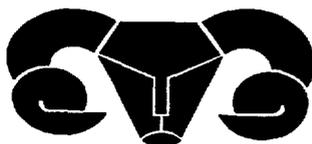


PD-ABP-104

**SMALL RUMINANT COLLABORATIVE  
RESEARCH SUPPORT PROGRAM**

**(SR-CRSP)**



**Sociological and Economic Analysis of Small Ruminant Production  
Systems**

**ANNUAL REPORT  
1996**

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# EXECUTIVE SUMMARY

## Kenya Dual Purpose Goat Component (KDPG)

Three general activities were the focus of research by KARI and University of Missouri researchers in sociology and economics with this year of funding. The first area, the impact assessment of the Kenyan Dual Purpose Goat at the household level focused on the economic performance of the KDPG enterprise, its role in household income, gender domains of the technology, and flexibility of the KDPG to adapt to different agroecologies, production systems and ethnic groups. Climatic conditions are not considered good for the years the KDPG has been introduced, and the technology appears to be performing. Research findings on performance during 1995 are encouraging, in that the enterprise shows positive returns in all clusters at the Coast (3) and Machakos (2). The relative importance in household agricultural income varies according to the production system and level of household wealth. At the cluster level analysis we find that the Coast cluster are relatively poorer than the Machakos clusters, therefore the relative importance of the KDPG is higher in the former. We also find at the Coast that the clusters had higher rates of pass on, and better relative performance. This is the case for both Kilifi and Vuga when compared to Kitanga and Kimutwa in Machakos. Matuga is the only Coast cluster that did not perform well. The multiplication of the KDPG, a second research activity this year, focused on analysis of the small holder multiplication system. Upgrading practices were observed as introduced by small holder producers owning KDPGs. The third activity focused on community and social networks developed by each cluster, Vuga, and Matuga in Kwale, and Kilifi at the Coast, and Kitanga and Kimutwa in Machakos. Community organization, social networks and social capital were studied combining PRAs and actor oriented research, to understand the positive externalities created by the pass on of the KDPG, and the conditions that make possible this type of multiplication. All cluster members were interviewed and a study completed. This is the basis for further research on the role of social capital, community organization and nongovernmental organizations in the success of development projects. A Resource Management-Gender and Labor questionnaire was developed to study gender income and labor domains at the household level, and credit and income transfer mechanisms available in each cluster, as well presence of credit systems and other networks in the area. This was applied in all clusters and is currently being analyzed. During year 18, 1997, we will concentrate on further analysis of the data at both the household and community levels. This has been the first year of full and stable funding for the impact assessment and it has raised interesting questions that will be pursued in 1997. A World Wide Web site has been developed for the Social Sciences SR-CRSP. Reports and publications can be requested through this site.

<http://www.ssu.missouri.edu/ssu/srcrsp>

## **Animal Health Management Through Biotechnology Component**

Two activities were conducted in year 17 by the Kenya Agricultural Research Institute and the University of Missouri in social science research related to animal health. The first is the study of vaccine production and distribution, which was conducted in collaboration with the Kenya Veterinary Vaccine Production Institute. Three specific objectives were: to determine the economic costs of production of the Contagious Caprine Pleuropneumonia (CCPP) vaccine in liquid and lyophilized forms; develop a profile of users of the vaccine, identified through sales by KEVEVAPI, sole producer of Caprivax; and to determine the level of competition in use of facilities, equipment, and labor in the production of Rinderpest Caprivax and Contavax vaccines. Costs of production were analyzed and recommendations to increase efficiency proposed. Sensitivity analysis was conducted to determine levels at which current prices would be economically efficient. The analysis of competition shows that given current vaccine production levels there would not be competition in the production of lyophilized CCPP vaccine. The market profile highlights the declining role of government as main buyer of the vaccine and the increasing participation of private individuals and nongovernmental organizations as consumers in this market.

The second main activity was to study the demand for animal health services, with an emphasis on CCPP vaccine as a case study. We conduct this study with the collaboration of the Kenya Veterinary Field Services Office. A study was conducted on the availability and use of animal health delivery services at the sites where the Kenya Dual Purpose Goat is being tested. The report appears in year 16 SR-CRSP annual report. After an appraisal of the knowledge of animal health delivery services for small ruminants we decided to conduct a study to determine the demand for these services and for CCPP vaccines, specifically. A survey was developed and field tested with the farmers participating in the testing of the lyophilized CCPP vaccine. Three sites were selected to conduct the study, Koibatek (pastoral production systems), Kitui (agropastoral production system) and Kajiado (pastoral production systems). All are CCPP endemic areas. Preliminary data analysis from the Koibatek study shows that farmers are not aware of the existence of the vaccine. Demand estimations for the liquid and lyophilized vaccines will be conducted in 1997. We have also developed a World Wide Web site where technical reports and other publications may be found.

## **Sustainable Agropastoral Systems on Marginal Lands-Bolivia**

Several activities were conducted by sociology and economics in collaboration with Instituto Boliviano de Tecnologia Agropecuaria and Utah State University. A research synthesis is being developed, and many chapters were completed this year. A workshop took place in Bolivia in November of 1995. It provided the opportunity to bring together researchers that had been involved in field activities in San Jose Llanga to discuss hypothesis on strategies of farmers in crop livestock production systems in marginal

drought and frost prone areas. Research continued on peasant household economic and social strategies that contribute to persistence in the Altiplano. Diversification and the role of livestock in food security were the main topics of publication during this year. Analysis of the household data for 1995 was initiated. It shows the diversification strategies pursued by peasant households in San José during a low rainfall year. This is compared to the strategies pursued in 1993. Marketing systems were studied which show producers of San José responding to market signals in the production of sheep and cattle. Finally a study of nutrition and livestock in Andean communities was initiated and will continue during 1997, supported by the University of Missouri, to look at the role of livestock in household food security. All Bolivian students have completed and submitted their theses. Our collaborating scientists continue to provide them support. Christian Jetté and Jorge Céspedes in Bolivia, and Lisa Markowitz in the U.S. have been essential to our project. We continue to collaborate in research with all of them. Support provided by IBTA allowed us to complete activities and close our program in San José Llanga, providing community leaders with studies that have been used to develop projects to benefit their members. We created a World Wide Web site that presents our activities, findings and publications.

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## Kenya Dual Purpose Goat Component (KDPG)

### *Narrative Summary*

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## *Research*

### **Activity I: Impact Assessment of the KDPG at the Household**

#### *Problem Statement and Approach*

The impact on the welfare of households, result of the introduction of the KDPG as an economic enterprise, and asset building important in smoothing income shocks are central research questions of the social sciences project. The effects of the KDPG on farm can be measured through: 1) the output generated, 2) changes in the intrahousehold allocation of resources, and income related to the KDPG that may change the bargaining position of members of the household, and 3) asset building that contributes to economic security, especially food security. Expenditure patterns of men and women have been shown in several studies to differ, especially in Kenya. If KDPGs become the income domain of female heads of household the probabilities of milk and cash from this activity being spent in consumption items for the family will increase. Gender along with wealth and ethnicity must be considered in the analysis. Chaiken and Conelly, in western Kenya found that income and poverty had stronger effects than gender in deriving benefits from the KDPG. Boserup, in her analysis of the changing roles of women with development, states that male migration, in colonial times, resulted in women's greater control of production activities in rural areas, especially food production.

The assessment of the impact of the KDPG focuses on economic viability of the KDPG measuring income generation, cash and in-kind, of the KDPG enterprise, and the diversity of economic activities carried out by the household producers on and off the farm; gender analysis through intrahousehold allocation of resources focusing on labor and income, to determine domains of the economic enterprises; and the flexibility of this technological package as it integrates to the household economy.

#### *Progress*

##### **1. Economic Viability of the KDPG**

The Kenya Dual Purpose Goat (KDPG) and the accompanying management package were introduced into a number of small holdings in the semi-arid midlands and in the humid Coastal lowlands of Kenya during the short rains season of 1993. These innovations were intended to help improve the welfare of smallholder households through increased income (cash and in kind) and nutrition. Introduction of livestock based innovations usually has significant impacts elsewhere in the farming systems.

A baseline survey of the main characteristics of the study sites was undertaken in 1993, preceding placement of the KDPG innovation. A monitoring survey designed to assess the extent of impacts was carried out in the five clusters between 1994 and 1996. Highlights of on-going research are presented in this report.

A combination of case-studies and questionnaires of all farmers was adopted for this study. Four instruments to capture farm and household information were designed, pretested and applied. The timing and frequency at which these instruments were applied were matched to the production and household activity calendars in the two sites. To keep track of the production, consumption and sales of livestock and products as the KDPG integrates into the farming systems, monthly farm visits were conducted.

Rapid Rural Appraisals (RRAs), one in each of the five clusters during the short rains season of 1993 preceded placement of the KDPGs. Base-line information about the small holdings in the regions was used as bench-mark for impact assessment. Each of the two clusters in the Machakos site (Kitanga and Kimutwa) and the two in the Coast site (Kilifi, Vuga) had 20 smallholder households that had been randomly selected from the farming community. The HPI cluster had been formed previously with the purpose of promoting the keeping of dairy cows by members. Each cluster was allocated 10 does and two bucks, five farmers received two does each. Apart from the requirement that each recipient be a member of the group, undertake to practice acceptable management, facilitate data collection and pass on the first two doelings to members on the waiting list, the individual groups were to regulate themselves. Kitanga, Kimutwa, Vuga and HPI clusters received their KDPGs during the short rains season of 1993, and the Kilifi cluster during early 1994.

Following the placement of the KDPGs on the farms, the Impact Assessment study was planned and implemented. Prior to this implementation, research themes were identified and the required data sets itemized. Finally, data capture instruments were drawn up and pre-tested.

The four instruments used to capture farm and household data were:

- I. Form M was designed to be administered monthly. Items of data recorded on this are: 1) Family labor availability (through changes in the family structure); 2) Family labor use: main occupations; 3) Household non-agricultural labor supply; 4) Wage rates; 5) Milk consumption/sales; and 6) Animal sales.
- II. Agricultural form to be applied 6 times a year, in April, July, October, November, February and March. Land use and cropping activities, access to credit, and remittances from friends and relatives were recorded. Information about production, sales and consumption of permanent crops and fodder was recorded. Difficulties in data collection stages did not allow full year coverage (e.g., monthly and agricultural). Fortunately, few data items were found so sensitive to the frequency at which data were collected.
- III. Captured on Form I were agricultural inputs (costs, source and use), mainly seeds, fertilizers and chemicals. The enumerator had ample opportunity to record pertinent observation. This instrument was designed to be administered at the beginning of each season.
- IV. Form O was designed to record the production of seasonal crops.

In both the Machakos and the Coast sites, data collection started during the short rains season of 1994/5. In the ninth month of data collection at the Katumani site, 37 out of 40 farms (92.5%) had been interviewed concerning input questionnaires and 33 out of the same 40 farms (82.5%) had been interviewed using output questionnaires. Similarly, during the same period, 154 out of the 180 farms (85.6%) had been interviewed with respect to the bi-monthly questionnaire on agricultural operations. This was quite a successful operation. However, the more regular monthly interviews were not equally successful. Indeed, of the 360 interviews to be carried out during the same period, only 148 (41%) were done. This was the year in which SR-CRSP funding was not available for the project.

In the Coast sites interviews started in August 1994 and through out serious disruptions were experienced. Whereas 61.4% of the interviews were carried out in August, only 35% of them were successfully carried out in September, 1994. The following month interviews picked up to 96.5% level but dropped to 52.6% in November. In December, no interviews were done. In January, 1995 modest activity resumed (35.1% of the interviews). The following three months (February, March and April) no interviews were done. In May about a third of the interviews were carried out (36.8%).

Over all, Katumani site did relatively better than Mtwapa site in data collection. Considering that both sites were receiving their financial support from the same source, it is evident that institutional constraints were greater in Mtwapa than in Katumani. Following consultations with the centre management in Mtwapa, arrangements were made to ensure more regular data collection in the future. It was decided that two field assistants be recruited for the highlands (Kitanga); lowlands (Kimutwa) in Machakos and one the Kilifi cluster. The field assistant who was already in place at the Coast would concentrate on the HPI and Vuga clusters in Kwale district. Due to delays in identifying a second field assistant for the Machakos site, it was decided that the one field assistant already in place would cover the two clusters. By January 1995, these measures had already been effected. However, the necessity to follow institutional regulations in channeling resources to the field assistants created some delays. The effects of institute wide shortages of personnel in the socio-economics field were also felt through the inability of collaborating scientists to allocate more time to the supervision of field work and also data management.

Nevertheless, 1995-1996 data represents a significant improvement over the previous year. There are fewer missing observations. In terms of consistency, missing observations, recording errors, etc., the performance of the Machakos field assistant appears reasonable. The Kilifi field assistant also performed satisfactorily, as did the Kwale field assistant, despite delays in dealing with logistical problems the latter was facing.

### **Estimation of the Impact of the KDPG on Farm Income**

The KDPG introduced to existing farming systems during the short rains season of 1993 would milk, bucklings, and possibly manure and skins, that were consumed or given away (income in kind) or may be sold. Products were multiplied by their respective cash values

in Kenya Shillings to calculate total income. Enterprise specific (variable) costs were assessed by estimating the value of inputs which were basically, housing, drugs and treatment, and in some cases water and supplementary feeding. The cost of labor was assumed to be constant and was not priced.

### Seasonal Conditions and Performance of the Farm Enterprise

This section is intended to provide a description of the seasonal conditions within which production took place. This has a direct bearing upon the interpretation of production data that is presented in the following sections. Table 1.1 shows rainfall data for the period short rains 1985-long rains 1996 for NDFRC Katumani. There was almost total crop failure during the long rains 1994 season, as in the preceding two seasons. This contributed to the difficulties in interviews because of the unavailability of responsible persons present on the farms during our visits (most would be away seeking means of sustenance).

**Table 1.1 - Climatic Conditions**

Seasonal rainfall (mm) for 1985-96, NDFRC				
Year	Long rains season		Short rains Season	
1985			311.2	Average
1986	327.2	Average	342.3	Average
1987	181.3	Fail	281.0	Marginal
1988	362.4	Good	455.8	Average
1989	263.4	Marginal	344.8	Average
1990	565.0	Good	395.8	Good
1991	197.4	Fail	342.5	Average
1992	240.9	Marginal	618.6	Good
1993	186.6	Fail	244.7	Marginal
1994	296.4	Marginal	589.4	Good
1995	316.7	Average	259.5	Marginal
1996	272.4	Marginal		
Mean	291.8		380.5	

To this date we are searching for comparable data for the Coast. Interviews with farmers are yielding the following perception regarding climate and cropping seasons: the short rains 1994 were "Poor", the long rains of 1995 were "fair to good", the short rains of 1995 were "poor", and the long rains of 1996, were "poor to fair".

### Performance of the Farm Enterprise

To assess impact on farm-household income, cash and in-kind income from other enterprises were measured. Four general classes of activity had been identified. These were: seasonal (mainly food) crops; perennial crops; other livestock and a variety of non-farm enterprises.

These assessments are summarized as follows:

$$Y = \sum_{j=1} (p_j y_j - p_j x_j) \quad j=1,2,\dots,n \quad (1)$$

Where  $Y$  is non-KDPG income,  $p_j$  represents the factor  $x$  and product  $y$  prices in the  $j$ th enterprise. For expository convenience, these enterprises are grouped as follows:

- i) Seasonal (mainly subsistence) crops
- ii) Perennial and high value horticultural crops (mainly for cash)
- iii) Productive animals other than the KDPGs (cattle, sheep and goats)
- iv) Draft and pack animals (oxen and donkeys mainly)
- v) The non-farm enterprise (wage/salaried employment, petty trading and crafting)
- vi) Borrowing and lending

To the extent that borrowing does in many instances allow smallholder households access to scarce capital resources which could supplement what can be generated on the farm, it was also considered as an inflow into the farm and credit repayments as outflows.

Among the commonly used farm inputs  $x_i$  seeds, fertilizers and crop pest and disease control chemicals. The number of miscellaneous inputs such as gunny bags can be very large, depending upon the crop enterprise in question.

$$K = \sum_{i=1} (p_i k_i - p_i x_i) \quad i=1,2,\dots,m \quad (2)$$

Where  $K$  is 'net' income generated through operation of the KDPG enterprise and  $p_i$  represents factor  $x$  and product  $k$  prices.

$$I_t = \frac{K_t}{(Y_t + K_t)} \times 100 \quad t=1,2,\dots,s \quad (3)$$

$I_t$  represents impact of the KDPG in the  $t$ th site, cluster or farm household, as the case may be.

Although cash remittances and credit were regarded as inflows and gifts and loan repayments were considered to be outflows, these did not directly enter into the calculations of net income from farm operations.

### **Main Findings**

The impact assessment study was designed to estimate likely impacts of the KDPG technology on household income, division of labor by gender and age groups within the smallholder families, crops and livestock interactions, and potential flexibility of the package.

We summarize the main findings relating to the contribution of the KDPG to income and nutrition in Table 1.2. In addition to these contributions, there were other benefits associated with the KDPG enterprise. These were direct consumption of the KDPG meat and production of manure which must have gone into improving the cropping system.

In the Machakos cluster, seasonal crops contributed well over half of the household income. Other important sources were livestock sales as well as remittances from those working off farm. Perennial crops and credit seem to have contributed little. The KDPG enterprise contributed 2.58 per cent to farm income in the lowlands (Kimutwa) and 4.65 percent in the highlands (Kitanga) cluster. This stands in sharp contrast with the situation at the Coast. The Kilifi cluster income generated from the KDPG represents 20 percent of the income, 10 percent in the case of Vuga and 4.6 percent in the case of the HPI/Matuga cluster. These percentages are sensitive to the size of the income, as it can be seen in table 1.2, because the net value contribution (in Kenya Shillings) does not exhibit those differences. Net contributions are higher in the case of the Kilifi cluster and this relate to milking information. Remittances were five percent of total farm value produced in 1995 by the Kitanga cluster, 4 percent for the Kimutwa cluster, 11 percent in the Kilifi cluster, 12 percent for the Vuga cluster. Absolute value of the remittances did not vary as much as the relative importance result of the greater differences in total value of production. Perennial crops clearly have a major role in their smallholder economy of the Coast. The contribution of the KDPG in the Vuga cluster is between 2 and 5 times that of the Machakos clusters.

**Table 1.2 - Contribution of the KDPG Enterprise to the Farm-Household (Cash and in Kind) Income Expressed in Kenya Shillings.**

	Kitanga	Kimutwa	Kilifi	Vuga	HPI
<b>KDPG</b>					
Weight gains (value in KShs)	1191.00	1258.67	1748.58	1202.48	867.00
KDPG milk (value in KShs)	446.40	235.20	1166.80	364.80	375.60
Sub-total (KDPG)	1637.40	1493.87	2915.01	1567.28	1242.60
<i>Less variable costs</i>	<i>-107.00</i>	<i>-169.00</i>	<i>-308.28</i>	<i>-207.5</i>	<i>-240.00</i>
<b>KDPG (net contribution)</b>	<b>1530.40</b>	<b>1324.87</b>	<b>2606.73</b>	<b>1359.78</b>	<b>1002.60</b>
<b>Crops</b>					
Seasonal crops	19717.00	30829.00	2789.00	2737.00	2960.00
Add tree crops	139.96	130.30	6019.00	7629.00	4886.00
Sub-total crops	19857.00	30959.30	8808.00	10366.00	7846.00
<i>Less variable costs (KShs)</i>	<i>-3887.00</i>	<i>-3754.00</i>	<i>-171.00</i>	<i>-608.00</i>	<i>-492.00</i>
<b>Net contribution (Crops)</b>	<b>15970.00</b>	<b>27205.30</b>	<b>8637.00</b>	<b>9758.00</b>	<b>7354.00</b>
<b>Livestock</b>					
Cattle	13018.80	20000.00	0.00	0.00	10000.00
Goats	1950.00	2811.11	1662.50	1866.60	2558.00
Sheep	875.00	800.00	0.00	0.00	0.00
<b>Sub-total livestock sales</b>	<b>15843.80</b>	<b>23611.10</b>	<b>1662.50</b>	<b>1866.60</b>	<b>12558.00</b>
Add cattle milk	837.96	352.80	652.40	828.00	1149.60
Subtotal	16681.70	23963.90	2314.90	2694.60	13707.60
<i>Less variable costs</i>	<i>-1266.70</i>	<i>-1083.30</i>	<i>-800.00</i>	<i>-336.00</i>	<i>-433.00</i>
<b>Net contribution (livestock)</b>	<b>15415.00</b>	<b>22880.60</b>	<b>1514.90</b>	<b>2358.60</b>	<b>13274.60</b>
<b>Contribution by farm enterprises</b>					
Crops	15969.96	27205.30	8637.00	9758.00	7354.00
Livestock (other than KDPG)	15415.01	22880.58	1514.90	2358.60	13274.60
KDPG	1530.40	1324.87	2606.73	1359.78	1002.60
<b>Total value of farm production</b>	<b>32915.37</b>	<b>51410.75</b>	<b>12758.63</b>	<b>13476.38</b>	<b>21631.20</b>
Crops %	48.52	52.92	67.69	72.41	33.99
Livestock other than KDPG %	46.83	44.51	11.87	17.50	61.37
<b>KDPG %</b>	<b>4.65</b>	<b>2.58</b>	<b>20.43</b>	<b>10.09</b>	<b>4.63</b>

Source: Data base monitoring 1995.

The KDPG was intended to enable smallholders for whom dairy cows were out of reach to have access to milk. Milk production was therefore an important aspect of the KDPG impact assessment. This assessment involved the estimation of the numbers of farmers who milked the KDPGs, the amount of milk produced, the amount sold, if any, and the prices obtained. The main findings are presented in Table 1.3. No less than 21 farm families, 2 in Kitanga, 4 in Kimutwa, 3 in Kilifi, 8 in Vuga, 4 in the HPI clusters had some goat milk during 1995. KDPG milk accounted for 20-42 per cent of milk produced.

**Table 1.3 - The Value of Milk Production in the Five Clusters**

Cattle/Goat milk	Cluster					Total
	Kitanga	Kimutwa	Kilifi	Vuga	HPI	
Milk	Value-KShs	Value KShs	Value KShs	Value KShs	Value KShs	KShs
Cattle	837.96	352.80	652.40	828.00	1149.60	3820.76
No. of obs.	8	8	5	2	4	27
Cattle %	65	58	80	69	75	
Goat	446.4	235.2	1166.8	364.80	375.60	1606.80
No. of obs.	2	4	3	8	4	21
Goat %	35	42	20	39	25	
Total	1284.36	606.00	819.20	1192.80	1525.20	5427.56

Source: Monitoring Data Base Socioeconomics.

**Table 1.4 - Land Use Credit and Remittances by Cluster at the Coast and Machakos During 1995.**

Cluster	Land Use (acres)	Remittances K.Shs.	Credit K.Shs.
Kitanga	27.8 (33)	1520 (1322)	80 (177)
Kimutwa	17(16)	1982 (2752)	228 (539)
Kilifi	15 (6)	1466 (929)	-
Vuga	9 (5)	1692 (2025)	-
HPI	8 (6)	800 (578)	850 (1344)

Source: Land size Baseline 1993, Other Data Base Monitoring, 1995. Standard Deviations in Parenthesis

### Impact on the Crop Livestock Interactions

Crops and livestock interactions in smallholder farming often involve the feeding of crop residues to livestock; use of organic fertilizer to raise yields through improved plant

nutrition, and in the case of oxen, supply of draft for timely field operations. Although the number of goats was small, these interactions were observed in all the five clusters. In all the three clusters at the Coast, all farmers reported that they used maize bran to feed the KDPGs, while in the Machakos clusters, various types of crop residue were used as supplementary feed for the goats. Goats produced manure which farmers claimed was richer than that from local goats. Average production of KDPG manure was 81 and 67 kg per goat in the Kimutwa and Kitanga clusters respectively. At least seven households had some KDPG meat, three in Kilifi, one in Kitanga, one in Vuga and one in the HPI clusters.

## 2. Gender Analysis

Field research on three specific activities of the household impact assessment workplan were targeted from June through August. A combination of open ended interviews and a questionnaire, were completed. Qualitative and quantitative analyses was conducted. The questionnaire included three areas:

- a. Gender Analysis: Gender domains with the introduction of the KDPG to understand technology domains to assist with diffusion and extension. This focused on labor and income to determine the domains of the economic activities related to the KDPG to understand the new household dynamics introduced by the new activity;
- b. Adoption of technological practices to determine if there are differences in adoption of elements of the technological package, and analyze the correlation with gender, income, ethnic and religious, distance to markets, availability of inputs, and/or agroecological conditions; and
- c. Credit sources available to farmers by gender. Data for the Machakos cluster has been entered and cleaned. Questionnaires for the Coast are currently being entered. This will be analyzed in the first quarter of 1997... Some frequencies from this survey have been completed and incorporated in to the "Of goats groups and gender" report.

The qualitative research took place from June through August. Results are presented in the technical report TR-MU-1 "Of goats groups and gender". It was clear in all clusters that women were the primary caretakers of the goats. In the open ended questions, the farmers were asked to explain what happened to a goat throughout the day. In most cases, it became clear that women were responsible for daily care of the goats and for its general management. Yet there were differences between the two regions. This may be directly related to access to information. In Machakos, the women attend meetings, are often members of other groups, and have time to interact and exchange information. In the Coast, men are seen as better caretakers, because they appear to be more knowledgeable of the management system. Men usually attend the meetings, while women have little time to access information on the care of the animals, because they are more likely to be working at home.

### 3. Flexibility of the KDPG Technological Package

The tradition of livestock is very important in the adoption of the KDPG. Farmers in Kwale knew the most about the various technologies that accompanied the KDPG. In contrast the farmers of Machakos district were less able to enumerate the various technologies, and were also less likely to use them, with the exception of the sheds. On the other hand, the farmers in Machakos were more likely to use technologies learned for other purposes, for instance, nappier grass.

Farmers at the Coast, have not been pastoralists, therefore they are more likely to adopt 'the whole package'. On the other hand farmers in Machakos have a tradition of raising goats, and thus are more relaxed, adopting elements that interest them.

**Table 1.4: Adoption of KDPG Technological Elements at the Coast and Machakos, 1996 (Number of Farmers).**

Technology	Machakos	The Coast
Milking	8	7
Fetching Water	8	21
Cut and carry	11	10
Herding	8	19
Tethering	8	19
Kidding	10	21
Planting Fodder	11	13
Record Keeping	7	11
Spraying and Dipping	12	20
	N=12 (with KDPG)	N=23 (with KDPG and Crossbreeds)

Source: Resource Management Labor and Gender Questionnaire, 1996, and "Of Goats Groups and Gender".

## Activity II: Markets: Multiplication and Privatization

### *Problem Statement and Approach*

At the market level an analysis of sustained models for the multiplication of the Kenya Dual Purpose Goat Multiplication Program will be documented. Two distinct models will be analyzed: privatized multiplication flocks of elite KDPG (moderate/commercial and small scale/micro-enterprise), and the upgrading model (at the small scale).

Case studies will be developed documenting the small scale multiplication schemes at the Coast and Machakos. Both the pure breed pass on scheme and the up-grading schemes will be analyzed. Prices of KDPG bucks will be recorded, as well as the rules set by each cluster to ensure both the pass on mechanisms and the rotation of bucks. Capital accumulation at the household and community levels generated by the sales of bucks for upgrading will be recorded. Interviews will also be conducted with Non Governmental Organizations interested in facilitating credit for micro-enterprise development.

A study of privatized multiplication flocks of elite KDPG with moderate scale commercial producers will be undertaken as part of the component's effort to sustain multiplication of this breed. Socio-economics tasks are two: 1. Market analysis of current pure breeds in Kenya to look at price formation to set a price for the registered KDPG; and 2. Development of instruments for the economic evaluation of this multiplication strategy.

### *Progress*

Commercial multiplication was initiated with an analysis of the potential multipliers and selection of two breeders. Profile of the Kenya breed market was developed and reported in last years annual report. The study served as a base to set the prices for sale to commercial multipliers. At the end of July 1996, KDPG seed stock was sold for this purpose to these selected commercial farmers. Two commercial multipliers signed agreements with KARI (see breeding annual report). Instrument for data collection of the commercial multiplication process was developed with the other projects. Evaluation of the multipliers will take place in 1997.

The upgrading multiplication process will be formulated for the full proposal for regionalization of the KDPG. Here we report basically on the process of the multiplication through the pass on. Details on community organization related to the pass on are described in activity III.

The initial clusters had 20 members each. By 1996 each cluster had 17 active original members. Four of the clusters started at the end of 1993, while Kilifi started in March of 1994 with does that were not pregnant, which has affected the multiplication process delaying roughly from ten to twelve months. Therefore numbers on growth are not comparable between Kilifi and the other four clusters.

**Table 2.1: Households Owning KDPGs and Upgrades, and Growth of Flocks.**

	Kimutwa	Kitanga	Vuga	HPI	Kilifi	Total
Farmer# with KDPG	9	8	14	4	7	42
KDPG #	19	22	49	11	20	131
Farmer # with Up grades	1	0	9	-	2	12
Upgrades #	4	0	35	-	3	42
%Pass-On	52.9	47	82	29	41	49

Source: Resource Management Labor and Gender Questionnaire and Monitoring Data Base.

Activities in 1995-1996 have focused on the small scale/micro-enterprise multiplication model. Assessment of the rate of pass-on and identifying constraints are activities under the economic assessment of the KDPG on farm. Crosses of native does with KDPG bucks are being documented to provide information for the development of a model of multiplication through up-grading.

At the small scale level the pass on rate shows that the Vuga cluster has completed almost the process to all the original members in waiting, 82 % (see table 2.1). The other clusters have had more difficulties in the process. The Kilifi cluster has a delay of almost a year because the does were place on farm almost five months later and were not in kid at the time, and the pass on rate is close to the experienced in Machakos. The Matuga cluster has not performed well. Analysis of the development of pass on institutions is developed in activity III.

In terms of the growth of KDPG numbers, this have increased by 262 % from the original base flock of 50 placed on small scale farms. Mortality rates were high in the first year affecting the rate at which the flock grew. A progress report of the animal health project (1996) indicates that the mortality rates during this year have dropped dramatically, which will contribute further to the multiplication and the pass on of the KDPG.

### **Activity III: Community: Social Networks**

#### *Problem Statement and Approach*

This activity focused on Impact of the KDPG at the community level, both at the Coast and Machakos in terms of the development of social networks and positive externalities. Successful economic development is currently being correlated to the strengths that communities may have. Social networks facilitate access to resources in situations where markets do not function efficiently. The introduction of the KDPG in the Kwale, Kilifi and Machakos is based on a community effort.

Social capital may be defined as the diversity of networks (social) that a person, family or household (or community) belongs to, allowing access to resources, information or assistance (insurance in case of income shocks). The networks may serve different purposes. Structural adjustment programs in some developing countries motivated the formation of networks so families could deal with the problem of hunger. People's kitchens became popular in poor urban areas. In Andean societies rural communities that have strong traditions and governing rules access their "social network" to use and exchange resources and services. A strong social network allows households to access resources under market failure conditions. SR-CRSP in a Bolivian peasant community showed that the presence of networks allowed families with different levels of wealth access to similar amounts of land. Existence of a strong social network also resulted in the construction of facilities, irrigation systems, tap water in the community reducing risk and improving the quality of life. Access to information was also instrumental in seeking funding for development projects for this rural community.

The approach that we use is development of case studies documenting past community efforts, and requirements introduced by the small scale multiplication effort not in place before. Some have been more successful than others in promoting cooperative actions and this will be analyzed, taking into account their history, social relations, economic base and demographic characteristics. Information is currently being collected on non-market mechanisms to access resources. Pass-on of the KDPGs, funding mechanisms for various related activities, and degree of participation will be documented. Criteria for evaluation was the development of case studies based on the five cluster to characterize the positive externalities of the pass on, and the importance of networks and social capital in the success of the multiplication efforts.

### *Progress*

Impact of the KDPG at the community level in terms of the development of social networks and positive externalities: PRAs and Actor Oriented Research. It is important to note that this research captures the perceptions of the farmers.

### **Participatory Rural Appraisals**

A series of participatory rural appraisals (PRAs) for the purpose of improving current understanding of the social and economic mechanisms which might propel smallholder adoption decisions pertaining to KDPG technologies were implemented. In response to concerns expressed about the poor performance of the KDPG technology on the farms in the Machakos site, two PRAs were implemented in the site in the third week of December 1995. The purpose, to facilitate a common understanding among farmers, KARI/SR-CRSP researchers, and extensionists about causes of poor performance. Standard PRA procedures were used with minor adaptations. PRAs were also conducted at the Coast, especially at the Kilifi cluster. During the second week of July 1996, KARI/SR-CRSP researchers and members of the local extension service conducted a PRA among farmers

within the Kilifi cluster, at different levels of the organization.

### **Social Networks and Community Perceptions**

Field work conducted during June July and August at all clusters, with actor oriented approach has been completed. See technical report TR-MU-1 "Of Goats Groups and Gender". Main findings on the pass on and community networks are the following:

Social networks are an integral part of the KDPG. In the case studies it became very clear that each group interpreted differently the purpose of the group, and goals. Vuga is closest to the initial objective for creating the groups, and has the past experience of members belonging to HPI. Kitanga has been the most creative with the group, using it as a means for uniting them for other projects as well as creating an ethic that secures that in the end all members will have a goat. Kilifi and Kimutwa are still trying to find a position for the group in their communities.

Each group however, seems to require a certain impetus to ensure its survival. However too much intervention is also not good, as is seen in Kilifi, to the degree that some members did not believe the goats really belonged to the group. It is interesting and important to note that each group has fostered new networks in their communities. It is crucial for any new research to be able to gauge exactly how important the existing networks are for future pass-on systems. Further research will be done in 1996-1997 with the information gathered and the resource management labor and gender questionnaire which captured information on networks. The groups have provided some members with an opportunity to learn about goats and how to organize themselves.

Cohesion is important and it is something all the groups lack. There was very little (or no) collective history in the groups. Most of the information that members provide on the functioning of the groups was sparse. Both cohesion and social networks require some time. All the clusters are very young in this sense, and have not established themselves to cultivate networks that may assist with the pass on system. The PRAs described above were in this sense very important. Although they were meant to get information from the farmers, they also served as a venue for them to meet. In other words, time and opportunities to interact are important elements in making the pass-on system a success.

Active participation and contact with leaders, may this be through extension or from within the group, may have a positive effect as was experienced by the Vuga cluster. On the other hand, in the Kilifi cluster the same active participation resulted in a sense of the goats not belonging to the farmers. The contact that brings with it information about the goats and the groups was a positive effect on the Vuga cluster.

The case studies show that each group has a distinct dynamic. The biggest difference seems to be the level of interaction group members have with each other. The group that has performed better in terms of pass-on is also the one with most contact among members. An objective of the pass on set up by the project was to use the group as a

mean of social control to ensure care of the goats. Though the concept is good, groups limited contact, could not build social networks to enforce this form of control. The groups were much too young, and although the farmers are in the same area and know each other, more opportunities are required to build social networks. These are very important in a system like the pass on, but little attention has been given so far to mechanisms for building them.

It is clear that the direct interaction between the farmers in the group and the people from the project is very important. The group with the most face to face contact with the project has the highest pass on rates (Vuga). The groups with little interaction have lower rates of success (Kitanga and Kimutwa). In the Kilifi cluster, too much intervention has created a sense of not belonging, ambivalent results.

Delay in passing on does is one of the major constraints identified by some clusters. This may be attributed to lack of social control, little pressure exists to avoid goat deaths. It may also be attributed to high mortality in previous years, and higher male kidding rates and abortions.

Two general questions drive this research activity that we will continue to pursue in 1997:

- a. How does the KDPG pass-on contribute to the development of social capital?
- b. How does the existence of social capital (presence of networks, other group organizations, active leaders in the community) contribute to the success of the KDPG multiplication effort through the pass-on system?

Our hypothesis is that differences in existence and strength of social networks and leadership in the community will be correlated to the level of success of the clusters; the higher the social capital the most successful the cluster will be in the pass-on and seeking assistance when problems arise. Extended families, ethnic groups, presence of community organizations to improve infrastructure are forces that can contribute to social capital formation. It is also important to discern if the success of the pass on is related to more or continuous presence of extension and research personnel at the household, training opportunities, education level, or other income generating opportunities. Therefore non governmental organization's work with livestock, especially small ruminants and pass on systems will be studied further.

## *Training*

### In the U.S.

The SR-CRSP project is not currently funding training of graduate students through this program. There are two graduate research assistants involved in activities related to the SR-CRSP, one from Rural Sociology, Nicoline de Haan, and one from Agricultural Economics, Dekha Sheikh. A Kenyan undergraduate is involved in the resource management and labor activities related to the KDPG and is completing an internship with us. Ms. Grace Njeru was field assistant for the impact assessment in Machakos before coming to Missouri to complete her undergraduate degree. She is writing a literature review on gender research and working on the development of a data set from the Resource Management Labor and Gender questionnaire in Machakos and the Coast.

### Short term in Kenya

Elizabeth Wekesa and Lutta Muhammad were involved in the planning and execution of several PRAs in the Coast area and Machakos to bring together the members of the pass on clusters.

### *Other Contributions*

**Environmental:** Introduction of livestock is carried out with a supporting package to avoid the negative effects encountered in some areas as a result of overgrazing. Manure from the goats is used to enhance soil productivity by the farmers participating in the impact assessment

**Agricultural Sustainability:** The KDPG is being assessed in two different agroecological environments to test the flexibility and adaptability of the technological innovations.

**Contributions to U.S. Agriculture:** research experience in interdisciplinary research and micro enterprise development are crucial to sustainable production systems design in Africa and in the new agricultural policy setting of the U.S.

**Contributions to host country:** development of interdisciplinary on-farm methodologies for biological and social science research at NARS. Introduction of livestock enterprises increase economic security and induce investments facilitating transition to market economies. Facilitating the commercial multiplication of the breed, the KDPG, contributes to the sustainability of the technology in the long run. Collaborative research with KARI scientists strengthens both U.S. and Kenyan research institutions, and provides opportunities for exchange that last many years.

**Linkages:** This is being developed with NGOs such as Heifer Project International, to assist in the on-farm multiplication and diffusion of the KDPG. This year Farm Africa and other institutions have been visited to establish linkages for the regionalization of the KDPG.

**Gender analysis:** our household level analysis includes intrahousehold allocation of resources and income domains, as well as decision making. Since a form of impact is on nutrition, and studies show that women outspend men 1 to 30 on food purchases for the children, we have to consider who manages the outputs generated by the KDPG, and look for mechanism to facilitate the flow if it does not exist.

**Collaboration:** The Sociology project bases its research on collaboration between Kenyan and U.S. scientists, and among all disciplines participating in the component; Collaboration with the private sector (commercial multipliers) and NGOs.

**Support for free markets and broad based economic growth:** growth of in kind and cash incomes contribute to family welfare, enabling accumulation and diversification to other economic activities, facilitating the development of demand, crucial in economic development.

**Contribution and compliance with mission objectives:** commercialization and micro-enterprise linkages of rural-urban flows, is being emphasized by the USAID Kenya Mission. Our research is looking into privatization and community organizations, as well as safety-net mechanisms that will contribute producers participation in the markets.

**Concern for individuals:** The focus is on peasant household families, and the purpose is to find ways to increase their welfare through technology and policy. Measuring the impact of the KDPG may be performed from the perspective of how this effort/event in their village, contributes to the development of networks that create other positive externalities. For example, Kilifi farmers visited in August of 1995 mentioned that members were contributing funds to the group and there were discussions of investing in other enterprises, and that if the KDPG had not come they would not have met as they were now doing. (Another, maybe positive externality, brought by the fact that the research project is working with extension, is that farmers are establishing links and obtaining information from the government extension services officers). Positive impacts of the KDPG may be catalyzing the construction of networks outside the extended family setting, building social capital. These groups are an asset when there is interest in accessing group lending institutions.

**Support for democracy:** improving the economic and nutritional well being of families through the KDPG increases their ability to participate in the economy. The KDPG has also increased the ability of farmers to organize and seek other projects, helping build social capital.

## *Collaborating Personnel*

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### *Reports and Publications*

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## *Comments*

This was a very active year. We had a resident scientist conducting research at Machakos and coordinating data collection and processing for the Coast and Machakos. At first responsibility for the Coast was placed in the Collaborating Scientists, but a readjustment took place, in coordination with them because data collection was still a problem at this site, even when research funds were available. The resident scientist had responsibility for KDPG research activities and coordinated with Willie Njoroge, who conducted an evaluation of breed markets for the impact assessment, and later concentrated on animal health research. The resident scientist was assigned to the site for a month to solve problems of lack of data for some farmers. We also had the opportunity of sending a doctoral candidate, rural sociologist Nicoline de Haan to conduct field research at both sites and coordinate the field testing and application of the resource management and labor questionnaire. Finally we were able to obtain internship funds for Grace Njeru to review the literature on gender and livestock for developing countries and work on the development and processing of the data from the resource management questionnaire. The Machakos data has been entered. The Coast questionnaires were recently completed and sent to Missouri for processing and analysis. The cars are a little bit old, some repairs delayed access to the field but the problems were solved.

## **Animal Health Management Through Biotechnology Component**

### *Narrative Summary*

Two activities were conducted in year 17 by the Kenya Agricultural Research Institute and the University of Missouri in social science research related to animal health. The first is the study of vaccine production and distribution, which was conducted in collaboration with the Kenya Veterinary Vaccine Production Institute. Three specific objectives were: to determine the economic costs of production of the Contagious Caprine Pleuropneumonia (CCPP) vaccine in liquid and lyophilized forms; develop a profile of users of the vaccine, identified through sales by KEVEVAPI, sole producer of Caprivax; and to determine the level of competition in use of facilities, equipment, and labor in the production of Rinderpest Caprivax and Contavax vaccines. Costs of production were analyzed and recommendations to increase efficiency proposed. Sensitivity analysis was conducted to determine levels at which current prices would be economically efficient. The analysis of competition shows that given current vaccine production levels there would not be competition in the production of lyophilized CCPP vaccine. The market profile highlights the declining role of government as main buyer of the vaccine and the increasing participation of private individuals and nongovernmental organizations as consumers in this market.

The second main activity was to study the demand for animal health services, with an emphasis on CCPP vaccine as a case study. We conduct this study with the collaboration of the Kenya Veterinary Field Services Office. A study was conducted on the availability and use of animal health delivery services at the sites where the Kenya Dual Purpose Goat is being tested. The report appears in year 16 SR-CRSP annual report. After an appraisal of the knowledge of animal health delivery services for small ruminants we decided to conduct a study to determine the demand for these services and for CCPP vaccines, specifically. A survey was developed and field tested with the farmers participating in the testing of the lyophilized CCPP vaccine. Three sites were selected to conduct the study, Koibatek (pastoral production systems), Kitui (agropastoral production system) and Kajiado (pastoral production systems). All are CCPP endemic areas. Preliminary data analysis from the Koibatek study shows that farmers are not aware of the existence of the vaccine. Demand estimations for the liquid and lyophilized vaccines will be conducted in 1997. We have also developed a World Wide Web site where technical reports and other publications may be found. Our address is:

*<http://www.ssu.missouri.edu/ssu/srccrsp>*

## *Research*

The SR-CRSP animal health research component since the early 1980s has focused its research on the development of vaccines for small ruminants. A Caprine Pleuro Pneumonia vaccine was produced in the 1980s, in liquid and freeze dried forms, and developing of multivalent vaccines for small ruminants continues. At present changes government policies affecting the Veterinary Field Services are affecting animal health delivery, from production to consumption. The activities reported by socioeconomics project concentrate on two specific areas of the delivery system and focuses on CCPP vaccine as an example, the production of CCPP vaccines (liquid and freeze dried) by KEVEVAPI and the use of vaccines and animal health services by the small holder livestock producers.

### **Activity I: Vaccine Production Distribution and Use**

#### *Problem Statement and Approach*

The original intent of socioeconomic research on the CCPP vaccine was to measure the impact, or potential impact of small ruminant diseases and the saving that vaccines can provide. Measuring this impact requires an understanding of the costs of production and delivery of vaccines, as well as the costs of the disease to producers in the absence of the vaccine. Elements required for this assessment are the activities carried out this year, both on the production and delivery of vaccines, as well as the characteristics of producers, potential buyers of vaccines: assessment. The potential economic impact of vaccine research by the SR-CRSP on CCPP, required information on current and past reported outbreaks, animal treatments and losses due to this disease, and cost saving to producers. Comparisons of treatment costs vs. vaccinations are made to determine unit cost reduction in the production of small ruminants. Two levels of impact may be measured, the first the result of the production of CCPP vaccines, the second the cost reduction result of the freeze dry processing stage of the vaccine.

The approach used was outlined in our work plan: to determine the feasibility of a returns to research study on CCPP, *sondeo* type interviews will be conducted at each step of production distribution and user chain. KEVEVAPI officials will be interviewed to determine current production conditions and who the buyers are. Interviews with health service providers, and agencies funding vaccination campaigns. This rapid appraisal inform on the need for further study of the demand for animal health preventive services. Costs of vaccine production will be calculated, if collaboration with KEVEVAPI is established. Outbreaks will be documented through government records. An appropriate methods to assess the impact of the vaccine will be selected. Absence of epidemiological research on CCPP difficults measure of potential returns to research.

## *Progress*

The review of methodologies to measure the impact of vaccine is complete and is part of a technical report: "The Small Ruminant Industry in Kenya: Assessing Returns to Animal Health Research and Vaccines, A Review" that will be available in February of 1997.

Collaboration with KEVEVAPI was established to achieve three specific objectives: a) to identify the buyers of Caprivax at KEVEVAPI; b) to estimate and compare the production costs of both types of Caprivax (CCPP vaccines), liquid and lyophilized; and c) to establish whether there is competition for machinery between Caprivax and the two other vaccines that are produced at the Muguga production unit, namely Rindervax and Contavax.

To determine if there was need to study the causes affecting the delivery of animal health services and CCPP vaccines several interviews, "sondeos", at the research institutions (domestic and international), the production centers for vaccines ((KEVEVAPI), the extension services working on the delivery of health services, and with the district and division veterinary officers as various sites. The purpose, to understand what is known about the presence and effect of CCPP on small holder flocks, and the animal health delivery system for small ruminant producers.

Officers from ODA, ILRI, KEVEVAPI, and the Veterinary Field Services were interviewed, and a common statement was that there was not enough information on the reasons for lack of use of the vaccine and constraints to the delivery. Statements from the Field Veterinary Services indicated that farmers did not want or were unable to pay for the vaccine. Information on outbreaks reported by the Field Veterinary Services, would record initial mortality when reporting outbreaks but not the total mortality nor morbidity rates associated with them, therefore not a good indicator of the patter of the disease. The outbreaks would be lower bound indicators, since all are not officially reported.

### **Demand For Vaccines: KEVEVAPI**

A first approximation to the demand of vaccines was through the sales by KEVEVAPI, the sole producer of the vaccine (Caprivax). A market profile was developed to understand who the users of the vaccine were in the past five years. Sales were summarized for the period 1991 through 1995 (see table 1). Data indicate that the government was the most important costumer, at the beginning of the 1990s with a decreasing participation as cost recovery policies are introduced (see table 1). The export and NGO markets are thin, and volatile. The private individuals purchasing directly the vaccine are increasing but have not been able to substitute for the main buyer, the government. Sales in 1995 were fifty percent lower than in 1991. As a consequence, KEVEVAPI reduced the production of vaccines. The decrease in government purchases, the reduction in vaccination campaigns and the market volatility have led in 1996 to a situation where outbreaks are taking place, and KEVEVAPI is having difficulties filling the increased demand, both from the private and NGO sectors (see Technical Report: An Economic Analysis of the Production and Distribution of CCPP Vaccine).

**Table 1 - Sales of CCPV Vaccines by KEVEVAPI 1991-1995 (number of doses).**

Buyers of Caprivax (CCPP vaccine)							
Year	Govt.	Private	NGO	Export	Research	Parastatal	Total
1991	127,500	1,009	0	0	0	0	128,500
1992	44,400	17,400	46,400	10,000	4,600	200	122,000
1993	150,150	41,950	0	0	3,300	2,000	160,400
1994	80,000	68,600	3,300	0	2,000	0	153,900
1995	22,850	39,250	600	0	1,700	0	64,400

Source: An Economic Analysis of the Production of CCPV Vaccine, 1996.

### Cost Analysis of CCPV Vaccine Production

Production costs were estimated using the vaccine formula (variable inputs) as well as assigned fixed capital and labor. Costs were calculated for 1991 to 1995, allowing to measure changes in productivity which have direct impact on the average cost of production. Sensitivity analysis was carried out to assess production conditions of CCPV vaccine that are economically efficient. Results on productivity indicate that KEVEVAPI was not operating in previous years to full potential. This is reflected in the doses per batch, the maximum potential being 20,000 doses per batch.

Table 2 presents the costs of production calculated for Caprivax using actual production data for the period 1992-1995. Current yields are lower than the potential level, especially because of recurrent losses of the culture through contamination, as the efficiency indicator shows. Sensitivity analysis measured the effect of improved production process that minimize frequency of culture media contamination.

**Table 2 - Production Efficiency and Average Cost in Kenyan Shillings of CCPV Vaccine (Caprivax) at KEVEVAPI**

Year	Batches Total/Efficiency %		Doses produced	Average Yld/batch	Average Cost liquid	Average Cost freeze
1992	17	53%	66,100	3,889	11.60	16.20
1993	31	97%	180,450	5,821	5.50	8.34
1994	43	58%	171,500	3,989	7.21	10.20
1995	22	41%	67,800	3,082	11.83	17.30
Average	29	66%	121,463	4,300	7.59	11.16

Source: "An Economic Analysis of the Production of CCPV Vaccine".

Table 3 presents an average yield based on production between 1992 and 1995. Sensitivity analysis modifies productivity to increase towards potential. Only with yields of 10,000 doses per batch or more costs of production equate the price set by the government. Details of the analysis and scenarios can be found in the technical report "An Economic Analysis of the Production of CCPV Vaccine." Recommendations were formulated to KEVEVAPI, result of the study, to reduce losses in the production process. Both the liquid and freeze dry vaccine costs were calculated, as well as the competition for equipment.

We still need to understand the discrepancies between the numbers quoted in the vaccination campaign record and the production of the vaccine, because the latter is lower than reported vaccination campaign numbers. We also found from the analysis that there is no competition in machinery nor labor in the production of CCPV vaccine, both in the liquid and lyophilized forms, at the present production levels of Rinderpest and Contavax.

**Table 3 - Sensitivity Analysis With Different Yield Levels.**

Year	Total batches	Yield/batch	Cost/unit (liquid)	Cost/unit (freeze)
Aggregate 92-95	113	1 <sup>a</sup> = 4,300	5.53	11.34
		2 <sup>b</sup> = 7,000	3.40	5.06
		3 <sup>c</sup> =10,000	2.38	3.93
		4 <sup>d</sup> =12,000	1.98	3.49

Source: Ibid.

Key: a is the actual yield/batch obtained,

b, c, d are sensitivity analysis with three higher levels of yield per batch.

### **Demand of Animal Health Services**

This is also an important part of the research in Activity II. Based on a rapid appraisal, interviews with decision makers and researchers, the project decided to conduct a study of animal health delivery and demand services. This would inform KEVEVAPI and animal health providers of the market conditions and potential for vaccines, and the constraints faced by users (household producers) in the delivery of CCPV vaccines and other animal health services. Because production decisions for several economic activities are joint (substitution and complement effects exist), especially in livestock production, information on the production system, demographic and cultural characteristics of the household producers were included in the study.

Four different ethnic groups involved in livestock, specifically goat production were chosen, Masai, Kalenjin, Bantu, and Hamites. Districts for each ethnic group were identified, and one was chosen. The Masai in Kajiado, the Kalenjin in Koibatek, the Bantu in Kitui and the Hamites in Marsabit. During 1996 the Kalenjin in Koibatek were surveyed. The Bantu and the Masai will be studied in 1996-1997. Marsabit, a camel small ruminant production system will be studied by KARI social scientists. Production system characteristics, ethnicity, agroecological/rainfall zones, and market

integration were the variables selected to characterize distinct groups, which may influence decision making. A necessary condition was that all production systems were in CCPP endemic areas, and that vaccination campaigns had been conducted in provinces and specific districts chosen. Support from the Veterinary Field Services Offices in Kabete, districts and locations was obtained for this study. A second condition was that the sites selected reflected the characteristics of the production systems where the lyophilized form of the vaccine was being tested (Suswa, Mogotio, Ngong and Kajiado). In order to assure this, the questionnaire was field tested with the farmers participating in the vaccine experiment. The questionnaire elicited information on the household production systems, animal herd composition, economic activities, livestock composition, animal health problems, and small ruminant diseases.

In order to develop the survey a literature review of methodologies was completed during 1995, a questionnaire was developed and field tested during 1996 and applied to sixty farmers at the first site selected, Koibatek for two months. This was formerly part of the Baringo district, where the Kalenjin live in pastoral production systems with some crop production for home consumption, as the survey results showed. In July 1995, just before the creation of Koibatek from Baringo, the district had the second largest goat population (732,000 head in 1994) after Kajiado (875,000).

Previous reports indicated that this was not only an endemic site with outbreaks, but also had experienced heavy vaccination campaigns financed by the government. Mogotio was the division selected, and two locations identified, Mugurin and Koibos. A sample frame was developed with the assistance of local chiefs, sub chiefs, and veterinary officer, and applied to 60 farmers selected at random. The data was processed and cleaned, and a code book developed. Data analysis is on going, and will be completed in 1997, as will data collection and analysis of additional sites with a contingent valuation model.

Farmers were asked to identify and rank animal diseases, for all livestock and for goats and sheep. They were also asked current methods to treat or deal with diseases, as well as experience with vaccines and animal health providers. Production and income information by economic enterprises was also gathered. A section on CCPP disease sought to understand outbreak patterns in households' flocks, and prevention and treatment methods used by producers, and associated costs. The purpose was to look at the level of risk, probability of occurrence, and treatment expenditures as well as identify economic losses. Distance to animal health delivery and awareness of the existence of vaccines was critical to the contingent valuation study. Willingness to pay information was identified by stating the value in terms of goats and cash income of vaccinating the flock. Some interesting results of the preliminary data analysis indicate that although this is an area of outbreaks, where vaccination campaigns against CCPP have taken place, the majority of farmers were not aware of the existence of the vaccine.

Two other sites will be researched in 1996-1997, Kitui, an agropastoral semiarid district in Eastern Province and Kajiado a pastoral setting (Masai people) in the Rift Valley.

## **Activity II: Animal Health Services and Use at the Household Level**

Address this: If the animal health project conducts the testing of the CCPV vaccine on farm, socio-economics will participate collecting social and economic information on the targeted producers, the costs of vaccination, reported presence of other animals and diseases and their occurrence.

### *Problem Statement and Approach*

Identification of prevalent animal health problems perceived by producers in the Machakos and Coast sites; current treatments and practices reported by the sample; costs, availability, and farmer's use of veterinary services for the KDPG.

### *Progress*

In Machakos and the Coast, a survey has been conducted on the prevalence of animal diseases, use of animal health services, and practices used by farmers. This was already reported on (see annual report 1994-1995). Records on services provided to KDPG by the vet will be recorded as well as the costs incurred by the farmer were captured when the information was available and has been used to calculate net value of the KDPG enterprise (see KDPG Component section in this annual report). A baseline report on animal health diseases and practices used by producers was developed. Data gathered and processed on the costs of treatment of small ruminant prevention and treatment of diseases was calculated and used in the evaluation of the KDPG.

Another level of analysis at the household level was initiated. It consisted of the analysis of small holder production systems and their expenditures on animal health according to animal species and disease problems. This is on-going research conducted in Koibatek, Kitui and Kajiado, as well as the CCPV testing sites. This has been partially reported in Activity I, under Demand for Animal Health Services. Data in Koibatek was gathered during 1996. Sixty farmers were interviewed and the information has been entered and cleaned and is being analyzed. The Kitui sites have been identified and the sample frame developed. Surveys will be conducted in January of 1997. The survey has been field tested. Sixty farmers will be interviewed here, as well as an additional 60 will be interviewed in Kajiado towards April. The five farmers participating in the CCPV vaccine testing experiment were also interviewed.

Koibatek, according to the responses obtained is an area where CCPV is considered a problem by farmers, ranked first as the most frequently mentioned. East Coast Fever was second. It was also interesting to find, that although Koibatek is a district (formerly part of Baringo) experiencing vaccinating campaigns, 60 percent of the farmers were unaware of the existence of the vaccine for CCPV. Fifty percent of the farmers had participated in

vaccination campaigns for other diseases. Valuation questions as well as current costs to deal with CCPP were also elicited. Mortality morbidity and frequency of outbreaks have been recorded. Farmer currently deal with CCPP by antibiotic treatments which they tend to administer themselves.

### *Training*

No training activities were supported with SR-CRSP funding. The University of Missouri, along with a scholarship from Winrock International supports the doctoral studies of Ms. Dekha Sheikh, co-investigator from KARI, who actively participates in the animal health research in the U.S. Her doctoral program started in January of 1995, she has completed successfully her qualifying exams. She remains a KARI employee and is co-investigator in our project. Her research focuses on methodologies for returns to research evaluation of CCPP and estimation models for demand of health services. She has also collaborated in the U.S. with data analysis of the Bolivia SR-CRSP project.

### *Other Contributions*

**Environmental:** Research on animal health is targeted at improving the productivity and feed use efficiency of small ruminants.

**Agricultural Sustainability:** Loss of efficiency resulting from animal health problems is high, and prevention can reduce mortality and morbidity that result in economic losses. To contribute to sustainable livestock production systems, animal health is a necessary condition.

**Contributions to U.S. Agriculture:** research experience in interdisciplinary research is crucial to sustainable production systems design in the U.S.

**Contributions to host country:** Animal health delivery systems are being transformed in Kenya, result of reforms and privatization. The present studies contribute to an understanding of how currently animal health services are delivered and the economic impact of diseases on the flocks of livestock producers in semi arid and arid environments. Collaborative research with KARI scientists strengthens both U.S. and Kenyan research institutions.

**Linkages:** This are being established with NGOs such as Heifer Project International. Linkages with Kenyan Veterinary Vaccine Production Institute and the Veterinary Field Services Offices have been established to provide information useful to institutions dealing directly with the producers.

**Gender analysis:** our household level analysis always incorporates gender questions regarding decision makers and, when possible, identifies income domains by gender.

Collaboration: The Sociology project bases its research in collaboration between Kenyan and U.S. scientists, and the component has a multidisciplinary approach. Collaboration with KEVEVAPI members and with veterinarians in the field have been part of our approach to research.

Support for free markets and broad based economic growth: increasing net in kind and cash income, through efficiency in production, contributes to the welfare of families and enables them to accumulate and diversify to other economic activities, facilitating the development of demand, crucial in economic development.

Contribution and compliance with mission objectives: private sector development is being emphasized by the USAID Kenya Mission. Our research is looking into privatization and community organizations, as well as safety-net mechanisms that will allow producer participation in markets.

Concern for individuals: The focus is on peasant household families, and the purpose is to increase their welfare. Some current practices of treating animals directly by the producers may have impact on family members if knowledge about the antibiotics is not known and products are consumed from treated animals. We are researching the knowledge of farmers regarding appropriate handling of antibiotics.

Support for democracy: improving the economic and nutritional well being of families through increases efficiency.

### *Collaborating Personnel*

#### United States:

Corinne Valdivia, Principal Investigator, University of Missouri-Columbia  
Michael F. Nolan, Principal Investigator, University of Missouri-Columbia  
Dekha Sheikh, Collaborating Scientist, Kenyan Agricultural Research Institute  
Domingo Martínez-Castilla, Research Associate, University of Missouri- Columbia  
Grace Njeru, Collaborating Scientist, Kenyan Agricultural Research Institute

#### Kenya:

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### *Publications*

McCorkle, C. M. And Mathias, E. 1995. Paraveterinary Healthcare Programs: A Global Overview. Livestock Production & Diseases. Proc. 8th Conf. Inst. Trop. Vet. Med. Berlin Germany.

McCorkle C.M. and Bazalar, H. 1996. Field Trials in Ethnoveterinary R&D: Lessons from the Andes.

McCorkle, C. M., Mathias, E. and Shillhorn van Veen, T.W. (Eds). 1996. *Ethnoveterinary Research and Development. IT Studies in Indigenous Knowledge and Development.*

Njoroge, W., Valdivia C., Wachira, J. and Mbabu, A. 1996. An Economic Analysis of the Production of CCPP Vaccine. Kenya SR-CRSP Technical report Series. TR-MU-96-3.

### *Comments*

Activities in Animal Health Research at the user level started this year. This research is on going and the main focus of activities in 1996-1997 as 180 household producers will be interviewed to study the health delivery services available in semiarid and arid regions of Kenya. Resources from the National Agricultural Research Project KARI will fund activities in the Kitui site.

## **Sustainable Agropastoral Systems on Marginal Lands-Bolivia**

### *Narrative Summary.*

Several activities were conducted by sociology and economics in collaboration with Instituto Boliviano de Tecnología Agropecuaria and Utah State University. A research synthesis is being developed, and many chapters were completed this year. A workshop took place in Bolivia in November of 1995. It provided the opportunity to bring together researchers that had been involved in field activities in San Jose Llanga to discuss hypothesis on strategies of farmers in crop livestock production systems in marginal drought and frost prone areas. Research continued on peasant household economic and social strategies that contribute to persistence in the Altiplano. Diversification and the role of livestock in food security were the main topics of publication during this year. Analysis of the household data for 1995 was initiated. It shows the diversification strategies pursued by peasant households in San José during a low rainfall year. This is compared to the strategies pursued in 1993. Marketing systems were studied which show producers of San José responding to market signals in the production of sheep and cattle. Finally a study of nutrition and livestock in Andean communities was initiated and will continue during 1997, supported by the University of Missouri, to look at the role of livestock in household food security. All Bolivian students have completed and submitted their theses. Our collaborating scientists continue to provide them support. Christian Jetté and Jorge Céspedes in Bolivia, and Lisa Markowitz in the U.S. have been essential to our project. We continue to collaborate in research with all of them. Support provided by IBTA allowed us to complete activities and close our program in San José Llanga, providing then community leaders studies that have been used to develop projects to benefit their members. We created a World Wide Web site that presents our activities, findings and publications. Our site address is:

<http://www.ssu.missouri.edu/ssu/srcrsp/srcrsp.htm>

## *Research*

### **Activity I: Synthesis of the Component**

#### *Problem Statement and Approach*

A synthesis proposal was submitted to the management entity in October of 1994. With some modifications, this activity will be lead by L. Coppock. The contributions of social sciences to this synthesis will be the responsibility of C. Valdivia. Some specific areas of contribution in social sciences are: Characterization of peasant households, their differentiation and interaction with higher order systems (the markets and the macroeconomy); the social and economic mechanisms securing access to resources for crop and livestock production; terms of trade between peasant agriculture in the Andes and the rest of the economy; marketing systems for livestock products in San José Llanga; and the role of market integration in risk reduction are on-going activities of the sociology and economics workplan that have been initiated to contribute to the synthesis. An agricultural calendar and a study on technological change in San José are part of the synthesis identifying labor constraints and the role of technology in crop and livestock activities.

#### *Progress*

The following are chapters completed that have or are being revised:

Chapter 2: National and Regional Context describing the national policy, and population, economic and historical context affecting the Altiplano region, specifically the Central highlands of Bolivia. The geography and ecological setting are also presented. Chapter 4: "Historical and Contemporary Aspects of the Social and Economic Setting for San José Llanga Region" by Valdivia, Jetté, Markowitz and Valdivia has been submitted for review. A draft of Chapter 6 has been completed by Valdivia on "Household Organization and Dynamics" which covers household peasant strategies under normal and drought conditions in San José and the role played by small ruminants in both climatic conditions. A chapter 8 on Technology Adoption and Appropriate Technological Concepts for Development" by Markowitz and Valdivia is almost complete. Remain to be added the technology adoption study on the development experiences by development and U.S. research institutions in the 1960s that today are found in the Aroma region.

A logit model to analyze factors affecting the adoption of improved sheep in the Aroma Province, conducted with Dekha Sheikh is showing training, agroecological characteristics, and number of criollo sheep as the independent variables that affect the probability of adoption of improved animals. The results of this study will be included in Chapter 8, and we will develop it further as an ex post analysis of the study conducted on returns to research investments by Wennergren and Whittaker. Finally, a paper summarizing the

projects findings on Social and Agropastoral Production Cycles in San José Llanga is being developed jointly with L. Markowitz.

## **Activity II: Final Workshop**

### *Problem Statement and Approach*

This is proposed to take place in November 1995. Two objectives will be accomplished. Researchers in Bolivia will have the opportunity to participate in working groups to discuss and prepare documents on central questions that will link the research results of the many thesis research themes developed for San José Llanga and Santiago de Machaca.

### *Progress*

The scope of the workshop was revised. It was held in November and consisted of discussion of potential hypotheses that were derived from the three years of field research in San José Llanga. This led to the reformulation of the synthesis as is presented by the Utah State Report and to which social sciences would contribute four chapters, and three developed jointly with range ecology and nutrition. Recommendations were developed at the meeting and shared with IBTA. That meeting also served to gain the support of IBTA in this last year of phasing out to provide access to facilities and communications to the resident scientists in sociology and economics remaining to complete the research.

## **Activity III: Strategies Under Environmental Stress: Delayed Rains and Frost**

### *Problem Statement and Approach*

We are in the process of completing analysis of the baseline data gathered for the gender and livestock project on income generation and the introduction of cash crops (dairy). The need to identify changing strategies under stress for different groups according to economic conditions and access to resources resulted in the application of a questionnaire that also gathered information on consumption and food storage capacity. The data has been entered. This will be analyzed by the co-investigators (resident scientists during the months of December and January) and the principal investigator to understand the role of livestock under climatic stress.

### *Progress*

Two different activities related to strategies under stress were developed. The first was to elicit in a consistent manner farmers' perceptions of previous years related to climatic

events and crop outcomes, and second to analyze the information of the household production income and consumption survey applied in 1995. Preliminary analysis has resulted in three publications, one already accepted, one submitted and a third that needs further analysis.

The first was to understand the role of small ruminants as a risk reduction strategy as well as a liquid asset that could reduce the need to diversify. "Diversification as a Risk Management Strategy in an Andean Agropastoral Community" developed an index of diversification for the economic portfolio of peasant households and studied the correlation between diversification and sheep assets, and the life cycle. Diversification was prevalent regardless of economic and liquid assets, though it was negatively correlated with the life cycle indicating that households with less labor access and at the last stage in the life cycle base their daily sustenance on family linkages and some food crops.

A second paper looks at diversification as a mechanism to fully utilize resources in highly variable economic and climatic environments, looking at the strategies pursued by farmers under stress situations. It also proposes a new perspective to the design of research and development programs in fragile environments ("Peasant Household Strategies Technologies and Diversification in Andean Fragile Lands"). Analysis of data from the 1994-1995 survey was included in this paper.

The third paper, "The Assessment and Forecast of Production from the Producers Point of View" (*Evaluación y Pronóstico de la Producción. El Punto de Vista del Productor Campesino*) was carried out in San José Llanga with J. Céspedes and Lily Rogríguez. Our purpose was to seek farmers' perceptions and assessment of cropping conditions in the last sixteen years. For the period before the most severe drought in the past three decades (1979-1982), during the drought (1982-1984) and after the drought (from 1984-1989) were used as memory landmarks. The years 1990 through 1995 were easier to remember by the producers. The crops used to measure impact were two very important food crops, sensitive to droughts and frosts: potato and quina. Producers were asked about past performance, and forecast future events. The assessment codes used were Very bad (nothing to harvest), bad (when only enough for seed is harvested, quality and quantity are very poor, usually related to frost and hail events), regular (when production only satisfies home consumption), good (when after consumption at least ten percent is available for sales), and very good (when at least two thirds of the harvest can be sold, and good quality crops remain for food consumption).

Results for example indicate that potato crops, during the year of the most severe drought, 12 of 20 farmers had a very bad year, 6 had a bad year and one a regular year. After the drought most had a regular period. 1992-1993 year of the gender and livestock first survey was classified by the households as a regular year, three a bad year and four a good year. The next was a good year for most farmers and 18 of the 20 farmers forecasted 1995 to be a regular year. In the case of quina, with the exception of 1991 most years were regular and bad, and 1995 was especially bad. Correlation between the frequencies in terms of potato and quina production in 1993 and 1995, and farmers' perceptions coincided.

## **Activity IV: Food Security, Livestock and Nutrition**

### *Problem Statement and Approach*

This research activity focuses on the analysis of cash and food crop production in crop-livestock systems, the levels of wealth generated and food security. Information on nutritional status of children was collected and analyzed. This information now will be correlated to data on economic and wealth status of the households. A census on livestock (sheep and cattle) has been updated and will be correlated to nutrition information, along with other relevant variables, such as age and composition of the family, herd composition and sheep production. It has been found that sheep is the domain of women and earnings are invested in food and household purchases.

### *Progress*

Markowitz and Valdivia presented a paper on food security and nutrition in San José Llanga. Results from the production and income survey and the findings from the nutrition study were presented. In on-going research Valdivia is analyzing the relationship between consumption smoothing and sheep remittances and life cycle, and has found all this variables to be significant in a multiple regression study. This research is on-going. Data from the nutritional study was used to create three variables, measuring stunted, underweight and wasted. The sample that we had of 32 children showed 48% were stunted (we were using Bolivian standards), 41% are underweight, and 7 percent are wasted.

Data analysis of the nutritional study in San José Llanga has been correlated with the sheep census of the same year. Correlation among all variables is showing a positive relationship between iron intake and sheep, calcium and milk sales, sheep numbers and weekly food expenses, expenses and iron intake, iron and the number of children in the family, and a negative correlation between sheep and education. The latter may be related to the fact that the younger population has more education and at the same time are at the initial stages of their life cycle as independent families.

Limited dependent regressions looked at the relationship between stunted, and underweight as dependent variables, and a series of socioeconomic characteristics of the household. This research is on going in the U.S. and funding will be sought for this research. Premature closing of the Bolivia program has affected this and research that looked at strategies through time (climatic changes). This research provides information to develop a research proposal that seeks to understand the role of livestock in consumption smoothing, food security, using anthropometric measures to determine the impact of idiosyncratic shocks on household and individual members welfare. We hypothesize that small stock, domain of women in the Altiplano, contribute to consumption smoothing and secure food. Valdivia continues to pursue this research. A paper on consumption smoothing and sheep will be completed this year and used as a basis, along

with the San José nutrition study, to develop a research proposal, possibly in collaboration with Markowitz.

### **Activity V: Marketing Systems of Livestock Products and By-Products: San José Llanga**

#### *Problem Statement and Approach*

This thesis study, guided by Jorge Céspedes, focuses on the marketing systems in place for livestock products (sheep and cattle), and for sales of by-products. A series of interviews and questionnaires have been applied. The purpose is to understand the marketing process and transactions costs present in this area. A data base for interdisciplinary research will be constructed for further analysis.

#### *Progress*

The thesis was completed and defense was set for December. We await information on the successful defense but we don't doubt this will happen. The research reviewed the marketing channels for cattle, sheep and hides in San José Llanga. Distribution channels to La Paz for meat were identified, as were the marketing channels for hides. The study looked at the costs of production and marketing for different types of livestock commodities, and briefly reviewed information on credit markets. Some of this information has been integrated in Chapter Four of the synthesis (Activity I) and we hope that Rodriguez and Céspedes will have the time to publish a technical report and an article from this research. Though the project phased out in June of this year completely, we continue to communicate and plan joint articles from this research. Céspedes developed a data base with the data from the economics thesis that we hope to use in further studies.

#### *Training*

In the U.S. a masters student in Agricultural Economics, Ms Kim Fender, is developing her M.S. thesis on Income domains and gender from the Gender and Livestock Research. She will conduct all her research in the U.S. and is not funded by the SR-CRSP.

#### *Completed*

In Bolivia Lily Rodríguez B.A. Economics, completed her thesis under the supervision of Jorge Céspedes at the University of Oruro. The title of her thesis is Marketing of Cattle and Sheep and Family Income in the Community of San José Llanga.

In Peru, Roberto Valdivia, not funded by SR-CRSP but advised Dr. Roberto Quiroz with co-advising by C. Valdivia successfully defended his thesis on risk in Andean Agriculture. C. Valdivia started this while working in Bolivia.

### *Thesis Awaiting Defense*

Paredes, Valeria, B.A. Sociology, El rol del género en el pastoreo. Estudio de caso: comunidad San José Llanga. (The role of gender in herding. A case study of San José Llanga). Thesis submitted to the Sociology Department, Universidad Mayor de San Andres, UMSA.

Eyzaguirre, José Luis. B.A. Economics, Production Structure and Labor Efficiency A Case Study San José Llanga. Submitted to the Department of Economics, UMSA.

### *Other Contributions*

The Sociology Project collaborates in this Component with Utah State University. A detail description of our contribution can be found in their section. Some additional information is presented below:

**The environment:** our aim is to understand and design sustainable production strategies that are economically viable, socially acceptable and environmentally sound. By understanding the nature of production systems in Andean systems we can provide alternatives that are viable in the long run.

**Agricultural Sustainability:** the production system, community and regional approach used allows us to look at the Sustainability of the production system and the role of markets in this process.

**Contributions to US agriculture:** the focus and methods of systems research is applied to U.S. agriculture in the post productivist phase.

**Contributions to the host country:** by training researcher in country in on-farm research we are contributing to the development of human capital. This is crucial to any development effort in which peasant agriculture is relevant. Introduction of sociology and economics as disciplines to the design and development of biological research in Bolivia has been integral to our work in IBTA. A non governmental organization recognized by the government of Bolivia was formed by graduates from our program.

**Linkages and networking:** we have been able to collaborate with several NGOs, such as CIPCA and AIGACAA. We are also collaborated with ORSTOM and IDRC as well as CONDESAN. Details of this collaboration are in previous annual reports. Today we continue to foster these collaborations, even though the SR-CRSP is no longer directly

involved.

**Gender analysis:** our study of gender and nutrition has resulted in an understanding of the important role that sheep play as a source of food and income, as well as economic power of women in the community. This is closely linked to nutrition of children. Further investment of time and research is expected in this area through collaborative linkages established in the three years are program worked in Bolivia.

**Support for free markets:** looking at the viability of different economic enterprises we address the issue of information as a necessary condition for development of alternative livestock related enterprises. Analysis of the role of livestock in capital accumulation and safety first attitudes can assist in economic development by providing conditions that motive investment decisions. This relates to the risk management and diversification research conducted.

**Contribution and compliance with mission objectives:** Food security is central to the Bolivia USAID Mission as well as was central to our Component, and on-going research themes that we pursue.

**Concern for individuals:** Our Component has created enough information about the Communities in which research was conducted. This has enabled members of the community to seek other development projects that are improving the quality of life in San José Llanga. Potable water, latrines, and a middle school are developments that took place in the years our component was at San José. Social networks of which the component has been a part, have been instrumental in this fast change that has benefited San José Llanga families. A booklet on San José was developed in Spanish that the community has used in this process of seeking projects to benefit their families.

**Support of democracy:** food security is one of the basis for democracy and of our research objectives.

**Humanitarian assistance:** see concern for individuals.

### *Collaborating Personnel*

#### United States

Corinne Valdivia, Principal Investigator, University of Missouri Columbia  
Michael F. Nolan, Principal Investigator, University of Missouri Columbia  
Lisa Markowitz, Collaborating Scientist, University of Louisville, Kentucky.  
Jere L. Gilles, Collaborating Scientist, University of Missouri Columbia.  
Elizabeth G. Dunn, Collaborating Scientist, University of Missouri Columbia  
Dekha Sheikh, graduate student, MU  
Joan Kagwanja, graduate student, MU

### Bolivia

Christian Jetté, Resident Scientist Sociology, and consultant Centro de Estudios y Proyectos.

Jorge Céspedes Estévez, Co-Investigator, and faculty member, Universidad de Oruro.

### Collaborating Scientist:

Christian Jetté, Centro de Estudios y Proyectos.

### *Collaborating Institution*

Instituto Boliviano de Tecnología Agropecuaria  
P.O. Box 5783  
La Paz, Bolivia

Utah State University (on going)

### *Publications*

Markowitz, L. and Jetté, C. "Social Practice and persistence in a Fragile Environment: A Case Study from the Bolivian Altiplano". *Agriculture and Human Values* (forthcoming).

Valdivia, C. , Dunn E., and Jetté, C. 1996. "Diversification, a Risk Management Strategy in an Andean Agropastoral Community". *American Journal of Agricultural Economics*. 78(5) (December).

Valdivia, C. and Jetté, C. 1996. "Peasant Households in Semi-Arid San José: Confronting Risk Through Diversification Strategies". IBTA 181/Tech. RPT. 49/SR-CRSP 47. La Paz.

Valdivia, C., Dunn E., and Sherbourne, E. 1996. "Gender, Livestock and Household Peasant Production: Dairy and Diversification in Crop-Livestock Systems of an Andean Community". IBTA 165/ Technical Report 33/SR-CRSP 31 (English). January, Columbia.

### *Abstracts and Presentations*

"Diversification as a Risk Management Strategy in an Andean Agropastoral Community" presented at the session on "Modeling Household Behavior in Developing Countries: New Empirical Analyses". American Agricultural Economics Meetings, San Antonio. July 30. 1996.

"Household Production and Food Security in an Andean Community" by Lisa Markowitz and Corinne Valdivia at the Association of Farming Systems Research Extension Meetings *Linkages among Farming Systems and Communities*. Iowa State University, November 5-8. Ames.

"The Nature of Traditional or Peasant Agriculture: The Case Study of San José Llanga in Bolivia". Valdivia, Corinne. Department of Agricultural Economics, University of Missouri, Columbia. November, 1996.

"Technology episodes and nutrition in San José Llanga" Markowitz, Lisa, University of Louisville, Culture and Nutrition. December 5th, 1996.

### *Observations*

Although the Management Entity of SR-CRSP officially closed the Agropastoral Research Component at the end of 1995, we continued some activities in country with the work of two Bolivian researchers. For six months the Instituto Boliviano de Investigacion Agropecuaria was kind to provide access to the facilities and support communications. Many research activities are on-going, and we hope that we will be able to continue them through the collaboration we developed. There are many areas of research that we will continue to pursue in the next year as time allows. Matching funds and PL480 support were available until the end of November and we are grateful for this support from the Bolivian Government and the AID Mission.