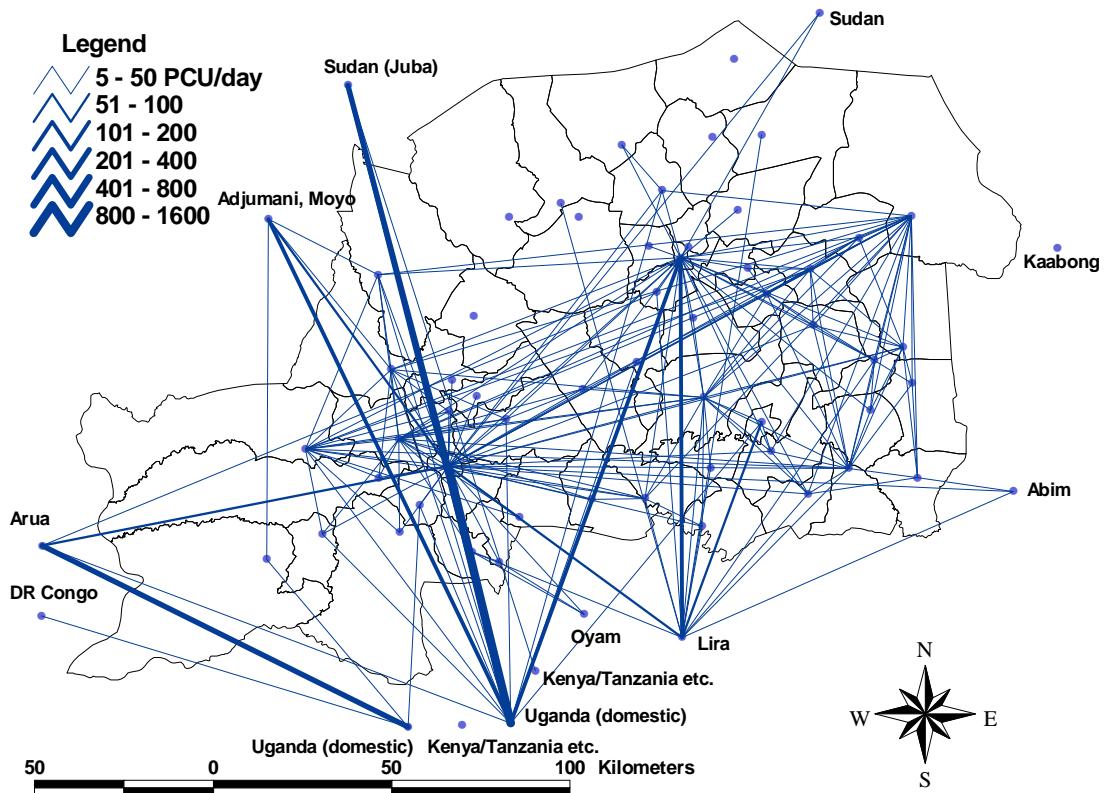


Source: JICA Study Team

Figure 12.3.3 Defined Free Flow Speed (Left: 2018, Right: 2030)

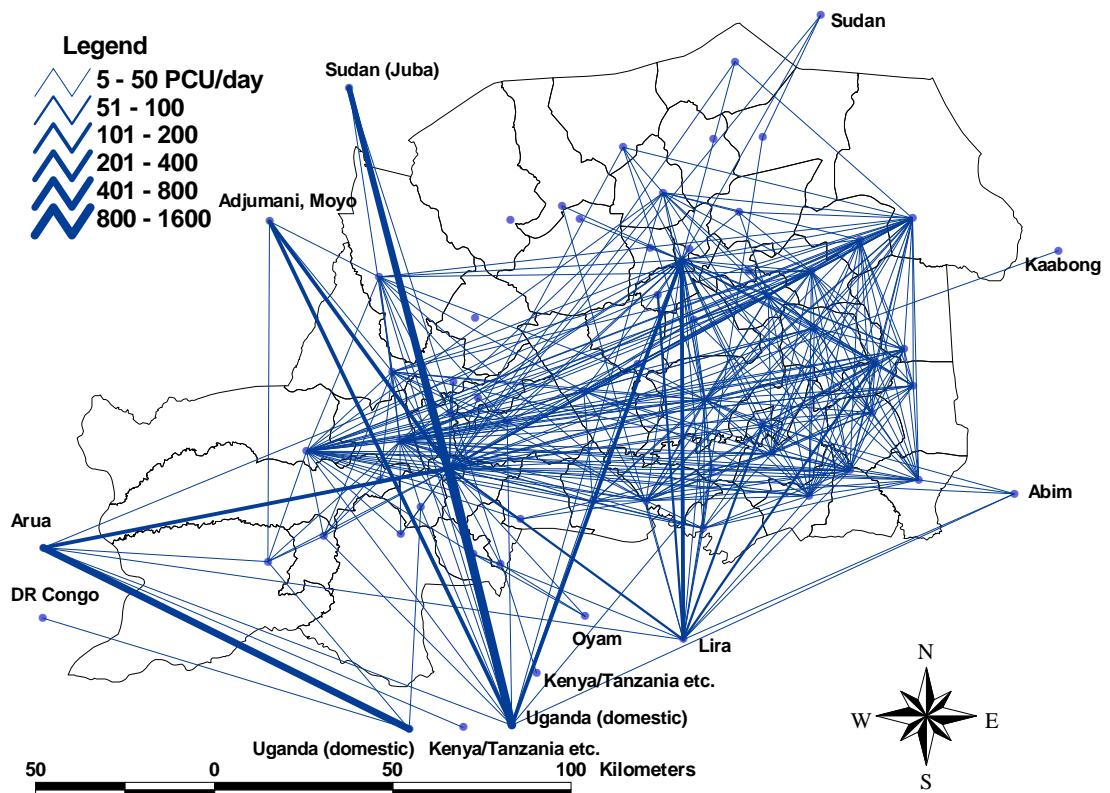
12.3.2 Future OD Matrices

Future OD (origin and destination) matrices are developed using the trip distribution model. This model-based forecast of future demand within Acholi sub-region and external trip demand are combined into the future OD matrices in 2018 and 2030. Figures 12.3.4 and 12.3.5 show forecast desire lines in 2018 and 2030, converting all the vehicles into equivalent passenger car units.



Source: JICA Study Team

Figure 12.3.4 Desire Lines in 2018 (Total Vehicles)



Source: JICA Study Team

Figure 12.3.5 Desire Lines in 2030 (Total Vehicles)

12.4 Traffic Demand Forecast

12.4.1 Assignment Cases

One of the purposes of the traffic demand forecast is evaluation of priority projects in Amuru and Nwoya Districts. Thus, traffic assignment is tested in the following five cases: (i) 2009 base case, (ii) 2018 without project case, (iii) 2018 with project case, (iv) 2030 without project case and (v) 2030 with project case. Both cases (iii) and (v) represent the future traffic demand when all the national and district roads in Amuru and Nwoya Districts are upgraded to the desired functional classification and service level in 2018 and 2030, respectively. Both cases (ii) and (iv) represent the future traffic demand when none of the projects is implemented.

Table 12.4.1 Traffic Assignment Cases

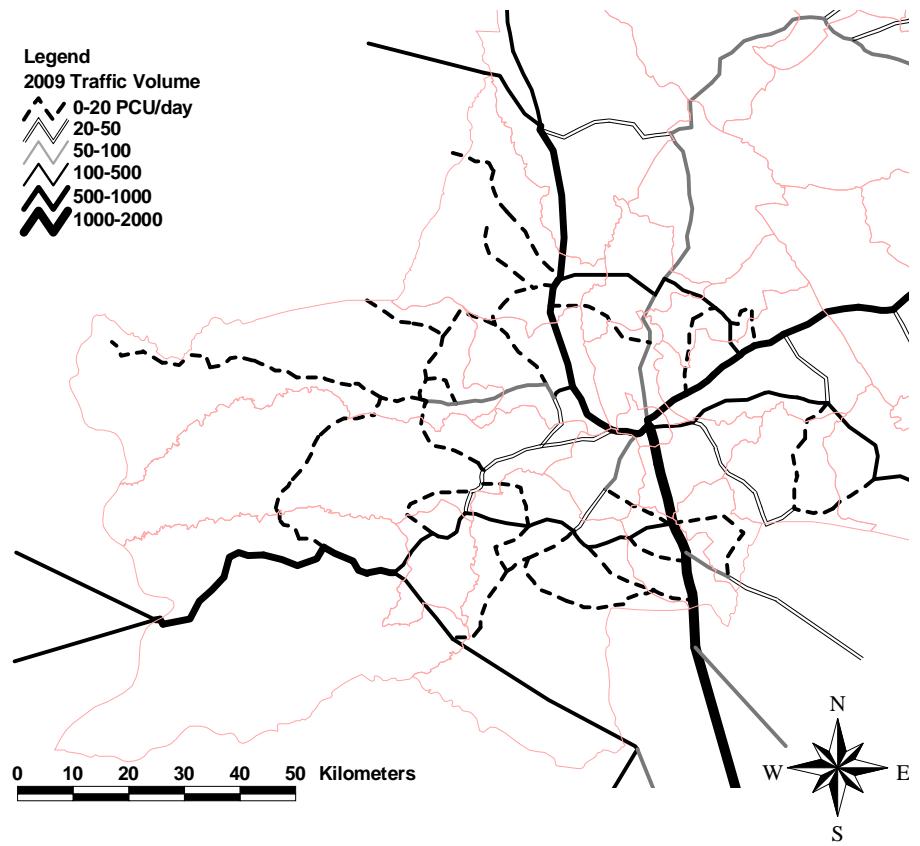
Case	Description	Road Network	Traffic Demand
(i)	Existing	2009 Network	2009 Existing
(ii)	Without projects	2009 Network	2018 Future
(iii)	With projects	2018 Network	2018 Future
(iv)	Without projects	2009 Network	2030 Future
(v)	With projects	2030 Network	2030 Future

Source: JICA Study Team

12.4.2 Traffic Assignment Results

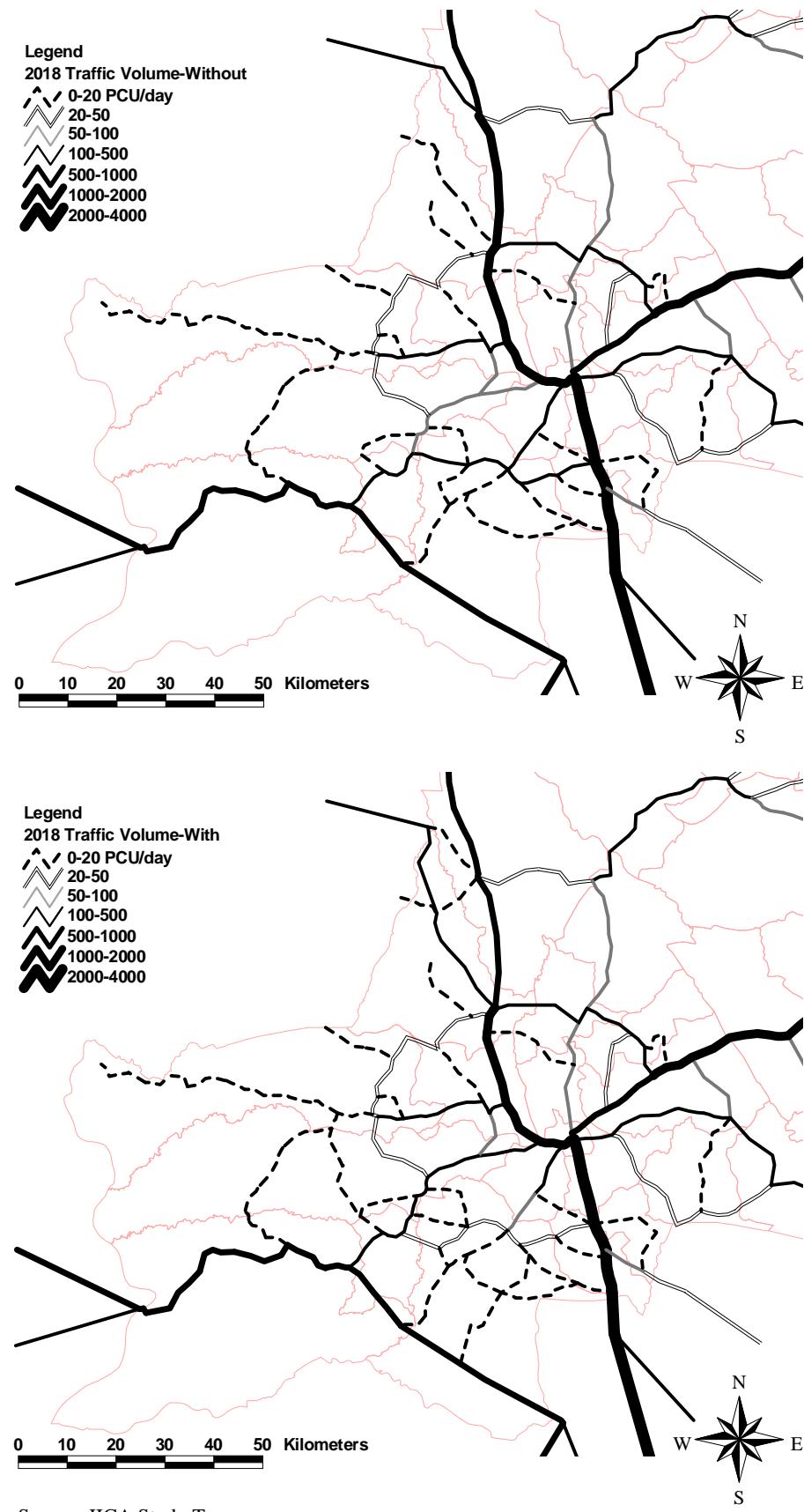
Figures 12.4.1 to 12.4.3 illustrate the existing and future traffic volumes assigned to the without-upgrade and with-upgrade road networks. The findings from this traffic assignment in Amuru and Nwoya Districts are summarized as follows:

- The north-south corridor, passing through Pabbo and Gulu towards Kampala, remains an international trunk road, connecting Kampala and northern Uganda and extending to Sudan. The traffic volume is projected to significantly increase from 1400 pcu/day in 2009 to 3000 pcu/day in 2030. Arua Road also remains a national trunk road, connecting Kampala and major regional centres in western Uganda. The traffic volume along Arua Road is projected to increase from around 500 pcu/day in 2009 to 1100 pcu/day in 2030.
- Apart from these two corridors, the traffic volume in Amuru and Nwoya Districts is estimated to be minimal. The traffic volume along the road section between Gulu-Koch Goma-Olwiyo is relatively large compared to other national and district roads in Amuru and Nwoya Districts and is projected to rise from 40-130 pcu/day in 2009 to 20-120 pcu/day in 2030 (for Case (v)).
- Comparing with and without project cases, newly constructed roads are expected to function as regional corridors in Amuru and Nwoya Districts. For instance, the new road section connecting Ceri and Amuru (Otwee) is expected to accommodate both diverted traffic from the national roads and regional traffic within Amuru and Nwoya Districts and the future traffic volume is estimated to fall between 140 and 490 pcu/day in 2030 (for Case (v)).



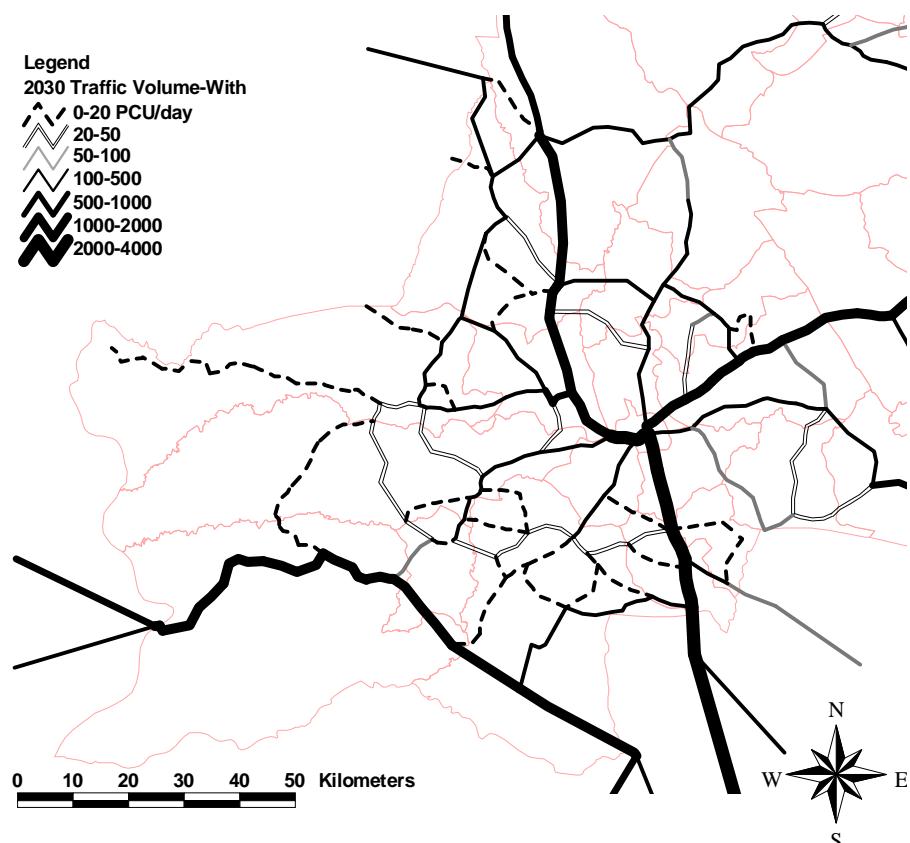
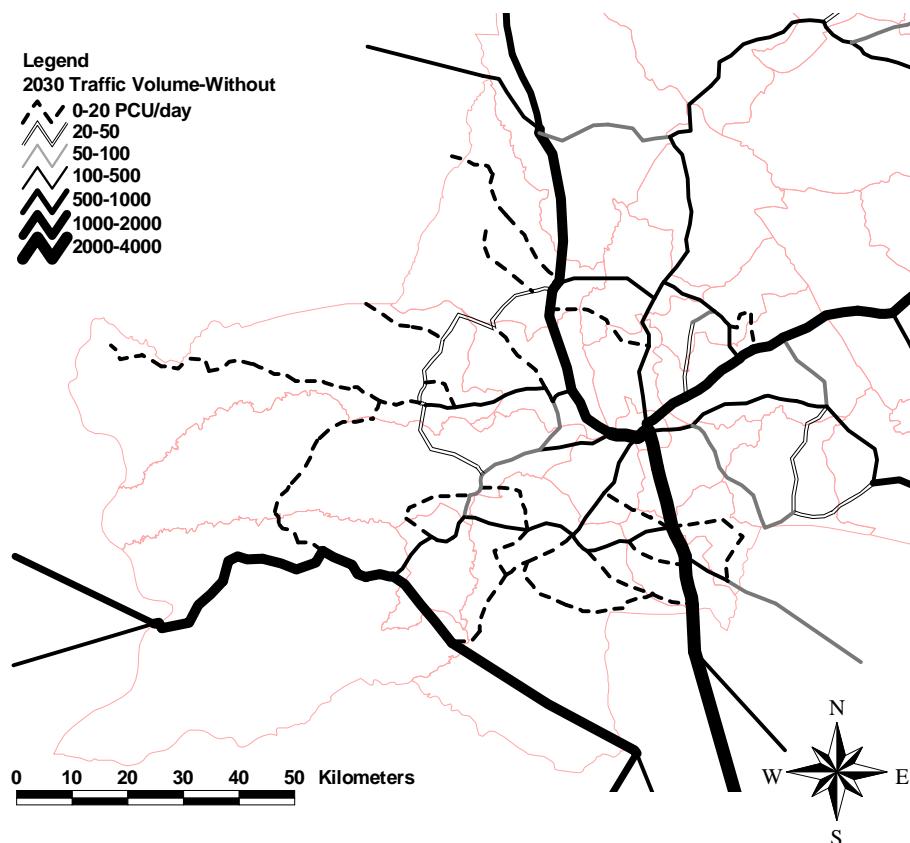
Source: JICA Study Team

Figure 12.4.1 Assigned Traffic Volume in 2009



Source: JICA Study Team

Figure 12.4.2 Assigned Traffic Volume in 2018 (Upper: Without Project, Lower: With Project)



Source: JICA Study Team

Figure 12.4.3 Assigned Traffic Volume in 2030 (Upper: Without Project, Lower: With Project)

13. OBJECTIVES AND BASIC STRATEGIES FOR RURAL ROAD IMPROVEMENT AND MAINTENANCE

13.1 Objectives for Rural Road Improvement and Maintenance in the Context of Amuru and Nwoya Districts

(1) Goals of Rural Road Improvement and Maintenance in Amuru and Districts

As described in Chapter 7, the following two pillars are goals of development to be sought by rural road development and maintenance in Amuru and Nwoya Districts:

- To improve the socioeconomic environment for stabilizing and enhancing livelihood of returnees in Amuru and Nwoya Districts as described below:
 - Road improvement is essential for the government administration to improve the quality and quantity of health and educational infrastructure and services.
 - Improved roads could also enhance the residential environment for health staff and school teachers.
 - Better road connections could secure access to markets for agricultural produce, which would reduce transport costs and improve the selling prices of the produce.
- To promote agricultural development in areas of agricultural potential by providing road access as described below:
 - There are still vast lands of high agricultural potential which have been underutilized due to poor road accessibility in Amuru and Nwoya Districts
 - Provision of road access to underutilized areas could also support the return of IDPs

(2) Primary Objectives for Rural Road Improvement and Maintenance in Amuru and Nwoya Districts

The primary objectives for rural road improvement and maintenance aim to attain the two identified goals and reverse the situation of underdevelopment that has taken place over the last 10 years, as follows:

- Vehicle roads should be improved by doing the following in a sustainable manner.
 - Expanding the total length of vehicle roads
 - Upgrading or improvement of service levels of vehicle roads
 - Improving the network of vehicle roads

-
- Vehicle roads should be maintained by locally appropriate technology and management methods.
 - Roads passable by bicycles and motorbikes should also be expanded and improved, in conjunction with vehicle road improvement and maintenance.

(3) Secondary Objectives for Rural Road Development and Maintenance in Amuru and Nwoya Districts

The following secondary objectives are set to attain the two identified goals in a more specific manner:

- Road improvement and maintenance in support of government administration and public services, should be promoted with due attention paid to:
 - Road Linkage between district centres and sub-county centres
 - Road Linkage between health units and district centres/Anaka Hospital/Atoka Health Centre 4
 - Road Access to village primary schools
- Road improvement and maintenance in support of agricultural development, should be promoted with due attention paid to:
 - Road Linkage between trading centres and major national roads (inter-regional roads)
 - Road Access to areas of agricultural potential

13.2 Basic Strategies for Rural Road Improvement and Maintenance

Basic strategies are formulated to efficiently achieve the primary and secondary objectives stated above and to sustainably and practically implement the road maintenance. The following three basic strategies are proposed:

Basic Strategy A: Basic Strategy following Appropriately Set Functional Road Classes

This basic strategy is about how to actually guide road improvement, as well as road maintenance in Amuru and Nwoya Districts. This strategy is important because no functional classes are designated as yet for any national roads or district roads. Amuru and Nwoya Districts are in the process of return of IDPs and re-development of their economies and societies.

- To establish functional road classes suitable for the context of Amuru and Nwoya Districts (suitable for the identified goals of rural road improvement in Amuru and Nwoya Districts)
- To implement improvement and maintenance of roads, in accordance with the established functional road classes

Basic Strategy B: Basic Strategy on Rural Road Maintenance

This basic strategy provides directions and necessary steps for reconstructing a system of rural road maintenance.

- To clarify the roles of the central government, district governments, sub-county governments and private sectors in rural road maintenance

- To reconstruct a practical system for rural road maintenance by effectively utilizing available resources (human resources, financial resources, etc) of the central government, district governments, sub-county governments and private sectors
- To promote capacity development of the central government, district governments, sub-county governments and private sectors for rural road maintenance

Basic Strategy C: Basic Strategy for Community Development

This basic strategy is to guide vehicle road improvement and maintenance from the perspective of returnees and communities.

- To promote vehicle road improvement and maintenance, which is integrated with community roads to provide access to home villages of IDPs
- To promote job creation for returnees by using Labour-based Technology for rural road maintenance