DOCUMENTO ORIGINAL EN MAL ESTADO

Summary

The Bolivian Disaster Surveillance Project has been in operation for almost one year with full staffing available for approximately 5 months. Logistic and staffing problems have contributed to a slight delay (8-10%) in data output as per original timetable. Errors in original questionnaire formulation have been corrected and adjustments in field operations are being made accordingly. The result is a working system capable of meeting the design requirements of hte original project. Issues are focused upon getting immediate results from the project and being able to replicate same if proven useful within economic possibilities of GOB. Suggestions for improving current operations are included in Appendix One. It should be noted that the continuing and severe economic and political crisis of the country makes any project difficult and the fact that this one has moved as well as it has is laudable.

TABLE OF CONTENTS

1. Introduction
2. Background
3. Computer and Data Processing Needs
4. Computer Hardware Considerations
5. Software
6. Summary of Data Processing and Computer Needs
7. Summary of Field Observations
9. Remote Sensing as the Ultimate Cost Effective System
10. Review of Information Currently Being Collected
11. Alternative Plan for Cost Effective Surveillance System

Appendices

1. Introduction

The document presented here is the result of activities carried out under a scope of work specified in contract 511-0581-S-00-5066 and will be organized according to the tasks outlined in the scope of work. These are:

A. Consult with project personnel regarding data processing hardware and software needs for the project.

B. Review implementation progress of the data collection system and advise on the procedures for collection, processing, and analysis of data.

   1. Travel in target areas for the purpose of assessing data data availability and field operations.

   2. Meet with technical personnel in government agencies responsible for collecting primary data on which the program depends.

   3. Consult with Project staff regarding adequacy of infer- nation available, indexes being used and overall system procedures.

2. Background

As part of the original design team for this project in Feb/March of 1984 this consultant has an informed perspective on the chronology of project development. Brief trips to consult with project personnel in June and November of 1984 added to this information base. The original project plan of hiring field agents, training them and beginning initial data collection by June of 1984 was delayed because of logistical problems relating primarily to the availability of transportation. The actual date for the beginning of collection of data on the short form protocols (see appendix 1) was October 1984 with data entry started in December of 1984. The first reporting of information was available for analysis in January of 1985. This represented data on 10 communities for each of 5 Departments. Data entry and manipulation were accomplished by Oscar Antezana , AID Project Manager and Patrick Marnane, System Director.

The project is within the schedule established in the original plan given the problems associated with logistics. The approximately 6 month delay in the availability of the first pre-test information is due to problems not under the control of project staff. Normal difficulties in commodity acquisition were made more difficult by the continuing economic crisis in Bolivia and its attendant difficulties for the AID mission staff. A summary of suggestions for possible improvement of these procedures is included in Appendix I.

3. Computer and Data Processing Needs

The IBM-XT which was delivered to USAID in early 1984 for project use has proven adequate for project needs with some exceptions. As is often the case with a helpful new technology several other offices within the mission have found the micro-computer useful with the result that it has remained in the central AID offices and not moved with the project to its new offices in the Condor building. The mission has recognized this as a problem and begun the process of acquiring several micro-computers with one to be directed towards the full time use of the Project in its offices. The physical location of the machine away from the project offices has not affected actual data processing until this point however staff training and practice time on the machine has been reduced markedly. Since the amount of information is increasing dramatically it is necessary to establish the originally planned facility for the project within its offices as soon as possible. The availability of $10,000.00 worth of data processing equipment should not hold up a several hundred thousand dollar project designed to deliver data in a timely fashion.

4. Computer Hardware Considerations

The IBM-XT ordered for the project is still appropriate for its needs. Any new machine intended for the in house needs should have a full graphics capability ,memory expanded to the full capacity of 640 K and the 8087 coprocessor chip for faster statistical work. Given the current drop in the price of IBM and IBM compatible equipment I would also strongly suggest the purchase of a dual floppy disk drive machine with 640 K to use for data entry and forms management and as a back up for the IBM-XT should the need arise. This kind of rendundancy in surveillance systems is standard and is well worth the minor added costs. A final suggestion, again within the original budget estimates, would be the purchase of a H-P 110 handheld microcomputer. This machine could be useful as a field data entry device and would also be sufficient for the analysis of small data sets for special studies in the field. The latter would be particularly useful for providing feedback to some of the local institutions with which the project is working. The H-P 110 has the added advantage of being fully battery powered and compatible with the IBM systems for data transfer with the purchase of an added card. All of the above equipment is on the AID approved list and has been field tested under conditions similar to those in Bolivia.

Printers represent the final point on hardware acquisitions with two considerations judged as important. These include printer speed and graphics output capability. Local maintenance and availability of supplies would also be important although probably not a major issue in Bolivia. Since all repairs and maintenance are through third parties. The new IBM dot matrix printer with significantly faster speed would be our current recommendation.

Mission arrangements to purchase micros and supplies through a local competent supplier are strongly supported. Asesoramiento Empresarial S.A. appears to be the logical choice for a full service purchase agreement and continues to be the suggestion for local supply. A back up source should be located in the states that could provide equipment on short notice should such be required. As of departure and debriefing in La Paz the plans for acquisition of hardware seem appropriate and should respond to the needs of the project.

5. Software

The original software suggested for the project was built around the spreadsheet capabilities of Lotus 123. Lotus has served until the moment with its ability to provide simple summary statistics and data entry capabilities. As the project becomes more complex however its data processing needs are also increasing. For project management as well as data entry activities one of the powerful relational data base managers is suggested. Through the Tulane/Mission co-operative agreement Knowledge Management (K-Man), a powerful relational data base manager has been left with the project. It is intended that this program will be utilized to design data entry and report formats for the project which can later be converted into data files for statistical analysis. The program also allows for full screen form design and the use of macro commands once files have been defined. It can be utilized to create form and paper management systems for general office and logistic control as well. Other programs are available which do roughly the same type of job however Kman has been consistently rated very highly and is the program of choice currently. Finally SPSS(Statistical Package For the Social Sciences) has developed a rather complete version of its set of programs which can be run on the IBM-XT. Since this is the most utilized statistical package around the world and many people have experience with its format it is the program suggested for this application and has been installed. With these three programs, the usual operating system software and a good word processer (Wordstar has also been left on the system) all data and information processing needs of the project can be met. A budget should be established however to maintain and organize these programs for project use. This can be covered by hiring custom programming work for developing KMAN instructioon sets and doing SPSS program development or given individuals within the project can be trained in all aspects of the above. In general the second option is preferable particularly if there will be expectations that the project is to be handed over to a Bolivian institution in the future. It is therefore suggested that a statistician be employed by the project and trained in the use of appropriate software as well as the presentation of reports and necessary graphics within these reports.

6. Summary of Data Processing and Computer Needs

A. The IBM-XT originally dedicated to the project is still adequate for processing needs if it is made available full time in the project offices immediately.

B. A second IBM-PC with full built up to full capacity would provide low cost security and added capability for office tasks. A Hewlitt Packard 110, a fully battery powered IBM-PC compatible microcomputer, could provide the capability for field data entry and small data processing tasks in the field. This could add significantly to the projects ability to rapidly evaluate alternative data sources and provide some feedback to the communities from whom we are expecting such major co- operation.

C. Software needs are basically met with LOTUS 123 as the spreadsheet package, Wordstar for word processing, Knowledgeman for data entry and record management and SPSS for statistical programming.

D. With greater data processing needs and the software available to manage same there exists a personnel problem which needs to be addressed. No fully trained personnel exist within the project with sufficient time available to dedicate to data processing needs. It is strongly suggested that an individual be contracted to do these tasks or that more support staff be provided such that the current staff can dedicate more time to this area.

The above represent the major conclusions reached after reviewing all the current data collection and processing activities of the project, individuals responsible for same and equipment available for use.

7. Summary of Field Observations

The six day field trip for the purpose of validating certain items on the protocol and reviewing the physical problems associated with data collection began by leaving from La Paz and going overland to Oruro visiting the village Ancacato. Arriving in Potosi the night of the first day, the overland trip to Pocoata took the better part of the second day where we spent the evening in the local hospital. The third day involved reviewing data collection in Pocoata and driving on to Ocuri to examine the data collection systems of the Instituto Politechnico Thomas Katari where the night was spent. The fourth day was spent partly in Ocuri moving on to Ravelo and finally to Sucre for the evening. From Sucre on the following day we departed to visit two area hospitals in Yamparaez and Tarabuco respectively. The final day involved returning to La Paz via air. While I do not generally consider a travelog as part of a final report it is included here because of the insights into the logistics of the data collection system designed. In five days we were able to visit 7 towns all of which were on major secondary roads. During 4 of these days rain fell during at least part of our travel making mountain road conditions worse and to some extent physically dangerous. Although we traveled during the first part of the rainy season the rains had been mild and rivers were fairly low. Even with new vehicles, travel through these rural zones is difficult and could create major problems in the flow of data during the rainy season. From the above it seems clear that our original estimate of thirty communities per month randomly seleted from each department is high and can only be met under the most ideal of conditions.

In all of the communities visited the reception to us and the project was positive. This had been an earlier concern of the design team since the project was not directly aiding the individuals who were collaborating in the provision of the information needed. Even well trained and equipped individuals will have difficulty meeting the timelines imposed by the project emphasizing the need for community acceptance. It would be appropriate to feed back information to the individual communities in order to assure that this high level of co-operation continues to exist. Several questions were directed to us regarding when information might be available and how it could be used. It was also clear that expectations existed in the villages regarding follow on projects that would be forthcoming from AID based on the field agents constantly identifying themselves as from USAID.

The census taking activity which has been undertaken on a pilot basis in several towns is appropriate to mention at this juncture. (More information on the census and the processing options for it is included in appendix II.) There is a demand from key informants in each community to receive information on a regular basis as well as give it. So far the census has provided one of the only basis for this information interchange to take place. By giving local communities some feedback on their own population characteristics the surveillance program has achieved a certain legitimacy while at the same time gathering important data to verify denominators and migration patterns. As a side benefit the census data gathering offered a training ground for all project personnel into the realities of field research in Bolivia. The census therefore has proved valuable in the following ways.

A. providing a useful service to village leadership for participation in surveillance project.

B. providing data relative to migration and population composition in order to supplement surveillance data.

C. provide denomiator figures for morbidity and mortality estimates.

D. Offer training to project staff.

8. Searching for the Hydrostatic Quotient

AID consultants in agriculture at the time of the original project design suggested that an important piece of data might be the "hydrostatic quotient." This was included in the original protocol and since that time several of us have been trying to track down a definition for the term.

The National Oceanic and Atmospheric Administration was contacted for more information and the chief meterologist has indicated that the hydrostatic quotient might be an old term which is not used anymore. He thinks that it refers to the gauge pressure which is the absolute pressure of a liquid in static state minus the atmospheric pressure.

It is given by the following equation:

$$P = egh$$

Where P = hydrostatic pressure
e = density of the liquid (in this case water)
g = gravitational force due to acceleeration
h = height of liquid column on depth of liquid

e the density varies with temperature.

A chart is included to calcuate e. The unit of measure is in grams per cubic centimer (g/cm]3).

On the following charts, the vertical column shows whole degrees in celcius and the horizontal column shows 1/10's of a degree celcius. Thus e at 9.2]oC (for example)is 0.999766 g/cm]3.

The acceleration due to gravity term is dependent on latitude, and is given in cm/sec]2.

E.g. hydrostatic pressure of water at 30]oC in New Orleans (30]oN latitude), at a depth of 2cm is:

0.995944g : 979.329 : . 2
P = ------------------------------------
cm sec]2

= 1950.714 g/cm-sec]2
or 1950.714 dynes/cm]2

since 1 tyne = 1 g-cm/sec]2

Enclosed are two charts useful for the definition.

are held together by nuclear forces of attraction, with exchange forces operating between them. The number of protons is equal to the atomic number (Z) of the element, the number of neutrons is equal to the difference between the mass number and the atomic number ($A - Z$). The number of excess neutrons, i.e. the excess of neutrons over protons, is of paramount importance for the radioactive properties or stability of the element.

Henry's law.—The mass of a slightly soluble gas that dissolves in a definite mass of a liquid at a given temperature is very nearly directly proportional to the partial pressure of that gas. This holds for gases which do not unite chemically with the solvent.

Hess' law of constant heat summation.—The amount of heat generated by a chemical reaction is the same whether reaction takes place in one step or in several steps, or all chemical reactions which start with the same original substances and end with the same final substances liberate the same amounts of heat, irrespective of the process by which the final state is reached.

Hooke's law.—Within the elastic limit of any body the ratio of the stress to the strain produced is constant.

Humidity, absolute.—Mass of water vapor present in unit volume of the atmosphere, usually measured as grams per cubic meter. It may also be expressed in terms of the actual pressure of the water vapor present.

Huygens' theory of light.—This theory states that light is a disturbance traveling through some medium, such as the ether. Thus light is due to wave motion in ether.

Every vibrating point on the wave-front is regarded as the center of a new disturbance. These secondary disturbances traveling with equal velocity, are enveloped by a surface identical in its properties with the surface from which the secondary disturbances start and this surface forms the new wave-front.

Hydrogen equivalent of a substance is the number of replaceable hydrogen atoms in 1 molecule or the number of atoms of hydrogen with which 1 molecule could react.

Hydrogen ion concentration.—The concentration of hydrogen ions in solution when the concentration is expressed as gram-ionic weights per liter. A convenient form of expressing hydrogen ion concentration is in terms of the negative logarithm of this concentration. The negative logarithm of the hydrogen ion concentration is called pH. The significance of pH is still in dispute (ref. J. Am. Chem. Soc. 60, 1094 (1938)).

Water at 25°C has a concentration of H ion of 10^{-7} and of OH ion of 10^{-7} moles per liter. Thus the pH of water is 7 at 24°C. *A greater accuracy is obtained if one substitutes the thermodynamic activity of the ion for its concentration.*

Hydrolysis is a double decomposition reaction involving the splitting of water into its ions and the formation of a weak acid or base or both.

Hydrostatic pressure at a distance h from the surface of a liquid of density d,

$$P = hdg.$$

The total force on an area A due to hydrostatic pressure,

$$F = PA = Ahdg.$$

Force in dynes and pressure in dynes per cm² will be given if h is in cm, d in g per cm³ and g in cm per sec².

Hyperon.—Any particle with mass intermediate between that of the neutron and the deuteron.—See *Meson*.

Hysteresis.—The magnetization of a sample of iron or steel due to a magnetic field which is made to vary through a cycle of values, lags behind the field. This phenomenon is called hysteresis.

Steinmetz' equation for hysteresis gives the loss of energy in ergs per cycle per cm³,

$$W = \eta B^{1.6}$$

where B is the maximum induction in maxwells per cm² and η the coefficient of hysteresis.

Illumination on any surface is measured by the luminous flux incident on unit area. The units in use are: the **lux,** one lumen per square meter, the **phot,** one lumen per square centimeter and the lumen per square foot. Since at unit distance from a point source of unit intensity the illumination is unity, unit illumination may be defined as that produced by a unit source at unit distance, hence the **meter-candle** or **candle-meter** which is equal to the lux and the **foot-candle** equivalent to one lumen per square foot.

Indeterminancy principle (Uncertainty principle).—The postulate that it is impossible to determine simultaneously both the exact position and the exact momentum of an electron. So this aspect of electronics can only be expressed as a probability.

Index of refraction for any substance is the ratio of the velocity of light in a vacuum to its velocity in the substance. It is also the ratio of the sine of the angle of incidence to the sine of the angle of refraction. In general, the index of refraction for any substance varies with the wave length of the refracted light.

Indicators are substances which change from one color to another when the hydrogen ion concentration reaches a certain value, different for each indicator.

Induced electromotive force in a circuit is proportional to the rate of change of magnetic flux through the circuit.

$$E = -\frac{d\phi}{dt}$$

ACCELERATION DUE TO GRAVITY AND LENGTH OF THE SECONDS PENDULUM

For Sea Level at Various Latitudes

Based on the formula of the U. S. Coast and Geodetic Survey. The length of the simple pendulum whose period is two seconds, that is which beats seconds, is computed in each case from the corresponding value of the acceleration.

Latitude	Acceleration due to gravity		Length of seconds pendulum	
°	cm/sec²	ft/sec²	cm	in.
0	978.039	32.0878	99.0961	39.0141
5	978.078	32.0891	99.1000	39.0157
10	978.195	32.0929	99.1119	39.0204
15	978.384	32.0991	99.1310	39.0279
20	978.641	32.1076	99.1571	39.0382
25	978.960	32.1180	99.1894	39.0509
30	979.329	32.1302	99.2268	39.0656
31	979.407	32.1327		
32	979.487	32.1353		
33	979.569	32.1380		
34	979.652	32.1407		
35	979.737	32.1435	99.2681	39.0819
36	979.822	32.1463		
37	979.908	32.1491		
38	979.995	32.1520		
39	980.083	32.1549		
40	980.171	32.1578	99.3121	39.0992
41	980.261	32.1607		
42	980.350	32.1636		
43	980.440	32.1666		
44	980.531	32.1696		
45	980.621	32.1725	99.3577	39.1171
46	980.711	32.1755		
47	980.802	32.1785		
48	980.892	32.1814		
49	980.981	32.1844		
50	981.071	32.1873	99.4033	39.1351
51	981.159	32.1902		
52	981.247	32.1931		
53	981.336	32.1960		
54	981.422	32.1988		
55	981.507	32.2016	99.4475	39.1525
56	981.592	32.2044		
57	981.675	32.2071		
58	981.757	32.2098		
59	981.839	32.2125		
60	981.918	32.2151	99.4891	39.1689
65	982.288	32.2272	99.5266	39.1836
70	982.608	32.2377	99.5590	39.1964
75	982.868	32.2463	99.5854	39.2068
80	983.059	32.2525	99.6047	39.2144
85	983.178	32.2564	99.6168	39.2191
90	983.217	32.2577	99.6207	39.2207

Free Air Correction for Altitude

−0.0003086 cm/sec²/m for altitude in meters.
−0.000003086 ft/sec²/ft for altitude in feet.

Altitude meters	Correction cm/sec.²	Altitude feet	Correction ft/sec.²
200	−0.0617	200	−0.000617
300	.0926	300	.000926
400	.1234	400	.001234
500	.1543	500	.001543
600	.1852	600	.001852
700	.2160	700	.002160
800	.2469	800	.002469
900	.2777	900	.002777

DATA IN REGARD TO THE EARTH

Equatorial radius, 6,378,388 meters, 3,963.34 miles.
Polar radius, 6,356,912 meters, 3,949.99 miles.
Radius of sphere having same volume, 6,371,221.3 meters, 3,958.89 miles.
Quadrant of the equator, 10,019,148.4 meters, 6,225.60 miles.
Quadrant of the meridian, 10,002,288.3 meters, 6,215.12 miles.
1° latitude at the equator = 68.70 miles.
1° latitude at the pole = 69.41 miles.
Mean density of the earth, 5.522 g/cm³, 344.7 lb./ft.³
Mass of the earth, 5.983×10^{24} kg, 6.595×10^{21} tons.
Mean surface density of the continents, 2.67 g/cm³, 166.7 lb./ft.³
Mean linear velocity of the earth in its orbit, 29.77 km/sec., 18.50 mi./sec.
Mean linear velocity of rotation of the surface at the equator, 0.465 km/sec., 0.289 mi./sec.

DATA IN REGARD TO THE EARTH (Continued)

Land area, $148,847 \times 10^3$ km², $57,470 \times 10^3$ sq. mi.
Ocean area, $361,254 \times 10^3$ km², $139,480 \times 10^3$ sq. mi.
Highest mountain, Everest, 8840 meters, 29,003 ft.
Greatest sea depth, 10,430 meters, 34,219 ft.
Thermal gradient of the earth, higher at increasing depths, 30° C per km, 48° C per mi. (uncertain).
Mean distance to the sun, 149,500,000 km or 92,900,000 mi.
Mean distance to the moon, 384,393 km or 238,854 mi.

THE COMMONER CHEMICAL ELEMENTS IN THE EARTH'S CRUST

Reprinted from "Principles of Geochemistry" (1952) with the permission of Brian Mason, author, and John Wiley and Sons, publishers.
The "Earth's Crust" refers to the rocks only and does not include atmosphere or the oceans. The atom percent column is obtained by dividing the weight percent by the atomic weights and reducing to 100%. The radius is the ionic radius. The volume percent is the multiplied by (r^3) and reducing to 100%.

Element	Weight %	Atom %	Ion Radius (Å)	Volume %
O	46.60	62.55	1.32	91.97
Si	27.72	21.22	0.39	0.80
Al	8.13	6.47	0.57	0.77
Fe	5.00	1.92	0.82	0.68
Mg	2.09	1.84	0.78	0.56
Ca	3.63	1.94	1.06	1.48
Na	2.83	2.64	0.98	1.60
K	2.59	1.42	1.33	2.14

THE AVERAGE AMOUNTS OF THE ELEMENTS IN EARTH'S CRUST IN GRAMS PER METRIC TON OR PARTS PER MILLION

Reprinted from "Principles of Geochemistry" (1952) with the permission of Brian Mason, author, and John Wiley and Sons, publishers.

O	466,000	N	46	Br	1.6
Si	277,200	Ce	46	Ho	1.2
Al	81,300	Sn	40	Eu	1.1
Fe	50,000	Y	28	Sb	1
Ca	36,300	Nd	24	Tb	0.9
Na	28,300	Nb	24	Lu	0.8
K	25,900	Co	23	Tl	0.6
Mg	20,900	La	18	Hg	0.5
Ti	4,400	Pb	16	I	0.3
H	1,400	Ga	15	Bi	0.2
P	1,180	Mo	15	Tm	0.2
Mn	1,000	Th	12	Cd	0.15
S	520	Cs	7	Ag	0.1
C	320	Ge	7	In	0.1
Cl	314	Sm	6.5	Se	0.09
Rb	310	Gd	6.4	A	0.04
F	300	Be	6	Pd	0.01
Sr	300	Pr	5.5	Pt	0.005
Ba	250	Sc	5	Au	0.005
Zr	220	As	5	He	0.003
Cr	200	Hf	4.5	Te	0.002?
V	150	Dy	4.5	Rh	0.001
Zn	132	U	4	Re	0.001
Ni	80	B	3	Ir	0.001
Cu	70	Yb	2.7	Os	0.001?
W	69	Er	2.5	Ru	0.001?
Li	65	Ta	2.1		

CHEMICAL COMPOSITION OF ROCKS

Reprinted from "Sedimentary Rocks" (1949) with the permission of F. J. Pettijohn, author, and Harper Brothers, publishers.

Element	Average igneous rock	Average shale	Average sandstone	Average limestone	Average sediment
SiO_2	59.14	58.10	78.33	5.19	57.95
TiO_2	1.05	0.65	0.25	0.06	0.57
Al_2O_3	15.34	15.40	4.77	0.81	13.39
Fe_2O_3	3.08	4.02	1.07	0.54	3.47
FeO	3.80	2.45	0.30		2.08
MgO	3.49	2.44	1.16	7.89	2.65
CaO	5.08	3.11	5.50	42.57	5.89
Na_2O	3.84	1.30	0.45	0.05	1.13
K_2O	3.13	3.24	1.31	0.33	2.86
H_2O	1.15	5.00	1.63	0.77	3.23
P_2O_5	0.30	0.17	0.08	0.04	0.13
CO_2	0.10	2.63	5.03	41.54	5.38
SO_3		0.64	0.07	0.05	0.54
BaO	0.06	0.05	0.05		
C		0.80			0.66
	99.56	100.00	100.00	99.84	99.93

HYDROMETER CONVERSION TABLES
(Continued)

Showing the Relation between Density (C. G. S.) and Baumé and Twaddell Scales for Densities above Unity.

Density	Degrees Baumé.	Degrees Twaddell.	Density.	Degrees Baumé.	Degrees Twaddell	Density	Degrees Baumé.	Degrees Twaddell.	Density.	Degrees Baumé	Degrees Twaddell
1.00	0.00	0	1.20	24.17	40	1.41	42.16	82	1.61	54.94	122
1.01	1.44	2	1.21	25.16	42	1.42	42.89	84	1.62	55.49	124
1.02	2.84	4	1.22	26.15	44	1.43	43.60	86	1.63	56.04	126
1.03	4.22	6	1.23	27.11	46	1.44	44.31	88	1.64	56.58	128
1.04	5.58	8	1.24	28.06	48	1.45	45.00	90	1.65	57.12	130
1.05	6.91	10	1.25	29.00	50	1.46	45.68	92	1.66	57.65	132
1.06	8.21	12	1.26	29.92	52	1.47	46.36	94	1.67	58.17	134
1.07	9.49	14	1.27	30.83	54	1.48	47.03	96	1.68	58.69	136
1.08	10.74	16	1.28	31.72	56	1.49	47.68	98	1.69	59.20	138
1.09	11.97	18	1.29	32.60	58	1.50	48.33	100	1.70	59.71	140
1.10	13.18	20	1.30	33.46	60	1.51	48.97	102	1.71	60.20	142
1.11	14.37	22	1.31	34.31	62	1.52	49.60	104	1.72	60.70	144
1.12	15.54	24	1.32	35.15	64	1.53	50.23	106	1.73	61.18	146
1.13	16.68	26	1.33	35.98	66	1.54	50.84	108	1.74	61.67	148
1.14	17.81	28	1.34	36.79	68	1.55	51.45	110	1.75	62.14	150
1.15	18.91	30	1.35	37.59	70	1.56	52.05	112	1.76	62.61	152
1.16	20.00	32	1.36	38.38	72	1.57	52.64	114	1.77	63.08	154
1.17	21.07	34	1.37	39.16	74	1.58	53.23	116	1.78	63.54	156
1.18	22.12	36	1.38	39.93	76	1.59	53.80	118	1.79	63.99	158
1.19	23.15	38	1.39	40.68	78	1.60	54.38	120	1.80	64.44	160
			1.40	41.43	80				....	.....	..

ABSOLUTE DENSITY OF WATER

Density in Grams per Cubic Centimeter, Computed from the Relative Values by Thiesen, Scheel and Disselhorst (1900), and the Absolute Value at 3.98° C. by the International Bureau of Weights and Measures (1910).

Degrees	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	0.999841	847	854	860	866	872	878	884	889	895
1	900	905	909	914	918	923	927	930	934	938
2	941	944	947	950	953	955	958	960	962	964
3	965	967	968	969	970	971	972	972	973	973
4	973	973	973	972	972	972	970	969	968	966
5	965	963	961	959	957	955	952	950	947	944
6	941	938	935	931	927	924	920	916	911	907
7	902	898	893	888	883	877	872	866	861	855
8	849	843	837	830	824	817	810	803	796	789
9	781	774	766	758	751	742	734	726	717	709
10	700	691	682	673	664	654	645	635	625	615
11	605	595	585	574	564	553	542	531	520	509
12	498	486	475	463	451	439	427	415	402	390
13	377	364	352	339	326	312	299	285	272	258
14	244	230	216	202	188	173	159	144	129	114
15	099	084	069	054	038	023	007	*991	*975	*959
16	0.998943	926	910	893	877	860	843	826	809	792
17	774	757	739	722	704	686	668	650	632	613
18	595	576	558	539	520	501	482	463	444	424
19	405	385	365	345	325	305	285	265	244	224
20	203	183	162	141	120	099	078	056	035	013
21	0.997992	970	948	926	904	882	860	837	815	792
22	770	747	724	701	678	655	632	608	585	561
23	538	514	490	466	442	418	394	369	345	320
24	296	271	246	221	196	171	146	120	095	069
25	044	018	*992	*967	*941	*914	*888	*862	*836	*809
26	0.996783	756	729	703	676	649	621	594	567	540
27	512	485	457	429	401	373	345	317	288	261
28	232	204	175	147	118	089	060	031	002	*973
29	0.995944	914	885	855	826	796	766	736	706	676
30	646	616	586	555	525	494	464	433	402	371

RELATIVE DENSITY AND VOLUME OF WATER

The mass of one cubic centimeter of water at 4° C is taken as unity.
The values given are numerically equal to the absolute density in grams per milliliter.
(Smithsonian Tables, compiled from Various Authors.)

Temp. ° C.	Density.	Volume.	Temp. ° C	Density.	Volume	Temp. ° C.	Density.	Volume.	Temp. ° C	Density.	Volume
-10	0.99815	1.00186	+0	0.99987	1.00013	10	0.99973	1.00027	20	0.99823	1.00177
-9	843	157	1	993	007	11	963	037	21	802	198
-8	869	131	2	997	003	12	952	048	22	780	221
-7	892	108	3	999	001	13	940	060	23	756	244
-6	912	088	4	1.00000	1.00000	14	927	073	24	732	268
-5	0.99930	1.00070	5	0.99999	1.00001	15	0.99913	1.00087	25	0.99707	1.00294
-4	945	055	6	997	003	16	897	103	26	681	320
-3	958	042	7	993	007	17	880	120	27	654	347
-2	970	031	8	988	012	18	862	138	28	626	375
-1	979	021	9	981	019	19	843	157	29	597	405

RELATIVE DENSITY AND VOLUME OF WATER

(Continued)

Temp. ° C.	Density.	Volume	Temp. ° C	Density.	Volume	Temp. ° C.	Density.	Volume.	Temp ° C	Density.	Volume
+30	0.99567	1.00435	42	147	861	54	621	398	120	0.9434	1.0601
31	537	466	43	107	901	55	0.98573	1.01448	130	0.9352	1.0693
32	505	497	44	066	943	60	324	705	140	0.9264	1.0794
33	473	530	45	0.99025	1.00985	65	059	979	150	0.9173	1.0902
34	440	563	46	0.98982	1.01028	70	0.97781	1.02270	160	0.9075	1.1019
35	0.99406	1.00598	47	940	072	75	489	576	170	0.8973	1.1145
36	371	633	48	896	116	80	0.97183	1.02899	180	0.8866	1.1279
37	336	669	49	852	162	85	0.96865	1.03237	190	0.8750	1.1429
38	299	706	50	0.98807	1.01207	90	534	590	200	0.8628	1.1590
39	262	743	51	762	254	95	192	959	210	0.850	1.177
40	0.99224	1.00782	52	715	301	100	0.95838	1.04343	220	0.837	1.195
41	186	821	53	669	349	110	0.9510	1.0515	230	0.823	1.215
									240	0.809	1.236
									250	0.794	1.259

DENSITY AND VOLUME OF MERCURY

BASED ON THE DENSITY OF MERCURY AT 0° C. BY THIESEN AND SCHEEL

(Selected from Smithsonian Tables)

Temp. ° C.	Mass in gr. per ml.	Vol. of 1 gr. in ml.	Temp. ° C.	Mass in gr. per ml.	Vol. of 1 gr. in ml.	Temp. ° C.	Mass in gr. per ml.	Vol. of 1 gr. in ml.	Temp. ° C.	Mass in gr. per ml.	Vol. of 1 gr. in ml.
−10	13.6202	0.0734205	30°	13.5217	0.0739552	11	5684	7011	150	2330	5686
−9	6177	4338	31	5193	9686	12	5659	7145	160	2093	7044
−8	6152	4472	32	5168	9820	13	5634	7278	170	1856	8402
−7	6128	4606	33	5144	9953	14	5610	7412	180	1620	9764
−6	6103	4739	34	5119	40087	15	13.5585	0.0737546	190	13.1384	0.0761128
−5	13.6078	0.0734873	35	13.5095	0.0740221	16	5561	7680	200	1148	2496
−4	6053	5006	36	5070	0354	17	5536	7813	210	0913	3865
−3	6029	5140	37	5046	0488	18	5512	7947	220	0678	5239
−2	6004	5273	38	5021	0622	19	5487	8081	230	0443	6616
−1	5979	5407	39	4997	0756	20	13.5462	0.0738215	240	13.0209	0.0767996
0	13.5955	0.0735540	40	13.4973	0.0740891	21	5438	8348	250	12.9975	9381
1	5930	5674	50	4729	2229	22	5413	8482	260	9741	70769
2	5906	5808	60	4486	3569	23	5389	8616	270	9507	2161
3	5881	5941	70	4244	4910	24	5364	8750	280	9273	3556
4	5856	6075	80	4003	6252	25	13.5340	0.0738883	290	12.9039	0.0774954
5	13.5832	0.0736209	90	13.3762	0.0747594	26	5315	9017	300	8806	6364
6	5807	6342	100	3522	8939	27	5291	9151	310	8572	7774
7	5782	6476	110	3283	50285	28	5266	9285	320	8339	9189
8	5758	6610	120	3044	1633	29	5242	9419	330	8105	80609
9	5733	6744	130	2805	2982	30	13.5217	0.0739552	340	12.7872	0.0782033
10	13.5708	0.0736877	140	13.2567	0.0754334				350	7638	3464
									360	7405	4903

9. Remote Sensing as the Ultimate Cost Effective System

As per discussions with Project personnel in La Paz the possibility of satellite data being used in a surveillance system was investigated using as the base a reçent Science article on Land-cover classification using satellite data referred to us by university based remote sensing laboratories (Tucker, Townshend Gaff, 1985) (Appendix III).

These preliminary investigations indicate that it may be possible to use satellite data to predict variations in crop production in the Altiplano areas in order to prdict famines. J. Tucker Compton and Thomas E. Goff, both of the NASA Goddard Space Flight Center in Maryland have been doing both types of satellite-based deforestation work studies in Randonia, Brazil, Borneo and China as well as some crop work (mostly rangeline studies) in Africa for the International Livestock and Cattlemen's Association, a UN based, independently funded group. The following is from telephone conversations with them.

The African studies are of a historical time series design. Using a satellite which has been up since 1979, it is possible to see changes in flora over the continent of Africa changing over several years.

Tucker and Goff are using the AVHR series of satellites for this research as well as for their other work in Brazil, Borneo and China. The AVHRs, at their best resolution, measure 1.1 Km. It is therefore possible to demonstrate the global dynamics of a change process. The AVHR satellites pick up data from each study area two times a day. This type of satellite is ideal for a temporal study but not for one which requires very precise spatial measurements. For example, the deforestation studies demonstrate, quantitatively over a period of time, how many leaves fall and therefore, quantitatively, how much less CO_2 and oxygen will be globally available. AVHRs have also supplied information to the U.S. Army on Rift Valley Fever in Africa. Rift Valley Fever is intimately tied to vegetation dynamics. THe AVHR satellites working group is small compared to NASA's Landsat group and could be potentially interested in the Bolivia project.

The Landsat series of satellites represent the area where more work is being done in a well funded effort. Landsat satellites measure in the 30m. bracket which provides a lot of detail. With this series of satellites, too much data makes it difficult to digest things, dependent upon what one is looking for. Landsats measure each study area once every fifteen days. Landsats are suitable for discrete readings but not for temporal readings.

Landsats for example, can tell what crop is growing in which field, whereas AVHRs can measure if the crop is growing more or less but cannot distinguish one crop from another. Were the Disaster Surveillance Project to enlist the use of satellites, many decisions would have to be made as to which questions were to be answered, for satellite series differ greatly in their capacities to measure different variables. Both systems appear to have promise however as potential sources of data for Bolivian famine and other disaster prediction. The field data being collected currently could provide verification needed to estimate current yields and develop models for predictions in the future. It is suggested that the Bolivia Disaster surveillance project investigate further this possible option. Satellite technology will continue to improve and ultimately provide the sort of early warning system so necessary inthe Bolivian case. A small added investment could provide much in the way of potential future sustainable surveillance based upon U.S. technology and with higher potential for valid, sustainable and timely results.

10. Review of Information Currently Being collected.

In this section we will review each of the data items currently being collected in the Bolivia disaster surveillance system. They will be evaluated according to the following criteria.

A. Review of data collected until present using criteria of usefulness to decision makers,variability of the measure and other relevant pieces of information.

B. Interviews with field agents about consistency and utility of information.

C. Field validation of data quality and ease of collection.

Example of Items Collected by the Current System and Suggestions for How They May be Used

What follows is a review of items reported on in the first data submission of the Bolivian Disaster Surveillance System. It combines elements considered as background independant variables and elements that are collected on a periodic basis by the field agents. Comments on these variables indicate the types of concerns that we might have about indicators in a surveillance system based primarily upon the distribution of these elements. This data is being further examined using statistical techniques which search for variance on Tulane's computer systems. The general philosophy is that if the indicator does not vary it cannot predict and hence is an inappropriate element in a surveillance system.

A. Population and Migration

Population data represents the single most important piece of information about the communities surveyed since it provides basic denominator information from which all other indicators take on their meaning. The system is currently collecting four separate items on population and migration including:

Approximate Population- This estimate is taken from key informants, community officials, projections from prior public census data and occasional special censuses. The project has encouraged special census activity in 4 communities which has been discussed, however the majority of data referred to here is somewhat subjectivve coming as it does from many sources. Significant variance exists in the total population figures and they do provide a direct indication as to the range of village size. When combined with results of the special census activities undertaken by the project these estimates take on more meaning and utility in calculating rates.

B. Approximate Number of Families.

This information is generally derived from the total population figure or house counts and suffers from the same problems mentioned above. It is important in many aspects of decision making related to disasters and should be included. The special census information is showing some interesting results regarding family structure which may help in our understanding of what number of families really means.

C. Temporal Migration

Migration seems such a universal phenomenon in highland communities that this data item may be unneeded. In all of the communities visited there was some evidence of temporal migration including one ,Pocoata where our reporting system indicated that there was not. In all four of the health facilities where we had a chance to investigate the records there were cases of malaria noted in the last year indicating at least some migration to and from the lowlands. It is doubtful that this indicator will provide information useful to rapid decision making and as such should probably be dropped from the protocol.

D. Permanent Migration.

This indicator is providing mixed results but appears to be demonstrating some variance. Some effort should be put into developing a consistent code for this item and it should be run for a few more cycles (8-12 months) and re-evaluated as to its utility.

E. Location

A useful item for overall classification and one that only needs to be collected once. I would suggest keeping it in a general file on community definition. This type of indicator is not an issue for the monthly collection cycles.

F. Source of Water Within 1/2 km

This item falls into the same category as the above with the exception of drought conditions. Here the source may change or go bad due to pollution. In the altiplano mining runoff can also have the same effect. Not much variance currently however it would be useful to know what the 10 per-cent who list none are doing for water. Would perhaps add an item on source of water and current quality and quantity using a 3 or 5 leveled response.

G. Access Period by Road

Very useful background information but not useful for monthly report form unless phrased as, access by road possible for approximately how many days this month. This would introduce some more variance into the item and perhaps improve current status reports.

H. Railroad Transportation

Again useful for original description but not needed on monthly basis. Some possible utility for overall community well being score.

I. Approx. No. Of Vehicles/Week

This item appears to showing considerable variance and has some potential. Clearly should be retained until we are able to ascertain what are the underlying factors which are creating the variance.

J. School

Useful for original community profile. Would suggest a ranking element be created i.e. 1=elementary, 2=elem.+Jr. High 3=all. Again might be useful as component of overall community score.

K. Health Center

Same as above with possible ranking as to level of sophistication of service. May also consider periodic check for functioning of service.

L. IBTA Agent

Same as health center

M. Mothers Club

Of the first three rounds the fact that the majority, 47/50, of the communities has mothers clubs suggests a possible base for other information collection. This network should be examined further as a possible base for expanding the collection of MCH related data. It would also appear to provide an entree to the poorer of a given regions inhabitants which may target the population truly at risk.

N. Services

Should be kept in the base community description file. Useful to note the widespread apparent availability of telegraph service as a possible communication link not dependent upon vehicle transportation.

O. Principal Agricultural Products

Again a useful one time definer. What variation exists is mostly related to ecological concerns.

P. Water Source

Shows some variation and is worth keeping in the overall descriptive file.

Q. Installed Water System

Again some variation is present. In all of the infrastructure services questions estimates of coverage and or change are indicated. i.e. Private system with 50% coverage 18 hours day. This might reflect seasonal and or other events in the area.

R. Epidemiological Data

In discussions with Dr.Angel Valencia , head of the Epidemiological surveillance system, it became evident that while the system is still operant there are numerous problems. Data entry is several months behind and publication of the reports are even further off. As a result our original expectations of the potential use of the data so collected have not been realized. The field agent's collection of the similar data at the community level has other problems associated with its use. These include spotty quality , questionable validity and unknown sensitivity. As a result it is recommended that these indicators be examined closely for their utility. It may be possible to reinforce the Ministry of Health in order to appropriately collect this type of information however such a decision would require policy decisions at the project level. Health indicators may be too difficult to collect at the field agent level. Certainly the special studies needed to verify and validate their meaning are beyond the range of this effort.

While the above only addresses part of the indicator set and is in no way complete it is intended to provide a demonstration of the kind of approach the analysis at Tulane is taking.

11. Alternative Plan for Cost Effective Surveillance System

Due to a number of concerns about the feasibility of continuing the surveillance project, in particular, the costs of maintaining automobiles and field teams in a failing economy the possibility of a far less expensive version is suggested on an experimental basis. The idea would be to select within one department twenty plus villages with roughly the same characteristics as inthe original six department sample. In each village a key informant would be identified with the same general characteristics as the informants used in the overall survey. Knowledgeable individuals, who have lived in the are for over 10 years and are in a position to observe activities in town. These individuals would be trained by a field supervisor in filling out the same information as is collected by the field agents in the regular system. Each informatn would be reimbursed for his completed information if and when he presents it to a central collection point. This information would then be collated and copies forwarded to Tulane where it would be analyzed independently of the larger systems data collection mechanisms. Implementation of the system would require the short term employment of a field person who would train individuals in each village, approximately 1/2 day should be programmed for each individual with the expectation of all 20-30 sites being covered in a one month period. When this data is processed and compared to regular surveillance system it will provide us with insight as to the feasibility of such a low cost system being developed. For the minimal investment in such a system it seems appropriate to test the hypothesis that a very low lost surveillance system can be developed.

A meeting of the entire AID project staff committee in La Paz approved this concept in principal and began to move in developing it more concretely in mid February 1985.