

II. LIVESTOCK FARMING SURVEY

1. Surveyed variables

(1) Type and number of livestock

Types of livestock found in the study area are as follows:

- ① Sheep
- ② Cow
- ③ Alpaca
- ④ Pork
- ⑤ Hog
- ⑥ Chicken

(2) Pasturage location

(3) Pasturage area (ha)

(4) Type of grasses used for grazing

2. Results

The results of the survey were summarized in the following tables.

Summary of livestock survey in the microcuencas
Estudio sobre el pastoreo en las microcuencas

Huaje (No.1)

Not necessary to entry

No.	Date Fecha	Location Localidad	Classification and Number of Livestock Especies y No. de Cabezas						Name of pasturage zone Nombre de la zona pastoreo	Pasturage area Area aprox. de zona pastoreo (ha)	Distance from pasturage zone to microcuencas (m)	Distance from microcuencas to lake (m)	Sort of grasses Especie de pasto
			Sheep Ovino	Cow Vacuno	Alpaca Canelidq	Pork Porcino	Equine Equino	Chicken Aves de corral					
P-HU-01	13-Feb-99	Huaje						3					Pasto natural, Totora
P-HU-02	13-Feb-99	Huaje	10	8		3			Chulluni orillas del Titicaca	0.050			Totora
P-HU-03	13-Feb-99	Huaje						4					Totora
P-HU-04	13-Feb-99	Huaje											Totora
P-HU-05	13-Feb-99	Huaje	8	10					Orilla del Lago Titicaca	0.050			Natural-Totora
P-HU-06	13-Feb-99	Huaje		7					Huaje				Natural-Totora
P-HU-07	13-Feb-99	Huaje	5			10			Huaje orilla del Lago Titicaca	0.300			Natural
P-HU-08	13-Feb-99	Huaje											
P-HU-09	13-Feb-99	Huaje	55	6					Orilla del Lago Titicaca	0.300			Natural, Totora, Avena Heno
P-HU-10	13-Feb-99	Huaje	33	12	25		2		Hacienda dueñas	7.000			Natural, Forraje Avena
P-HU-11	13-Feb-99	Huaje	4						Huaje	0.500			Natural
P-HU-12	13-Feb-99	Huaje	25						Huaje	0.500			Natural-Totora
P-HU-13	13-Feb-99	Huaje	15						Orilla del Lago Titicaca	0.050			Natural-Totora
P-HU-14	13-Feb-99	Huaje		1				2	Huaje	0.005			Totora
P-HU-15	13-Feb-99	Huaje	8	2		3		3	Orilla del Lago Titicaca	0.700			Natural, Totora, Pasto cultivado (alfalfa)
P-HU-16	13-Feb-99	Huaje	6			2			Orilla del Lago Titicaca	0.010			Natural-Totora
P-HU-17	14-Feb-99	Huaje Sector San José	12						San José	1.000			Pasto natural, totora
P-HU-18	14-Feb-99	Huaje Sector San José	6					3	San José	0.500			Natural-Totora
P-HU-19	14-Feb-99	Huaje Sector San José	2						San José	0.500			Natural
P-HU-20	14-Feb-99	Huaje Sector San José	10	2		6			San José	1.500			Pasto natural, Forraje totora
P-HU-21	14-Feb-99	Huaje Sector San José	8					2	San José	0.040			Pasto natural, totora
P-HU-22	14-Feb-99	Huaje Sector San José	6			1			San José	0.050			Natural, Forraje
Sub-total			213	48	25	25	2	17		13.055			

Huaje (No.2)

Not necessary to entry

[illegible]

Dos de Mayo

Not necessary to entry

3 - 20

Ventilla

100

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Summary of livestock survey in the microcuencas Estudio sobre el pastoreo en las microcuencas

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Рисамауо

: Not necessary to entry

Chacarilla

Estudio sobre el pastoreo en las microcuencas

3 - 24

Santa Rosa

100

3 - 25

San Martin

Not necessary to entry

3 - 26

Alto Manto

[illegible]Total

Huayna Pucara

Not necessary to entry

3 - 28

Capullani

10

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Summary of livestock survey in the microcuencas
Estudio sobre el pastoreo en las microcuencas

Jayllihuaya (No.1)

: Not necessary to entry

No.	Date Fecha	Location Localidad	Classification and Number of Livestock Especies y No. de Cabezas							Name of pastorage zone Nombre de la zona pastoreo	Pastorage area Area aprox. de zona pastoreo (ha)	Distance from pastorage zone to microcuencia (m)	Distance from microcuencia to lake (m)	Sort of grasses Especie de pasto
			Sheep Ovino	Cow Vacuno	Alpaca and/or vicuña	Pork Porcino	Equine Equino	Chicken (Area de avícola)						
P-JAY-01	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)	10	2			1	1	Alto Jayllihuaya	1.500			Natural	
P-JAY-02	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)					4							
P-JAY-03	22-Feb-99	Jayllihuaya (Alto Jayllihuaya)		1					Alto Jayllihuaya	0.200			Natural Heno Cebada	
P-JAY-04	22-Feb-99	Jayllihuaya (Alto Jayllihuaya)												
P-JAY-05	22-Feb-99	Jayllihuaya (Alto Jayllihuaya)												
P-JAY-06	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)												
P-JAY-07	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)												
P-JAY-08	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)	6				1		Alto Jayllihuaya	0.500			Natural	
P-JAY-09	22-Feb-99	Jayllihuaya (Sector Alto Jayllihuaya)	10	2					Alto Jayllihuaya	1.000			Natural	
P-JAY-10	22-Feb-99	Jayllihuaya (Sector Pantine)												
P-JAY-11	22-Feb-99	Jayllihuaya (Sector Pantine)												
P-JAY-12	23-Feb-99	Jayllihuaya (Sector Yanamire)												
P-JAY-13	23-Feb-99	Jayllihuaya (Sector Yanamire)												
P-JAY-14	23-Feb-99	Jayllihuaya (Sector Yanamire)	10						Alto Yanamire	1.000			Natural	
P-JAY-15	23-Feb-99	Jayllihuaya (Sector Yanamire)	5	1			1	1	Alto Yanamire	1.000			Natural	
P-JAY-16	23-Feb-99	Jayllihuaya (Sector Yanamire)	12					1	Alto Yanamire	1.000			Natural	
P-JAY-17	23-Feb-99	Jayllihuaya (Sector Yanamire)	50	2				3	Alto Yanamire	4.500			Natural	
P-JAY-18	23-Feb-99	Jayllihuaya (Sector Yanamire)												
P-JAY-19	23-Feb-99	Jayllihuaya (Sector Yanamire)	15	4					Alto Yanamire	1.500			Natural, Forraje	
P-JAY-20	23-Feb-99	Jayllihuaya												
P-JAY-21	23-Feb-99	Jayllihuaya (Sector Yauruyo)												
P-JAY-22	23-Feb-99	Jayllihuaya (Sector Yauruyo)		2					Alto Yanamire	1.000			Natural, Forraje Cebada	
Sub-total			118	14	0	7	6	0		13.200				

Jaylihuaya (No.2)

Not necessary to entry

Chimu

Not necessary to entry

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Summary table of type and number of livestock

Name of Micro Cuenca	Classification and number of Livestock																		Pastorage Area		
	Especies y No. de Cabezas																				
	Sheep			Cow			Alpaca			Porcino			Equino			Chicken					
	Ovino			Vacuno			Canelido			Porcino			Equino			Aves de corral					
	Survey	Percentage	Number	Survey	Percentage	Number	Survey	Percentage	Number	Survey	Percentage	Number	Survey	Percentage	Number	Survey	Percentage	Number		Survey	Percentage
1 Huaje	231	92.4%	250	54	83.1%	65	25	83.3%	30	27	48.0%	56	2	25.0%	8	30	75.0%	40	14.5	67.8%	21.0
2 Dos de Mayo	44	88.0%	50	4	66.7%	6	10	83.3%	12	4	20.0%	20	0			30	50.0%	60	6.5	51.3%	13.0
3 Ventilla	657	93.9%	700	94	61.3%	153	12	24.0%	50	6	12.0%	50	2	20.0%	10	12	24.0%	50	101.2	39.2%	258.0
4 Orkopata	14	70.0%	20	0			0			6	20.0%	30	0			4	40.0%	10	1.3	21.7%	6.0
5 Pucamayo	10	14.3%	70	4	40.0%	10	0			8	32.0%	25	0			0			2.6	14.4%	18.0
6 Chacarilla	65	92.9%	70	0			0			0			0			0			6.0	15.5%	39.0
7 Santa Rosa	52	86.7%	60	0			0			5	33.3%	15	1	50.0%	2	2.9	28.3%		10.0		
8 San Martin	27	77.1%	35	3	60.0%	5	0			2	8.0%	25	0			3			2.1	24.2%	9.0
9 Alto manto	178	89.0%	200	9	22.5%	40	13	52.0%	25	0			0			2	20.0%	10	24.6	30.6%	80.0
10 Huayna Pucar	36	80.0%	45	1	10.0%	10	2	40.0%	5	2	8.0%	25	0			4	26.7%	15	4.2	27.5%	15.0
11 Capullani	573	36.2%	1583	86	43.0%	200	35	20.8%	168	2	13.3%	15	0			15	50.0%	30	771.0	27.2%	2,833.0
12 Jayllihuaya	128	8.5%	1500	16	5.3%	302	0			7	35.0%	20	6	60.0%	10	0			14.7	18.1%	81.0
13 Chimu	49	3.0%	1633	12	15.0%	80	0			12	40.0%	30	0			5	25.0%	20	4.5	13.8%	33.0
Total	2,064		6,216	283		871	97		290	81		311	11		30	105		235	956.1		3416.0

Estimation of pollution load generation by livestock

Organic Matter (BOD)

		Sheep		Cow		Alpaca		Hog		Total
		(head)	BOD (kg/d)	(head)	BOD (kg/d)	(head)	BOD (kg/d)	(head)	BOD (kg/d)	
1	Huáje	250	15.0	65	3.9	30	1.8	56	3.9	24.6
2	Dos de Mayo	50	3.0	6	0.4	12	0.7	20	1.4	5.5
3	Ventilla	700	42.0	153	9.2	50	3.0	50	3.5	57.7
4	Orkopata	20	1.2	0	0.0	0	0.0	30	2.1	3.3
5	Pucamayo	70	4.2	10	0.6	0	0.0	25	1.8	6.6
6	Chacarilla	70	4.2	0	0.0	0	0.0	0	0.0	4.2
7	Santa Rosa	60	3.6	0	0.0	0	0.0	15	1.1	4.7
8	San Martín	35	2.1	5	0.3	0	0.0	25	1.8	4.2
9	Alto manto	200	12.0	40	2.4	25	1.5	0	0.0	15.9
10	Huayna Pucara	45	2.7	10	0.6	5	0.3	25	1.8	5.4
11	Capullani	1583	95.0	200	12.0	168	10.1	15	1.1	118.2
12	Jayllhuaya	1500	90.0	302	18.1	0	0.0	20	1.4	109.5
13	Chimu	1633	98.0	80	4.8	0	0.0	30	2.1	104.9
Total		6216	373	871	52.3	290	17.4	311	22	464.7

Nitrogen (T-N)

		Sheep		Cow		Alpaca		Hog		Total
		(head)	T-N (kg/d)	(head)	T-N (kg/d)	(head)	T-N (kg/d)	(head)	T-N (kg/d)	
1	Huáje	250	6.8	65	0.8	30	0.8	56	1.0	9.4
2	Dos de Mayo	50	1.4	6	0.1	12	0.3	20	0.3	2.1
3	Ventilla	700	18.9	153	1.8	50	1.4	50	0.9	23.0
4	Orkopata	20	0.5	0	0.0	0	0.0	30	0.5	1.0
5	Pucamayo	70	1.9	10	0.1	0	0.0	25	0.4	2.4
6	Chacarilla	70	1.9	0	0.0	0	0.0	0	0.0	1.9
7	Santa Rosa	60	1.6	0	0.0	0	0.0	15	0.3	1.9
8	San Martín	35	0.9	5	0.1	0	0.0	25	0.4	1.4
9	Alto manto	200	5.4	40	0.5	25	0.7	0	0.0	6.6
10	Huayna Pucara	45	1.2	10	0.1	5	0.1	25	0.4	1.8
11	Capullani	1583	42.7	200	2.4	168	4.5	15	0.3	49.9
12	Jayllhuaya	1500	40.5	302	3.6	0	0.0	20	0.3	44.4
13	Chimu	1633	44.1	80	1.0	0	0.0	30	0.5	45.6
Total		6216	167.8	871	10.5	290	7.8	311	5.3	191.4

Phosphorus (T-P)

		Sheep		Cow		Alpaca		Hog		Total
		(head)	T-P (kg/d)	(head)	T-P (kg/d)	(head)	T-P (kg/d)	(head)	T-P (kg/d)	
1	Huáje	250	1.8	65	0.5	30	0.2	56	0.4	2.9
2	Dos de Mayo	50	0.4	6	0.0	12	0.1	20	0.1	0.6
3	Ventilla	700	4.9	153	1.1	50	0.4	50	0.4	6.8
4	Orkopata	20	0.1	0	0.0	0	0.0	30	0.2	0.3
5	Pucamayo	70	0.5	10	0.1	0	0.0	25	0.2	0.8
6	Chacarilla	70	0.5	0	0.0	0	0.0	0	0.0	0.5
7	Santa Rosa	60	0.4	0	0.0	0	0.0	15	0.1	0.5
8	San Martín	35	0.2	5	0.0	0	0.0	25	0.2	0.4
9	Alto manto	200	1.4	40	0.3	25	0.2	0	0.0	1.9
10	Huayna Pucara	45	0.3	10	0.1	5	0.0	25	0.2	0.6
11	Capullani	1583	11.1	200	1.4	168	1.2	15	0.1	13.8
12	Jayllhuaya	1500	10.5	302	2.1	0	0.0	20	0.1	12.7
13	Chimu	1633	11.4	80	0.6	0	0.0	30	0.2	12.2
Total		6216	43.5	871	6.2	290	2.1	311	2.2	54

Unit pollution load (g/head/day)

	BOD	T-N	T-P
Sheep	60	27	7
Cow	60	12	7
Alpaca	60	27	7
Hog	70	17	7

Questionnaires

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Estudio sobre el pastoreo en las microcuencas

1. No. P- _____
2. Fecha _____
3. Localidad _____
4. Especies y No. de Cabezas Ovino _____, Procino _____
 Vacuno _____, Equino _____
 Canélido _____, Aves de corral _____
5. Nombre de Propietario(a) _____
6. Distancia hasta la zona de pastoreo _____ km
7. Nombre de la zona de pastoreo _____
8. Area aprox. de zona pastoreo _____
9. Especie de pasto _____
10. Motivo de crianza _____

Estudio sobre área de cultivo y variedades cultivadas

1. No. C- _____
2. Fecha _____
3. Localidad _____
4. Cultivo _____
5. Producción _____ kg No. de Sacos _____ Arroba
6. Nombre de agricultor(a) _____
7. Area total _____ ha. m²
8. Area apta para cultivo _____ ha. m²
9. Area cultivada _____ ha. m²
10. Epoca de siembra y cosecha _____
11. Abono (Tipo y cantidad) _____
12. Insecticida (Tipo y cantidad) _____

4. DATA CONCERNED TO SOLID WASTE MANAGEMENT

I . DATA CONCERNED TO THE COLLECTION AND TRANSPORTATION

INTRODUCTION

The microbasin of Puno has a 5,699.6 has. Surface (PELT, 1999). It is located among the 3,809 m., the lacustrine coast level, and the 4,500 m. height, the highest point marked by Hill Putina's summit.

The water divide that marks the microbasin limit has 51.99 km. long, and the lacustrine coast line has approximately 16.5 km long. The total perimeter of the microbasin is 68.5 km. (values calculated by planimetric measure).

The hills surrounding the microbasin have very steep slopes which fluctuate among 25 and 37 slope degrees. The adjacent or near areas to the bay can reach a slope near to 0 degrees, being their average 5.2%, in some sites.

Puno City, located inside the microbasin, is an urban place with the largest population concentration in the Peruvian lacustrine coast. It is also the nodal center of the transoceanic way.

Activities generated by construction credits have encouraged the urban development in the city, and also the constructions of commercial centers and houses.

Nowadays, Puno bears the most important national and international tourist flow of the highland with approximately 120,000 tourists per year. This represents a 14% of the national tourism activity (in accordance with one Tourist Information Official from INEI).

This has caused a bigger demand of services, of specially those related to the environmental improvement and to the solid residuals treatment.

Due to the characteristics that presents this study area, solid residuals are spilled into the lake in a directly and indirectly way, which causes serious problems to the ecology, to the environmental health and to the landscape aesthetics with the consequent devaluation of cultural and landscape heritage of the highest navigable lake in the world.

1 CONCEPTUAL BACKGROUND

Cleaning Campaigns

These are the activities that are carried out apart from public cleaning normal service in areas where refuse collecting service do not work regularly. It includes refuse collecting in solid residual clandestine accumulation places.

Gathering Points

These are the places where sweepers, tricicleros (people who gather refuse inside trycicles) and wheelbarrow men accumulate street refuse in order to be collected and transported to the sanitary landfill by collecting trucks.

Accumulation

It is the process for which tricicleros and wheelbarrow men collect refuse in a gathering point or dump.

Dump

Places where refuse is accumulated in a free and direct way without any technical handling are called dumps. A dump is clandestine when municipal governments do not accomplish a regular collecting of accumulated refuse. Collecting in these clandestine dumps is accomplished by means of cleaning campaigns planned each 15 or 30 days.

Construction and Demolition Waste

Waste products of building industry. Construction and demolition waste is not considered a solid residual by public cleaning workers; for this reason it is not collected.

Refuse Dispersion

It is due to transport agents such as graveness, wind, water, animals and human beings. Dispersion is a process for which refuse extends its alteration in a natural or urban landscape.

Transport Processes

These are the ones originated as of transport agents such as: eolic process.- refuse transport by means of the wind.

Topographical Medium

In a microbasin, a topographical medium is a modifier of the acting form of agents and of processes manifestations.

Climatic Environment

Climatic crises have generated a resistant environment in this microbasin; therefore, current erosive processes originated by rains and superficial water flows are very violent.

2 TIME AND MATION STUDY DESCRIPTION

It consists in determining the duration or time employed by a collecting truck during its run or route in a work day for collecting in gathering points and also for residual domiciliary collecting.

The objectives for being fulfill are:

- Establishment of the route accomplished by a collecting truck.
- Determination of the time employed by the collecting truck in accomplishing its work route.
- A speed measure by kilometers per hour record traveled in each route.

Participating personnel:

7 Economical engineering students from the Universidad Nacional del Altiplano.
1 Study Manager.

Materials and Methods

Materials:

- A survey format.
- Scale maps 1:10,000 and 1:50,000.
- Chronometers, boards and stationery.
- Transportation (double cabin station wagons, double traction station wagons).
- Information about routes provided by Puno's Municipal Government.

Method:

Among November 19th. and 30th. the participating student selection and training was carried out.

Procedure

Training consisted on imparting knowledge on:

- Objectives and characteristics of the study and its importance.
- General notions about projects. The project applied to solid residuals, solid residual concept, recycling, sanitary landfill. The collecting processes, transport and final disposal.
- Cartography notions, map management, thematic map, scale calculation.
- The city, the urban morphology, its structure and configuration, vehicle flow and accessibility.

Tasks assignment and organization

Work organization:

Due to the existence of 4 collecting trucks, it was constituted 4 work groups; 2 students for each vehicle.

Each group had to copy the route accomplished by the assigned vehicle on Tuesdays, Wednesdays and Thursdays.

On Saturdays 21st. and 28th. and on Sunday 29th. of November 1998 it was carried out travels to different places of the city by means of that area means of transportation.

The students verified:

- Gathering points and clandestine dumps.
- Nomenclature and numeration of streets.
- Cartographic information provided by the municipal government.

On November 30th. 1998 at 3:30 it was started the training last stage which finished at 2:00 p.m.

Students guided by the Study Manager carried out the pursuit of the compactor vehicle N° 1 testing a way of fill out the formats.

In the evening (from 7:00 p.m. to 10:00 p.m.) the work was discussed and doubts and disquiets were solved. The Project Manager suggested some strategies to obtain a good information.

On December 1st., 2nd., and 3rd. 1998 it was accomplished the respective work according to what is indicated on the given planes and formats.

3 TABLE RESUME OF TIME AND MOTION STUDY

GARBAGE TRUCK NUMBER	TIME AND DISTANCE VALUES:										DATE	CLIMATE CONDITION
	IN THE FIRST PERIOD				IN THE SECOND PERIOD				TOTAL VALUES			
	BEGINNING TIME	END TIME	TIME TRAVELED	DISTANCE TRAVELED	BEGINNING TIME	END TIME	TIME TRAVELED	DISTANCE TRAVELED	TOTAL TIME	TOTAL DISTANCE		
1	4h 11' 05"	8h 43' 50"	4h 31' 35"	23.0 Km	8h 58' 45"	12h 29' 56"	3h 31' 13"	25.0 Km	8h 02' 48"	48.0 Km	01/12/98	GOOD
2	4h 04' 21"	7h 39' 45"	3h 35' 24"	25.05 Km	7h 42' 05"	11h 58' 20"	4h 16' 15"	21.85 Km	7h 51' 39"	46.9 Km	01/12/98	GOOD
3	4h 12' 45"	8h 17' 10"	4h 04' 25"	27.6 Km	8h 38' 20"	12h 03' 00"	3h 24' 40"	21.2 Km	7h 29' 05"	48.8 Km	01/12/98	GOOD
4	4h 10' 38"	8h 08' 22"	3h 57' 44"	24.3 Km	8h 31' 05"	13h 47' 55"	5h 57' 44"	21.7 Km	8h 55' 28"	46.0 Km	01/12/98	GOOD
1	3h 53' 02"	7h 55' 26"	4h 02' 24"	22.05 Km	8h 02' 33"	11h 46' 00"	3h 43' 27"	23.0 Km	7h 55' 51"	45.05 Km	02/12/98	CLOUDY
2	4h 07' 30"	8h 40' 47"	4h 33' 17"	27.2 Km	8h 55' 07"	12h 53' 05"	3h 57' 58"	24.8 Km	8h 31' 15"	52.0 Km	02/12/98	CLOUDY
3	4h 11' 40"	7h 35' 50"	3h 24' 10"	26.2 Km	9h 34' 28"	12h 20' 14"	4h 14' 34"	33.8 Km	7h 38' 44"	60.0 Km	02/12/98	CLOUDY
4	4h 12' 20"	7h 39' 20"	3h 27' 00"	23.3 Km	8h 04' 21"	13h 49' 30"	5h 45' 09"	27.3 Km	9h 12' 09"	50.6 Km	02/12/98	CLOUDY
2	4h 05' 04"	9h 21' 05"	5h 16' 01"	27.5 Km	9h 26' 16"	13h 07' 47"	3h 41' 31"	21.9 Km	8h 57' 32"	49.4 Km	03/12/98	GOOD
3	4h 07' 51"	7h 39' 32"	3h 31' 31"	25.0 Km	8h 13' 03"	12h 14' 40"	4h 28' 39"	36.0 Km	8h 00' 10"	61.0 Km	03/12/98	GOOD